Appendix B

Basic Life Support – 2025 Evidence Updates
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2025 Evidence Update
BLS 2003 – CPR Wearing PPE

Worksheet Author(s): Sung Phil Chung
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: None

PICOST / Research Question: ***(Attach SAC representative approved completed PICOST template)***

PICOST	Description
Population	Adults and children in any setting (in hospital or out of hospital) with cardiac arrest (including simulated cardiac arrest)
Intervention	CPR by rescuers wearing personal protective equipment (PPE)
Comparison	CPR by rescuers not wearing PPE (2023 COSTR) CPR by rescuers not wearing PPE or wearing an alternative strategy of PPE (PROSPERO)
Outcomes	- Critical: Survival to discharge and ROSC - Important: CPR quality, time to the procedure of interest, and rescuer's fatigue and neuropsychiatric performance such as concentration and dexterity
Study Design	RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Unpublished studies (eg, conference abstracts, trial protocols) were excluded.
Timeframe	All years and all languages were included as long as there was an English abstract. The literature search was updated to May 23, 2022.

Year of last full review: 2023 COSTR

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We recommend monitoring for fatigue in all rescuers performing CPR (good practice statement).
We suggest increased vigilance for fatigue in rescuers wearing PPE (weak recommendation, very low–certainty evidence).

Current Search Strategy (for an existing PICOST):
Search strategy

Embase Classic+Embase <1947 to 2024 August 09>

1	resuscitation.ti,kw. or (resuscitation and (quality or effectiv* or delay or fatigue or survival or mortality)).ab.	72689
2	cpr.ti,kw. and resuscitation.ab,kw.	2732
3	((cardiopulmonary or 'cardio-pulmonary') adj1 reanimation).ti,kw.	38
4	'mouth-to-mouth'.ti,kw.	234
5	ventilation*.ti,ab,kw. and (resuscitation.ab. or cpr.ti,ab,kw. or 'chest compression'.ti,ab,kw. or 'life support'.ti,ab,kw.)	11892
6	intubation'.ti,kw.	24518
7	chest compression*'.ti,ab,kw.	8230
8	defibrillation.ti,ab,kw.	14332
9	basic life support'.ti,ab,kw.	3842
10	advanced life support'.ti,ab,kw.	4094
11	advanced cardiac life support'.ti,ab,kw.	1856
12	trauma life support'.ti,ab,kw.	1143
13	((neonatal or newborn or pediatric or paediatric) adj2 ('life support' or resuscitation)).ti,ab,kw.	6622
14	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13	121074
15	*resuscitation/	63947

16	exp 'rescue breathing'/	174
17	exp manual ventilation'/	2065
18	'noninvasive ventilation'/	21716
19	'intubation'/	56870
20	'respiratory tract intubation'/	5421
21	exp 'endotracheal intubation'/	70442
22	'defibrillation'/	18739
23	'basic life support'/	1094
24	exp 'advanced life support'/	3165
25	'advanced cardiac life support'/	827
26	'advanced trauma life support'/	479
27	'pediatric advanced life support'/	981
28	'newborn resuscitation'/	109
29	'newborn'/ and 'resuscitation'/	9180
30	15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29	231159
31	14 or 30	280475
32	protective equipment'.ti,kw.	2133
33	ppe.ti,kw.	1221
34	glove*.ti,kw.	5118
35	gloving.ti,kw.	175
36	gown*.ti,kw.	515
37	coverall*.ti,kw.	57
38	protective layer*'.ti,kw.	208
39	apron*.ti,kw.	368
40	smock*.ti,kw.	12
41	hazmat suit*'.ti,kw.	0
42	mask.ti,kw.	12108
43	masks.ti,kw.	4043
44	air purifying respirator*'.ti,kw.	111
45	respiratory protection'.ti,kw.	465
46	filtering face piece*'.ti,kw.	36
47	filtering facepiece*'.ti,kw.	308
48	goggle*.ti,kw.	387
49	visor*.ti,kw.	164
50	facial protection equipment'.ti,kw.	3
51	safety glass*'.ti,kw.	47
52	safety spectacles'.ti,kw.	2
53	overshoe*'.ti,kw.	10
54	shoe cover*'.ti,kw.	22
55	rubber boot*'.ti,kw.	19
56	32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55	26324
57	'protective equipment'/	29578
58	'protective clothing'/	13024
59	'glove'/	8778
60	'protective glove'/	1551
61	'coveralls'/	65
62	exp 'mask'/	60168
63	'face shield'/	1290
64	'eye shield'/	250
65	exp 'eye protective device'/	3889
66	'gown'/	12

67	57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66	106700
68	56 or 67	115926
69	31 and 68	12285
70	(conference abstract or conference review or editorial or erratum or letter or note or book or 'case report').pt.	8705154
71	69 not 70	7963
72	limit 71 to dd=20220525-20240809	62

Cochrane 2024-08-13 12:27

#1	(resuscitation OR cpr OR 'mouth-to-mouth' OR ventilation* OR intubation OR 'chest compression*' OR defibrillation OR 'basic life support' OR 'advanced life support' OR 'advanced cardiac life support' OR 'trauma life support'):ti	19855
#2	('protective equipment' OR ppe OR glove* OR gloving OR gown* OR coverall* OR 'protective layer*' OR apron* OR smock* OR 'hazmat suit*' OR mask OR masks OR 'air purifying respirator*' OR 'respiratory protection' OR 'filtering face piece*' OR 'filtering facepiece*' OR goggle* OR visor* OR 'facial protection equipment' OR 'safety glass*' OR 'safety spectacles' OR overshoe* OR 'shoe cover*' OR 'rubber boot*'):ti	4926
#3	#1 AND #2	1046
#4	#3 with Cochrane Library publication date Between May 2022 and Aug 2024, in in Cochrane Reviews, Cochrane Protocols	0
#5	#3 with Publication Year from 2022 to 2024, in Trials	2

Database searched: Medline Embase Cochrane
Time Frame: 25 May 2022 – 9 Aug 2024
Date Search Completed: 9 Aug 2024
Search Results: 64 articles identified, but no relevant study found.
Another hand search identified 4 relevant studies: 2 compared PPE vs no PPE (Sellmann 2022, Tangpaisarn 2023) 2 compared alternative types of PPEs (Starosolski 2022, Cheng 2023).

Summary of Evidence Update:

- **Relevant Guidelines or Systematic Reviews:** none
- **RCTs:**

Study Acronym; Author; Year Published	**Aim of Study; Study Type; Study Size (N)**	**Patient Population**	**Study Intervention (# patients) / Study Comparator (# patients)**	**Endpoint Results (Absolute Event Rates, P value; OR or RR; & 95% CI)**	**Relevant 2° Endpoint (if any); Study Limitations; Adverse Events**
Starosolski 2022	**Study Aim:** To evaluate the effects of PPE on the performance of emergency resuscitation by medical students and non-medical personnel. **Study Type:** Simulation RCT	**Inclusion Criteria:** Participants: 25 pairs of medical students and 26 pairs of non-medical personnel (n=51 pairs)	**Intervention:** PPE group: double nitrile gloves, mask Air-purifying Respirator (APR), eye goggles, PROTEX protection suit **Comparison:** Control group: gloves, N95 mask	**1° endpoint:** CPR quality measures; Most determinants of CPR had deteriorated among medical students; average rate of chest compressions (123 vs 114/min; P=0.004), chest recoil (69 vs 93; P=0.0050, correct depth of chest compressions (86.5 vs 97%; P=0.0081),	**Study Limitations:** Resuscitation among non-medical personnel showed no significant differences between groups.

				quality of ventilation (85 vs 89%; P=0.0041)	
Cheng 2023	**Study Aim:** To evaluate the impact of different types and levels of PPE on CPR quality and rescuer safety. **Study Type:** Simulation crossover RCT	**Inclusion Criteria:** Doctors or nurses working experience of more than 1 year and those who had certified BLS or ACLS. (n=30)	**Comparison:** three types of PPE; 1) level D PPE (surgical mask, face shield, hair cover, gloves, gown, foot cover); 2) level C PPE (N95 mask, face shield, hair cover, protective clothing, gloves, foot cover, gown) 3) level C PPE plus PAPR	**1° endpoint:** Percentage of effective chest compression; CPR during the first 2 minutes, the best performance was obtained when using D-PPE, 87.4 ± 0.1%, while C-PPE was 86.2 ± 0.1%, and PAPR was 84.4 ± 0.1%, but there was no significant difference (p=0.716)	**Study Limitations:** The differences in vital signs before and after CPR were not significantly different among the groups. The fatigue and total perception scores of wearing PPE were significantly higher for level C-PPE than PAPRs: 3.8 ± 1.6 vs. 3.0 ± 1.6 (p < 0.001) and 27.9 ± 5.4 vs. 26.0 ± 5.3 (p < 0.001), respectively.
Tangpaisarn 2023	**Study Aim:** To compare the tidal volume generated by mouth-to-mouth ventilation (MMV), surgical mask-to-mouth ventilation (SMV), mouth-to-surgical mask ventilation (MSV), and surgical mask-to-surgical mask ventilation (SSV) in a manikin. **Study Type:** Simulation crossover RCT	**Inclusion Criteria:** Medical personnel (physicians, medical students, nurses, and emergency medical technicians) who were ≥ 18 years of age and had received BLS certification (n=42)	**Comparison:** MMV (no protective barrier), SMV (participant wearing a surgical mask), MSV (manikin wearing a surgical mask), and SSV (both participant and manikin wearing surgical masks)	**1° endpoint:** Difference in the tidal volume; The average tidal volume of MMV (828 ± 278 ml) was significantly higher than those of MSV (648 ± 250 ml, P < 0.001) and SSV (466 ± 301 ml, P < 0.001), but not SMV (744 ± 288 ml, P = 0.054).	**Study Limitations:** Adequate ventilation was achieved in 144/168 (85.7%) patients in the MMV group, significantly higher than in the SMV (77.4%, P = 0.02), MSV (66.7%, P < 0.001), and SSV (39.3%, P < 0.001) groups.

- **Nonrandomized Trials, Observational Studies**

Study Acronym; Author; Year Published	**Study Type/Design; Study Size (N)**	**Patient Population**	**Primary Endpoint and Results (include P value; OR or RR; & 95% CI)**	**Summary/Conclusion Comment(s)**
Sellmann 2022	**Study Type:** Controlled before after study (simulation)	**Inclusion Criteria:** Simulation CPR training of resident physicians in pandemic years 2020 and 2021 (PPE group, n=689) vs pre-pandemic year of 2016 to 2019	**1° endpoint:** Hands-on times: lower in PPE group than control group (86% vs. 90%); 95% CI for difference 3–4, p < 0.0001) **2° endpoint:** PPE teams made fewer change-overs and delayed defibrillation and administration of drugs.	Having to wear PPE during CPR is an additional burden in an already demanding task. PPE is associated with an increase in perceived task load, lower hands-on times, fewer change-overs, and delays in defibrillation and the administration of drugs.

		(control group, n=1451)	PPE teams perceived higher task loads (57 vs. 63; 95% CI for difference 5–8, $p < 0.0001$)	

Reviewer Comments:

Four studies have been published during two years since the previous SR. All studies were based on simulation and CPR quality was set as the primary outcome. There is no evidence to change the current 2023 COSTR.

Even if wearing PPE reduces CPR quality, we should wear appropriate PPE during CPR. Because CPR is considered as an aerosol generating procedure. It would be good to conduct a scoping review of studies on the most efficient CPR methods while wearing PPE in the future.

Since relevant studies were not searched in the existing search strategy, the search strategy needs to be re-generated during the next evidence update.

Reference list:

- Cheng CH, Cheng YY, Yuan MK, Juang YJ, Zeng XY, Chen CY, Foo NP. Impact of Personal Protective Equipment on Cardiopulmonary Resuscitation and Rescuer Safety. Emerg Med Int. 2023 Nov 30;2023:9697442.
- Sellmann T, Nur M, Wetzchewald D, Schwager H, Cleff C, Thal SC, Marsch S. COVID-19 CPR-Impact of Personal Protective Equipment during a Simulated Cardiac Arrest in Times of the COVID-19 Pandemic: A Prospective Comparative Trial. J Clin Med. 2022 Oct 5;11(19):5881.
- Starosolski M, Zysiak-Christ B, Kalemba A, Kapłan C, Ulbrich K. A Simulation Study Using a Quality Cardiopulmonary Resuscitation Medical Manikin to Evaluate the Effects of Using Personal Protective Equipment on Performance of Emergency Resuscitation by Medical Students from the University of Silesia, Katowice, Poland and Non-Medical Personnel. Med Sci Monit. 2022 Jul 2;28:e936844.
- Tangpaisarn T, Chaiyakot N, Saenpan K, Sriphrom S, Owattanapanich N, Kotruchin P, Phungoen P. Surgical mask-to-mouth ventilation as an alternative ventilation technique during CPR: A crossover randomized controlled trial. Am J Emerg Med. 2023 Oct;72:158-163.

