2025 ILCOR Statement

2025 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations

Education, Implementation, and Teams

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ABSTRACT

The International Liaison Committee on Resuscitation conducts continuous reviews of new, peer-reviewed, published cardiopulmonary resuscitation science and publishes more comprehensive reviews every 5 years. The Education, Implementation, and Teams chapter of the *2025 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations* describes all published resuscitation evidence reviewed by the International Liaison Committee on Resuscitation's Education, Implementation, and Teams Task Force science experts since 2020. This summary addresses the evidence in 4 subchapters: (1) training populations, (2) faculty development, (3) knowledge translation and implementation, and (4) instructional design. Members from the Education, Implementation, and Teams 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. Priority knowledge gaps for further research are listed.

Key words: Education, implementation, team, resuscitation, CPR, teaching, training, simulation, laypersons, health care professional, facilitator, instructor, faculty development

INTRODUCTION

This International Liaison Committee on Resuscitation (ILCOR) Education, Implementation, and Teams (EIT) Task Force *2025 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations* (CoSTR) publication includes all the reviews conducted by the EIT Task Force in the previous year. Reviews conducted and published since the 2020 publication are also summarized to provide a single, more comprehensive reference document for readers. New work from the past year encompasses 12 PICOST (population, intervention, comparator, outcome, study design, and time frame) studies reviewed in some capacity, including 10 systematic reviews (SysRevs). Draft CoSTRs for all 2025 topics evaluated with SysRevs were posted between December 1, 2024, and January 15, 2025, 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. EIT Task Force members 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 represent the opinion of task force experts 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 publication 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 EIT Task Force, as well as summaries of the evidence identified. SysRevs include evidence-to-decision highlights and knowledge gaps, and

ScopRevs summarize task force insights on specific topics. 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.

Topics are presented using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach[3] in the PICOST format. To minimize redundancy, the study designs have been removed from the text except in cases where the designs differed from the EIT standard criteria. Standard study designs included are randomized controlled trials (RCTs) and nonrandomized studies (nonrandomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies), and all languages were included provided there was an English abstract. Unpublished studies (eg, conference abstracts, trial protocols), letters, editorials, comments, and case reports were excluded.

From 2020 onward, the EIT Task Force grouped its PICOST questions in 4 categories and identified some topics to exclude because the content was either outdated or irrelevant due to more modern teaching or methods of implementation. The 4 categories and the topics addressed in this EIT Task Force CoSTR summary are delineated in Table 1. All EIT PICOST questions reviewed since 2020 have been reviewed in some form for 2025. The type of review done this year and the most recent preceding review are summarized in Table 1. A supplementary Table S1 lists previous and updated treatment recommendations from 2021 to 2025 and includes the corresponding knowledge gaps.

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

1 **Table 1. Overview of PICOSTs Addressed From 2021-2025**

	PICOST number	Type of review for 2025	Year of previous review	Type of previous review
Training populations				
Disparities in education	EIT 6102	EvUp	2023	ScopRev
EMS experience and exposure	EIT 6104	EvUp	2020	SysRev
BLS training for likely rescuers of high-risk populations	EIT 6105	EvUp	2022	SysRev
Patient outcomes when team member attended CPR course	EIT 6106	EvUp	2022	SysRev
CPR education tailored for specific populations	EIT 6108	EvUp	2024	ScopRev
Faculty development				
Faculty development approaches for CPR instructors	EIT 6200	EvUp	2022	ScopRev
Knowledge translation and implementation				
Debriefing of resuscitation performance	EIT 6307	SysRev	2020	SysRev
Medical emergency systems for adults	EIT 6309	SysRev	2020	SysRev
Systems performance improvements	EIT 6310	SysRev	2020	SysRev
Prehospital critical care for OHCA patients	EIT 6313	SysRev	new in 2025	
CPR coaching during adult and pediatric cardiac arrest	EIT 6314	SysRev	new in 2025	
OHCA Termination of Resuscitation rules	EIT 6303	Adolopment	2020	SysRev
Community initiatives to promote BLS implementation	EIT 6306	ScopRev	2020	ScopRev
Family presence in adult resuscitation	EIT 6300	EvUp	2023	SysRev
Cardiac arrest centers	EIT 6301	EvUp	2024	SysRev
Technology to summon providers	EIT 6302	EvUp	2020	SysRev
Willingness to provide CPR	EIT 6304	EvUp	2020	ScopRev
Clinical decision rules to facilitate in-hospital DNACPR	EIT 6305	EvUp	2022	SysRev
Termination of resuscitation for IHCA	EIT 6308	EvUp	2020	SysRev
Chain of survival	EIT 6311	EvUp	2024	ScopRev
Impact of support on mental health in co-survivors of CA patients	EIT 6315	EvUp	new in 2025	
Instructional design				
CPR feedback devices during training	EIT 6404	SysRev	2020	SysRev
CPR self-instruction versus instructor-guided	EIT 6406	SysRev	2021	SysRev
In situ training	EIT 6407	SysRev	2020	EvUp
Manikin fidelity in resuscitation education	EIT 6410	SysRev	2020	EvUp
Cognitive aids during resuscitation	EIT 6400	EvUp	2024	SysRev

	PICOST number	Type of review for 2025	Year of previous review	Type of previous review
Provider workload and stress during resuscitation	EIT 6401	EvUp	2024	ScopRev
Stepwise approach to skills training in resuscitation	EIT 6402	EvUp	2023	SysRev
Immersive technologies–virtual and augmented reality	EIT 6405	EvUp	2024	SysRev
Blended learning approach for life-support education	EIT 6409	EvUp	2022	SysRev
Gamified learning versus nongamified learning	EIT 6412	EvUp	2024	SysRev
Scripted debriefing versus nonscripted debriefing	EIT 6413	EvUp	2024	ScopRev
Rapid-cycle deliberate practice in resuscitation training	EIT 6414	EvUp	2024	SysRev
Team competencies in resuscitation training	EIT 6415	EvUp	2024	SysRev

BLS indicates basic life support; CPR, cardiopulmonary resuscitation; DNACPR, do not attempt cardiopulmonary resuscitation; EMS, emergency medical services; IHCA, in-hospital cardiac arrest; OHCA, out-of-hospital cardiac arrest; and PICOST, population, intervention, comparator, outcome, study design, and time frame.

CONTENTS

  - Technology to Summon Providers (EIT 6302, EvUp 2025)
  - Willingness to Provide CPR (EIT 6304, EvUp 2025)
  - Clinical Decision Rules to Facilitate In-Hospital Do-Not-Attempt CPR (EIT 6305, SysRev 2022, EvUp 2025)
  - Termination of Resuscitation for In-hospital Cardiac Arrest (EIT 6308, EvUp 2025)
  - Chain of Survival (EIT 6311, ScopRev 2024, EvUp 2025)
  - Impact of Support on Mental Health in Cosurvivors of Cardiac Arrest Patients (EIT 6315, EvUp 2025)
- Instructional Design
  - CPR Feedback Devices During Training (EIT 6404, SysRev 2025)
  - CPR Self-Instruction versus Instructor Guided (EIT 6406, SysRev 2025)
  - In Situ Training (EIT 6407, SysRev 2025)
  - Manikin Fidelity in Resuscitation Education (EIT 6410, SysRev 2025)
  - Cognitive Aids During Resuscitation (EIT 6400, SysRev 2024, EvUp 2025)
  - Provider Workload and Stress During Resuscitation (EIT 6401, ScopRev 2024, EvUp 2025)
  - Stepwise Approach to Skills Training in Resuscitation (EIT 6402, SysRev 2023, EvUp 2025)
  - Immersive Technologies–Virtual and Augmented Reality (EIT 6405, SysRev 2024, EvUp 2025)
  - Blended Learning Approach for Life-Support Education (EIT 6409, SysRev 2022, EvUp 2025)
  - Gamified Learning versus Nongamified Learning (EIT 6412, SysRev 2024, EvUp 2025)

    - Scripted Debriefing versus Non-scripted Debriefing (EIT 6413, ScopRev 2024, EvUp 2025)
    - Rapid Cycle Deliberate Practice in Resuscitation Training (EIT 6414, SysRev 2024, EvUp 2025)
    - Team Competencies in Resuscitation Training (EIT 6415, SysRev 2024, EvUp 2025)
- Topics Not Included in the 2025 Review
    - Resuscitation Training in Low-Income Countries (EIT 6100, ScopRev In 2020, task force statement 2023)
    - Spaced Learning (EIT 6408, SyR 2020, EvUp 2022)

Training Populations

Disparity in Layperson Resuscitation Education (EIT 6102, ScopRev 2023, EvUp 2025)

A ScopRev was performed for 2023, and details can be found in the 2023 CoSTR summary.[4-6] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Laypersons (defined as non–healthcare professional)
- Intervention (Exposure): Presence of any specific factor
- Comparator: Absence of the specific factor
- Outcome: Likelihood of undertaking resuscitation education, including adult/pediatric BLS, and neonatal resuscitation program
- Time frame: January 1, 2023, to October 31, 2024

Summary of Evidence

Two new observational studies were found investigating disparities in layperson resuscitation training.[7,8] The factors identified in the 2 studies align with the categories outlined in the previous scoping review, specifically personal factors, socioeconomic status and education, and geographic factors. An updated SysRev was not thought to be warranted, but there is a need for further research to explore overlooked aspects that may be associated with these disparities.

EMS Experience and Exposure (EIT 6104, EvUp)

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children with out-of-hospital cardiac arrest (OHCA)
- Intervention: Resuscitation by experienced emergency medical service practitioners or practitioners with higher exposure to resuscitation
- Comparator: Resuscitation by less-experienced or lower-exposed practitioners
- Outcomes: Improved OHCA patient outcome (good neurological outcome at discharge/30 days; survival to hospital discharge/30 days; survival to hospital [event survival]; return of spontaneous circulation [ROSC]); EMS personnel confidence/satisfaction with OHCA procedures/training
- Time frame: April 10, 2020, to May 6, 2024

Summary of Evidence

A SysRev was performed for 2020 and details can be found in the 2020 CoSTR.[9-11] The complete EvUp is provided in Appendix B. No further relevant papers were identified; therefore, a SysRev is not required.

Treatment Recommendations (2020)

We suggest that EMS systems (1) monitor their clinical personnel’s exposure to resuscitation and (2) implement strategies, where possible, to address low exposure or ensure that treating teams have members with recent exposure (weak recommendation, very low–certainty evidence).

BLS Training for Likely Rescuers of High-Risk Populations (EIT 6105, SysRev 2022, EvUp 2025)

A SysRev was performed for 2022, and details can be found in the 2022 CoSTR summary.[12,13] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children at high risk of OHCA
- Intervention: Targeted BLS training of likely rescuers (eg, family members or caregivers)
- Comparator: No such targeting
- Outcomes
  - Patient: Favorable neurological outcome at hospital discharge or to 30 days, survival at hospital discharge or to 30 days, ROSC, rates of bystander CPR (subsequent use of skills), bystander CPR quality during an OHCA (any available CPR metrics), and rates of automated external defibrillator (AED) use (subsequent use of skills)
  - Educational: CPR quality and correct AED use at end of training and within 12 months of training, CPR and AED knowledge at end of training and within 12 months after training, confidence and willingness to perform CPR at end of training and within 12 months after training, and CPR training of others
- Time frame: January 1, 2014, to July 31, 2024

Summary of Evidence

The 5 new observational studies identified are consistent in supporting previous findings and do not substantially change the weight of evidence.[14-18] A SysRev for studies before 2010 will be considered.

Treatment Recommendations (2022)

We recommend BLS training for likely rescuers of populations at high-risk of out-of-hospital cardiac arrest (strong recommendation, low- to moderate-certainty evidence).

We recommend healthcare professionals encourage and direct likely rescuers of populations at high risk of cardiac arrest to attend BLS training (good practice statement).

Patient Outcomes When CPR Team Member Attended a CPR Course (EIT 6106, SysRev 2022, EvUp 2025)

A SysRev was performed in 2022 and details can be found in the 2022 CoSTR summary.[12,13,19] The complete EvUp is provided in Appendix B.

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

- Population: Patients of any age requiring in-hospital cardiac arrest (IHCA) resuscitation
- Intervention: Prior participation of ≥1 members of the resuscitation team in an accredited advanced life support (ALS) course
- Comparator: No such participation
- Outcomes: ROSC, survival to hospital discharge or to 30 days, survival to 1 year, and survival with favorable neurological outcome
  - Additional outcomes for Neonatal Resuscitation Training: stillbirth rate, neonatal and perinatal mortality
- Study designs: In this review we excluded studies of the impact of individual components of courses (eg, airway, drug therapy, defibrillation), studies relating to BLS and first aid courses, studies on dedicated trauma courses (eg, Advanced Trauma Life Support , European Trauma Course), and studies relating to OHCA.
- Time frame: June 1, 2022, to July 31, 2024

Summary of Evidence

No relevant studies were identified, and no new SysRev is indicated.

Treatment Recommendations (2022)

We recommend the provision of accredited ALS training (advanced cardiovascular life support, ALS) for health care providers who provide ALS care for adults (strong recommendation, very low–certainty evidence).

We recommend the provision of accredited courses in neonatal resuscitation training (neonatal resuscitation training, neonatal resuscitation programs) and Helping Babies Breath for health care providers who provide ALS care for newborns and babies (strong recommendation, very low–certainty evidence).

We have made a discordant recommendation (strong recommendation despite very low–certainty evidence) because we have placed a very high value on an uncertain but potentially life-preserving benefit, and the intervention is not associated with prohibitive adverse effects.

CPR Education Tailored for Specific Populations (EIT 6108, ScopRev 2023, EvUp 2025)

The complete EvUp is provided in Appendix B. A ScopRev was performed in 2023, and details can be found in the 2023 CoSTR summary.[4,5,20]

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

- Population: Specific adult layperson populations and/or groups (defined below) participating in BLS training
- Intervention: Tailored BLS training
- Comparator: Generic BLS training
- Outcomes:
  - Patient: ROSC, survival to hospital discharge, 30 days, and 12 months; neurological outcome

  - Clinical: Starting CPR in case of real cardiac arrest, performance during real CPR
  - Educational: knowledge and skills acquisition, willingness to perform CPR, barriers to performing CPR, participant satisfaction and/or knowledge and skills retention at end of the respective course and later (eg, 3 months, 1 year), implementation success, resource implications, and cost-effectiveness
- Study designs: Research aimed at teaching BLS to children, research on CPR training for various healthcare professionals (both sufficiently covered elsewhere) were excluded.
- Time frame: January 1, 2023, to October 22, 2024

Summary of Evidence

Insights from the 2023 review included that tailored BLS education for specific populations is probably feasible and that groups that may otherwise have been left out (eg, individuals with disabilities) can be added into the pool of potential bystander CPR providers. Specific tailored courses for first responders with and without a duty to respond need to be explored. In this EvUp search, no relevant studies were found. There is too little evidence on the topic of tailored BLS training for specific population groups to perform a SysRev, but the task force thought a good practice statement was important to encourage progress in this area.

Treatment Recommendations (2025)

The task force encourages resuscitation councils to develop, offer, and implement tailored BLS courses for specific populations based on their needs and specific educational approach (good practice statement).

FACULTY DEVELOPMENT

Faculty Development Approaches for Resuscitation Instructors (EIT 6200, ScopRev 2022, EvUp 2025)

A ScopRev was conducted for 2022,[21] and details of that review can be found in the 2022 CoSTR summary.[12,13] The complete EvUp is provided in Appendix B.