2025 Evidence Update
BLS 2102 – Optimisation of Dispatcher-Assisted Recognition

Worksheet Author(s): Carolina Malta Hansen
Task Force: Basic Life Support
Date Approved by SAC Representative: 12 November 2024
Conflicts of Interest: None

PICOST / Research Question:

PICOST	Description
Population	Adult or pediatric OHCA patients with calls to the EMS
Intervention	Factors to improve or hinder OHCA recognition
Comparison	No prespecified comparator
Outcomes	Telecommunicator recognition of OHCA which leads to specific initiation of cardiac arrest-specific actions such as initiation of instructions
Study Design	Randomized controlled trials, observational studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies), and qualitative studies are eligible for inclusion
Timeframe	From February 3rd, 2023 to June 18th, 2024. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

Year of last full review*:* 2021. A scoping review was undertaken in 2023

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
ILCOR 2020 COSTR:[1]

We recommend dispatch centres implement a standardized algorithm and/or standardized criteria to immediately determine if a patient is in cardiac arrest at the time of emergency call. (Strong Recommendation, very-low certainty of evidence).
We recommend that dispatch centres monitor and track diagnostic capability
We recommend that dispatch centres look for ways to optimize sensitivity (minimize false negatives)
We recommend high quality research that examines gaps in this area

Current Search Strategy:
1. Emergency Medical Service Communication Systems/
2. Emergency Medical Dispatch/
3. Emergency Medical Dispatcher/
4. Call Centers/
5. Hotlines/
6. Triage/
7. telephone/ or cell phone/ or smartphone/
8. exp Telecommunications/
9. "911".mp.
10. "9-1-1".mp.
11. "999".mp.
12. "9-9-9".mp.
13. "1-1-2".mp.
14. "1-1-6".mp.
15. dispatch*.mp.
16. despatch*.mp.
17. "call adj3 take*".mp.

18. "calls adj3 take*".mp.
19. calltaker*.mp.
20. "call taker*".mp.
21. "call receiver*".mp.
22. phone*.mp.
23. (smartphone* or "smart phone*").mp.
24. telephone*.mp.
25. telecommunicat*.mp.
26. ("T-CPR" or "DA-CPR").mp.
27. ("dispatcher assisted CPR" or "dispatcher assisted cardiopulmonary resuscitation" or "telephone assisted CPR" or "telephone assisted cardiopulmonary resuscitation").mp.
28. operator*.mp.
29. "emergency call*".mp.
30. "emergency medical call*".mp.
31. "call centre*".mp.
32. "call center*".mp.
33. (emd or "emergency medical dispatch*").mp.
34. hotline*.mp.
35. or/1-32
36. exp Heart Arrest/
37. exp Death, Sudden/
38. Ventricular Fibrillation/
39. Ventricular Flutter/
40. Tachycardia, ventricular/
41. exp Resuscitation/
42. "cardi* arrest*".mp.
43. "heart arrest*".mp.
44. ("sudden cardi* death" or "sudden death" or "sudden unexpected death").mp.
45. (CPR or "cardiopulmonary resuscition*").mp.
46. ("advanced cardiac life support" or ACLS).mp.
47. ("basic life support" or BLS).mp.
48. asystol*.mp.
49. "pulseless electrical activit*".mp.
50. ("return of circulation" or "return of spontaneous circulation" or ROSC).mp.
51. resuscitat*.mp.
52. ("ventricular fibrillation*" or "ventricular flutter" or VF).mp.
53. "chest compression*".mp.
54. ("agonal breath*" or "agonal agonal respirat*").mp.
55. Electric Countershock/
56. Defibrillators/
57. "electric countershock".mp.
58. defibrillat*.mp.
59. (aed* or "automated external defibrillat*").mp.
60. exp Drowning/
61. drown*.mp.
62. or/36-61
63. Communication/
64. exp communication barriers/
65. Linguistics/
66. exp diagnosis/
67. Clinical Protocols/
68. Critical Pathways/
69. Risk Assessment/
70. (recogni* or identif* or detect* or diagnos*).mp.
71. (unrecogni* or unidentif* or undetect* or undiagnos*).mp.
72. "communication barrier*".mp.

73."miss* diagnos*".mp.
74."delay* diagnos*".mp.
75.or/63-74
76.35 and 62 and 75
77.limit 76 to (comment or editorial or letter)
78.76 not 77
79.78 not (animals/ not humans/)
80.remove duplicates from 79
Databases searched: Medline, Embase
Time Frame: February 2023 to June 2024
Date Search Completed: June 18th, 2024.
Search Results:
Articles retrieved: 4,927 titles two of which were relevant.

Summary of Evidence Update:
In 2021 ILCOR conducted a systematic review of dispatcher recognition.[2] In 2023 ILCOR decided to conduct a scoping review (rather than an evidence update) as the evidence base had widened incorporating the use of video technologies. This was justified as the existing search strategy was not optimized to identify studies using video technology. The 2023 ILCOR COSTR summarized the findings of 60 publications identified through Medline (including studies from the 2021 SR). In 2024, the literature search was rerun including EMBASE which identified 2 additional studies. The scoping review was then published in 2024 including 62 studies summarizing the.an evidence update was conducted on the 2023 scoping review. Only two additional studies were identified – this update has since been published.[4]

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR SR, Drennan et al 2021[2]	Systematic review	As above	47	Sensitivity and specificity of cardiac arrest recognition at the time of emergency call varied across dispatch centres and did not appear to differ by dispatch algorithm/criteria used or education of the dispatcher, although comparisons were hampered by heterogeneity across studies.	No TR
ILCOR ScR, Malta-Hansen et al[3]	Evidence Update	As above	60	The most pertinent challenge to dispatcher-assisted recognition of OHCA seems to be determining whether the patient is breathing normally. Several strategies were studied, including bypassing breathing in the initial assessment and asking the caller to put their hand on the patient's stomach. No strategy showed better results than the commonly used 2-questions strategies.	No TR

ILCOR ScR , Grabmayr et al 2024[4]	Scoping review	As above	62	Twenty-one studies investigated how patient characteristics and symptoms affected OHCA recognition. Sixteen studies investigated how factors related to the caller, the telecommunicator, or the interplay between the two affected communication in emergency calls. Twenty-six studies evaluated the accuracy of OHCA recognition in relation to the use of dispatch protocols and quality improvement initiatives. Eight studies reported on new technology to improve OHCA recognition.	No TR

RCT:

Study Acronym; Author; Year Published	**Aim of Study; Study Type; Study Size (N)**	**Patient Population**	**Study Intervention (# patients) / Study Comparator (# patients)**	**Endpoint Results (Absolute Event Rates, P value; OR or RR; & 95% CI)**	**Relevant 2° Endpoint (if any); Study Limitations; Adverse Events**

Nonrandomized Trials, Observational Studies:

Study Acronym; Author; Year Published	**Study Type/Design; Study Size (N)**	**Patient Population**	**Primary Endpoint and Results (include P value; OR or RR; & 95% CI)**	**Summary/Conclusion Comment(s)**
Tangpaisarn T, 2021[5]	Observational	OHCA patients who were transferred to hospital via Emergency Medical Services (EMS) of Srinagarind hospital, Khon Kaen, Thailand, from 1st January 2020 to 31st December 2020.	To identify symptoms that led to an unrecognized cardiac arrest by the EMS call handlers. Secondary outcomes were to identify the recognition rate of OHCA by emergency medical services call handlers, and assess the outcome of CPR performed on OHCA patients. Included 58 patients. 26 patients (44.8%) and 32 patients (55.2%) belonged to the unrecognized and recognized cardiac arrest groups, respectively. The most common symptoms that led to unrecognized cardiac arrest were a state of unconsciousness (46.2%), major trauma (15.4%), and seizure-like activity (11.5%).	Falling unconscious is the most common symptom of unrecognized OHCA cases seen by EMS in Thailand.

			The rate of ROSC was higher in the unrecognized cardiac arrest group (34.6% vs. 15.6%) but the rate of survival to hospital discharge was higher in the recognized cardiac arrest group (6.3% vs 0%).	
Saberian P, 2019 [6]	Observational	All patients over 18 years of age with suspected OHCA byEMDs of the Tehran EMS Centre or EMS technicians at thepatient's bedside were eligible for inclusion in the study.	Diagnostic accuracy of OHCA identification by EMDs in Iran. PPV, NPV and accuracy was 86.1%(95% CI: 84.5–87.6), 87.8% (95% CI: 86.8–88.8) and 87.3%(95%CI: 86.3–88.2), respectively.	PPV, NPV and accuracy was 86.1%(95% CI: 84.5–87.6), 87.8% (95% CI: 86.8–88.8) and 87.3%(95%CI: 86.3–88.2), respectively. The sensitivity of diagnosis increased with increasing EMD's work experience and also increasing the number of reported OHCA cases.

Reviewer Comments:
The recent ILCOR scoping review included 62 studies There is no new evidence to justify a new systematic review.

Reference list:

1. Olasveengen TM, Mancini ME, Perkins GD, et al. Adult Basic Life Support: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation* 2020; **142**(16_suppl_1): S41-S91.
2. Drennan IR, Geri G, Brooks S, et al. Diagnosis of out-of-hospital cardiac arrest by emergency medical dispatch: A diagnostic systematic review. *Resuscitation* 2021; **159**: 85-96.
3. Greif R, Bray JE, Djärv T, et al. 2024 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Resuscitation* 2024; **205**: 110414.
4. Grabmayr AJ, Dicker B, Dassanayake V, Bray J, Vaillancourt C, Dainty KN, Olasveengen T, Hansen CM. Optimising telecommunicator recognition of out-of-hospital cardiac arrest: A scoping review. *Resuscitation Plus* 2024; **20**:100754.
5. Tangpaisarn. 2021 . Unrecognized out of hospital cardiac arrest symptoms during thailand's emergency medical services. Open Access Macedonian J Med Sci 2021;**9**:1–4. https://journals.sagepub.com/doi/10.33151/ajp.16.691
6. Saberian P. 2019. Diagnosis of Out-of-Hospital Cardiac Arrest by Emergency Medical Dispatchers: A Diagnostic Accuracy Study. https://journals.sagepub.com/doi/10.33151/ajp.16.691

2025 Evidence Update
BLS 2113 – Optimisation of Dispatcher-Assisted CPR

Worksheet Author(s): Katie N. Dainty, Guillaume Debatey, Christian Vaillancourt
Task Force: Basic Life Support
Date Approved by SAC Representative: 28 November 2024
Conflicts of Interest: None

PICOST / Research Question:

PICOST	Description (with recommended text)
Population	Adult and pediatric in out-of-hospital cardiac arrest where dispatcher-assisted CPR (DA-CPR) is implemented
Intervention	Interventions used in addition to DA-CPR
Comparison	Non-modified DA-CPR
Outcomes	• Good neurological outcome at hospital discharge/30-days; Survival at hospital discharge/30-days; Return of spontaneous circulation (ROSC) • Time to initiation of bystander CPR; Rates of bystander CPR; • Rates of automated external defibrillator (AED) use; • Bystander CPR quality (any available CPR metrics: chest compression depth and rate; chest compression fraction; full chest recoil, ventilation rate, overall CPR competency); • Bystander fatigue; • Confidence & willingness to perform CPR.
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Unpublished studies (e.g., conference abstracts, trial protocols), editorials, commentaries, animal studies and systematic reviews are excluded. If there will be insufficient studies from which to draw a conclusion, case series may be included in the initial search.
Timeframe	2000 to November 1 2024 and all languages are included if there is an English abstract

Year of last full review: 2024

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
Optimization of Dispatcher Assisted (DA)-recognition of OHCA: A scoping review (BLS-2102)

Current Search Strategy:
Database searched: Embase, Medline, CINAHL and Cochrane Database of Systematic Reviews
Time Frame: December 2023 to November 1, 2024
Date Search Completed: November 1, 2024
Search Results:
Studies identified in Evidence update = 20
Studies screened = 19
Studies sought for retrieval = 10
Studies assessed for eligibility = 10
Studies included in Evidence update = 9

Summary of Evidence Update:
Nine new studies were included in this evidence update of the original scoping review published in September 2024. {Dainty, 2011 #3055} [1] The majority were focused on the use of video vs. audio alone using randomized mannikin simulation studies. {Szollosi, 2023 #84916; Aranda-Garcia, 2023 #84917;Barcala-Furelos, 2023 #84918;Wetsch, 2024 #84921} [2-5] In addition there was one new

study on using persuasive terminology {Chen, 2024 #84919} [6], two new studies on implementation of novel dispatcher-assisted CPR protocols {Holzing, 2023 #84920;Xu, 2023 #84922} [7,8] including one testing a protocol for the multiple responder situation {Xu, 2023 #84922} [8], one new study on animated images versus dispatcher instructions only {Ohk, 2024 #84923} [9] and one looking at using verbal encouragement versus standard dispatch instructions. {Takano, 2022 #84924} [10]