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

- Population: Instructors of accredited life-support courses, including basic life support (BLS), pediatric basic life support, ALS, pediatric advanced life support, and neonatal resuscitation programs
- Intervention: Any faculty development approach to improve instructional competence in accredited life-support courses
- Comparator: No such approach or any other faculty development approach
- Outcomes:
  - Patient outcomes:
    - Critical: outcome of patients resuscitated by students of the instructors, including favorable neurological outcome, survival to discharge, short-term survival, ROSC, sustained ROSC, and survival to admission
  - Educational outcomes:
    - Critical: Skill performance of students of the instructors in actual resuscitation
    - Important: Knowledge, skill performance, attitudes, willingness to perform resuscitation, and confidence of students of the instructors immediately after the provider course or at defined periods of time after course completion
  - Instructors outcome:
    - Important: Knowledge, instructional skills, and attitudes of instructors at end of instructor training course; knowledge, instructional skills, and attitudes of

instructors at defined periods of time after end of instructor training course; confidence of instructors to teach students at end of instructor training course at defined periods of time after course completion; instructor acceptance of a faculty development approach; cost of faculty development

- Study designs: In addition to standard criteria, grey literature, non–peer-reviewed studies, unpublished studies, conference abstracts, and trial protocols were eligible for inclusion.
- Time frame: January 1, 2022 (after last research), to June 30, 2024

Summary of Evidence

Two studies identified in this evidence update found that instructor courses with reduced face-to-face time were not inferior to traditional instructor courses.[22,23] Two other studies incorporating techniques for identifying and correcting common student errors improved student BLS performance.[24,25] This suggests that integrating techniques for recognizing common student mistakes in instructor courses may enhance the effectiveness of teaching. This ScopRev has not identified sufficient evidence to support a SysRev.

Treatment Recommendations (2025)

The task force encourages resuscitation councils to implement faculty development programs for the teaching staff of their accredited resuscitation courses (good practice statement).

Knowledge Translation and Implementation

Debriefing of Clinical Resuscitation Performance (EIT 6307, SysRev 2025)

Rationale for Review

Strategies to provide debriefing to improve CPR team performance and optimize delivery of care are available and often common practice. However, there are few data showing either improved patient outcome or negative side effects (eg, cost, emotional impact on professionals). The last review of this topic was in 2020, and awareness of new data prompted this SysRev, which was registered in Prospective Register of Systematic Reviews (PROSPERO) (CRD42024595033). The full CoSTR is available on the ILCOR website.[26]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Healthcare providers performing resuscitation in any clinical setting
- Intervention: Postevent clinical debriefing
- Comparator: No debriefing
- Outcomes:
  - Clinical: Resuscitation skills performance (in clinical contexts, eg, CPR quality, time to medication administration, initiation of CPR, time to defibrillation, chest compression fraction, etc.), and resuscitation knowledge
  - Patient: Favorable neurological outcome at hospital discharge/30 days, survival at hospital discharge/30 days, survival to hospital admission, event survival
- Time frame: January 1, 2014, to September 26, 2024

Consensus on Science

Six studies in adults,[27-32] 1 in children,[33] and 3 in neonatal cardiac arrests[34-36] were identified. All were nonrandomized studies providing very low certainty of evidence. Interventions included post-resuscitation debriefings;[27] audiovisual feedback plus weekly post-event debriefings;[28] short, individual oral debriefings;[29] hot or cold debriefings;[30] weekly debriefing sessions with audiovisual feedback during cardiac arrest[31] after-training workshops with debriefing;[34] video-assisted, performance-focused debriefings;[36] positive-pressure ventilation refresher and performance debriefings;[35] and post-resuscitation interdisciplinary team debriefings.[33] One study stratified hospitals by debriefing frequency.[32] Because of this heterogeneity, no meta-analyses could be performed. Key study findings are presented in Table 2.

Table 2. Key Findings of Included Studies on Post-event Debriefing

Outcome of interest	Favorable neurological outcome	Survival to hospital discharge	ROSC	Chest compression depth	Chest compression rate	Chest compression fraction	Adherence to resuscitation guidelines
Number of studies	5 nonrandomized studies[28-30,32,33]	6 nonrandomized studies[27-29,32,33]	7 nonrandomized studies[28-31,33,34]	3 nonrandomized studies[28,29,31]	4 nonrandomized studies[27-29,31]	4 nonrandomized studies[27-29,31]	2 studies[35,36]
Number of patients	46 145	46 269	46 459	1773	1897	1897	381
Evidence	1 study favored hot debriefings[30]—using a Bayesian hierarchical logistic regression model—77% probability of increased odds of favorable neurological outcome with hot debriefings (OR 1.11; 95% CI, 0.83–1.44). However, 1% probability of increased odds of favorable neurological outcome with cold debriefings (OR 0.69; 95% CI, 0.49–0.93).	1 study favored hot debriefings,[30] finding 67% probability of increased odds of survival with hot debriefings (OR, 1.06; 95% CI, 0.81–1.37). However, 11% probability of increased odds of survival with cold debriefings (OR, 0.83; 95% CI, 0.62–1.11)	1 study[30] found 48% probability that hot debriefings increase the odds of ROSC (OR, 0.99; 95% CI, 0.80–1.21) and 89% probability that cold debriefings increase the odds of ROSC (OR, 1.15; 95% CI, 0.90–1.43).	1 study[31] found that CC depth was 50 mm (10) with debriefing and 44 mm (10) without debriefing (*P*<0.001). No effect size reported.	1 study[27] found that CC rate was 93/min with debriefing (9) and 81/min (13) without (*P*=0.03). No effect size reported.	1 study[27] found that CCF was 79% (70%–85%) with debriefing and 86% (82%–89%) without. No effect size or *P* value reported.	1 study[36] found a median total NRPE score of 89% (86, 93) with debriefing and 77% (75, 81) without (*P*<0.001).
	1 study[33] found debriefing was associated with improved favorable neurologic outcome. Univariate: (50% versus 29%; *P*=0.036); multivariate: (aOR,	1 study[33] found no association between debriefing and improved survival in univariate analysis (52% versus 33%;	1 study[31]–reported a ROSC rate of 59% with debriefing, and 45% without (*P*=0.03). No effect size reported.		1 study[31] found a CC rate of 105/min (10) with debriefing and 100/min (13) without (*P*=0.003). No effect size reported.	1 study[31] found a no-flow fraction of 0.13 (0.10) with debriefing and 0.20 (0.13) without (*P*<0.001). No effect size reported.	1 study[35] found a median NRPE score of 89% (86%–92%) with debriefing and 77% (75%–81%) without (*P*<0.001.)

Outcome of interest	Favorable neurological outcome	Survival to hospital discharge	ROSC	Chest compression depth	Chest compression rate	Chest compression fraction	Adherence to resuscitation guidelines
	2.75; 95% CI, 1.01–7.5; *P*=0.047).	*P*=0.054); after controlling for potential confounders (aOR, 2.5; 95% CI, 0.91–6.8; *P*=0.075).					
			1 study[34] showed no significant differences between groups for time of neonate's color to return to normal, and Apgar scores at 1, 5, and 10 min were higher in the debriefing group compared with those reported for other groups. No effect sizes reported.				
	3 studies showed no effect.[28,29,32]	4 studies showed no effect.[27-29,32]	4 studies showed no effect.[28,29,32,33]	2 studies showed no effect.[28,29]	2 studies showed no effect.[28,29]	2 studies showed no effect.[29,30]	

aOR indicates adjusted odds ratio; CC, chest compressions; CCF, chest compression fraction; NRPE, Neonatal Resuscitation Performance Evaluation; OR, odds ratio; and ROSC, return of spontaneous circulation.

Prior Treatment Recommendations (2020)

We suggest data-driven, performance-focused debriefing of rescuers after IHCA for both adults and children (weak recommendation, very low–certainty evidence).

We suggest data-driven, performance-focused debriefing of rescuers after OHCA in both adults and children (weak recommendation, very low–certainty evidence).

Treatment Recommendations (2025)

We suggest performing post-event debriefing after adult, pediatric, and neonatal cardiac arrest in all settings (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

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

Performance of post-event debriefing was either associated with no effect or with improved outcome (favorable neurological outcome, survival to discharge, ROSC, chest compression depth, chest compression rate, chest compression fraction, adherence to guidelines). Because of the high heterogeneity across studies (variation in debriefing design, patient population [adults, children, neonates], outcome measures) no statement can be made about the most effective type of debriefing. No undesirable effects (eg, emotional trauma to the debriefed team, needed resources– including costs) have been identified, but neutral to positive effects on resuscitation outcomes were reported. Hence, we consider that the reported positive effects outweigh any possible undesirable effects. This treatment recommendation is based on nonrandomized studies. No study compared debriefing with no debriefing after CPR in a randomized controlled trial, resulting in serious risk of bias.

Knowledge Gaps

- RCTs on debriefing after CPR are needed.

- The effect of debriefing by subgroups such as adult versus pediatric cardiac arrest, in-hospital versus out-of-hospital setting, or hot versus cold debriefing
- Cost-effectiveness of debriefing or effect of post-event debriefings in low-resource settings are warranted.
- Whether there are any negative effects of debriefing on the resuscitation team

Medical Emergency Systems for Adult In-Hospital Patients (EIT 6309, SysRev 2025)

Rationale for Review

Patients admitted to hospital might be at risk of deterioration, which can lead to cardiac arrest. These patients often have symptoms and signs of deterioration hours before cardiac arrest.[37] A rapid response system includes an afferent component to identify such deterioration early to prevent serious adverse events and an efferent component, which is a rapid response team or a medical emergency team.[38,39] Because there is uncertainty if rapid response or medical emergency teams improve patient outcomes after cardiac arrest, this SysRev was initiated by the EIT Task Force. It was registered at PROSPERO (CRD42024615077), and the CoSTR is available on the ILCOR website.[40]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults at risk of cardiac or respiratory arrest in hospital
- Intervention: Rapid response system (includes rapid response team or medical emergency team)
- Comparator: No rapid response system
- Outcomes: Survival to hospital discharge with good neurological outcome; survival to hospital discharge; in-hospital incidence of cardiac/respiratory arrest
- Time frame: All years to September 9, 2024

Consensus on Science

Because of extensive heterogeneity between the studies, no meta-analyses were performed. However, the summary of available evidence indicates reduced incidence of cardiac arrest in those hospitals that implemented a rapid response system, and a dose-response effect. Table 3 presents data on the incidence of cardiac arrest, and survival to discharge or 30 days. We did not find any study reporting data for survival with favorable neurological outcome. Of the 56 nonrandomized studies reporting the incidence of cardiac arrest after implementation of a rapid response system,[41-96] 39 showed improvement,[41-43,45,49,51-57,59,61-65,67,68,71,73-77,81-90,94,95] and 17 showed no improvement.[44,46-48,50,58,66,69,70,72,78,80,91-93,96]

Table 3. Summary of Findings of Studies on Effect of Rapid Response Systems on Incidence and Outcome of In-hospital Cardiac Arrest

Study design	Total number of studies	Evidence
RCTs	3 RCTs[97-99] on incidence of cardiac arrest	1 study reported cardiac arrest rates of 1.3 versus 1.0/1000 admissions (OR, 0.71; 95% CI, 0.33–0.52) with or without RRS.[97]
		After implementation of RRS, the proportion of patients admitted to the ward who received CPR decreased from 4.86% to 3.61% (unadjusted OR, 0.73; 95% CI, 0.64–0.85). There was no difference after adjustment (aOR, 1.00; 95% CI, 0.69–1.48).[98]
		Cardiac arrest incidence 1.64/1000 in patients without RRS versus 1.31/1000 with RRS (*P*=0.306; 95% CI, −0.264 (−2.449 to 1.921).[99]
Non-RCTs	11 nonrandomized studies on survival[41-49,100,101]	8 studies[41-44,46-48,100] reported no improvement in survival to discharge after cardiac arrest.
		1 pre/post RRS implementation study found no difference in survival 30 days after cardiac arrest.[45]
		1 pre/post study showed increased long-term survival post-surgery in hip fracture patients: 71.8 months pre-RRS versus 75.0 months post-RRS (*P*=0.008).[101]
		1 study found RRS did not impact overall survival to discharge for female patients. However, an increase was reported for females aged 18-34 years.[49]

CPR indicates cardiopulmonary resuscitation; RCT, randomized controlled trial; and RRS, rapid response system.

Treatment Recommendations (2025)

We suggest that hospitals consider the introduction of a rapid response system to reduce the incidence of in-hospital cardiac arrest (weak recommendation, low-quality 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 emphasizes the importance of outcomes such as preventing in-hospital cardiac arrests and increasing survival to hospital discharge, despite the considerable costs associated with these systems. Numerous healthcare institutions globally have effectively adopted rapid response systems,[102] and it is recommended by the Institute for Healthcare Improvement.[103]

Implementing an effective rapid response system requires strong afferent (detection and activation) and efferent (response by the rapid response team/medical emergency team team) limbs. These are supported by administrative and quality improvement measures,[104] which include comprehensive staff training on consistent and appropriate monitoring of vital signs, clear protocols on early warning scores to facilitate early detection, and a tiered clinical response structure.

Knowledge Gaps

- Effect of rapid response systems on long-term survival with positive neurological outcome
- Role of technology in enhancing rapid response systems
- Essential components of the afferent limb in rapid response systems (eg, which vital signs, clinical observations, and laboratory parameters should be monitored, as well as the optimal frequency for these assessments)
- Optimal design of education programs to improve the recognition of patient deterioration

- Ideal composition of the efferent limb, or the response team
- Most effective mechanism for escalating assistance
- Cost-effectiveness of rapid response systems in practice

System Performance Improvement (EIT 6310, SysRev 2025)

Rationale for Review

The clinical outcomes of patients with cardiac arrest differ around the world. There is a need for a systematic review of system-wide interventions to better understand their impact. System performance improvement is defined as hospital-level, community-level, or country-level advancements related to structure, care pathways, processes, and quality of care. This can include single interventions or multidisciplinary approaches deployed to improve outcomes of cardiac arrest patients. As the last systematic review on this topic was in 2020 the EIT Task Force initiated a new review, which was registered in PROSPERO under the number CRD42020161882. The full CoSTR is available on the ILCOR website.[105]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Resuscitation systems caring for patients in cardiac arrest in any setting
- Intervention: System performance improvement initiative(s)
- Comparator: No system performance improvement initiative(s)
- Outcomes: Survival with favorable neurologic outcome at discharge, survival to hospital discharge, skill performance in actual resuscitations, survival to admission, system-level variables
- Time frame: July 1, 2020, to June 30, 2024

Consensus on Science

This systematic review found 15 new studies,[106-120] which added to the 27 publications[31,33,121-145] from the previous CoSTR in 2020.[9]

The interventions investigated in the 15 new studies are summarized in Table 4. Those 27 described previously were included in the earlier publication.[146] Key results from these studies are summarized in Table 5.

Table 4. Interventions in Included Studies

Study (author, year, setting)	Interventions
Blewer 2020 (OHCA)[107]	National bystander-focused public health interventions including DA-CPR, CPR training programs, and the CC application
Lee 2020 (OHCA)[113]	Citywide interventions including (1) mandatory CPR and AED training, DA-CPR, and the establishment and actions of the Daegu cc and (2) public-access defibrillation program; team CPR program; dual-patch system; standardized post-CA treatment; education program for medical staff; regional OHCA registry; and public reporting and feedback to provinces, hospitals, and EMTs
Kim 2020 (OHCA)[111,112]	Implementing the PDSA model for quality improvement: (1) bystander CPR education and dispatcher training, (2) regular skills training sessions for EMTs, (3) detailed data collection instrument, (4) medical director assignment
Kim 2020 (OHCA)[110]	A multidisciplinary approach including (1) re-education of BLS, (2) simulation training for real-time medical direction via video call, (3) 2-tier dispatch
Auricchio 2020 (OHCA)[106]	Statewide initiatives including recording of OHCAs; initiatives on AED density, bystander and layperson recruitment; first responder network
Nehme 2021 (OHCA)[118]	High-performance CPR focusing on team dynamics and communication, with emphasis on optimizing resuscitation flow and minimizing delays
Dong 2022 (OHCA)[108]	Citywide quality improvement program consisting of (1) standardized ambulance treatment protocol adopted, (2) ambulance crew targeted training, (3) quality monitoring, feedback, and post-event debriefing
Kim 2022 (OHCA)[111]	SALS protocol incorporating changes in CPR assistance and coaching by physicians via real-time video calls
Lin 2022 (OHCA)[115,117]	Citywide bundle initiative including (1) commencement of medical direction and public-access defibrillation project, (2) digitized Utstein-based registry, (3) public involvement and continuous QA process, (4) proactive CPR promotion and PAD, (5) built and implemented culture of excellence and smart technology
McCoy 2023 (IHCA)[117]	Bundled intervention on IHCA survival in patients on centralized telemetry: (1) telemetry hotline for telemetry technicians t o reach nursing staff, (2) empowerment of telemetry technicians to directly activate the IHCA response team, and (3) standardized escalation system for automated critical alerts within the nursing mobile phone system
Freedman 2023 (IHCA)[109]	Bundled intervention on IHCA including EMC restructuring, CPR coach, replacing defibrillators, defibrillator data review, training program, metronomes, code documentation, debriefing, and event reviews
Li 2023 (OHCA)[114]	RQI HeartCode Complete program, designed to enhance CPR training by using real-time feedback manikins
Lyngby 2023 (OHCA)[116]	Real-time feedback displayed on the defibrillator screen, presenting compression depth, compression rate, and audible rate guidance

Study (author, year, setting)	Interventions
Riyapan 2024 (OHCA)[119]	CQI low-dose, high-frequency training interventions included advanced airway management, high-performance CPR, and postevent debriefing with video recording
Vaillancourt 2024 (IHCA)[120]	Implementation of medical directive allowing nurses to use defibrillators in AED mode for IHCA

AED indicates automated external defibrillator; BLS, basic life support; CPR, cardiopulmonary resuscitation; CQI, Continuous Quality Improvement; DA-CPR, dispatcher-assisted cardiopulmonary resuscitation; EMC, Emergency Management Committee; EMT, emergency medical technician; IHCA, in-hospital cardiac arrest; OHCA, out-of-hospital cardiac arrest; PAD, public access defibrillation; PDSA, Plan-Do-Study-Act; RQI, Resuscitation Quality Improvement; and SALS, Smart Advanced Life Support.

Table 5. Summary of Outcomes Reported in Studies About System Interventions

Survival with favorable neurologic outcome at discharge	**Survival to hospital discharge**	**Skill performance in actual resuscitations**	**Survival to admission**	**System-level variables**
1 cluster-randomized trial showed survival with favorable neurologic outcome at discharge was not higher after interventions[130]	1 cluster-randomized trial showed survival to hospital discharge was not higher after interventions[130]	1 cluster-randomized trial showed that rescuer skill performance improved after interventions[130]	1 cluster-randomized trial showed survival to admission was not higher after interventions[130]	
17 non-RCTs showed significantly higher survival with favorable neurologic outcome at discharge after interventions[33,110,111,113,115,122,125-128,131,133,134,139,140,142,143]	20 non-RCTs showed significantly higher survival to hospital discharge after interventions.[33,106,107,111,113,115,118,122,125-128,131,133-135,137,139,140,143]	16 non-RCTs reported that improved rescuer skill performance after interventions.[31,33,110,114,116,118,120,123,128,131-133,135,136,141,145]	3 non-RCTs showed significantly higher survival to admission after interventions.[126,137,140]	18 non-RCTs achieved all or partial goals from individual interventions or improved specific system-level variables (including rate of bystander CPR or AED, rate of prehospital or in-hospital hypothermic temperature control, use of automatic CPR devices, CPR feedback devices, or percutaneous coronary intervention[106,107,110,112,113,115,116,121,125,126,128,129,133,134,137,139,142,144]
7 non-RCT showed no significant improvement after interventions.[106,112,123,124,129,135,144]	14 non-RCTs showed no significant improvement after interventions.[31,109,110,112,116,117,119,120,123,124,129,141,142,144]	2 non-RCTs showed no significant improvement after interventions[124,138]	6 non-RCTs showed no significant improvement after interventions.[110,115,116,119,129,142]	

AED indicates automated external defibrillation; CPR, cardiopulmonary resuscitation; and RCT, randomized controlled trial.

Prior Treatment Recommendations (2020)

We recommend that organizations or communities that treat cardiac arrest evaluate their performance and target key areas with the goal to improve performance (strong recommendation, very low–certainty evidence).

Treatment Recommendations (2025)

We recommend that organizations or communities that treat cardiac arrest use system-improvement strategies to improve patient outcome (strong recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

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

The EIT Task Force decided to exclude studies investigating extracorporeal CPR, which were included previously, because the prevalence of extracorporeal CPR is increasing, and several RCTs were reviewed in another PICOST. In making this recommendation, the task force prioritized the benefits of system performance improvements, recognizing that they present no known risks and hold substantial potential for positive impact. The task force recognized that the evidence supporting this recommendation is derived from studies with very low certainty across all evaluated outcomes, primarily due to risks of bias and inconsistencies. However, most studies found that interventions to improve system performance not only improve system-level variables and skill performance in actual resuscitations among rescuers, but also clinical outcomes of patients with out-of-hospital or in-hospital cardiac arrest. We acknowledge that these interventions demand funding, personnel, and stakeholder support to improve system performance. Varying levels of resources across settings may influence the effectiveness of implementing these performance improvements.

Knowledge Gaps

- Cost-effectiveness of individual interventions aimed at improving systems
- Feasibility of implementing community interventions across diverse resource settings
- Effects of individual and bundled interventions across diverse resource settings

Prehospital Critical Care for Out-of-Hospital Cardiac Arrest (EIT 6313, SysRev 2025)

Rationale for Review

The emergency medical service (EMS) system response is a critical element in the pathway of care for OHCA patients.[147,148] Prehospital critical care teams as part of a tiered EMS response are emerging.[149-151] These are specialists in the care of critically ill patients requiring resuscitation,[152] and they have competencies in advanced life support beyond that of standard EMS teams.[153] Understanding the clinical efficacy of prehospital critical care teams may inform the decision to implement this into practice. This SysRev on pre-hospital critical care teams for nontraumatic OHCA[154] was registered in PROSPERO under the number CRD42023478216. The full CoSTR is available on the ILCOR website.[155]

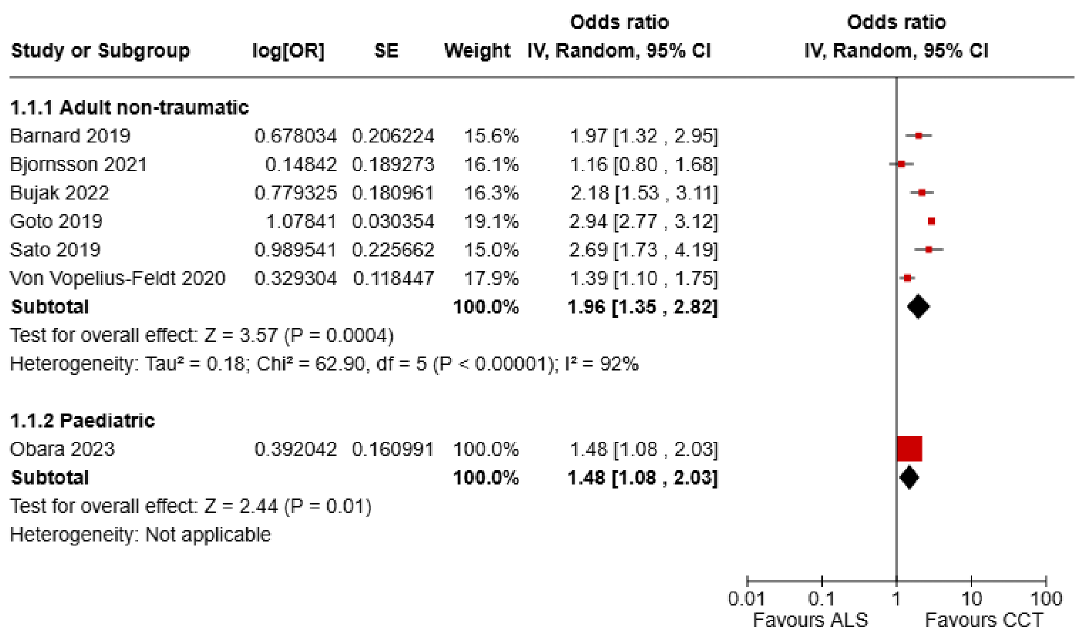
Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children with OHCA and attempted resuscitation. Traumatic cardiac arrest was excluded.
- Intervention: Attendance of a prehospital critical care team. Prehospital critical care was defined as any provider with clinical competencies beyond that of standard paramedics using ALS algorithms and dedicated dispatch to critically ill patients.
- Comparator: Advanced life support by any other prehospital healthcare provider
- Outcomes: Clinical outcomes of survival, favorable neurological outcome, and ROSC; resource and cost implications
- Time frame: All years to April 20, 2024

Consensus on Science

Out of 15 articles included,[147-153,156-163] no randomized studies were identified. A total of 1 188 287 patients were included in the non-RCTs, and 1 included children only.[157] Seven studies came from Japan, 3 from the UK, and 1 each from Australia, Iceland, Norway, Poland, and the USA. In 14 studies prehospital critical care teams included physicians,[147-153,156-158,160-163] including specialists in emergency medicine,[148-150,156,157,160,162] anesthesia,[156,158,162] or critical/intensive care medicine.[148,150,156,160,162] Four studies included specially trained critical care paramedics,[147,159,161,162] 3 from the United Kingdom,[147,161,162] and 1 from Australia that included solely critical-care paramedics.[159] For the combined outcome of ROSC and survival to hospital admission, pooled results from 6 adult non-RCTs found a benefit from prehospital critical care teams.[147,148,150,156,160,162] A single non-RCT in pediatric OHCA enrolled 1187 patients and also found an association of prehospital critical-care teams with better outcome[157] (**Figure 1**).

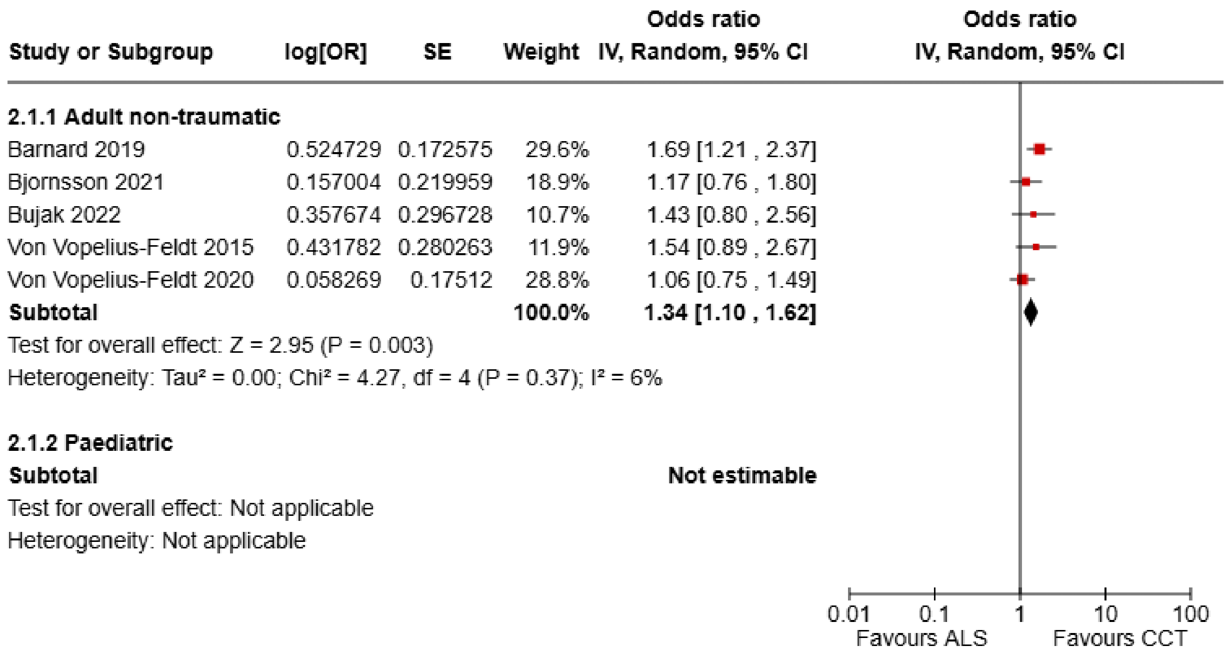
Figure 1. Survival to hospital admission/return of spontaneous circulation with prehospital critical-care teams compared with standard advanced life support.



ALS indicates advanced life support; and CCT, critical-care team.
Adapted from Boulton et al.[153] This is an Open Access article under the CC BY 4.0 license.

For survival to hospital discharge, pooled results from 5 adult non-RCTs found a benefit from prehospital critical care teams.[147,148,156,161,162] No study on children included this outcome (**Figure 2**).

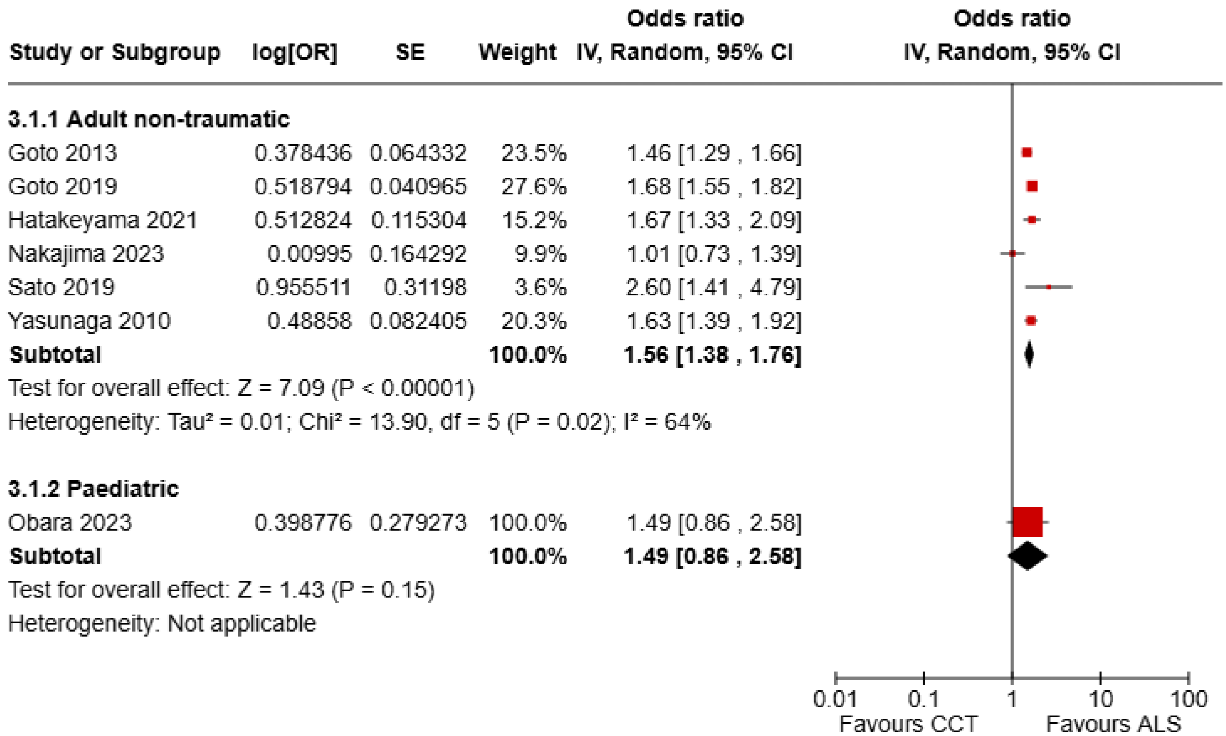
Figure 2. Survival to hospital discharge with prehospital critical-care teams compared with standard advanced life support.