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
Dainty (2024)[1]	Scoping Review	Interventions to optimize dispatcher-assisted CPR instructions	109	There is insufficient evidence on most of the interventions included in this review to recommend progression to a formal systematic review of any intervention. The exception is the use of video versus audio-call only where there is a mounting amount of evidence, however most of it is conducted in simulation studies. There is a distinct lack of high-quality human research on any interventions and therefore a tremendous an opportunity for future research.	N/A
Nikolaou (2019)[11]	Systematic Review and Meta-Analysis	Effect of dispatcher-assisted CPR (DA-CPR) on outcomes from sudden cardiac arrest in adults and children	33	In system-level and patient-level comparisons, the provision of DA-CPR compared with no DA-CPR was consistently associated with improved outcome across all analyses. Comparison of DA-CPR to bystander CPR produced conflicting results. Findings were consistent across sensitivity analyses and the pediatric sub-group.	N/A

RCTs:

Study Acronym; Author; Year Published	Aim of Study; Study Type; Study Size (N)	Patient Population	Study Intervention (# patients) / Study Comparator (# patients)	Endpoint Results (Absolute Event Rates, P value; OR or RR; & 95% CI)	Relevant 2° Endpoint (if any); Study Limitations; Adverse Events
Szollosi 2023 [2]	Randomized simulation study (n=150)		Video input vs. Audio-only input vs. unassisted CPR	No difference between the three groups with regard to chest compression depth (p = 0.065) Mean chest compression rate and overall proportion of correct hand position was the best in the V-CPR group (100.9 min−1, SD = 17.1; 48.96% respectively) V-CPR led to a delay in time to first chest compression compared with the unassisted CPR group (77.5 s, SD = 19.2 vs. 31.3 s, SD = 13.3, p < 0.001).	**Study Limitations:** Simulation study; no patient outcomes measured
Aranda-Garcia 2023 [3]	Randomized simulation study (n=24)		Video input (SG-VA) via Smart glasses vs. Audio-only input (SP-AA)	9/ 14 SG-VA rescuers correctly completed the BLS protocol compared with none of the SP-AA rescuers (p = 0.01). Significantly higher number of SG-VA rescuers successfully opened the airway (p = 0.002), checked breathing (p = 0.03), correctly positioned the AED pads (p = 0.001), and warned bystanders to stay clear before delivering the shock (p < 0.001). No significant differences observed for performance times or chest compression quality (including mean compression rate and depth).	Simulation study; no patient outcomes measured
Wetsch 2024 [5]	Randomized simulation study (n=93)		Correct classification of CPR performance	CPR performance was classified correctly from a side perspective in 81.3%, from a foot	Simulation study; no patient outcomes measured

			depending on camera perspective	perspective in 68.8% and from a head perspective in 73.6%, revealing a significant difference in error recognition depending on the camera perspective (p=.01).	
Xu 2024 [8]	Randomized simulation study (n=132)		Novel team-based DA-CPR protocol vs. standard DA-CPR protocol	Team-based tele-instruction tool significantly improved quality of chest compressions incl average compression rate. Delay to emergency response noted (time to first chest compression: median 20, IQR 15-24.8 seconds vs median 25, IQR 20.5-40.3 seconds; p=.03)	Simulation study; no patient outcomes measured
Ohk 2024 [9]	Randomized simulation study (n=80)		Animated GIF + Voice vs. Voice Only	Intervention group had higher CPR performance scores and better compression rate ratio ($p < 0.001$ and 0.047 resp.)	Simulation study; no patient outcomes measured
Takano 2022 [10]	Randomized simulation study (n=49)		Verbal encouragement (Coaching) vs. standard language (no Coaching)	Chest compression fraction was higher in the Coaching Group (99.4% vs. 93.0%, $p = 0.005$), depth increased over time (40.9 mm, 43.9 mm, 44.1 mm, and 42.8 mm), and no participants interrupted chest compression more than 10 s in this group	Simulation study

Non-randomized Trials, Observational Studies

Study Acronym; Author; Year Published	Study Type/Design; Study Size (N)	Patient Population	Primary Endpoint and Results (include P value; OR or RR; & 95% CI)	Summary/Conclusion Comment(s)
Barcala-Fuegos 2023 [4]	Descriptive Feasibility simulation (n=12)	Fisherman working on boats	Feasibility proven; Dispatcher's feedback through smart glasses helped to improve bystanders' performance; after dispatcher gave feedback via SGs, only 3% of skills were incorrect. When comparing the 1st minute with 2nd minute, there were significant differences in the percentage of compressions with correct depth (1st:48 ± 42%, 2nd:70 ± 31, p = 0.02).	Using smart glasses in aquatic settings is feasible and improves BLS response however CPR quality markers were similar between groups.
Chen 2024 [6]	Before/After registry study (n=1818)		ROSC rate, time to first chest compression, and good neurological outcome were significantly improved in the postintervention group (20.9% vs. 31.0%, p < 0.001;168 seconds vs. 151 seconds, p = 0.004; 2.8% vs. 5.3%, p = 0.024, respectively).	Use of verbal encouragement may improve CPR quality and patient outcomes.
Holzing 2023 [7]	Non-randomized simulation study (N=48)		Recommended actions performed more in modified wording group (check for breathing p=0.035; head tilt-chin manoeuvre p<0.001); no difference in chest compression rate; depth was slightly deeper in modified wording group.	Modified wording may lead to more consistent performance of recommended actions.

Reviewer Comments:

There is insufficient evidence on most of the interventions included in this review to recommend progression to a formal systematic review of any intervention. The exception is the use of video versus audio-call only where there is a mounting amount of evidence, however most of it is conducted in simulation studies. There is a distinct lack of high-quality human research on any interventions and therefore a tremendous an opportunity for future research.

From the previous scoping review on this topic, pre-recorded instructions, centralized dispatch, advanced dispatcher training, use of metronomes and varying metronome rates, the addition of verbal encouragement and instructions to undress the patient all have less than two papers published and therefore we are unable to make any summary comment on their effectiveness at this point.
The interventions which have five or more studies are showing directional trends:

- The studies which focus on simplifying the compression instruction language *(ie. "Push as hard as you can" vs "Push approximately 2 inches/5cm")* suggests an improvement in CPR quality.
- The studies which look at adding video to the emergency call (vs. audio-only calls) suggests an improvement in CPR quality.

That said, terminology changes in instructions may not be generalizable to other languages and almost half of the studies comparing video to audio were simulation studies.

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2025 Evidence Update
BLS 2122 – Drone Delivery of AEDs

Worksheet Author(s): Louise Kollander Jakobsen, Vicor Kjærulf, Janet Bray, Theresa Mariero Olasveengen, Fredrik Folke.
Task Force: Basic Life Support
Conflicts of Interest: None

PICOST / Research Question:

PICOST	Description
Population	Adults and children with out-of-hospital cardiac arrest (OHCA) or suspected OHCA.
Intervention	Drone delivered automated external defibrillators (AEDs).
Comparison	"None/Open" to assess broadly. Comparison could be e.g., EMS Response times (or time for EMS-delivered AED), AEDs delivered by bystander, volunteer responders or professional first responders.
Outcomes	All outcomes. e.g., real-world or predicted feasibility, time gain of drone-delivered AEDs (compared to other delivery methods), area coverage of drone AEDs, and real or predicted outcomes such as quality-adjusted life years (QALYs) gained, cost-effectiveness, defibrillation rates, and survival. Furthermore, qualitative outcomes such as bystander acceptance or social acceptance of AED-delivering drones are included.
Study Design	All study designs. e.g., real-world feasibility studies, prediction models (e.g., spatial analysis, Geographic Information System [GIS] models), observational studies (including randomized controlled trials), simulation studies/test flights, and qualitative studies on human-drone interaction. Grey literature, was included if retrieved from the searched databases and if it provided empirical data.
Timeframe	All years from database inception to February 4, 2024, with publications in English. Updated searches will be conducted before article submission.

Year of last full review: -

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST: -

Search Strategy:
To better align with scoping review guidelines, the PICOST framework, which left the "COST" components open-ended, was replaced with the Population, Concept, and Context (PCC) framework. This adjustment enabled a broader and more flexible approach to address the research question:
"What evidence exists regarding the use of drone-delivered AEDs for out-of-hospital cardiac arrests (OHCAs)?"
Inclusion Criteria:

- Population: Individuals experiencing or suspected of experiencing out-of-hospital cardiac arrest (OHCA).
- Concept: Drone-delivered automated external defibrillators (AEDs).
- Context: Broadly defined to include various settings, locations, and outcome measures. These encompass real-world or estimated feasibility, time savings of drone-delivered AEDs (compared to standard EMS delivery), predicted survival, predicted quality-adjusted life years gained, cost-effectiveness, bystander experiences, and qualitative analyses).

Grey Literature: Included if identified during database searches and containing empirical data.
Exclusion Criteria:

- Publications on medical drones not related to AED delivery.

- Non-empirical literature (e.g., reviews, editorials, or commentary) used for background knowledge but excluded from the final review.

This approach ensured a comprehensive exploration of the available evidence, consistent with the broad and exploratory aims of a scoping review. The search string remained unchanged.

Existing Search Strategy

Search initially developed in April 2022 in liaison with Connie Skrubbeltrang, Information Specialist at Aalborg University Hospital, Denmark. Key search terms are “drone” AND (“out-of-hospital cardiac arrest (OHCA)” OR “automated external defibrillator (AED)”). All terms are included with synonyms and MESH terms.

Initial PubMed search (April, 2022):
((Drone[Text Word] OR drones[Text Word] OR "Unmanned Aerial Vehicle*"[Text Word] OR UAV[Text Word] OR PRAS[Text Word] OR "unmanned aircraft*"[Text Word]) OR (UAS[Text Word])) AND (((OHCA[Text Word]) OR ("out of hospital cardiac arrest"[Text Word])) OR ((("Defibrillators"[Mesh]) OR ("Electric Countershock"[Mesh])) OR (Defibrillat*[Text Word] OR AED[Text Word] OR aeds[Text Word] OR "aed’s"[Text Word])))

Revised Search strategy: (for a new PICOST should be outlined here as per Evidence Update Process)
Based on the initial search strategy, however, extended with a few extra synonyms in collaboration with Information Specialist Annemette Moeller Hansen from Copenhagen University Library, Denmark.
Updated PubMed search (October 2023)**:**
("Drone"[Text Word] OR "drones"[Text Word] OR "drone*"[Text Word] OR "unmanned aerial vehicle*"[Text Word] OR "UAV"[Text Word] OR "RPAS"[Text Word] OR "unmanned aircraft*"[Text Word] OR "UAS"[Text Word] OR "Unmanned aerial devices"[MeSH Terms]) AND ("OHCA"[Text Word] OR "out-of-hospital cardiac arrest"[Text Word] OR "out-of-hospital cardiac arrest"[MeSH Terms] OR "out of hospital cardiac arrest*"[Text Word] OR ("Defibrillators"[MeSH Terms] OR "Electric Countershock"[MeSH Terms] OR ("defibrillat*"[Text Word] OR "AED"[Text Word] OR "aeds"[Text Word] OR "aed's"[Text Word] OR "Electric Countershock"[Text Word])))

Databases searched: PubMed, Web of Science and Cochrane.
Time Frame: to August 2024
Date Search Completed: August 6th 2024.
Search Results (Number of articles identified and number identified as relevant):
306 articles identified 59 articles for full text screening and 11 articles for final inclusion.

Summary of Evidence Update:
The updated review process identified 39 publications for inclusion, compared to the 28 studies in the previous CoSTR. Thematic analysis revealed that the 11 additional publications could be seamlessly integrated into the existing three categories:

1. Real-world Drone AED Delivery for OHCA
    - Three publications (compared to two studies in the previous CoSTR), all from Sweden, investigated real-life drone delivery of AEDs to OHCA patients.
2. Test Flights, Simulation Studies, and Qualitative Analyses
    - 15 studies (nine in the previous CoSTR) evaluated the feasibility of real-world AED delivery by drones through simulated OHCA scenarios. These studies also explored laypeople's perceptions and experiences with the concept.
3. Computer/Prediction Models for Drone AED Feasibility and Effectiveness
    - 21 studies (17 in the previous CoSTR) employed various strategies to assess the optimal placement of AED drone bases, estimated time savings compared to EMS response times, and evaluated cost-effectiveness and other metrics.