ALS indicates advanced life support; and CCT, critical care team.
Adapted from Boulton et al.[153] This is an Open Access article under the CC BY 4.0 license.

For survival at 30 days, pooled results from 6 adult non-RCTs found a benefit from prehospital critical care teams.[150-153,160,163] A single non-RCT in pediatric OHCA did not find a benefit from prehospital critical care teams[157] (**Figure 3**).

Figure 3. Survival at 30 days with prehospital critical-care teams compared with standard advanced life support.



ALS indicates advanced life support; and CCT, critical care team.
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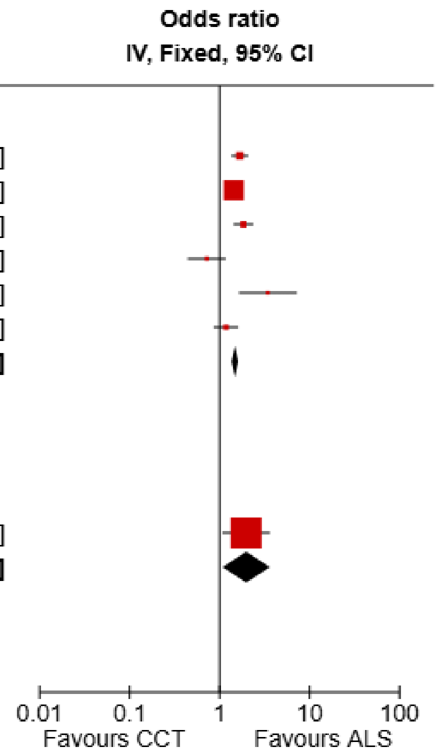
Favorable neurological outcome at hospital discharge was addressed in 1 nontraumatic OHCA study enrolling 973 patients, showing no significant difference (OR 1.35, 95% CI 0.71-2.60).[158] No pediatric study addressed this outcome.

Favorable neurological outcome at 30 days was addressed in 6 nontraumatic OHCA studies, which found a benefit from prehospital critical-care teams.[150-153,160,163] A single non-RCT in pediatric OHCA found an association of prehospital critical-care teams with better outcome[157] (**Figure 4**).

Figure 4. Favorable neurological outcome at 30 days with prehospital critical-care teams compared with standard advanced life support.

Study or Subgroup	log[OR]	SE	Weight	Odds ratio IV, Fixed, 95% CI
4.1.1 Adult non-traumatic				
Goto 2013	0.518794	0.108391	15.8%	1.68 [1.36 , 2.08]
Goto 2019	0.364643	0.05494	61.5%	1.44 [1.29 , 1.60]
Hatakeyama 2021	0.609766	0.128884	11.2%	1.84 [1.43 , 2.37]
Nakajima 2023	-0.328504	0.24949	3.0%	0.72 [0.44 , 1.17]
Sato 2019	1.235471	0.378109	1.3%	3.44 [1.64 , 7.22]
Yasunaga 2010	0.165514	0.159966	7.3%	1.18 [0.86 , 1.61]
Subtotal			**100.0%**	**1.48 [1.36 , 1.61]**
Test for overall effect: Z = 9.11 (P < 0.00001)				
Heterogeneity: Chi² = 19.79, df = 5 (P = 0.001); I² = 75%				
4.1.2 Paediatric				
Obara 2023	0.683097	0.30996	100.0%	1.98 [1.08 , 3.63]
Subtotal			**100.0%**	**1.98 [1.08 , 3.63]**
Test for overall effect: Z = 2.20 (P = 0.03)				
Heterogeneity: Not applicable				



ALS indicates advanced life support, and CCT, critical-care team.

Adapted from Boulton et al.[153] This is an Open Access article under the CC BY 4.0 license.

Treatment Recommendations (2025)

We recommend that prehospital critical-care teams attend adults with nontraumatic, out-of-hospital cardiac arrest within EMS systems with sufficient resource infrastructure (weak recommendation, low certainty of evidence).

We suggest that prehospital critical-care teams attend children with out-of-hospital cardiac arrest within EMS systems with sufficient resource infrastructure (weak recommendation, very low certainty of evidence).

Justification and Evidence-to-Decision Framework Highlights

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

The EIT Task Force has made a recommendation alongside low-certainty evidence for adults in light of consistent benefits across clinical outcome from a variety of different healthcare systems. One study including 1187 children also found benefit; hence the EIT Task Force also made a treatment recommendation favoring prehospital critical-care teams for children.

This SysRev demonstrated that many settings have already implemented prehospital critical-care teams. Expanding prehospital critical-care services and implementing these services in other healthcare systems is likely to incur additional resources, training, and EMS infrastructure costs, and hence may not be universally available.

Knowledge Gaps

- RCTs investigating prehospital critical-care teams for OHCA are needed.
- Evidence about children with out-of-hospital cardiac arrest is based on only 1 study.
- Which patient groups would benefit most from prehospital critical-care teams
- Optimal composition of prehospital critical-care teams, their professional background, and training requirements
- Associated resource costs, cost-effectiveness, impact on health equity, and feasibility of implementation of prehospital critical-care teams

CPR Coaching During Adult and Pediatric Cardiac Arrest (EIT 6314, SysRev 2025)

Rationale for Review

Despite CPR training, adherence to guidelines is poor during cardiac arrest. Visual feedback devices during CPR can improve chest compression (CC) quality, but compliance for CC depth is still <40%.[164] To implement well-known evidence into clinical practice, the integration of a CPR coach within the resuscitation team has been proposed.[165,166] A CPR coach is a resuscitation team member whose primary responsibility is to provide real-time coaching on resuscitation quality. The EIT Task Force initiated this SysRev focusing on coaching where the coach is an active resuscitation team member. The SysRev was registered on PROSPERO (CRD42017080475), and the full CoSTR is available on the ILCOR website.[167]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Healthcare teams managing adult or pediatric cardiac arrest
- Intervention: CPR coach as a resuscitation team member
- Comparator: No CPR coach on the resuscitation team
- Outcomes: Simulation-based clinical skills: CPR skill performance, adherence to guidelines, teamwork, provider workload
  - Real-life clinical performance: CPR skill performance, adherence to guidelines
  - Patient survival: ROSC, survival to hospital discharge or 30 days, survival with favorable neurological outcome, survival beyond discharge or 30 days
- Time frame: All years to October 11, 2024

Consensus on Science

We identified 7 studies investigating the use of a CPR coach versus no use of a CPR coach as a resuscitation team member.[165,168-173] One study investigated use of CPR coaches in a clinical setting,[170] and 6 were simulation studies.[165,168,169,171-173] Five of the simulation studies were based on the same randomized controlled trial.[165,169,171-173] The outcomes of the included studies are presented in Table 6. The outcomes of adherence to guidelines in a clinical setting and patient survival were not reported in any studies.

Table 6. Study Outcomes and Certainty of Evidence for Use by CPR Coaches During Resuscitation

Outcome	Evidence with CPR coach implementation	Certainty of evidence
Clinical CPR performance	CCF at adequate depth improved from 69.8%-80.4%. Compression depth increased from 43.6mm to 47.2mm. Time to defibrillation decreased from 13.2sec-7.2sec.[170]	very low (downgraded for risk of bias, indirectness, imprecision)
CPR performance in a simulated setting	Higher fraction of excellent chest compressions (63% versus 31%; Diff, 31.8 [17.7, 45.9]), higher fraction of compressions within guideline recommendations (38.0% versus 69.5%; Diff, 31.5 [15.7, 47.4]), higher guideline compliance rate (88% versus 80%; *P*=0.07), higher CCF (82% versus 77%; *P*=0.04) for coached versus noncoached teams.[165] Shorter total mean pause duration (98.6sec versus 120.85sec; 95% CI of mean diff 0.6 sec-43.9 sec, *P*=0.04).[172] Shorter time to backboard placement (22 sec versus 55 sec; *P*=0.02). No difference in: compression rate, no-flow time, time to first epinephrine, time to first shock, peri-shock pause duration.[168]	very low (downgraded for risk of bias, imprecision) no significantly higher
Adherence to guidelines in a simulated setting	Clinical performance tool scores were higher (73.4 versus 68.3; Diff, 5.2 points; 95% CI, 1.0-9.3; *P*=0.016).[169]	low (downgraded for risk of bias, indirectness, imprecision)
Teamwork in a simulated setting	Coached teams used more words/min (160 versus 134; *P*<0.05) driven by more directives on chest compression rate and depth, and positive verbal cues from the CPR coach to the team; team leaders and others said fewer words/min (70 versus 88 and 30 versus 46; *P*<0.05).[171]	very low (downgraded for risk of bias, indirectness, imprecision)
Workload in a simulated setting	One study found no significant difference for overall workload for team leaders; chest compressors had lower mental demand but higher physical demand in coached teams.[173] Another study showed no differences on any NASA Task Load index subscales for team leader.[168]	very low (downgraded for risk of bias, inconsistency, and indirectness)

CCF indicates chest compression fraction; Diff, difference; NASA, National Aeronautics and Space Administration.

Treatment Recommendations (2025)

We recommend considering the inclusion of a CPR Coach as a member of the resuscitation team during cardiac arrest resuscitation in settings with adequate staffing (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

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

CPR Coaches were generally associated with improved outcomes, and no harmful effects were observed. Use of a CPR Coach may be considered a specific way of using shared leadership in resuscitation teams. Shared leadership has been suggested to be useful in several studies on IHCA.[174-176] CPR Coaches are already implemented as part of the resuscitation teams in many hospitals,[177] suggesting that staff members are often available to fill this role.[174] This may differ in low-resource settings and out-of-hospital settings.

Most of the evidence was based on 1 randomized simulation-based trial.[173]

Knowledge Gaps

- Identified evidence was limited (from 1 RCT simulation,[165] 1 clinical observational study,[170] 1 pilot RCT simulation[168]). Further evidence on CPR Coaching from RCTs is needed.
- Effect of CPR coaches on real cardiac arrest and patient survival outcome
- Effect of CPR coaches on prespecified subgroups (eg adult versus pediatric patients, trained versus untrained CPR Coaches, use of CPR feedback devices versus no CPR feedback devices)
- Optimal role and effectiveness of a CPR Coach in out-of-hospital settings and in-hospital settings
- Cost-effectiveness or utilization of CPR Coaches in limited resource settings

Out-of-Hospital Cardiac Arrest Termination of Resuscitation Rules (EIT 6303, SysRev ADOLOPMENT 2025)

Rationale for Review

A systematic review on prehospital TOR rules was first published as part of the 2020 ILCOR CoSTR.[178] Subsequently, a systematic review including these findings was published, including a literature update in January 2024 that reviewed additional literature on cost-effectiveness.[179] The EIT Task Force conducted an adolopment of the recently published review, searched recent literature from January 2023 to October 2024, and conducted data extraction and risk of bias assessment for any paper published after the initial review. We considered papers on prehospital TOR rules used in the prehospital setting. Studies addressing TOR for patients arriving at the emergency department by ambulance in-hospital TOR were excluded. The adoloped review was registered in PROSPERO (CRD42019131010), and the full online CoSTR is available on the ILCOR website.[180]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in cardiac arrest who do not achieve ROSC in the out-of-hospital environment.
- Intervention: (Index test) TOR rules.
- Comparator: (Reference standard) In-hospital outcome: survival, favorable or unfavorable neurologic outcome
- Outcomes: Ability of TOR to predict death in hospital or unfavorable neurologic outcome. Cost-effectiveness
- Time frame: January 1, 2023, to October 19, 2024

Consensus on Science

The 2020 ILCOR CoSTR identified several studies addressing the use of TOR rules, but a meta-analysis was not possible because of high risk of bias and heterogeneity.[178]

The updated review published in 2024 identified 10 new observational studies on the validation of different TOR rules from historical cohorts.[181-190] These studies, grouped by outcome reported, are summarized in Tables 7 through 9. Several studies validated more than 1 score or applied the same score in different cohorts.

1 **Table 7. Prediction of No Return of Spontaneous Circulation**

Study	TOR Rule	Population	TP	FP	FN	TN	Sensitivity	Specificity
Harris 2021[182]	MIEMS	Child (trauma, age 0-17)	27	4	71	36	0.28 [0.19-0.37]	0.90 [0.76-0.97]
Harris 2021[182]	MIEMS	Child (trauma, age 0-14)	39	4	107	50	0.27 [0.20-0.35]	0.93 [0.82-0.98]
Harris 2021[182]	MIEMS	Child (medical, age 0-17)	44	1	1028	322	0.04 [0.03-0.05]	1.00 [0.98-1.00]

2 FP indicates false positive; FN, false negative; MIEMS, Maryland Institute for Emergency Medical Services Systems; TN, true negative; and TP, true positive.

3 **Table 8. Prediction of Death in Hospital**

Study	TOR Rule	Population	TP	FP	FN	TN	Sensitivity	Specificity
Park 2023[189]	KoCARC 1	Adult (medical)	668	7	1039	113	0.39 [0.37-0.41]	0.94 [0.88-0.98]
Park 2023[189]	KoCARC 2	Adult (medical)	687	11	1020	109	0.40 [0.38-0.43]	0.91 [0.84-0.95]
Park 2023[189]	KoCARC 3	Adult (medical)	524	6	1183	114	0.31 [0.29-0.33]	0.95 [0.89-0.98]
Hreinsson 2020[184]	uTOR	Adult (cardiac)	202	0	252	113	0.44 [0.40-0.49]	1.00 [0.97-1.00]
Hsu 2022[185]	uTOR	Adult (medical)	40904	657	10873	2630	0.79 [0.79-0.79]	0.80 [0.79-0.81
Hreinsson 2020[184]	ALS	Adult (cardiac)	35	0	414	113	0.08 [0.05-0.11]	1.00 [0.97-1.00]
Hsu 2022[185]	ALS	Adult (medical)	25164	385	26613	2902	0.49 [0.48-0.49]	0.88 [0.87-0.89]
Smits 2023[190]	ALS	Adult (cardiac, male)	3834	6	15240	2728	0.20 [0.20-0.21]	1.00 [1.00-1.00]
Smits 2023[190]	ALS	Adult (cardiac, female)	2301	3	7704	764	0.23 [0.22-0.24]	1.00 [0.99-1.00]
Matsui 2023[188]	ALS	Child (medical & trauma)	299	21	1319	190	0.18 [0.17-0.20]	0.90 [0.85-0.94]
Matsui 2023[188]	BLS	Child (medical & trauma)	5474	440	869	657	0.86 [0.85-0.87]	0.60 [0.57-0.63]
Hsu 2022[185]	GOTO 1	Adult (medical)	27856	283	23921	3004	0.54 [0.53-0.54]	0.91 [0.90-0.92]

Study	TOR Rule	Population	TP	FP	FN	TN	Sensitivity	Specificity
Jabre 2016[186]	JABRE	Adult (cardiac)	2799	1	3435	728	0.45 [0.44-0.46]	1.00 [0.99-1.00]
Hreinsson 2020[184]	JABRE	Adult (cardiac)	215	0	240	113	0.47 [0.43-0.52]	1.00 [0.97-1.00]
Glober 2020[181]	Glober 1	Adult (medical & trauma)	290	0	3407	344	0.08 [0.07-0.09]	1.00 [0.99-1.00]
House 2018[183]	PEA	Adult (cardiac, transported)	829	3	955	328	0.46 [0.44-0.49]	0.99 [0.97-1.00]

ALS indicates Advanced Life Support; BLS, Basic Life Support; FN, false negative, FP, false positive; KoCARC, Korean Cardiac Arrest Research Consortium; PEA, Pulseless Electrical Activity; TN, true negative; TP, true positive; and uTOR, Universal Termination of Resuscitation.