Relevant Guidelines or Systematic Reviews: none

RCTs: none

Nonrandomized Trials, Observational Studies

Study Acronym; Author; Year Published	Study Type/Design; Study Size (N)	Patient Population	Primary Endpoint and Results (include P value; OR or RR; & 95% CI)	Summary/Conclusion Comment(s)
Schierbeck et al. 2023	Prospective study. Five AED-equipped drones across two controlled airspaces in Sweden	211 suspected out of hospital cardiac arrest	Drones were dispatched in 34% of cases. AEDs were successfully delivered in 81% of instances. Drones arrived before ambulances in 67% of cases, with a median time gain of 3 minutes and 14 seconds. Pads from drone-delivered AEDs were attached in six cases, with two resulting in shocks administered before ambulance arrival and one person achieving survival to 30 days.	
Davidson et al 2024	Simulation study. Assessed the safety of bystander interaction in 24 simulated emergencies. Investigated the impact of pre-arrival, drone-specific dispatch instructions (DSDI) on bystanders' ability to interact with the medical drone and provide safe, high-quality interventions.		All participants successfully provided patient care. Drone-specific dispatch instructions positively impacted bystander safety.	
Leith et al 2024	Simulation study. Conducted 24 simulations to evaluate lay bystander interactions with a multipurpose drone delivering a medical kit for OHCA and anaphylaxis treatment. A non-flying drone was placed 30 meters from the incident site. Quantitative		Participants found it easy to locate the drone (96%), locate and retrieve the medical kit (79-96%), and, use the AED (83%). Participants showed enthusiasm for the drone as a rapid response mechanism, with 83% indicating positive comfort levels with drones.	

	and qualitative data on bystander-drone interactions were measured.			
Starks et al 2024	Simulation study. Timed interactions between humans and drones in OHCA simulations and assessed CPR quality. Timed AED retrieval and application in 51 public cardiac arrest simulations with single bystander responders. Among 51 lay participants, 21 had recent CPR training. Drone flights were within line of sight.		The median time to retrieve the AED from the drone, apply it, and deliver a shock was 1:59 minutes (01:50–02:20), suggesting that drone-delivered AEDs need to arrive at least 2 minutes before EMS for effective bystander intervention. Lower participant age and recent CPR training were associated with faster AED use.	
Scholz et al 2023	Explored the feasibility of BVLOS drones for nighttime AED delivery. Conducted 10 flights to simulated OHCA sites during night and 10 during the day in a rural German region. Assessed delivery time and safety, with a focus on critical events.		Nighttime missions were feasible, with no safety incidents reported. No major operational differences were observed between day and nighttime drone operations for AED delivery.	
Fischer et al 2023	Examined feasibility of using drones for BVLOS drone AED delivery in mountainous regions through 29 simulated OHCA scenarios in Austria. Involved 10 paramedics and 19 laypersons, with timing and qualitative		BVLOS drone delivery of AEDs in mountainous regions was feasible. Participants accepted drone-delivered AEDs well.	

	measures in each simulation.			
Purahong et al 2022	Developed a medical drone system for AED delivery during emergencies. An application was created for bystanders to request a medical drone. Upon receiving coordinates, the drone is remotely piloted to land on the location.		After being tested in a simulation situation, the operational field test yielded satisfactory results	
Starks et al 2024	Computer modelling Assessed the impact of a combination of providing First Responders with an AED and placing AED delivering drones in optimized locations to ensure an AED within 5 minutes to OHCAs. Based on historical OHCA data.	USA, North Carolina (48 counties) Population: 7.5 million inhabitants. Area: 65,451 km2 (47% of the total state area)	With 326 drones and AEDs to First Respodners, the median county-level response was predicted to improve from 8 to 4.8 minutes and median 5-minute coverage from 16.5 % to 56.3%. Survival was estimated to increase from 14.5% to 19.4% for witnessed OHCA.	
Ren and Li 2023	Computer modelling Modelled a network of AED-equipped drones to ensure response times within 4 minutes across the entire city. Estimations, including survival, were based on 62 OHCAs, correlating to the OHCA incidence.	China, Jinnan District in Tianjin City (urban) Population: 928,066 inhabitants. Area: 421 km2.	The estimated survival rate with existing EMS, based on Euclidean distance response times, was 22%. With 24 drone launch sites, the estimated survival rate increased to 64%.	
Frigstad et al 2023	Computer modelling	Sweden, Västra Götaland (mixed	With 20 drone launch sites, AED arrival times were reduced from 15:59 to 10:30	

	Simulated the combined dispatch of volunteer responders and a network of AED-equipped drones to estimate the shortest AED arrival time and potential survival impact under various scenarios.	urban/suburban/rural) Population: 1.7 million inhabitants. Area: 25,247 km2.	(min:sec), and survival rates was predicted to increase from 9.6% to 15.8%..	
Yukun et al 2023	Computer modelling Compared a heuristic computer model with an improved algorithm for deploying a semi-automatic AED drone. Evaluated stability of the system, rescue time, and total system cost across 300 simulated OHCA locations.	China, main municipal district of Tianjin (urban) Population: NA. Area: NA.	25 drone launch sites achieved coverage of the study area within an average response time of 2 minutes and 7 seconds. The post-algorithm solution enhanced system stability by 42% and reduced the maximum number of required drone bases by 29%.	

Reviewer Comments:
We chose a scoping review over a systematic review due to the heterogeneity of the identified studies. The publications varied widely in study design, objectives, and outcome measures, including real-world implementations, simulations, computer models, and qualitative analyses.
A scoping review enabled us to capture the breadth of available evidence and highlight areas requiring further study, such as the need for real-world data (and RCTs). A systematic review would not have adequately addressed the complexity and variability of the evidence base.

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2025 Evidence Update
BLS 2403 – Passive Ventilation

Worksheet Author(s): Giuseppe Ristagno
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	Adults and children with presumed cardiac arrest in any settings
Intervention	Any passive ventilation technique (eg positioning the body, opening the airway, passive oxygen administration, Boussignac tube, constant flow insufflation of oxygen) in addition to chest compression
Comparison	Standard CPR
Outcomes	Survival to hospital discharge with good neurological outcome and survival to hospital discharge were ranked as critical outcomes. Return of spontaneous circulation (ROSC) was ranked as an important outcome
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion
Timeframe	All years and all languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

Year of last full review: 2021

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We suggest against the routine use of passive ventilation techniques during conventional CPR (weak recommendation, very low-quality evidence).

Current Search Strategy:
Medline:
((((((((((((((((((((((((((((((Heart Arrest[MeSH Terms]) OR Ventricular Fibrillation[MeSH Terms]) OR Cardiopulmonary Resuscitation[MeSH Terms]) OR Heart Massage[MeSH Terms]) OR “heart arrest”[Title/Abstract]) OR “cardiac arrest”[Title/Abstract]) OR asystole[Title/Abstract]) OR “ventricular fibrillation”[Title/Abstract]) OR “cardiopulmonary arrest”[Title/Abstract]) OR “cardiovascular arrest”[Title/Abstract]) OR resuscitation[Title/Abstract]) OR CPR[Title/Abstract]) OR “heart massage”[Title/Abstract]) OR “cardiac massage”[Title/Abstract]) OR “chest compression*”[Title/Abstract]) OR “cardiac compression*”[Title/Abstract]) OR “Basic Life Support”[Title/Abstract]) OR BLS[Title/Abstract]) OR "Life Support Care"[Mesh]) OR OHCA [Title/Abstract]) OR "Out of Hospital Cardiac Arrest*"[Title/Abstract]) OR "out-of-hospital cardiac arrest*"[Title/Abstract])))))) AND ((((((((((((((((((((((Insufflation[MeSH Terms]) OR “passive airway”[Title/Abstract]) OR “passive ventilation”[Title/Abstract]) OR “passive oxygen*”[Title/Abstract]) OR continuous positive ventilation [Title/Abstract]) OR “continuous positive airway pressure” [Title/Abstract]) OR CPAP[Title/Abstract]) OR Boussignac tube [Title/Abstract]) OR Boussignac endotracheal tube [Title/Abstract]) OR Boussignac tube ventilation [Title/Abstract]) OR “positive end-expiratory pressure” [Title/Abstract]) OR PEEP[Title/Abstract]) OR “head tilt”[Title/Abstract]) OR “chin lift”[Title/Abstract]) OR “laryngeal airway”[Title/Abstract]) OR “pharyngeal airway”[Title/Abstract]) OR “oropharyngeal airway” [Title/Abstract]) OR “nasopharyngeal airway” [Title/Abstract]) OR “oral airway” [Title/Abstract]) OR “nasal airway” [Title/Abstract]) OR ((position*[Title/Abstract]) AND body[Title/Abstract])) OR ((open*[Title/Abstract]) AND airway*[Title/Abstract])))))))

Embase:
('heart arrest'/exp/mj OR 'heart arrest'/mj OR 'cardiopulmonary resuscitation'/exp/mj OR 'cardiopulmonary resuscitation'/mj OR 'heart massage'/exp/mj OR 'heart massage'/mj OR 'cardiac arrest'/exp/mj OR 'cardiac arrest'/mj OR 'asystole'/exp/mj OR

'asystole'/mj OR 'ventricular fibrillation'/exp/mj OR 'ventricular fibrillation'/mj OR 'cardiopulmonary arrest'/exp/mj OR 'cardiopulmonary arrest'/mj OR 'cardiovascular arrest' OR 'resuscitation'/exp/mj OR 'resuscitation'/mj OR cpr OR 'cardiac massage'/exp/mj OR 'cardiac massage'/mj OR 'chest compression*' OR 'cardiac compression*' OR 'basic life support'/exp/mj OR 'basic life support'/mj OR bls OR 'life support care'/exp/mj OR 'life support care'/mj OR 'ohca'/exp/mj OR 'ohca'/mj OR 'out of hospital cardiac arrest*' OR 'out-of-hospital cardiac arrest*') AND ('insufflation'/exp/mj OR 'insufflation'/mj OR 'passive airway' OR 'passive ventilation' OR 'passive oxygen*' OR 'continuous positive ventilation' OR 'continuous positive airway pressure'/exp/mj OR 'continuous positive airway pressure'/mj OR 'cpap'/exp/mj OR 'cpap'/mj OR 'boussignac tube' OR 'boussignac endotracheal tube' OR 'boussignac tube ventilation' OR 'positive end-expiratory pressure'/exp/mj OR 'positive end-expiratory pressure'/mj OR 'peep'/exp/mj OR 'peep'/mj OR 'head tilt'/exp/mj OR 'head tilt'/mj OR 'chin lift'/exp/mj OR 'chin lift'/mj OR 'laryngeal airway'/exp/mj OR 'laryngeal airway'/mj OR 'pharyngeal airway' OR 'oropharyngeal airway'/exp/mj OR 'oropharyngeal airway'/mj OR 'nasopharyngeal airway'/exp/mj OR 'nasopharyngeal airway'/mj OR 'oral airway'/exp/mj OR 'oral airway'/mj OR 'nasal airway' OR 'body position'/exp/mj OR 'body position'/mj OR 'open airway*') AND [embase]/lim AND [english]/lim

Cochrane:
MeSH descriptor: [Heart Arrest] (explode all trees) OR MeSH descriptor: [Ventricular Fibrillation] (explode all trees) OR MeSH descriptor: [Cardiopulmonary Resuscitation] (explode all trees) OR MeSH descriptor: [Heart Massage] (explode all trees) OR ("cardiac arrest" OR asystole OR "ventricular fibrillation" OR "cardiopulmonary arrest" OR "cardiovascular arrest" OR resuscitation OR CPR OR "cardiac massage" OR "chest compression*" OR "cardiac compression*" OR "Basic Life Support" OR BLS OR "Life Support Care" OR OHCA OR "Out of Hospital Cardiac Arrest*" OR "out-of-hospital cardiac arrest*"):ti,ab,kw (Word variations have been searched) AND (Insufflation OR “passive airway” OR “passive ventilation” OR “passive oxygen*” OR “continuous positive ventilation” OR “continuous positive airway pressure” OR CPAP OR “Boussignac tube” OR “Boussignac endotracheal tube” OR “Boussignac tube ventilation” OR “positive end-expiratory pressure” OR PEEP OR “head tilt” OR “chin lift” OR “laryngeal airway” OR “pharyngeal airway” OR “oropharyngeal airway” OR “nasopharyngeal airway” OR “oral airway” OR “nasal airway” OR “body position” OR “open airway*”):ti,ab,kw (Word variations have been searched)

Databases searched: Medline, Embase, Cochrane
Time Frame: Oct 16th, 2021 – July 5th, 2024
Date Search Completed: July 5th 2024
Search Results:
Articles identified from the search: 142; relevant: none
Summary of Evidence Update:
No new relevant articles were identified

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR; Wyckoff 2022	Systematic review	BLS 352 Passive ventilation	4	The overall certainty of evidence was rated as very low.	We suggest against the routine use of passive ventilation techniques during conventional CPR (weak recommendation, very low–certainty evidence)

Groulx 2021	Systematic review	Continuous flow insufflation of oxygen (CFIO)	4	CFIO was not associated with significantly different rates of ROSC, sustained ROSC or survival when compared to other ventilation techniques. According to a limited number of human, sometimes at high and serious risk of bias, CFIO might be associated with improved oxygenation.	n.a.

RCT: none

Nonrandomized Trials, Observational Studies: none found

Study Acronym; Author; Year Published	**Study Type/Design; Study Size (N)**	**Patient Population**	**Primary Endpoint and Results (include P value; OR or RR; & 95% CI)**	**Summary/Conclusion Comment(s)**
	Study Type:	**Inclusion Criteria:**	**1° endpoint:**	

Reviewer Comments:

No new articles have been identified over the last frame period. The systematic Groulx 2021 identified 2 articles relevant for the PICOST, that, however, had been already considered and included in the last ILCOR systematic (Wyckoff 2022).

In conclusion, the results are sufficient to challenge current guidelines and warrant a full review.

Reference list:

No new references identified

2025 Evidence Update
BLS 2504 – Minimizing Pauses in Chest Compressions

Worksheet Author(s): Mike Smyth
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	Among adults who are in cardiac arrest in any setting
Intervention	Minimization of pauses in chest compressions (higher CPR fraction or lower peri-shock pauses compared to control)
Comparison	Standard CPR (lower CPR fraction or higher peri-shock pauses compared to intervention)
Outcomes	survival with a favourable neurological outcome (critical), survival (critical), ROSC (important)
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded
Timeframe	From June 2021 onward.

Year of last full review: 2021

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We suggest CPR fraction and per-shock pauses in clinical practice be monitored as part of a comprehensive quality improvement program for cardiac arrest designed to ensure high-quality CPR delivery and resuscitation care across resuscitation systems (weak recommendation, very-low-certainty evidence).

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

We suggest during CPR fraction (CPR time devoted to compressions) should be as high aspossible and at least 60% (weak recommendation, very-low-certainty evidence).

Current Search Strategy:
MEDLINE

1 Time Factors/ and (heart massage/ or ((chest or cardiac or heart) adj4 (compression* or compressor* or massag*)).tw,kf.
2 ((compression* or compressor* or massag*) adj4 (handson* or hands-on* or handsoff* or hands-off* or fraction* or time or times or interval* or interrupt* or inter-rupt* or uninterrupt* or break or breaks or continu* or delay* or pause* or pausing or period* or ongoing or on-going or intermittent or inter-mittent)).tw,kf.
3 (no flow time or no flow fraction* or no flow ratio*).tw,kf.
4 (ventilation adj2 (pause* or interrupt* or inter-rupt*)).tw,kf.
5 or/2-4 4678
6 heart arrest/ or death, sudden, cardiac/ or out-of-hospital cardiac arrest/
7 Ventricular Fibrillation/ or tachycardia, ventricular/ or torsades de pointes/
8 (return of circulation or return of spontaneous circulation or recovery of circulation or recovery of spontaneous circulation).tw,kf.
9 Shock, Cardiogenic/ or (cardi* shock* or heart shock*).tw,kf.
10 (asystol* or heart standstill or OHCA or idioventric* tachycardia* or accelerated idioventric* rhythm* or (shockable adj2

rhythm*)).tw,kf.
11 ((ventricular or ventricle) adj2 (tachy* or fibrillation*)).tw,kf.
12 ((cardiac or cardiopulmonary or cardio-pulmonary or heart or circulat*) adj2 (arrest* or resuscitat*)).tw,kf.
13 (sudden adj2 (cardiac or heart) adj2 death*).tw,kf.
14 ((pulseless adj3 electric* adj3 activit*) or (agonal breath* or code blue)).tw,kf.
15 Electric Countershock/ or Defibrillators/ or (cardioconversion* or cardio version* or electroversion* or electroconversion* or electrocardioversion* or electrocardio version* or cardioversion* or counter shock* or countershock* or defibrillation* or defibrillator*).tw,kf.
16 resuscitation/ or cardiopulmonary resuscitation/ or advanced cardiac life support/ or heart massage/
17 (CPR or ((chest or cardiac or heart) adj4 (compression* or compressor* or massag*))).tw,kf.
18 or/6-17
19 5 and 18
20 ((chest or cardiac or heart) adj3 (compression* or compressor* or massag*) adj3 (handson* or hands-on* or handsoff* or hands-off* or fraction* or time or times or interval* or interrupt* or inter-rupt* or uninterrupt* or break or breaks or continu* or delay* or pause* or pausing or period* or ongoing or on-going or intermittent or inter-mittent)).tw,kf.
21 ((perishock* or peri-shock* or preshock* or pre-shock* or postshock* or post-shock* or postanaly* or post-analy* or preanaly* or pre-analy*) adj3 (pause* or pausing)).tw,kf.
22 ((compressionventilation or compression ventilation) adj2 ratio*).tw,kf.
23 ((cardiac or cardiopulmonary or cardio-pulmonary) adj2 resuscitat* adj4 (interrupt* or inter-rupt* or uninterrupt* or pause* or pausing or fraction*)).tw,kf.
24 (CPR adj4 (interrupt* or inter-rupt* or uninterrupt* or pause* or pausing or fraction*)).tw,kf.
25 or/1,19-24
26 ((Animal Experimentation/ or exp Animals/ or exp Models, Animal/) not Humans/) or ((veterinar* or animal or animals or rabbit or rabbits or rodent or rodents or rat or rats or mouse or mice or hamster or hamsters or pig or pigs or piglet or piglets or porchine or pigeon or pigeons or horse or horses or equine or cow or cows or bovine or goat or goats or sheep or lamb or lambs or monkey or monkeys or murine or ovine or dog or dogs or canine or cat or cats or feline or dolphine or dolphins or elephant* or swine or swines or cadaver*) not (patient or patients or human or humans)).ti.
27 simulation training/ or high fidelity simulation training/ or patient simulation/ or Manikins/ or (training or simulat* or manikin* or mannequin*).ti. or (simulation* or manikin* or mannequin*).kf. or ((simulation or manikin or mannequin) adj (study or trial)).ab.
28 25 not (26 or 27)

Embase

1 time factor/ and (heart massage/ or ((chest or cardiac or heart) adj4 (compression* or compressor* or massag*)).tw,kw.)
2 ((compression* or compressor* or massag*) adj4 (handson* or hands-on* or handsoff* or hands-off* or fraction* or time or times or interval* or interrupt* or inter-rupt* or uninterrupt* or break or breaks or continu* or delay* or pause* or pausing or period* or ongoing or on-going or intermittent or inter-mittent)).tw,kw.
3 (no flow time or no flow fraction* or no flow ratio*).tw,kw.
4 (ventilation adj2 (pause* or interrupt* or inter rupt*)).tw,kw.
5 or/2-4
6 heart arrest/ or cardiopulmonary arrest/ or experimental heart arrest/ or "out of hospital cardiac arrest"/ or sudden cardiac death/
7 heart ventricle fibrillation/ or heart ventricle tachycardia/ or "electrical storm (heart)"/ or torsade des pointes/ or "return of spontaneous circulation"/
8 (return of circulation or return of spontaneous circulation or recovery of circulation or recovery of spontaneous circulation).tw,kw.
9 cardiogenic shock/ or (cardi* shock* or heart shock*).tw,kw.
10 (asystol* or heart standstill or OHCA or idioventric* tachycardia* or accelerated idioventric* rhythm* or (shockable adj2

rhythm*)).tw,kw.
11 ((ventricular or ventricle) adj2 (tachy* or fibrillation*)).tw,kw.
12 ((cardiac or cardiopulmonary or cardio-pulmonary or heart or circulat*) adj2 (arrest* or resuscitat*)).tw,kw.
13 (sudden adj2 (cardiac or heart) adj2 death*).tw,kw.
14 ((pulseless adj3 electric* adj3 activit*) or (agonal breath* or code blue)).tw,kw.
15 defibrillation/ or defibrillator/ or external defibrillator/ or automated external defibrillator/ or defibrillator monitor/ or manual external defibrillator/ or defibrillator*.tw,kw.
16 cardioversion/ or (cardioconversion* or cardio version* or electroversion* or electroconversion* or electrocardioversion* or electrocardio version* or cardioversion* or counter shock* or countershock* or defibrillation*).tw,kw.
17 resuscitation/ or heart massage/ or (CPR or ((chest or cardiac or heart) adj4 (compression* or compressor* or massag*))).tw,kw.
18 or/6-17
19 5 and 18
20 ((chest or cardiac or heart) adj3 (compression* or compressor* or massag*) adj3 (handson* or hands-on* or handsoff* or hands-off* or fraction* or time or times or interval* or interrupt* or inter-rupt* or uninterrupt* or break or breaks or continu* or delay* or pause* or pausing or period* or ongoing or on-going or intermittent or inter-mittent)).tw,kw.

21 perishock pause/ or ((perishock* or peri-shock* or preshock* or pre-shock* or postshock* or post-shock* or postanaly* or post-analy* or preanaly* or pre-analy*) adj3 (pause* or pausing)).tw,kw.
22 ((compressionventilation or compression ventilation) adj2 ratio*).tw,kw.
23 ((cardiac or cardiopulmonary or cardio-pulmonary) adj2 resuscitat* adj4 (interrupt* or inter-rupt* or uninterrupt* or pause* or pausing or fraction*)).tw,kw.
24 (CPR adj4 (interrupt* or inter-rupt* or uninterrupt* or pause* or pausing or fraction*)).tw,kw.
25 or/1,19-24
26 limit 25 to conference abstracts
27 25 not 26
28 ((exp animal/ or exp animal model/ or nonhuman/) not exp human/) or ((veterinar* or animal or animals or rabbit or rabbits
or rodent or rodents or rat or rats or mouse or mice or hamster or hamsters or pig or pigs or piglet or piglets or porchine or
pigeon or pigeons or horse or horses or equine or cow or cows or bovine or goat or goats or sheep or lamb or lambs or monkey or monkeys or murine or ovine or dog or dogs or canine or cat or cats or feline or dolphin or dolphins or elephant* or swine or swines or cadaver*) not (patient or patients or human or humans)).ti.
29 simulation/ or patient simulation/ or simulation training/ or manikin/ or (training or simulat* or manikin* or mannequin*).ti.
or (simulation* or manikin* or mannequin*).kw. or ((simulation or manikin or mannequin) adj (study or trial)).ab.
30 27 not (28 or 29)

CINAHL

S1 (MH "Heart Massage") AND ((MH "Periodicity+") OR (MH "Time Factors") OR (MH "Turnaround Time"))
S2 ((compression* OR compressor* OR massag*) N3 (handson* OR hands-on* OR handsoff* OR hands-off* OR fraction* OR time OR times OR interval* OR interrupt* OR inter-rupt* OR uninterrupt* OR break OR breaks OR continu* OR delay OR delays OR pause* OR pausing OR period* OR ongoing OR on-going OR intermittent OR inter-mittent))
S3 ("no flow time" OR "no flow fraction*" OR "no flow ratio*")
S4 (ventilation N1 (pause* OR interrupt* OR "inter rupt*"))
S5 S2 OR S3 OR S4
S6 (MH "Heart Arrest") OR (MH "Death, Sudden, Cardiac")
S7 (MH "Torsades de Pointes")
S8 (MH "Return of Spontaneous Circulation")
S9 ("return of circulation" OR "return of spontaneous circulation" OR recovery of circulation OR "recovery of spontaneous circulation")
S10 (MH "Shock, Cardiogenic")
S11 ("cardi* shock*" OR "heart shock*")
S12 (asystol* OR "heart standstill" OR OHCA OR "idioventric* tachycardia*" OR "accelerated idioventric* rhythm*" OR

(shockable N1 rhythm*))
S13 ((ventricular OR ventricle) N1 (tachy* OR fibrillation*))
S14 ((cardiac OR cardiopulmonary OR "cardio pulmonary" OR heart OR circulat*) N1 (arrest* OR resuscitat*)) Search modes – Boolean/Phrase
S15 (sudden N1 (cardiac OR heart) N1 death*)
S16 ((pulseless N2 electric* N2 activit*) OR (agonal breath* OR code blue))
S17 (MH "Defibrillation")
S18 (MH "Defibrillators") OR (MH "Defibrillators, Automated External")
S19 defibrillator*
S20 (MH "Cardioversion")
S21 (cardioconversion* OR "cardio version*" OR electroversion* OR electroconversion* OR electrocardioversion* OR "electrocardio version*" OR cardioversion* OR "counter shock*" OR countershock* OR defibrillation*)
S22 (MH "Resuscitation") OR (MH "Heart Massage") OR (MH "Resuscitation, Cardiopulmonary+") OR (MH "Advanced Cardiac Life
Support+") OR (MH "Pediatric Advanced Life Support") OR (MH "Bystander CPR")
S23 (CPR OR ((chest OR cardiac OR heart) N3 (compression* OR compressor* OR massag*)))
S24 S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23
S25 S5 AND S24
S26 ((chest OR cardiac OR heart) N2 (compression* OR compressor* OR massag*) N2 (handson* OR hands-on* OR handsoff* OR hands-off* OR fraction* OR time OR times OR interval* OR interrupt* OR inter-rupt* OR uninterrupt* OR break OR breaks OR continu* OR delay OR delays OR pause* OR pausing OR period* OR ongoing OR on-going OR intermittent OR intermittent))
S27 ((perishock OR "peri shock" OR preshock OR "pre shock" OR postshock OR "post shock" OR postanaly* OR "post analy*" OR
preanaly* OR "pre analy*") N2 (pause* OR pausing))
S28 (compressionventilation OR compression ventilation) N1 ratio*
S29 ((cardiac OR cardiopulmonary OR "cardio pulmonary") N1 resuscitat* N3 (interrupt* OR "inter rupt*" OR uninterrupt* OR pause* OR pausing OR fraction*))
S30 (CPR N3 (interrupt* OR "inter-rupt*" OR uninterrupt* OR pause* OR pausing OR fraction*)
S31 S1 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30
S32 ((MM "Animals") NOT (MH "Human")) OR (TI ((veterinar* OR animal OR animals OR rabbit OR rabbits OR rodent OR rodents OR rat OR rats OR mouse OR mice OR hamster OR hamsters OR pig OR pigs OR piglet OR piglets OR porchine OR pigeon OR pigeons OR horse OR horses OR equine OR cow OR cows OR bovine OR goat OR goats OR sheep OR lamb OR lambs OR monkey OR monkeys OR murine OR ovine OR dog OR dogs OR canine OR cat OR cats OR feline OR dolphin OR dolphins OR elephant* OR swine OR swines OR cadaver*) not (patient OR patients OR human OR humans)))
S33 ((MH "Models, Anatomic") OR (TI training OR simulat* OR manikin* OR mannequin*)) OR AB (((simulation OR manikin OR mannequin) W0 (study OR trial)))
S34 S32 OR S33
S35 S31 NOT S34