Table 9. Death or Survival With Unfavorable Neurological Outcome

Study	TOR Rule	Population	TP	FP	FN	TN	Sensitivity	Specificity
Lin 2022[187]	uTOR	Adult (2015 cohort)	738	19	113	13	0.87 [0.84-0.89]	0.41 [0.24-0.59]
Lin 2022[187]	uTOR	Adult (2020 cohort)	430	8	116	18	0.79 [0.75-0.82]	0.69 [0.48-0.86]
Lin 2022[187]	ALS	Adult (2015 cohort)	122	2	231	22	0.35 [0.30-0.40]	0.92 [0.73-0.99]
Lin 2022[187]	ALS	Adult (2020 cohort)	104	0	279	24	0.27 [0.23-0.32]	1.00 [0.85-1.00]
Park 2023[189]	KoCARC 1	Adult (medical)	672	3	1074	78	0.39 [0.36-0.41]	0.96 [0.90-0.99]
Park 2023[189]	KoCARC 2	Adult (medical)	695	3	1051	78	0.40 [0.38-0.42]	0.96 [0.90-0.99]
Park 2023[189]	KoCARC 3	Adult (medical)	527	3	1183	78	0.31 [0.29-0.33]	0.96 [0.90-0.99]

ALS indicates Advanced Life Support; FN, false negative, FP, false positive; KoCARC, Korean Cardiac Arrest Research Consortium; TN, true negative; TP, true positive; and uTOR, Universal Termination of Resuscitation.

Following the 2024 publication, we identified 3 additional studies, 2 investigating cost-effectiveness of different TOR rules[191,192] and 1 on the derivation of a new TOR rule for pediatric OHCA.[193]

One study estimated quality-adjusted life years for survivors following OHCA in the United Kingdom.[191] The most cost-effective strategies were the European Resuscitation Council TOR rule (incremental cost-effectiveness ratio (ICER) of £8,111), the Korean Cardiac Arrest Research Consortium 2 (KOC 2) TOR rule (ICER of £17,548), and the universal Basic Life Support (BLS) TOR rule (ICER of £19,498,216).[191] The KOC 2 TOR rule was cost-effective at the established cost-effectiveness threshold of £20,000–£30,000 per quality-adjusted life year (providing the most quality-adjusted life years being below the established ICER threshold).

Another study investigated the cost-effectiveness of implementation of TOR rules in Singapore based on cases terminated in the field and all cases eligible for TOR but transported to hospital.[192] They found that terminating CPR on all patients eligible for the TOR rule would result in 31 additional deaths per 10,000 patients compared with no TOR. If TOR is exercised for every eligible case, it could save approximately $400,440 per quality-adjusted life year loss compared with no TOR, and $821,151 per quality-adjusted life year loss compared with the actual observed rate of TOR in the field.

TOR Rules for Pediatric Out-of-Hospital Cardiac Arrest

We identified 3 studies assessing TOR rules for the prediction of death in children.[182,188,193] One study applied adult TOR rules in children,[188] another, a derivation of the Maryland Institute for Emergency Medical Services Systems (MIEMSS) score,[182] and the third, a derivation of the pediatric TOR score.[193] All studies were downgraded for risk of bias, imprecision, and indirectness, and the evidence was rated as very low certainty.

A new pediatric TOR rule to predict no survival or unfavorable neurological outcome was included,[193] which was derived from a dataset spanning 2013-2019 and validated during 2020-2022 (including the period of COVID-19). The specificity was 99.1% (sensitivity 29.6%) in the derivation cohort and 99.7% in the validation cohort (sensitivity 30.4%).

Prior Treatment Recommendations (2020)

We conditionally recommend the use of TOR rules to assist clinicians in deciding whether to discontinue resuscitation efforts out of hospital or to transport to hospital with ongoing CPR (conditional recommendation/very low–certainty evidence).

Treatment Recommendations (2025)

For adult out-of-hospital cardiac arrest, we conditionally recommend that emergency medical service systems may implement termination of resuscitation (TOR) rules to assist clinicians in deciding whether to discontinue resuscitation efforts at the scene or to transport to hospital with ongoing CPR. We suggest that TOR rules may only be implemented following local validation of the TOR rule with acceptable specificity considering local culture, values, and setting (conditional recommendation, very low–certainty evidence).

For pediatric out-of-hospital cardiac arrest because of insufficient evidence, we suggest against the use of TOR rules to decide whether to terminate resuscitation efforts (conditional recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

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

The task force made a conditional recommendation for the use of TOR rules for adult OHCA in line with the last CoSTR on TOR. The values in making this recommendation remain largely unchanged. The certainty of evidence is limited by a lack of clinical validation studies. The task force recognizes that application of TOR rules may result in missed survivors but has the potential to reduce variation in practice associated with clinician judgment and prevent premature terminations by clinicians.

In making this recommendation, the EIT Task Force recognizes variation in patient values, resources available, and performance of TOR rules in different settings, and that the performance of TOR rules varies depending on the EMS system, the setting, and the survival rate in the population. Therefore, TOR rules should not be implemented without assessing the local validity of a TOR rule, and the validity should be reassessed as survival outcome changes over time.

The task force recognizes that TOR rules are already implemented in some EMS systems. In settings where EMS personnel will transport all patients to the hospital, the use of TOR rules may reduce costs. In contrast, the potential economic benefit in EMS systems with physician-staffed ambulances already making decisions about terminating CPR may be absent.

The task force considered pediatric OHCA separately and acknowledged that missed survivors in this population may be valued differently from the adult population. Several missed survivors were seen when applying adult TOR rules to children, and the 2 TOR rules derived specifically for children have yet to be externally validated.

Knowledge Gaps

- Accuracy of TOR rules in clinical practice
- Compliance with out-of-hospital TOR rules currently in use
- Evidence-based implementation strategies for TOR rules for EMS
- Societal perceptions and acceptability of TOR rules
- Validation of TOR rules in children
- Impact of TOR rules on non–heart-beating organ donation
- Risk associated with emergent transport of futile cases with ongoing resuscitation

Community Initiatives to Promote BLS Implementation (EIT 6306, ScopRev 2025)

Rationale for Review

Rapid BLS interventions significantly increase survival rates and improve neurological outcome for OHCA patients. Various community-based initiatives have emerged, ranging from dispatcher-assisted CPR to public access defibrillation programs, AED distribution, simplification of CPR techniques, and applications locating first responders and AEDs.[194-197] The impact of such initiatives on BLS implementation is less clear, especially regarding public education and training. Given these uncertainties, the EIT Task Force undertook a ScopRev of this topic. The full report of this ScopRev is available on the ILCOR website.[198]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: People who have an out-of-hospital cardiac arrest
- Intervention (exposure): Community initiatives to promote BLS implementation
- Comparator: Current practice
- Outcomes: Survival to hospital discharge with good neurological outcome, survival to hospital discharge, ROSC, time to first compressions, bystander CPR rate, and proportion of population trained.
- Time frame: January 1, 2019, to July 31, 2024

Summary of Evidence

The scoping review included 21 studies,[133,199-218] conducted in the United States (47.6%),[199-205,210,217] Denmark (23.8%),[206,211,212,218] Korea (19.0%),[133,214,215] Japan (4.8%),[213] Singapore (4.8%),[216] UK (4.8%),[209] and China (4.8%).[208] Design included cohort studies (42.9%),[200,202,205,206,209-213] before-and-after studies (28.6%),[133,200,207,208,216,217] cross-sectional studies (23.8%),[203,214,215,218] RCT (4.8%),[204] and 1 non-randomized controlled trial (4.8%).[199] More than half were prospective (57.1%),[133,199,203,204,206,208,211-214,216,218] and the others were retrospective (42.9%).[200-202,207,209,210,215,217] All studies involved adult OHCA, with interventions implemented in workplaces, schools, government offices, public events, and shared community spaces.

The community initiatives, summarized in Table 10, were grouped into 3 categories:

1. Community CPR training programs ([n=11):[200,201,203-206,210-212,216,217] (52.3% of studies)]
2. Mass-media campaigns [(n=1):[199] (4.8%)] on public awareness through media outlets
3. Bundle interventions [(n=9):[133,202,207-209,213-215,218] (42.9% of studies)], defined as % efforts combining CPR training with other community-based strategies (eg, public awareness campaigns, guideline implementation, legislative changes, and mandatory training for driver's license applicants).

Time to first compressions was not reported as an outcome in any of these studies.

The full study characteristics and detailed results are provided in supplement Table S2.

Table 10. Community Initiatives to Promote BLS Implementation

Outcome type	Community CPR training programs (n=11)[200,201,203-206,210-212,216,217]	Mass-media campaigns (n=1)[199]	Bundle interventions (n=9)[133,202,207-209,213-215,218]
Bystander CPR rate	7 studies reported an increase[200,201,203,210-212,216]	Reported increase following television public service announcements	Reported increase in 6 studies[133,208,209,214,215,218] of combinations of instructor-led training, guideline implementation, and public initiatives
	3 studies reported no change[204,206,217]		3 studies reported no change[202,207,213]
Proportion of population trained	3 studies, all reporting increase[200,203,206]		3 studies, all reporting increase[133,208,213]
ROSC	2 studies,[216,217] 1 reported increase[216]		1 study reporting increase[208]
Survival to hospital discharge after instructor-led training	2 studies reported increase[205,216]		1 study reported increase[208]
	4 studies reported no change[201,211,212,217]		1 study reported no increase[213]
Survival with good	1 study reported increase[210]		
	2 studies reported no change[205,212]		1 study reported no change[213]

Outcome type	Community CPR training programs (n=11)[200,201,203-206,210-212,216,217]	Mass-media campaigns (n=1)[199]	Bundle interventions (n=9)[133,202,207-209,213-215,218]
neurological outcome after instructor-led training			

Task Force Insights

Initially, the EIT Task Force refined the inclusion and exclusion criteria to avoid overlap with other more specific PICOSTs. Therefore, we excluded studies on public access defibrillation programs, dispatched or telephone CPR and apps, the impact of social or economic factors on bystander engagement, and the effect of different CPR techniques or protocols including guideline changes.

Findings strongly suggest that community initiatives are effective and able to improve response to OHCA. However, for patient outcomes such as survival and neurological outcome, the results did not clearly favor the intervention.

In 2020 the focus of this PICOST was changed to investigate system interventions in general, which resulted in a scoping review,[219] subsequently updated for this CoSTR. However, the EIT Task Force values community initiatives to promote BLS implementation as highly important because the identified studies reported positive signals without any negative or detrimental effects. Thus, in addition to maintaining the existing treatment recommendation from 2015, the EIT Task Force generated a good practice statement in 2025 for this PICOST.

Treatment Recommendations (2015 and 2025)

We recommend implementation of resuscitation guidelines within organizations that provide care for patients in cardiac arrest in any setting (strong recommendation, very low–certainty evidence).

We propose that community initiatives to promote BLS implementation should be endorsed and supported (good practice statement).

Knowledge Gaps

- Effect of community initiatives to promote BLS implementation in more diverse geographic areas, including low resource settings
- Effect of community initiatives to promote BLS implementation on neonatal and pediatric resuscitations
- More well-designed RCTs are needed to report key patient outcome and enable a systematic review
- Effect of public campaigns such as World Restart A Heart in regions beyond the United Kingdom
- Influence of specific legal regulations on CPR uptake in countries other than China
- How specific laws and regulations affect community response to cardiac arrest
- Cost-effectiveness of each intervention for BLS implementation, and its specific impact on clinical outcomes

Family Presence in Adult Resuscitation (EIT 6300, SysRev 2022, EvUp 2025)

A SysRev was conducted for 2022,[220] and details of that review can be found in the 2022 CoSTR summary.[12,13] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults requiring resuscitation in any setting
- Intervention: Family presence during resuscitation
- Comparator: No family presence during resuscitation
- Outcomes: patient outcomes (short- and long-term), family-centered outcomes (short- and long-term psychological stress, perception of the resuscitation), and health care provider-centered outcomes (psychological stress, perception of the resuscitation).
- Time frame: May 10, 2022, to April 28, 2024

Summary of Evidence

The evidence update identified 7 new primary studies[221-227] and 2 systematic reviews.[228,229] Patient outcomes were lacking. A dedicated family support role led to a more positive view of family presence. Family member outcomes demonstrated mixed positive and negative responses. Given the number of new studies, an escalation to a new SysRev might be considered.

Treatment Recommendations (2022)

We suggest that family members be provided with the option to be present during in-hospital adult resuscitation from cardiac arrest (weak recommendation; very low–certainty evidence).

We suggest that family members be provided with the option to be present during out-of-hospital adult resuscitation from cardiac arrest acknowledging that providers are often not able to control this (weak recommendation; very low–certainty evidence).

Policies or protocols about family presence during resuscitation should be developed to guide and support health care professional decision-making (good practice statement).

When implementing family presence procedures, healthcare providers should receive education about family presence during adult cardiac arrest resuscitation, including how to manage these stressful situations, family distress and their own responses to these situations (good practice statement).

Cardiac Arrest Centers (EIT 6301, SysRev 2024, EvUp 2025)

A SysRev was conducted in 2024,[230] and details of that review can be found in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults with attempted resuscitation after nontraumatic IHCA or OHCA

- Intervention: Care at a specialized cardiac arrest center
- Comparator: Care in an institute not designated as a specialized cardiac arrest center
- Outcomes: Survival with favorable neurological outcome at 30 days and at hospital discharge; survival at 30 days and at hospital discharge; ROSC post-hospital admission for patients with ongoing CPR.
- Time frame: December 31, 2023, to November 18, 2024

Summary of Evidence

Three new observational studies were found in this EvUp.[233-235] The new data does not warrant a new SysRev.

Treatment Recommendations (2024)

We suggest adults with OHCA should be cared for in cardiac arrest centers (weak recommendation, very low–certainty evidence).

Technology to Summon Providers (EIT 6302, EvUp)

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children with OHCA
- Intervention: Having a citizen CPR responder notified of the event via mobile technology or social media.
- Comparator: No such notification
- Outcomes:
  - Patient survival to hospital discharge with good neurological function, 30-day survival, survival to hospital discharge, Hospital admission, ROSC
  - Non-patient–bystander CPR rates, time to first compression, response time, activation rate, system reliability, user satisfaction, cost-effectiveness

- Time frame: October 21, 2021, to October 27, 2024

Summary of Evidence

A SysRev was conducted in 2020, and details of that review can be found in the 2020 CoSTR; an EvUp was done in 2021.[9,10,236,237] The complete 2025 EvUp is provided in Appendix B. Given the absence of RCTs, the 4 newly identified observational studies do not warrant a new SysRev.[238-241]

Treatment Recommendations (2020)

We recommend that citizen/individuals who are in close proximity to a suspected out-of-hospital cardiac arrest event and are willing to be engaged/notified by a smartphone app with mobile positioning system or text message-alert system should be notified (strong recommendation, very low–certainty evidence).