Databases searched: Medline, Embase, Cochrane
Time Frame: June 2021 – April 2024
Date Search Completed: April 14th 2024
Search Results (Number of articles identified and number identified as relevant):
Number of titles identified by the search: 255; number of relevant articles: 7

Summary of Evidence Update:
Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
Lingby 2021 [1]	Systematic review	Does real-time and post-event feedback improve CPR quality metrics, ROSC and survival to discharge/30 days	8	Real-time feedback (3 studies) showed no significant association with CCF (MD 7.26; 95% CI, -0.37, 14.88) Real-time feedback (5 studies) showed no significant association with ROSC (RR 1.05; 95% CI, 0.92, 1.19)	CPR feedback was assosciated with a marginal improvement in some CPR quality metrics but not with improvement in clinical outcomes

RCT: none

Non-randomized Trials, Observational Studies:

Study Acronym; Author; Year Published	Study Type/Design; Study Size (N)	Patient Population	Primary Endpoint and Results (include P value; OR or RR; & 95% CI)	Summary/Conclusion Comment(s)
De Wolfe 2021 [2]	Retrospective observational study (n=168). Analysis of video from bodyworn camera assessing number and duration of interruptions	129 OHCA transported to ED, 39 IHCA	No significant association between CCF and ROSC (OHCA: p = 0.08; IHCA: p = 0.17). CCF had no significant influence on survival (cox regression analysis; OHCA: p = 0.9263; IHCA: not determined due to low number of patients). The number of interruptions >10 s had no significant influence on ROSC (p = 0.266) or 1 month survival (p = 0.958). The effect of a pause with a duration of >60s had no significant influence on ROSC (p = 0.962) or 1 month survival (p = 1.0).	Small sample, single center. Potential measurement bias in assessing duration of pauses.
Iversen 2021 [3]	Retrospective observational study (n=178). Compared "precharging" defibrillator toward end of 2 min cycle vs "delaying" defibrillator charge	OHCA	Patients with precharge had lower hands-off fraction than those without precharge (12.2 (IQR 9.1–15.1) vs. 20.1 (IQR 16.1–24.1) %, p < 0.001). Using precharge defibrillation may be associated with ROSC (aOR 2.91; 95 %CI 1.09–7.8, p = 0.03).	Small sample. "Delayed" defibrillation included two sub-types of defibrillation precedures. i) No compressions during charge ii) Compressions during charge

	until pause in 2 minute CPR cycle.			
Leo 2023 [4]	Retrospective observational study (n=64) Evaluated quality of chest compressions following adoption of a real-time feedback device.	IHCA	Primary outcomes were CCF, proportion of compressions in target, mean compression rate and proportion of compressions in target rate, mean compression depth and proportion of compressions in target depth, and mean release velocity (RV) Secondary outcome variables were downtime, survival and neurological outcomes. 71.9% of cases achieved CCF of above 80%. No significant relationship was observed between CCF and survival ($p = 0.40$)	Small sample, single centre
Lyngby 2023 [5]	Retrospective observational study (n=64) Before and after study to evaluate quality of chest compressions following adoption of a real-time feedback device.	OHCA	CCF without vs with feedback was was 78.9% and 81.9% respectively ($P<0.001$). No significant difference in ROSC (OR 1.08 [95% CI, 0.84–1.39]), sustained ROSC (OR, 1.00 [95% CI, 0.77–1.31]), or survival to hospital discharge (OR, 0.91 [95% CI, 0.64–1.30]).	Small study, single centre
Schmicker 2021 [6]	Secondary analysis of data from the ALPS study (n=26,810). Compared CPR quality metrics and patient outcomes among patients receving continuos chest compressions (CCC) vs standard 30:2	OHCA	Patients with CCC strategy higher mean CCF than those with 30:2 strategy (0.87 vs 0.80) CCC had significantly lower survival OR (95%CI) = 0.72 (0.64, 0.81) while 30:2 had higher survival, OR (95%CI) = 1.05 (0.90, 1.22).	When stratified by CPR strategy, 58.6% of CCC cases and 48.3% of 30:2 cases met predefined quality criteria. Although survival was higher with 30:2 strategy it also exhibited lower quality CPR than CCC.
Shimizu 2021 [7]	Retrospective observational study (n=159) Compared CCF and ROSC before	OHCA. 163 advanced airway. 86 BVM	CCF was higher in the AA group than in the BVM group (89.4% vs 84.3%, p<0.001)	Small study, single centre.

	hospital arrival among patients receving BVM ventilation vs advanced airway (AA) (ETT or SGA)		ROSC rates were higher for AA than in the BVM group (31.8% vs 12.2%, p= 0.006)	

Reviewer Comments:
Several studies reported meaningful data concerning interruptions in human cardiac arrest populations, but were excluded as they did not report the prespecified outcomes of interest (survival with favourable neurologic outcome, survival to discharge and ROSC). For example, how choice of airway management strategy (ETT vs LMA) impacted time off the chest and compression fraction. This suggests the evidence might be strengthened by reviewing the PICO question in the future.

Despite excluding several reports, the identified literature suggests that minimizing interruptions optimizes CCF. Only one study identifies an imporoved CCF and improved ROSC rate (Shimizu 2021 [7]) however this finding may associated with improved ventilation/oxygenation rather an improved CCF.

No new data were identified to indicate the current treatment recommendation is in need of revision.

Reference list:

1. Lyngby RM, Händel MN, Christensen AM, et al. Effect of real-time and post-event feedback in out-of-hospital cardiac arrest attended by EMS — A systematic review and meta-analysis. *Resuscitation Plus* 2021; **6**: 100101.
2. Dewolf P, Wauters L, Clarebout G, et al. Assessment of chest compression interruptions during advanced cardiac life support. *Resuscitation* 2021; **165**: 140-7.
3. Iversen BN, Meilandt C, Væggemose U, Terkelsen CJ, Kirkegaard H, Fjølner J. Pre-charging the defibrillator before rhythm analysis reduces hands-off time in patients with out-of-hospital cardiac arrest with shockable rhythm. *Resuscitation* 2021; **169**: 23-30.
4. Leo WZ, Chua D, Tan HC, Ho VK. Chest compression quality and patient outcomes with the use of a CPR feedback device: A retrospective study. *Scientific Reports* 2023; **13**(1): 19852.
5. Lyngby RM, Quinn T, Oelrich RM, et al. Association of Real-Time Feedback and Cardiopulmonary-Resuscitation Quality Delivered by Ambulance Personnel for Out-of-Hospital Cardiac Arrest. *Journal of the American Heart Association* 2023; **12**(20): e029457.
6. Schmicker RH, Nichol G, Kudenchuk P, et al. CPR compression strategy 30:2 is difficult to adhere to, but has better survival than continuous chest compressions when done correctly. *Resuscitation* 2021; **165**: 31-7.
7. Shimizu K, Wakasugi M, Kawagishi T, Hatano T, Fuchigami T, Okudera H. Effect of advanced airway management by paramedics during out-of-hospital cardiac arrest on chest compression fraction and return of spontaneous circulation. *Open access emerg* 2021: 305-10.

2025 Evidence Update
BLS 2702 – Drowning: In-water CPR

Worksheet Author(s): Gavin Perkins, Janet Bray
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	In adults and children who are submerged in water
Intervention	Immediate resuscitation in-water[a]
Comparison	Delaying resuscitation until on land[b]
Outcomes	Survival with favourable neurological outcome to discharge / 30 days or later Survival to discharge / 30 days or later Return of spontaneous circulation (ROSC)
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Manikin studies will only be included if no human studies are available.
Timeframe	From April 2023 onward. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

[a] Immediate resuscitation in-water resuscitation is defined as delivering ventilations only to a non-breathing casualty while still in the water.

[b] Land is si defined as a firm, stable surface out of the water (e.g., wharf, pontoon, beach) with sufficient space for rescuers to safely perform CPR.

Year of last full review: 2023

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We suggest in-water resuscitation (ventilations only) may be delivered if rescuers, trained in this technique, if they determine that it is feasible and safe, with the equipment available, and the distance to shore warrants its use (weak recommendation, very low-certainty evidence).

If the rescuers feel that in-water resuscitation is, or becomes too difficult or unsafe, then the rescuers should delay resuscitation until on dry land (good practice statement).

Current Search Strategy:
NOTE: several PICOST questions addressed topics related to drowning (BLS2702, BLS 2703, BLS 2704, BLS2705, BLS2706, BLS2707). To prevent unnecessary duplication of screening a single common search strategy addressing all of the PICOST questions was utilised. This approach meant first-pass screening needed to be completed once only. Selected manuscripts were then assessed and interpreted within their respective PICOST questions

MEDLINE
1 exp Near Drowning/ or exp Drowning/ or drowning.mp.
2 drown*.mp.
3 exp Immersion/
4 immers*.mp.
5 submer*.mp.
6 ships/
7 (boat or boats).mp.
8 in-water.mp.
9 exp Fresh water/ or exp Seawater/ or exp Saline water/

10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11 exp Resuscitation/ or resuscitat*.mp.
12 cpr.mp. or exp Cardiopulmonary Resuscitation/
13 exp Extracorporeal Membrane Oxygenation/ or ecmo.mp.
14 aed.mp.
15 ARDS.mp.
16 exp Respiratory Distress Syndrome, Adult/
17 intubation.mp. or exp Intubation/ or exp Intubation, Intratracheal/
18 airway management.mp. or exp Airway Management/
19 artificial respiration.mp. or exp Respiration, Artificial/
20 (oxygen adj3 (therapy or delivery or additional)).mp. or exp Oxygen Inhalation Therapy/
21 positive pressure ventilation.mp. or exp Positive-Pressure Respiration/
22 (Peep or positive end expiratory pressure).mp.
23 (niv or non-invasive ventilation or non invasive ventilation or noninvasive ventilation).mp.
24 hospital admission.mp. or exp Hospitalization/
25 Defibrillators/ or defibrillat*.mp.
26 exp patient discharge/
27 ((patient or hospital) adj3 discharg*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
28 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
29 10 and 28
30 limit 29 to yr="2000 -Current"
31 exp animals/ not humans.sh.
32 30 not 31

Embase

1 exp near drowning/ or exp drowning/
2 drown*.mp.
3 exp immersion/ or exp water immersion/
4 immers*.mp.
5 submer*.mp.
6 exp ship/
7 (boat or boats).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
8 exp fresh water/
9 exp sea water/
10 exp salt water/
11 in-water.mp.
12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 exp resuscitation/ or resuscitat*.mp.
14 cpr.mp.
15 cardiopulmonary resuscitation.mp.
16 exp extracorporeal oxygenation/ or ecmo.mp.
17 aed.mp. or exp automated external defibrillator/
18 ards.mp. or exp adult respiratory distress syndrome/
19 intubation.mp. or exp endotracheal intubation/ or exp intubation/
20 airway management.mp. or exp respiration control/
21 artificial respiration.mp. or exp artificial ventilation/
22 oxygen inhalation therapy.mp. or exp oxygen therapy/
23 (oxygen adj3 (therapy or delivery or additional)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
24 positive pressure ventilation.mp. or exp positive end expiratory pressure/
25 peep.mp.