Willingness to Provide CPR/AED (EIT 6304, EvUp)

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Bystanders (laypersons) in actual situation of adult or pediatric patients with OHCA
- Intervention (Exposure): Factors (barriers or facilitators) that affected the willingness of bystanders to perform CPR and/or use an AED
- Comparator: No such factor or any other factor that affected the willingness of bystanders to perform CPR and/or use an AED
- Outcomes: Bystander CPR rate, rate of bystander defibrillation with an AED, willingness to provide CPR in actual situation, willingness to provide defibrillation with an AED in actual situation
- Time frame: August 1, 2022, to June 28, 2024

Summary of Evidence

A ScopRev was conducted for 2020,[242] and details of that review can be found in the 2020 CoSTR. An EvUp was done in 2022.[9,10,12,13] The complete 2025 EvUp is provided in Appendix B. Three new observational studies, like several others included in earlier searches, focused on disparities in receiving CPR rather than factors affecting willingness to perform it. A revised PICOST should distinguish between factors related to OHCA patients receiving CPR (such as community-level disparities) and factors associated with bystanders performing CPR and using AEDs (such as personal-level willingness). Because the recommendation from 2020 was not based on a GRADE SysRev, the EIT Task Force added a new good practice statement to the existing treatment recommendations.

Treatment Recommendations (2020, Unchanged From 2010)

To increase willingness to perform CPR, laypeople should receive training in CPR. This training should include recognizing gasping or abnormal breathing as a sign of cardiac arrest when other signs of life are absent.

Laypeople should be trained to start resuscitation with chest compressions in adult and pediatric victims. If unwilling or unable to perform ventilation, rescuers should be instructed to continue compression-only CPR.

EMS dispatchers should provide CPR instructions to callers who report cardiac arrest. When providing CPR instructions, EMS dispatchers should include recognition of gasping and abnormal breathing.

Treatment Recommendations (2025)

The task force encourages resuscitation councils, communities, and emergency medical services to provide easy access to BLS courses, raise awareness about cardiac arrest and its treatment, and utilize training, public outreach, and social media to increase laypersons' willingness to perform CPR (good practice statement).

Clinical Decision Rules to Facilitate In-hospital Do-Not-Attempt CPR (EIT 6305, SysRev 2022, EvUp 2025)

A SysRev was conducted in 2022,[243] and details of that review can be found in the 2022 CoSTR summary.[9,10,236,237] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Hospitalized adults and children experiencing an in-hospital cardiac arrest
- Intervention: Any pre-arrest clinical prediction rule
- Comparator: No clinical prediction rule
- Outcomes: Return of spontaneous circulation, survival to hospital discharge/30-days or survival with favorable neurological outcome
- Time frame: January 1, 2021, to November 27, 2024

Summary of Evidence

Four new studies were found.[244-247] Overall, there are still no studies investigating the prospective implementation of prediction models for do-not-attempt cardiopulmonary resuscitation orders. Therefore, a SysRev is not warranted.

Treatment Recommendations (2022)

We recommend against using any currently available pre-arrest prediction rule as a sole reason to not resuscitate an adult with in-hospital cardiac arrest (strong recommendation, very low–certainty evidence).

We are unable to recommend for or against any available pre-arrest prediction rule to facilitate do-not-attempt cardiopulmonary resuscitation discussions with adult patients or their next of kin as there are no studies investigating the effect of clinical implementation of such score.

We are unable to provide any recommendation for pediatric patients as no studies on children were identified.

Termination of Resuscitation for In-Hospital Cardiac Arrest (EIT 6308, EvUp 2025)

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children with IHCA
- Intervention: Use of any clinical decision rule
- Comparator: No clinical decision rule
- Outcomes: No return of spontaneous circulation, death before hospital discharge, survival with unfavorable neurological outcome, death within 30 days
- Time frame: January 1, 2020, to May 20, 2024

Summary of Evidence

A SysRev was previously conducted in 2020.[248] An EvUp was done in 2025.[9,10,236,237] The complete EvUp is provided in Appendix B. This Evidence Update did not identify any new studies. Accordingly, a new SysRev is not warranted.

Treatment Recommendations (2020)

We did not identify any clinical decision rule that was able to reliably predict death following in-hospital cardiac arrest. We recommend against use of the UN10 rule (U–unwitnessed arrest; N–nonshockable rhythm; 10–ROSC not obtained within 10 minutes) as a sole strategy to terminate in-hospital resuscitation (strong recommendation, very low–certainty evidence).

Chain of Survival (EIT 6311, SysRev 2024, EvUp 2025)

A SysRev was conducted in 2024,[249] and details of that review can be found in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

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

- Population: Literature using the term *chain of survival* or similar terms (eg, *survival chain*, *chain of* [other pathology])
- Intervention (Exposure): Adaptations of the original chain of survival[250]
- Comparator: The original chain of survival[250]
- Outcomes: Composition of the specific variations in adapted versions, attitudes, rationale, and views concerning the adaptation; incentives to develop novel versions; way of implementation of adapted versions; way of using adapted versions in education; variations in visualization; effect of the use of the chain of survival or variants on teaching, implementation, and patient outcomes
- Study designs: In addition to standard criteria, designs such as narrative literature, letters, commentaries, and editorials were included.
- Time frame: January 1, 2023, to October 21, 2024

Summary of Evidence

The 7 newly found studies do not add any new information to the CoSTR from 2024.[251-257] No new SysRev is indicated. Task force insights were discussed in detail in the 2024 CoSTR summary.[231,232,258]

Impact of Support on Mental Health in Cosurvivors of Cardiac Arrest Patients (EIT 6315, EvUp 2025)

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Co-survivors (any age) who witnessed resuscitation of cardiac arrest (any age)
- Intervention: Co-survivors who received support for their mental health, after the event
- Comparator: No support or any other type of support
- Outcomes: Mental health (eg, anxiety, depression, post-traumatic stress disorder), quality of life, socio-economic measures
- Time frame: From inception to October 24, 2024

Summary of Evidence

The complete EvUp is provided in Appendix B. Co-survivor is a general term for family members, friends, neighbors, or anyone in a close relationship with the cardiac arrest patient. Out of 652 articles identified, none were relevant to the PICOST. We encourage further research to explore the effect of support for co-survivors who witnessed a cardiac arrest and the effect on their mental health. As this was a new PICOST, no treatment recommendations were generated.

INSTRUCTIONAL DESIGN

CPR Feedback Device Use in Resuscitation Training (EIT 6404, SysRev 2025)

Rationale for Review

Chest compression skills are an important component of effective resuscitation during cardiac arrest. CPR feedback devices provide immediate, real-time feedback on quality of chest compressions. Use of CPR feedback devices during resuscitation skills training has the potential to enhance CPR skill acquisition and retention.

Recent scientific statements highlight a growing trend in the use of CPR feedback devices during resuscitation courses. While earlier reviews showed that these devices can improve short-term educational outcomes, the results have been inconsistent. This topic was last reviewed in the 2020 CoSTR[9,10] and an updated review was undertaken. The review was registered in PROSPERO (CRD42023376751) and the full CoSTR is available on the ILCOR website.[259]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: All laypersons and healthcare providers in any educational setting
- Intervention: Use of CPR feedback/guidance device during resuscitation training
- Comparator: No use of CPR feedback/guidance device during resuscitation training
- Outcomes: Patient survival, quality of performance in actual resuscitations, skill retention (performance after course conclusion), skill acquisition (performance at course conclusion).
- Time frame: January 1, 2005, to June 13, 2024

Consensus on Science

Three studies were conducted in lay providers [260-262] and 17 in healthcare providers.[263-279] No studies were identified that examined the impact of using CPR feedback devices during resuscitation training on the outcomes of patient survival or quality of performance in actual resuscitation.

Compression Depth

Fifteen randomized controlled trials (RCTs) with a total of 4185 participants evaluated the effect of CPR feedback devices on objectively measured mean compression depth, favoring feedback devices (standardized mean difference [SMD] 0.76; 95% CI, 0.02-1.50;

I^2=94%).[260,261,263,265-269,274,276-279] No difference was found between health care professionals and lay persons *P*=0.10).

Sixteen RCTs involving 4,304 participants examined the effect of CPR feedback devices during resuscitation training on compression depth compliance, quantitatively measured as the percentage of compressions meeting the resuscitation guidelines during assessment, favoring feedback devices (SMD 0.98; 95%CI, 0.10-1.87; I^2=94%).[260-262,264-268,270-274,278-280] No difference was found between health care professionals and lay persons (*P*=0.09).

Compression Rate

Seventeen RCTs involving a total of 4,327 participants evaluated the effect of CPR feedback devices on objectively measured mean compression rate.[260-263,265-270,273-279] Participants trained with CPR feedback devices had a significantly lower mean compression rate compared with those trained without them, as participants in the nonfeedback group tended to compress too quickly (>120 bpm) (SMD –0.29; 95% CI, 0.48-0.10, I^2=3%). No difference was found between health care professionals and laypersons (*P*=0.67).

Nine RCTs involving 905 participants examined the effect of CPR feedback devices during resuscitation training on compression rate compliance measured as the percentage of compressions within the guideline-recommended rate of 100–120 bpm, and results favored use of feedback devices (SMD 0.44, 95%CI, 0.23-0.66; I^2=61%).[260,264,267,269-272,278,279] No difference was found between health care professionals and lay persons (*P*=0.80).

Chest Recoil

Ten RCTs involving a total of 3,496 participants evaluated the effect of CPR feedback devices during training on chest recoil quantitatively measured as the percentage of compressions with full chest recoil, overall favoring feedback devices (SMD 0.53; 95% CI, 0.31-0.75, I^2=87%). [260,261,264,265,269,271,272,276,278,279] Subgroup analysis showed that the effect of the feedback device on recoil compliance was significantly improved in the healthcare providers (SMD 0.67; 95% CI, 0.52-0.82; I^2=0%), but not in the laypersons (SMD 0.20; 95% CI, 0.24-0.64; I^2=83%).

Overall Quality of CPR

Eight RCTs involving a total of 3261 participants evaluated the effect of CPR feedback devices on overall CPR quality during resuscitation training assessed by computer software integrating all 3 metrics of chest compression (depth, rate and recoil), with limited validity evidence favoring feedback devices (SMD 0.7; 95% CI, 0.40-1.03, I^2=86%).[260,261,265,269-271,276,278] Subgroup analysis showed that the effect of the feedback device use on the overall CPR score was statistically significantly higher in the healthcare professionals than in the lay persons (*P*=0.02).

Three RCTs involving a total of 349 participants evaluated the effect of CPR feedback devices on overall CPR quality during resuscitation training assessed dichotomously, based on whether compression depth, rate, and recoil all concurrently met guideline standards, favoring feedback devices (SMD 0.19; 95% CI, 0.01-0.38, I^2=76%).[272,274,277]

Prior Treatment Recommendations (2020)

We suggest the use of feedback devices that provide directive feedback on compression rate, depth, release, and hand position during CPR training (weak recommendation, low-certainty evidence).

If feedback devices are not available, we suggest the use of tonal guidance (examples include music or metronome) during training to improve compression rate only (weak recommendation, low-certainty evidence).

Treatment Recommendations (2025)

We recommend the use of CPR feedback devices during resuscitation training for healthcare providers and lay providers (strong recommendation, moderate-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

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

The results of the meta-analyses of RCTs found evidence favoring the use of feedback devices during training across all CPR quality outcomes with moderate to strong association.

Subgroup analyses showed the effect of feedback devices on resuscitation training was greater in healthcare providers than in the lay providers, but there was still a significant effect for most CPR metrics in lay providers. No undesirable effects were detected in the review, feedback devices are well accepted, and their use is feasible with relatively low or negligible costs.

Knowledge Gaps

- Relative and synergistic effect of feedback device use when combined with other educational strategies and instructional design features
- Impact of feedback devices on skill retention beyond the end of a course
- Impact of improved CPR skills from training with feedback devices on patient outcome
- Costs associated with implementing feedback devices during resuscitation training, as well as its cost-effectiveness

Self-Directed, Digital-Based Versus Instructor-Led Cardiopulmonary Resuscitation Education and Training in Adults and Children (EIT 6406, SysRev 2025)

Rationale for Review

CPR and AED training is known to improve the willingness and confidence in someone performing bystander CPR.[281] Little is known about whether self-directed digital CPR training is superior to instructor-led training in developing sufficient skills to provide adequate CPR. This topic was reviewed in 2021 and included RCTs and non-RCTs. Since then, several RCTs on this topic were published and the EIT Task Force initiated a new systematic review that included only RCTs, which was registered in PROSPERO (CRD42020199176). The full CoSTR is available on the ILCOR website.[282]

We defined self-directed digital-based CPR training as any form of digital education or training for CPR that can be completed without an instructor. Instructor-led training was defined as education or training that occurred in the presence of a BLS instructor.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children undertaking CPR training
- Intervention: Self-directed digitally based CPR training
- Comparator: Instructor-led CPR training
- Outcomes:
  - Patient outcomes: good neurological outcome at hospital discharge or 30 days, survival at hospital discharge or 30 days, ROSC, rates of bystander CPR, bystander CPR quality during an OHCA (any available CPR metrics), rates of automated external defibrillator (AED) use
  - Educational outcomes at end of training and within 12 months: CPR quality (chest compression depth and rate, chest compression fraction, full chest recoil, hand position, ventilation rate) and AED competency; CPR and AED knowledge; confidence and willingness to perform CPR
- Time frame: October 11, 2022, to March 28, 2024

Consensus on Science

No studies were identified for any patient outcome.

For the educational outcomes, we identified 29 RCTs.[283-311] Because of the high degree of heterogeneity in the interventions, comparators, and measurements of outcomes, no meta-analysis was performed.

Sample sizes ranged from 52 participants[311] to 826 participants,[298] and 14 of the 29 studies had sample sizes less than 140 participants.[283-285,294-297,299-301,305,307-309,311] Populations included children; high-school students;[285,288,306,310,311] university students,[283,299-301] including specific cohorts such as medical[284,304,307,308] and nursing students;[291,296] adults,[286,287,290,292,293,297,298,303,305,309] including specific cohorts such as those over 60 years,[302] parents/caregivers of children,[295] parents of children at high risk for sudden cardiopulmonary arrest;[289] university staff and their spouses;[300] and caregivers of family members with cardiac histories.[294] Details of study designs are displayed in Table 11.

Table 11. Self-Directed Digital-Based CPR Training Versus Instructor-led CPR Training Studies

Educational Outcome Study n	**CPR quality 27** [283-286,288-301,303-311]	**AED use 10** [284,287,288,291,300,302-304,306,307]	**Knowledge 7** [289,294,299,305,306,308,309]	**Confidence to perform CPR 10** [283,292,294-296,298,300,302,304,311]	**Willingness to perform CPR 6** [286,296,298,300-302]	**Test scores immediately to <1 month 25** [283-286,288-301,303-312]	**Test scores between 1-12 months of training 15** [284,285,287,290,293,294,296,302,304-306,308-311]
No. of studies per intervention	8 video-only[283-285,287,291,293,294,305]	16 video + manikin practice approach [286,287,289,290,293,295-299,301,302,304,308-310]	1 app-based self-training intervention [288]	1 virtual reality [303]	1 video + manikin + scenario self-training [287]	3 computer program/online tutorial + video + manikin [292,300,307]	1 interactive computer session [306] 1 game-in-film [311]
Details of interventions	Video-only interventions ranged from 1-minute [293] to 20-minutes [284] in length (length often not stated)	Videos used with manikin practice ranged from 4–35 [301]mins[293, 300] to minutes (length often not stated)	Not well described	Not well described	Not well described	Not well described	Not well described
Comparators	7 formal certified courses [297,298,300,302,307-309]	Course length: 9 min(1) up to 5 hours[307]	Not well described	Not well described	Not well described	Not well described	Not well described

Only some studies with self-directed training interventions had sufficient numbers for comparison at immediate testing (with video + manikin and video-only self-directed training). A video + manikin self-directed intervention was used in 15 studies.[286,289,290,293,295-299,301,302,304,308-310] Most of these studies demonstrated no difference between self-directed training using a video + manikin versus an instructor-led training. Only 1 study favored video + manikin self-directed training for compression rate,[309] proportion of compressions at the correct rate[293] and hand position.[293,297] Instructor-led training was favored over video + manikin self-directed training for chest compression depth,[293] proportion of chest compressions at the correct depth,[286] hand position,[286,290,301] knowledge,[289] and confidence.[304]

Video-only self-directed training was used in 7 studies[283-285,291,293,294,305] and was the favored arm in 3 instances for proportion of compressions at the correct depth,[291] chest recoil,[291]and confidence.[283] Instructor-led training was favored over video-only self-directed training in other studies for proportion of compressions done at the correct rate,[293] compression depth,[293] knowledge,[294] and confidence.[294] Across the studies compression rate, depth, fraction, chest recoil, hand position, ventilation rate, AED use, and knowledge and confidence were measured a further 19 times, and no difference was identified between the video-only self-directed training and instructor-led groups.