26 positive pressure respiration.mp.
27 exp noninvasive ventilation/ or niv.mp.
28 hospital admission.mp. or exp hospital admission/
29 exp hospitalization/ or hospitalisation.mp.
30 exp hospital discharge/
31 ((hospital or patient) adj3 discharg*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
32 exp defibrillator/ or defibrillat*.mp. or exp defibrillation/
33 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34 12 and 33
35 (exp animal/ or nonhuman/) not exp human/
36 34 not 35
37 limit 36 to yr="2000 -Current"
38 limit 37 to (article or article in press or "review")

Cochrane

#1 MeSH descriptor: [Near Drowning] explode all trees
#2 MeSH descriptor: [Drowning] explode all trees
#3 (drown*):ti,ab,kw
#4 MeSH descriptor: [Immersion] explode all trees
#5 (immers* or submer*):ti,ab,kw
#6 MeSH descriptor: [Ships] explode all trees
#7 (boat or boats):ti,ab,kw
#8 ("in-water"):ti,ab,kw
#9 MeSH descriptor: [Fresh Water] explode all trees
#10 MeSH descriptor: [Seawater] explode all trees
#11 MeSH descriptor: [Saline Waters] explode all trees
#12 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 MeSH descriptor: [Resuscitation] explode all trees
#14 (resuscitat*):ti,ab,kw
#15 (cpr):ti,ab,kw
#16 MeSH descriptor: [Cardiopulmonary Resuscitation] explode all trees
#17 (ecmo):ti,ab,kw
#18 MeSH descriptor: [Extracorporeal Membrane Oxygenation] explode all trees
#19 (aed):ti,ab,kw
#20 MeSH descriptor: [Respiratory Distress Syndrome, Adult] explode all trees
#21 (ards):ti,ab,kw
#22 (intubation):ti,ab,kw
#23 MeSH descriptor: [Intubation] explode all trees
#24 MeSH descriptor: [Intubation, Intratracheal] explode all trees
#25 (airway management):ti,ab,kw
#26 MeSH descriptor: [Airway Management] explode all trees
#27 (artificial respiration):ti,ab,kw
#28 MeSH descriptor: [Respiration, Artificial] explode all trees
#29 MeSH descriptor: [Oxygen Inhalation Therapy] explode all trees
#30 (oxygen near/3 (therapy or delivery or additional)):ti,ab,kw
#31 (positive pressure ventilation):ti,ab,kw
#32 MeSH descriptor: [Positive-Pressure Respiration] explode all trees
#33 (peep or positive pressure expiratory pressure):ti,ab,kw
#34 (niv or non-invasive ventilation or noninvasive ventilation or non invasive ventilation):ti,ab,kw
#35 (hospital admission):ti,ab,kw
#36 MeSH descriptor: [Hospitalization] explode all trees

#37 (patient or hospital) near/3 discharg*
#38 MeSH descriptor: [Patient Discharge] explode all trees
#39 MeSH descriptor: [Defibrillators] explode all trees
#40 (defibrillat*):ti,ab,kw
#41 #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40
#42 #12 and #41

Databases searched: Medline, Embase, Cochrane
Time Frame: April 2023 – April 2024
Date Search Completed: April 14th 2024
Search Results:
Articles identified by the search: 669; relevant articles: 0

Summary of Evidence Update:
No new relevant articles were identified

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR 2024 (Berg 2024, 195)	Systematic review	In-water ventilations vs no in-water ventilations	1	In-water ventilation-only resuscitation was associated with improved survival with favorable neurological outcome (52.6% versus 7.4%; relative risk, 7.1 [95% CI,1.8–28.8]) and survival to hospital discharge (52.6% versus 16.7%; relative risk, 5.7 [95% CI, 2.3–14.3]).	See above TR

RCT: none

Nonrandomized Trials, Observational Studies: none

Reviewer Comments:
No new studies were identified over the search interval. There are no new data to challenge current guidelines or to warrant a further review.

Reference list:
Berg KM, Bray JE, Ng K-C, et al. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Resuscitation* 2024; **195**. https://www.resuscitationjournal.com/article/S0300-9572(23)00306-4/fulltext

2025 Evidence Update
BLS 2703 – Drowning: On-boat CPR

Worksheet Author(s): Gavin Perkins, Janet Bray
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	In adults and children who are submerged in water
Intervention	Immediate resuscitation on boat[a]
Comparison	Delaying resuscitation until on land[b]
Outcomes	Survival with favourable neurological outcome to discharge / 30 days or later Survival to discharge / 30 days or later Return of spontaneous circulation (ROSC)
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Manikin studies will only be included if no human studies are available.
Timeframe	From April 2023 onward. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

[a]The definition of on-boat resuscitation includes resuscitation (ventilations only or ventilations and chest compressions) in a boat (e.g., lifeboat, inflatable rescue boat, fishing boats etc.) before returning to land).
[b]The definition of land is a firm, stable surface out of the water (e.g., wharf, pontoon, beach) with sufficient space for rescuers to safely perform CPR.

Year of last full review: 2023

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We suggest on-boat CPR may be delivered if rescuers, trained in this technique, determine that it is feasible and safe to attempt resuscitation (good practice statement).

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

Current Search Strategy:
NOTE: several PICOST questions addressed topics related to drowning (BLS2702, BLS 2703, BLS 2704, BLS2705, BLS2706, BLS2707). To prevent unnecessary duplication of screening a single common search strategy addressing all of the PICOST questions was utilised. This approach meant first-pass screening needed to be completed once only. Selected manuscripts were then assessed and interpreted within their respective PICOST questions

MEDLINE
1 exp Near Drowning/ or exp Drowning/ or drowning.mp.
2 drown*.mp.
3 exp Immersion/
4 immers*.mp.
5 submer*.mp.
6 ships/
7 (boat or boats).mp.
8 in-water.mp.
9 exp Fresh water/ or exp Seawater/ or exp Saline water/
10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9

11 exp Resuscitation/ or resuscitat*.mp.
12 cpr.mp. or exp Cardiopulmonary Resuscitation/
13 exp Extracorporeal Membrane Oxygenation/ or ecmo.mp.
14 aed.mp.
15 ARDS.mp.
16 exp Respiratory Distress Syndrome, Adult/
17 intubation.mp. or exp Intubation/ or exp Intubation, Intratracheal/
18 airway management.mp. or exp Airway Management/
19 artificial respiration.mp. or exp Respiration, Artificial/
20 (oxygen adj3 (therapy or delivery or additional)).mp. or exp Oxygen Inhalation Therapy/
21 positive pressure ventilation.mp. or exp Positive-Pressure Respiration/
22 (Peep or positive end expiratory pressure).mp.
23 (niv or non-invasive ventilation or non invasive ventilation or noninvasive ventilation).mp.
24 hospital admission.mp. or exp Hospitalization/
25 Defibrillators/ or defibrillat*.mp.
26 exp patient discharge/
27 ((patient or hospital) adj3 discharg*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
28 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
29 10 and 28
30 limit 29 to yr="2000 -Current"
31 exp animals/ not humans.sh.
32 30 not 31

Embase

1 exp near drowning/ or exp drowning/
2 drown*.mp.
3 exp immersion/ or exp water immersion/
4 immers*.mp.
5 submer*.mp.
6 exp ship/
7 (boat or boats).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
8 exp fresh water/
9 exp sea water/
10 exp salt water/
11 in-water.mp.
12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 exp resuscitation/ or resuscitat*.mp.
14 cpr.mp.
15 cardiopulmonary resuscitation.mp.
16 exp extracorporeal oxygenation/ or ecmo.mp.
17 aed.mp. or exp automated external defibrillator/
18 ards.mp. or exp adult respiratory distress syndrome/
19 intubation.mp. or exp endotracheal intubation/ or exp intubation/
20 airway management.mp. or exp respiration control/
21 artificial respiration.mp. or exp artificial ventilation/
22 oxygen inhalation therapy.mp. or exp oxygen therapy/
23 (oxygen adj3 (therapy or delivery or additional)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
24 positive pressure ventilation.mp. or exp positive end expiratory pressure/
25 peep.mp.
26 positive pressure respiration.mp.

27 exp noninvasive ventilation/ or niv.mp.
28 hospital admission.mp. or exp hospital admission/
29 exp hospitalization/ or hospitalisation.mp.
30 exp hospital discharge/
31 ((hospital or patient) adj3 discharg*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
32 exp defibrillator/ or defibrillat*.mp. or exp defibrillation/
33 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34 12 and 33
35 (exp animal/ or nonhuman/) not exp human/
36 34 not 35
37 limit 36 to yr="2000 -Current"
38 limit 37 to (article or article in press or "review")

Cochrane

#1 MeSH descriptor: [Near Drowning] explode all trees
#2 MeSH descriptor: [Drowning] explode all trees
#3 (drown*):ti,ab,kw
#4 MeSH descriptor: [Immersion] explode all trees
#5 (immers* or submer*):ti,ab,kw
#6 MeSH descriptor: [Ships] explode all trees
#7 (boat or boats):ti,ab,kw
#8 ("in-water"):ti,ab,kw
#9 MeSH descriptor: [Fresh Water] explode all trees
#10 MeSH descriptor: [Seawater] explode all trees
#11 MeSH descriptor: [Saline Waters] explode all trees
#12 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 MeSH descriptor: [Resuscitation] explode all trees
#14 (resuscitat*):ti,ab,kw
#15 (cpr):ti,ab,kw
#16 MeSH descriptor: [Cardiopulmonary Resuscitation] explode all trees
#17 (ecmo):ti,ab,kw
#18 MeSH descriptor: [Extracorporeal Membrane Oxygenation] explode all trees
#19 (aed):ti,ab,kw
#20 MeSH descriptor: [Respiratory Distress Syndrome, Adult] explode all trees
#21 (ards):ti,ab,kw
#22 (intubation):ti,ab,kw
#23 MeSH descriptor: [Intubation] explode all trees
#24 MeSH descriptor: [Intubation, Intratracheal] explode all trees
#25 (airway management):ti,ab,kw
#26 MeSH descriptor: [Airway Management] explode all trees
#27 (artificial respiration):ti,ab,kw
#28 MeSH descriptor: [Respiration, Artificial] explode all trees
#29 MeSH descriptor: [Oxygen Inhalation Therapy] explode all trees
#30 (oxygen near/3 (therapy or delivery or additional)):ti,ab,kw
#31 (positive pressure ventilation):ti,ab,kw
#32 MeSH descriptor: [Positive-Pressure Respiration] explode all trees
#33 (peep or positive pressure expiratory pressure):ti,ab,kw
#34 (niv or non-invasive ventilation or noninvasive ventilation or non invasive ventilation):ti,ab,kw
#35 (hospital admission):ti,ab,kw
#36 MeSH descriptor: [Hospitalization] explode all trees
#37 (patient or hospital) near/3 discharg*

#38 MeSH descriptor: [Patient Discharge] explode all trees
#39 MeSH descriptor: [Defibrillators] explode all trees
#40 (defibrillat*):ti,ab,kw
#41 #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40
#42 #12 and #41

Databases searched: Medline, Embase, Cochrane
Time Frame: April 2023 – April 2024
Date Search Completed: April 14th 2024
Search Results:
Articles identified by the search: 669; relevant articles: 0

Summary of Evidence Update:
No new relevant articles were identified

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR 2024 (Berg 2024, 195)	Systematic review	On-boat vs on land CPR	0	NA	See above TR

RCT: none

Nonrandomized Trials, Observational Studies: none

Reviewer Comments:
No new studies were identified over the search interval. There are no new data to challenge current guidelines or to warrant a further review.

Reference list:
Berg KM, Bray JE, Ng K-C, et al. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Resuscitation* 2024; **195**. https://www.resuscitationjournal.com/article/S0300-9572(23)00306-4/fulltext

2025 Evidence Update
BLS 2704 – Drowning: CPR (CAB vs. ACB)

Worksheet Author(s): Gavin Perkins, Janet Bray
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	In adults and children who are submerged in water
Intervention	Resuscitation that incorporates a compression-first strategy (C-A-B)
Comparison	Resuscitation that starts with ventilation (A-B-C)
Outcomes	Survival with favourable neurological outcome to discharge / 30 days or later Survival to discharge / 30 days or later Return of spontaneous circulation (ROSC)
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Manikin studies will only be included if no human studies are available.
Timeframe	From April 2023 onward. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

Year of last full review: 2022

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We recommend a compression-first strategy (C-A-B) for laypeopleproviding resuscitation for adults and children in cardiac arrest caused by drowning (good practice statement).

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

Current Search Strategy:
NOTE: several PICOST questions addressed topics related to drowning (BLS2702, BLS 2703, BLS 2704, BLS2705, BLS2706, BLS2707). To prevent unnecessary duplication of screening a single common search strategy addressing all of the PICOST questions was utilised. This approach meant first-pass screening needed to be completed once only. Selected manuscripts were then assessed and interpreted within their respective PICOST questions

MEDLINE
1 exp Near Drowning/ or exp Drowning/ or drowning.mp.
2 drown*.mp.
3 exp Immersion/
4 immers*.mp.
5 submer*.mp.
6 ships/
7 (boat or boats).mp.
8 in-water.mp.
9 exp Fresh water/ or exp Seawater/ or exp Saline water/
10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11 exp Resuscitation/ or resuscitat*.mp.
12 cpr.mp. or exp Cardiopulmonary Resuscitation/
13 exp Extracorporeal Membrane Oxygenation/ or ecmo.mp.