Educational outcomes measured up to 12 months were reported in 14 studies (at 4 months,[296] 6 months,[284] between 2-6 months,[308]and between 1-6 months after the training[285,287,290,293,294,302,304-306,310,311]). Many of these studies reported a reduction in the quality of the skills being performed (compression rate: 2 studies,[293,310] compression depth: 4 studies,[293,304,306,310] chest compression fraction: 1 study,[311] chest recoil: 1 study,[304] hand position: 4 studies,[293,304,306,310] ventilation rate: 1 study,[290] AED: 1 study,[302] knowledge: 1 study,[294] confidence: 1 study[304]). The opposite of this was seen in 1 study where both the groups were more likely to pass the AED testing at 2 months than immediately after the training.[287]

Prior Treatment Recommendations (2020)

We recommend instructor-led training (with manikin practice with feedback device) or the use of self-directed training with video kits (instructional video and manikin practice with feedback device) for the acquisition of CPR theory and skills in layperson adults and high school-aged (more than 10 years old) children (strong recommendation, moderate-certainty evidence).

We recommend instructor-led training (with AED scenario and practice) or the use of self-directed video kits (instructional video with AED scenario) for the acquisition of AED theory and skills in layperson adults and high school–aged (more than 10 years old) children (strong recommendation, low-certainty evidence).

We suggest that BLS video education (without manikin practice) be used when instructor-led training or self-directed training with video kits (instructional video plus manikin with feedback device) are not accessible, or when quantity over quality of BLS training is needed in adults and in children (weak recommendation, low-certainty evidence).

There was insufficient evidence to make a recommendation on gaming as a CPR or AED training method.

There was insufficient evidence to suggest a treatment effect on bystander CPR rates or patient outcomes.

Treatment Recommendations (2025)

We suggest the use of either instructor-led training or self-directed digital training for the acquisition of CPR or AED skills in lay adults and high-school–aged (>10 years) children (weak recommendation, very low–certainty evidence).

We suggest self-directed digital training be used when instructor-led training is not accessible, or when quantity over quality of CPR training is needed in adults and children (weak recommendation, very low–certainty evidence).

There was insufficient evidence to make a recommendation on game-in-film, virtual reality, computer programs, online tutorials or app-based training as a CPR or AED training method.

Justification and Evidence-to-Decision Framework Highlights

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

The acquisition of CPR skills may vary across different mediums and age groups. However, any form of CPR/AED training is likely to improve knowledge, confidence and willingness in simulated settings, but this may not translate to real-life situations. Digital and instructor-led materials need updating to ensure training complies with CPR recommendations. Digital training enables skills to be refreshed at any time, and at no additional cost, and provides the opportunity to teach others. It also enables more people to be educated in periods of need (eg, pandemics).

Cost-effectiveness analysis favored digital self-directed training.[292,310] This reflects the known barriers that exist to attending instructor-led CPR classes (eg, time, costs, and accessibility) and the need to make CPR training available to everyone.

Knowledge Gaps

- Standardized outcome measures (educational and CPR performance outcomes) are needed to enable pooling of data. Comparator groups should be aligned using standardized, accepted instructor-led training programmes to reduce inconsistency and uncertainty.

- The ability of these interventions and comparators to produce findings that meet accepted standards for adequate CPR that are maintained at defined time intervals
- Effectiveness of specific self-directed digital interventions, such as game-in-film, virtual reality, computer programmes, online tutorials or app-based training
- The treatment effect on bystander CPR rates and patient outcomes

In Situ (Workplace-Based) Simulation-Based Cardiopulmonary Resuscitation Training (EIT 6407, SysRev 2025)

Rationale for Review

Simulation-based training is traditionally performed in classrooms or laboratories specifically equipped with manikins, monitors, and equipment needed for running cardiac arrest scenarios. Providing such training within patient care areas has theoretical advantages, with learning occurring in the context of the real clinical environment and organizational structures. The EIT Task Force performed a SysRev, which was registered in PROSPERO (CRD42024521780). The full CoSTR can be found on the ILCOR website.[313]

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

- Population: Healthcare providers
- Intervention: In situ (workplace-based) simulation-based CPR training
- Comparator: Traditional training
- Outcomes: Patient survival and outcome, CPR skill performance at course completion and in actual resuscitation, CPR skill performance <1yr and ≥1yr after course completion; CPR quality (at course completion, <1yr and ≥1yr after course completion). Teamwork competencies (at course completion, <1yr and ≥1yr after course completion); resources (time, equipment, cost), clinical performance (adherence to guidelines, time to critical interventions, medication errors, etc.)

- Study Designs: In addition to standard criteria, reviews and studies with self-assessment as the only outcome were excluded.
- Time frame: From inception to March 25, 2024

Consensus on Science

We identified 4 studies in adults,[314-317] 3 in children,[318-320] and 2 in neonates.[321,322] Results globally favored in situ simulation across all studies. Because of heterogeneity in the interventions and outcome definitions, no meta-analysis or formal subgroup analysis according to the type of training (ie, BLS, advanced cardiovascular life support, pediatric advanced life support, neonatal life support) was performed.

Patient Survival

One nonrandomized prospective observational study with historical controls[319] reported an association between the in situ simulation period and higher odds of survival at hospital discharge in children who experienced cardiac arrest [50/124 (40.3%) survival in the pre-intervention period versus 28/46 (60.9%) in the post-intervention period; (OR, 2.06; 95% CI, 1.02-4.25)].

Other Patient Outcomes

One nonrandomized study[322] reported a lower incidence of neonatal asphyxia [88 (0.64%) versus 133 (0.84%); *P*=0.045], severe asphyxia [8 (0.058%) versus 22 (0.138%); *P*=0.029], hypoxic-ischemic encephalopathy [2 (0.01%) versus 16 (0.1%); *P*=0.003], and meconium aspiration syndrome [12 (0.09%) versus 31 (0.19%); *P*=0.014] in the post intervention (in situ simulation) versus pre-intervention period, but no difference in the composite outcome of neonatal asphyxia or low Apgar score [111 (0.8%) versus 154 (0.97%); *P*=0.128], or low Apgar score [23 (0.17%) versus 21 (0.13%); *P*=0.445].

Clinical Performance in Actual Resuscitation

Three nonrandomized studies were identified.[315,318,319] One before-and-after study[319] reported no difference in neurologic outcome at hospital discharge, the performance of chest compressions for heart rate <60/sec, or the performance of shock <3 min from recognized ventricular fibrillation/pulseless ventricular tachycardia, but found improvement in chest compressions between rhythm checks with in situ simulation.

Another before-and-after study[315] reported a 12% reduction in time to call for help, a 52% reduction in time elapsed to initiation of chest compressions, and a 37% reduction in time to initial defibrillation, all favoring in situ simulation. A third before-and-after study[318] reported a 39% decrease in nonadherence to pediatric advanced life support guidelines for subsequent epinephrine timing, favoring in situ simulation, but no significant difference in the administration of epinephrine every 3-5 min.

Teamwork Competencies in Actual Resuscitation at Course Completion and Less Than 1 Year After the Course

One nonrandomized study[319] reported higher adherence to resuscitation standard operating performance variables amongst pediatric code teams during the period of in situ simulation [38/183 (20.8%) versus 23/64 (35.9); OR, 2.14; 95% CI; 1.15-3.99].

Clinical Performance in Simulation

We found 4 RCTs[320,316,321,317] and 1 nonrandomized study.[314] One RCT[320] reported improved skill performance measured by the Clinical Performance Tool [6.2 (± 4.3) versus 1.2 (± 2.9); P=0.004]. One RCT[317] reported shorter time to call for help and initiation of chest compression with in situ simulation (P<0.001). The same study found shorter time to successful defibrillation (P<0.001), and improvement in the composite outcome of initiation of compressions within 20 sec of cardiac arrest, defibrillation within 180 sec of detection of a shockable rhythm and use of a backboard (*P*<0.001).

One RCT[321] reported improvement in technical skills and adherence to guidelines with in situ simulation and a higher percentage of scenarios with efficient resuscitation at 3 minutes [14 (24%) versus 2 (4%); *P*=0.003] and 5 minutes [40 (68%) versus 25 (47%); *P*=0.06].

One RCT[316] reported better medical management test scores with in situ simulation (*P*<0.001), while another[314] reported no difference between the 2 groups during mock code.

Teamwork Competencies in Simulation at Course Completion and Less Than 1 Year After the Course

One RCT[320] reported no difference in teamwork assessed by the Behavioral Assessment Score [2.8 (± 3.6) versus 3.0 (± 4.0); *P*=0.69]. Other RCTs reported better team performance score[321] during in situ simulation [31.1 (20.8–36.8) versus 19.9 (13.3–25.0); *P*=<0.001], while better teamwork with in situ simulation was reported in another RCT[316] [10.84 (±3.26) versus 7.87 (±4.14), *P*< 0.001].

CPR Skill Performance in Simulation at Course Completion

One nonrandomized study[314] evaluated CPR fraction as a measure of skill and found improvement favoring in situ simulation (1.8% per time interval of training (*P*=0.02).

No studies were found analyzing resources needed for in situ simulation, or CPR skill performance in actual resuscitation.

Treatment Recommendations (2025)

We recommend that in situ simulation may be considered as an option for CPR training where resources are readily available (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

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

Evidence from RCTs and nonrandomized studies supports the effectiveness of in situ simulation to teach CPR. Critical outcomes, including patient survival and clinical performance and teamwork competencies in actual resuscitation, improved with in situ simulation. The balance between the benefit and the resources needed may be favorable, especially when critical outcomes are considered. Studies addressing patient survival and other clinical outcomes were found only in the pediatric setting, which provides indirect evidence for adults.

Knowledge Gaps

- The resources required for implementation of in situ training, including direct and indirect costs, workload, and equipment needed
- The feasibility of in situ training in low and middle-income countries.

Manikin Fidelity in Resuscitation Education (EIT 6410, SysRev 2025)

Rationale for Review

Higher-fidelity manikins have physical features that make them more realistic, including changes in simulated physical states. Greater realism during life support training may enhance learner engagement and make it easier to suspend disbelief. However, using higher-fidelity manikins depends on the availability of resources to purchase, properly implement, and maintain them; additionally, centers require trained personnel who can operate such manikins. The EIT Task Force initiated this SysRev that was registered in PROSPERO (CRD4202453504), and the full online CoSTR is available on the ILCOR website.[323]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Participants undertaking basic and advanced life support training in an education setting
- Intervention: Use of high-fidelity manikins
- Comparator: Use of low-fidelity manikins

- Outcomes: Patient outcomes, skill performance in actual resuscitations, skill/knowledge at 1 year, skill/knowledge at time between course conclusion and 1 year, skill/knowledge at course conclusion, learner confidence, learner preference, cost/resource utilization
- Time frame: January 1, 2005, to April 30, 2024

Consensus on Science

Twenty-one studies were included.[324-344] All involved healthcare professionals or trainees and were performed in North America,[325-333] Asia,[324,336,338,340] Europe,[334] and Australia.[337]

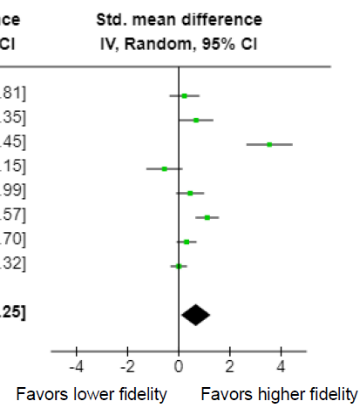
Skill at Course Conclusion

Data were reported in 8 RCTs with a total of 550 participants.[326,327,329-331,333,336,341] RCTs assessed performance in scenarios with manikins: 4 of adults,[327,331,333,341] 2 of children,[326,329] and 2 of neonates.[327,333] Meta-analysis results of these studies favored high-fidelity manikins (**Figure 5**).

Figure 5. Skill at completion of courses using high-fidelity manikins.

	Higher fidelity			Lower fidelity				Std. mean difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Cheng 2013	7.9	7	23	6.3	7.1	22	12.5%	0.22 [-0.36 , 0.81]
Conlon 2014	66.3	9	18	60.1	8.9	18	12.0%	0.68 [0.00 , 1.35]
Donoghue 2009	11.1	1.8	25	4.8	1.7	26	10.6%	3.55 [2.64 , 4.45]
Finan 2012	72.2	9	16	78.2	11.7	16	11.8%	-0.56 [-1.27 , 0.15]
Hoadley 2009	26.1	2.5	29	24.7	3.7	24	12.7%	0.45 [-0.10 , 0.99]
Lo 2011	41.5	5.6	45	35	6	41	13.2%	1.11 [0.66 , 1.57]
Nimbalkar 2015	31.5	6.1	50	29.7	5.6	51	13.4%	0.31 [-0.09 , 0.70]
Settles 2011	17.2	1.4	73	17.2	1.6	73	13.7%	0.00 [-0.32 , 0.32]
Total (95% CI)			**279**			**271**	**100.0%**	**0.66 [0.08 , 1.25]**

Heterogeneity: Tau² = 0.61; Chi² = 70.00, df = 7 (P < 0.00001); I² = 90%
Test for overall effect: Z = 2.24 (P = 0.02)
Test for subgroup differences: Not applicable

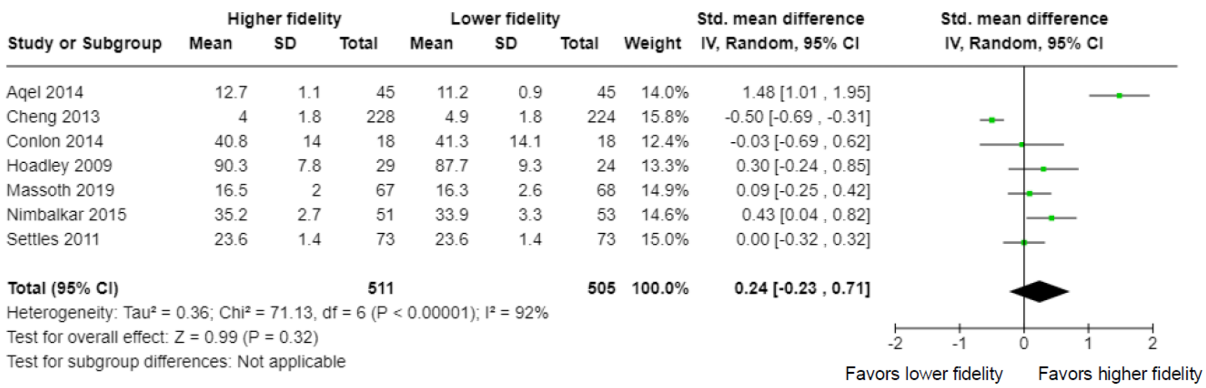


Two additional RCTs with 107 participants did not report sufficient measures of variance for inclusion in the meta-analysis. Both found no difference in skill performance at course completion.[328,337]

Knowledge at Course Completion

Data were reported in 7 RCTs with 1016 participants.[324,326,327,331,334,336,341] Five scenarios were in adults,[324,327,331,334,341] 1 in children,[326] and 1 in neonates.[336] The meta-analysis revealed no significant effect of high-fidelity manikins (Figure 6).

Figure 6. Knowledge at completion of courses using high-fidelity manikins.



Three additional RCTs with 184 participants and 1 observational study of 34 subjects did not report sufficient measures of variance for inclusion in meta-analysis.[332,337,339,342] One of these found improved knowledge at course completion;[337] the others found no difference.[332,339,342]

Skill: Time-to-Task Performance at Course Conclusion

Three RCTs with 179 participants[325,342,344] were reviewed. One found faster time-to-task completion (EMS activation),[335] another found shorter time to intervention and assessment,[342] and 1 other study found no difference in time to tracheal intubation during neonatal resuscitation program training.[325]

Skill: Teamwork at Course Conclusion

Teamwork performance was reported in 3 RCTs with 193 participants.[326,337,343] Two found improved teamwork behaviors with higher-fidelity manikins,[337,343] and 1 found no difference.[326]

Skill: CPR Parameters at Course Conclusion

Two RCTs with 80 intervention subjects and 80 controls were reviewed. One study found greater improvement as measured at course completion by the American Heart Association CPR skills checklist among subjects trained on higher-fidelity manikins.[324] The second RCT found better compression depth and compression fraction immediately post–training among subjects trained on higher-fidelity manikins.[335]

Skill: Clinical Performance at 3 Months or Greater

Clinical performance was reported in 3 RCTs with 312 participants.[324,333,341] One RCT in nursing students found better clinical performance in a CPR scenario 3 months after training with higher-fidelity manikins;[324] 2 studies of advanced cardiovascular life support skills found no difference at 3 months or at 1 year posttraining.[333,341]

Knowledge at 3 Months or Longer

Knowledge retained months after training was reported in 3 RCTs with 330 participants.[324,341,342] Two RCTs found improved knowledge following higher-fidelity manikin training (3 months after BLS training,[324] 6 months after pediatric advanced life support training,[342]) and 1 RCT found no difference in advanced cardiovascular life support knowledge at 6 to 9 months post-training.[341]

Attitudes and Preferences

Learner preference and confidence following training were reported in 10 RCTs with 818 participants.[325,327,328,330,331,334,338,340,341,344] Seven RCTs found greater effectiveness of training with higher-fidelity manikins,[325,327,328,334,338,340,344] and 3 RCTs found no difference.[330,331,341]

Prior Treatment Recommendations (2015)

We suggest the use of high-fidelity manikins when training centers/organizations have the infrastructure, trained personnel, and resources to maintain the program (weak recommendations, very low–quality evidence).

If high-fidelity manikins are not available, we suggest that the use of low-fidelity manikins is acceptable for standard ALS training in an educational setting (weak recommendation, low-quality evidence).

Treatment Recommendations (2025)

We suggest the use of high-fidelity manikins when training centers or organizations have the infrastructure, trained personnel, and resources to use them (weak recommendations, very low–certainty evidence).

If high-fidelity manikins are not available, we suggest that the use of low-fidelity manikins is acceptable for life-support training in an educational setting (weak recommendation, low-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

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

Most studies found a positive impact on skill or knowledge at conclusion of courses with high-fidelity manikins, and no study demonstrated a negative effect on educational outcomes. Given that resource use and cost were not directly studied, and higher-fidelity manikins are likely more expensive to obtain and maintain, we limited our recommendation to centers where these resources are available.

The recommendation for use of low-fidelity manikins when higher-fidelity manikins are not available is based on studies which found improved performance in post-training versus pre-training assessment in all groups irrespective of level of manikin fidelity.

No studies reported on cost or resources needed to implement higher-fidelity manikins. Our recommendation is predicated on the higher-fidelity manikins being used in a setting with appropriate space, infrastructure, personnel, and resources to use them properly. Educational settings where these resources are less available might make implementation difficult.

Knowledge Gaps

- Cost-effectiveness and implementation needs for high-fidelity manikin use in training
- Effect of high-fidelity manikins on longer-term educational outcomes (skill, knowledge retention, decay)
- Specific simulation features that are most associated with improved learning
- Effect of high-fidelity manikin use in training on actual patient-care processes and patient outcomes
- Benefits of high-fidelity manikin use in training in different resource settings

Cognitive Aids During Resuscitation (EIT 6400, SysRev 2024, EvUp 2025)

A SysRev was conducted for 2024[345]; details can be found in the 2024 CoSTR summary.[231,232] The complete 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults, children and neonates in any setting (in-hospital or out-of-hospital) requiring resuscitation provided by lay providers or health care professionals
- Intervention: Use of cognitive aids during resuscitation
- Comparator: No use of cognitive aids
- Outcomes: Survival to hospital discharge with good neurological outcome and survival to hospital discharge were ranked as critical outcomes. Quality of performance in actual resuscitations, skill performance 1 year after course conclusion, skill performance between course conclusion and 1 year, skill performance at course conclusion, and

knowledge at course conclusion were included as important outcomes. Measures of effect outcomes included adherence to resuscitation guidelines, CPR quality, and test scores.

- Time frame: June 1, 2023, to 23 April 2024

Summary of Evidence

The 3 new studies identified are consistent in supporting previous findings and do not substantially change the weight of evidence.[346-348] A further SysRev or ScopRev is not currently warranted.

Treatment Recommendations (2024)

We suggest the use of cognitive aids by healthcare providers in resuscitation (weak recommendation, very low–certainty evidence).

We do not recommend the use of cognitive aids for lay providers initiating CPR (weak recommendation, low-certainty evidence).

We did not examine the use of cognitive aids in health professional or lay rescuer training in resuscitation, so no recommendation for or against can be made.

Provider Workload and Stress During Resuscitation (EIT 6401, ScopRev 2024, EvUp 2025)

A ScopRev was completed for 2024,[349] and details can be found in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

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

- Population: Health care providers performing resuscitation on patients in cardiac arrest in clinical settings or on manikins in a simulated setting
- Exposure: Presence of any factors that would possibly impact the healthcare provider's perceived workload or stress
- Comparison: Absence of the specific factor

- Outcomes: Objective or subjective measures of workload and stress experienced by healthcare providers during resuscitations
- Study design: In addition to standard criteria, unpublished studies (eg, conference abstracts, trial protocols), letters, editorials, comments, case reports, grey literature, and social media were eligible for inclusion.
- Time frame: February 2, 2024, to October 2, 2024

Summary of Evidence

This EvUp found 2 new RCTs in a simulation setting (1 in neonatal resuscitation, the other in adult simulation). The evidence in these studies did not add to that already known, and therefore a new SysRev is not warranted.

Stepwise Approach to Skills Training in Resuscitation (EIT 6402, SysRev 2023, EvUp 2025)

A SysRev was conducted for 2023,[350] and details of that review can be found in the 2023 CoSTR summary.[4,5] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children undertaking skills training related to resuscitation and First Aid in any educational setting
- Intervention: Approaches to skills teaching that are not the Peyton 4-steps approach, including approaches without distinct stages, or modified Peyton 4-steps approaches with more or less than 4 steps, or with delivering 1 or more steps by alternative methods (eg, video)
- Comparator: Peyton’s 4-steps approach for skills teaching
- Outcomes:

- Improved educational outcomes: skill performance after end of course; skill performance at end of course; participants' confidence to perform the skill on patients; participants' preference of teaching method
- Patient outcomes: skills performed appropriately on real patient after the course.
- Additional outcomes: teachers' preference of teaching method; side effects of teaching.

- Time frame: January 1, 2022, to November 20, 2024

Summary of Evidence

One new RCT was found[351], which does not add new evidence to that already known. A SysRev is not currently warranted.

Treatment Recommendations (2023)

We suggest that stepwise training should be the method of choice for skills training in resuscitation (weak recommendation, very low–certainty evidence).

Immersive Technologies: Virtual Reality, Augmented Reality (EIT 6405, SysRev 2024, EvUp 2025)

A SysRev was conducted for 2024,[352] and details of that review can be found in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: All laypersons and health care providers in any educational setting.
- Intervention: Immersive technologies (virtual reality, augmented reality, mixed reality, extended reality) as part of instructional design to train neonatal, pediatric, adult basic and advanced life support.
- Comparator: Other methods of resuscitation training in basic and advanced life support (eg, traditional manikin-based simulation training, other).

- Outcomes: Knowledge acquisition and retention, skills acquisition and retention, skill performance in real CPR, willingness to help, bystander CPR rate, and patients' survival.
- Time frame: April 4, 2023, to October 10, 2024.

Summary of Evidence

No studies on augmented reality were found in this updated search. For virtual reality, 5 RCTs[353-357] and 2 observational studies[358,359] were found. The evidence identified continues to support the current recommendations,[360] and the certainty of this evidence remains low. The current evidence update does not warrant a new SysRev.

Treatment Recommendations (2024)

We suggest the use of either augmented reality or traditional methods for basic life support training of lay people and healthcare providers (weak recommendation, very low–certainty evidence).

We suggest against the use of virtual reality-only for basic and advanced life support training of lay people and healthcare providers (weak recommendation, very low–certainty evidence).

Blended Learning Approach for Life Support Education (EIT 6409, SysRev 2022, EvUp 2025)

A SysRev was conducted for 2022,[361] and details of that review can be found in the 2020 CoSTR.[6,7] An EvUp was done in 2025.[12,13] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Participants undertaking an accredited life support course (eg BLS, ALS, pediatric advanced life support)
- Intervention: Blended learning approach
- Comparator: Non blended learning approach

- Outcomes:
  - Clinical outcomes: Survival (Critical) and neurological outcome.
  - Knowledge acquisition (end of course, 6 months, 1 year).
  - Skills acquisition (end of course, 6 months, 1 year).
  - Participant satisfaction (end of course).
  - Implementation outcomes (cost, time needed).
- Time frame: Jan 1, 2021, to Jun 19, 2024

Summary of Evidence

No relevant studies were identified and no new SysRev is indicated.

Treatment Recommendations (2022)

We recommend blended-learning as opposed to a nonblended approach for life support training when resources and accessibility permit its implementation (strong recommendation, very low–certainty evidence).

Gamified Learning Versus Other Forms of Nongamified Learning (EIT 6412, SysRev 2024, EvUp 2025)

A SysRev was done for 2024[362] and details can be found in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Learners training in basic or advanced life support
- Intervention: Instruction using gamified learning (use of game-like elements in the context of training (eg point systems, intergroup competition, leaderboards, scaffolded learning with increasing challenge, medals or badges)
- Comparator: Traditional instruction or other forms of nongamified learning

- Outcomes:
  - Educational outcomes: skill (eg CPR performance, other procedural performance, scores in scenarios, time to task performance) immediately following training (eg end of course), at 3 months, 6 months, 1 year. Knowledge eg test scores immediately following training (eg end of course), at 3 months, 6 months, 1 year. Attitudes: Participant satisfaction, learner preference, learner confidence
  - Clinical outcomes: change in healthcare practitioner behavior at resuscitation in case of real cardiac arrest (CPR quality, time to task completion, teamwork/crisis resource management)
  - Patient outcomes: ROSC, survival to hospital discharge; neurologic intact survival
  - Process: costs and resources utilization
- Time frame: February 1, 2024, to October 30, 2024

Summary of Evidence

Three new RCTs have been identified.[363-365]Including these studies would not alter the strength of the existing recommendation, therefore no new SysRev is warranted.

Treatment Recommendations (2024)

We suggest the use of gamified learning be considered as a component of resuscitation training for all types of BLS and ALS courses (weak recommendation, very low–certainty evidence).

Scripted Debriefing Versus Nonscripted Debriefing (EIT 6413, ScopRev 2024, EvUp 2025)

A ScopRev was conducted for 2024[366] and is included in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Health care professionals or laypeople receiving resuscitation training (primary), and instructors teaching resuscitation courses (secondary)
- Intervention: Debriefing with a cognitive aid, checklist, script or tool
- Comparator: Debriefing without the use of a cognitive aid, checklist, script or tool
- Outcomes:
  - Primary population: Patient outcomes: improved resuscitation performance in clinical environments; improved learning outcomes (knowledge and skill acquisition and retention); satisfaction of learning.
  - Secondary population: quality of teaching/debriefing; workload/ cognitive load of instructor/ debriefer
- Time frame: January 1 to October 10, 2024

Summary of Evidence

As there were no new studies identified, this evidence update does not warrant a SysRev.

Treatment Recommendations (2024)

Consider using debriefing scripts to support instructors during debriefing in resuscitation programs because they may improve learning and performance. Instructors need to ensure they have a complete understanding of how the debriefing script should be used (good practice statement).

Rapid Cycle Deliberate Practice in Resuscitation Training (EIT 6414, SysRev 2024, EvUp 2025)

A SysRev was conducted for 2024,[367] and details can be found in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Learners in training for BLS or ALS
- Intervention: Instruction that uses rapid cycle deliberate practice
- Comparator: Traditional instruction or other forms of learning without rapid cycle deliberate practice
- Outcomes: Knowledge acquisition and retention, skills acquisition and retention, skill performance in real CPR, attitudes, willingness to help, and patients' survival
- Time frame: September 1, 2022, to October 30, 2024

Summary of Evidence

This update found 2 additional RCTs that do not change available evidence.[368,369] Therefore, a new SysRev is not warranted.

Treatment Recommendations (2024)

We suggest that it may be reasonable to include rapid cycle deliberate practice in BLS and ALS training (weak recommendation, very low–certainty evidence).

Team Competencies in Resuscitation Training (EIT 6415, SysRev 2024, EvUp 2025)

A SysRev was conducted for 2024,[370] and details can be found in the 2024 CoSTR summary.[231,232] The complete EvUp is provided in Appendix B.

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

- Population: Learners undertaking life support training in any setting
- Intervention: Life support training with a specific emphasis on team competencies training
- Comparator: Life support training without specific emphasis on team competencies training

- Outcomes: Patient survival (actual resuscitation), CPR skill performance at course completion (simulation), CPR skill performance (in actual resuscitation and simulation) <1 year and ≥1 year of course completion; CPR quality (simulation) (at course completion, <1 year and ≥1 year of course completion); confidence (at course completion and <1 year and ≥1 year of course completion), teamwork competencies (in actual resuscitation and simulation) (at course completion, <1 year and ≥1 year of course completion); resources (time, equipment, cost).
- Study design: In addition to the standard criteria, studies evaluating scoring systems (no relevant outcome), and studies with self-assessment as the only outcome were excluded.
- Time frame: August 30, 2023, to November 6, 2024

Summary of Evidence

The 2 new studies identified are consistent in supporting previous findings; however, they do not substantially change the weight of evidence.[371,372] Therefore, a further SysRev or ScopRev is not warranted.

Treatment Recommendations (2024)

We suggest that teaching teamwork competencies be included in BLS and all kinds of advanced life support training (weak recommendation, very low quality of evidence).

Topics Not Included in the 2025 Review

- **EIT 6100 Resuscitation training in low-income countries** (ScopRev in 2020,[373] task force statement 2023)[374]
- **EIT 6408 Spaced Learning** (SyR 2020,[375] EvUp from 2022 in Appendix B available)

Appendixes

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