14 aed.mp.
15 ARDS.mp.
16 exp Respiratory Distress Syndrome, Adult/
17 intubation.mp. or exp Intubation/ or exp Intubation, Intratracheal/
18 airway management.mp. or exp Airway Management/
19 artificial respiration.mp. or exp Respiration, Artificial/
20 (oxygen adj3 (therapy or delivery or additional)).mp. or exp Oxygen Inhalation Therapy/
21 positive pressure ventilation.mp. or exp Positive-Pressure Respiration/
22 (Peep or positive end expiratory pressure).mp.
23 (niv or non-invasive ventilation or non invasive ventilation or noninvasive ventilation).mp.
24 hospital admission.mp. or exp Hospitalization/
25 Defibrillators/ or defibrillat*.mp.
26 exp patient discharge/
27 ((patient or hospital) adj3 discharg*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
28 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
29 10 and 28
30 limit 29 to yr="2000 -Current"
31 exp animals/ not humans.sh.
32 30 not 31

Embase

1 exp near drowning/ or exp drowning/
2 drown*.mp.
3 exp immersion/ or exp water immersion/
4 immers*.mp.
5 submer*.mp.
6 exp ship/
7 (boat or boats).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
8 exp fresh water/
9 exp sea water/
10 exp salt water/
11 in-water.mp.
12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 exp resuscitation/ or resuscitat*.mp.
14 cpr.mp.
15 cardiopulmonary resuscitation.mp.
16 exp extracorporeal oxygenation/ or ecmo.mp.
17 aed.mp. or exp automated external defibrillator/
18 ards.mp. or exp adult respiratory distress syndrome/
19 intubation.mp. or exp endotracheal intubation/ or exp intubation/
20 airway management.mp. or exp respiration control/
21 artificial respiration.mp. or exp artificial ventilation/
22 oxygen inhalation therapy.mp. or exp oxygen therapy/
23 (oxygen adj3 (therapy or delivery or additional)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
24 positive pressure ventilation.mp. or exp positive end expiratory pressure/
25 peep.mp.
26 positive pressure respiration.mp.
27 exp noninvasive ventilation/ or niv.mp.
28 hospital admission.mp. or exp hospital admission/
29 exp hospitalization/ or hospitalisation.mp.

30 exp hospital discharge/
31 ((hospital or patient) adj3 discharg*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
32 exp defibrillator/ or defibrillat*.mp. or exp defibrillation/
33 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34 12 and 33
35 (exp animal/ or nonhuman/) not exp human/
36 34 not 35
37 limit 36 to yr="2000 -Current"
38 limit 37 to (article or article in press or "review")

Cochrane

#1 MeSH descriptor: [Near Drowning] explode all trees
#2 MeSH descriptor: [Drowning] explode all trees
#3 (drown*):ti,ab,kw
#4 MeSH descriptor: [Immersion] explode all trees
#5 (immers* or submer*):ti,ab,kw
#6 MeSH descriptor: [Ships] explode all trees
#7 (boat or boats):ti,ab,kw
#8 ("in-water"):ti,ab,kw
#9 MeSH descriptor: [Fresh Water] explode all trees
#10 MeSH descriptor: [Seawater] explode all trees
#11 MeSH descriptor: [Saline Waters] explode all trees
#12 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 MeSH descriptor: [Resuscitation] explode all trees
#14 (resuscitat*):ti,ab,kw
#15 (cpr):ti,ab,kw
#16 MeSH descriptor: [Cardiopulmonary Resuscitation] explode all trees
#17 (ecmo):ti,ab,kw
#18 MeSH descriptor: [Extracorporeal Membrane Oxygenation] explode all trees
#19 (aed):ti,ab,kw
#20 MeSH descriptor: [Respiratory Distress Syndrome, Adult] explode all trees
#21 (ards):ti,ab,kw
#22 (intubation):ti,ab,kw
#23 MeSH descriptor: [Intubation] explode all trees
#24 MeSH descriptor: [Intubation, Intratracheal] explode all trees
#25 (airway management):ti,ab,kw
#26 MeSH descriptor: [Airway Management] explode all trees
#27 (artificial respiration):ti,ab,kw
#28 MeSH descriptor: [Respiration, Artificial] explode all trees
#29 MeSH descriptor: [Oxygen Inhalation Therapy] explode all trees
#30 (oxygen near/3 (therapy or delivery or additional)):ti,ab,kw
#31 (positive pressure ventilation):ti,ab,kw
#32 MeSH descriptor: [Positive-Pressure Respiration] explode all trees
#33 (peep or positive pressure expiratory pressure):ti,ab,kw
#34 (niv or non-invasive ventilation or noninvasive ventilation or non invasive ventilation):ti,ab,kw
#35 (hospital admission):ti,ab,kw
#36 MeSH descriptor: [Hospitalization] explode all trees
#37 (patient or hospital) near/3 discharg*
#38 MeSH descriptor: [Patient Discharge] explode all trees
#39 MeSH descriptor: [Defibrillators] explode all trees
#40 (defibrillat*):ti,ab,kw

#41 #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40
#42 #12 and #41

Databases searched: Medline, Embase, Cochrane
Time Frame: April 2023 – April 2024
Date Search Completed: April 14th 2024
Search Results:
Articles identified by the search: 669; relevant articles: 0

Summary of Evidence Update:
No new relevant articles were identified

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR (Wyckoff 2022, 208)	Systematic review	CAB vs. ACB	0	No studies were identified comparing initial resuscitation strategies (ventilation first or compression first) for cardiac arrests caused by drowning	See above TR

RCT: none

Nonrandomized Trials, Observational Studies: none

Reviewer Comments:
No new studies were identified over the search interval. There are no new data to challenge current guidelines or to warrant a further review.

Reference list:
Wyckoff MH, Greif R, Morley PT, et al. 2022 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Resuscitation* 2022; **181**: 208-88. https://www.sciencedirect.com/science/article/pii/S0300957222006840

2025 Evidence Update
BLS 2704 – Drowning: Chest Compressions Only vs. Conventional CPR

Worksheet Author(s): Gavin Perkins, Janet Bray
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	In adults and children who are submerged in water
Intervention	Chest compression–only CPR
Comparison	Conventional CPR (compressions and ventilations)
Outcomes	Survival with favourable neurological outcome to discharge / 30 days or later Survival to discharge / 30 days or later Return of spontaneous circulation (ROSC)
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Manikin studies will only be included if no human studies are available.
Timeframe	From April 2023 onward. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

Year of last full review: 2023

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
For lay responders, the treatment recommendations for CPR in drowned patients with OHCA who have been removed from the water remain consistent with CPR for all patients in cardiac arrest (good practice statement).

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

We suggest that bystanders provide CPR with ventilation for infants and children <18 years of age with OHCA. We recommend that if bystanders cannot provide rescue breaths as part of CPR for infants and children <18 years with OHCA, they should atleast provide chest compressions.

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

Current Search Strategy:
NOTE: several PICOST questions addressed topics related to drowning (BLS2702, BLS 2703, BLS 2704, BLS2705, BLS2706, BLS2707). To prevent unnecessary duplication of screening a single common search strategy addressing all of the PICOST questions was utilised. This approach meant first-pass screening needed to be completed once only. Selected manuscripts were then assessed and interpreted within their respective PICOST questions

MEDLINE
1 exp Near Drowning/ or exp Drowning/ or drowning.mp.
2 drown*.mp.
3 exp Immersion/
4 immers*.mp.
5 submer*.mp.
6 ships/
7 (boat or boats).mp.

8 in-water.mp.
9 exp Fresh water/ or exp Seawater/ or exp Saline water/
10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11 exp Resuscitation/ or resuscitat*.mp.
12 cpr.mp. or exp Cardiopulmonary Resuscitation/
13 exp Extracorporeal Membrane Oxygenation/ or ecmo.mp.
14 aed.mp.
15 ARDS.mp.
16 exp Respiratory Distress Syndrome, Adult/
17 intubation.mp. or exp Intubation/ or exp Intubation, Intratracheal/
18 airway management.mp. or exp Airway Management/
19 artificial respiration.mp. or exp Respiration, Artificial/
20 (oxygen adj3 (therapy or delivery or additional)).mp. or exp Oxygen Inhalation Therapy/
21 positive pressure ventilation.mp. or exp Positive-Pressure Respiration/
22 (Peep or positive end expiratory pressure).mp.
23 (niv or non-invasive ventilation or non invasive ventilation or noninvasive ventilation).mp.
24 hospital admission.mp. or exp Hospitalization/
25 Defibrillators/ or defibrillat*.mp.
26 exp patient discharge/
27 ((patient or hospital) adj3 discharg*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
28 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
29 10 and 28
30 limit 29 to yr="2000 -Current"
31 exp animals/ not humans.sh.
32 30 not 31

Embase

1 exp near drowning/ or exp drowning/
2 drown*.mp.
3 exp immersion/ or exp water immersion/
4 immers*.mp.
5 submer*.mp.
6 exp ship/
7 (boat or boats).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
8 exp fresh water/
9 exp sea water/
10 exp salt water/
11 in-water.mp.
12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 exp resuscitation/ or resuscitat*.mp.
14 cpr.mp.
15 cardiopulmonary resuscitation.mp.
16 exp extracorporeal oxygenation/ or ecmo.mp.
17 aed.mp. or exp automated external defibrillator/
18 ards.mp. or exp adult respiratory distress syndrome/
19 intubation.mp. or exp endotracheal intubation/ or exp intubation/
20 airway management.mp. or exp respiration control/
21 artificial respiration.mp. or exp artificial ventilation/
22 oxygen inhalation therapy.mp. or exp oxygen therapy/
23 (oxygen adj3 (therapy or delivery or additional)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]

24 positive pressure ventilation.mp. or exp positive end expiratory pressure/
25 peep.mp.
26 positive pressure respiration.mp.
27 exp noninvasive ventilation/ or niv.mp.
28 hospital admission.mp. or exp hospital admission/
29 exp hospitalization/ or hospitalisation.mp.
30 exp hospital discharge/
31 ((hospital or patient) adj3 discharg*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
32 exp defibrillator/ or defibrillat*.mp. or exp defibrillation/
33 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34 12 and 33
35 (exp animal/ or nonhuman/) not exp human/
36 34 not 35
37 limit 36 to yr="2000 -Current"
38 limit 37 to (article or article in press or "review")

Cochrane

#1 MeSH descriptor: [Near Drowning] explode all trees
#2 MeSH descriptor: [Drowning] explode all trees
#3 (drown*):ti,ab,kw
#4 MeSH descriptor: [Immersion] explode all trees
#5 (immers* or submer*):ti,ab,kw
#6 MeSH descriptor: [Ships] explode all trees
#7 (boat or boats):ti,ab,kw
#8 ("in-water"):ti,ab,kw
#9 MeSH descriptor: [Fresh Water] explode all trees
#10 MeSH descriptor: [Seawater] explode all trees
#11 MeSH descriptor: [Saline Waters] explode all trees
#12 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 MeSH descriptor: [Resuscitation] explode all trees
#14 (resuscitat*):ti,ab,kw
#15 (cpr):ti,ab,kw
#16 MeSH descriptor: [Cardiopulmonary Resuscitation] explode all trees
#17 (ecmo):ti,ab,kw
#18 MeSH descriptor: [Extracorporeal Membrane Oxygenation] explode all trees
#19 (aed):ti,ab,kw
#20 MeSH descriptor: [Respiratory Distress Syndrome, Adult] explode all trees
#21 (ards):ti,ab,kw
#22 (intubation):ti,ab,kw
#23 MeSH descriptor: [Intubation] explode all trees
#24 MeSH descriptor: [Intubation, Intratracheal] explode all trees
#25 (airway management):ti,ab,kw
#26 MeSH descriptor: [Airway Management] explode all trees
#27 (artificial respiration):ti,ab,kw
#28 MeSH descriptor: [Respiration, Artificial] explode all trees
#29 MeSH descriptor: [Oxygen Inhalation Therapy] explode all trees
#30 (oxygen near/3 (therapy or delivery or additional)):ti,ab,kw
#31 (positive pressure ventilation):ti,ab,kw
#32 MeSH descriptor: [Positive-Pressure Respiration] explode all trees
#33 (peep or positive pressure expiratory pressure):ti,ab,kw
#34 (niv or non-invasive ventilation or noninvasive ventilation or non invasive ventilation):ti,ab,kw

#35 (hospital admission):ti,ab,kw
#36 MeSH descriptor: [Hospitalization] explode all trees
#37 (patient or hospital) near/3 discharg*
#38 MeSH descriptor: [Patient Discharge] explode all trees
#39 MeSH descriptor: [Defibrillators] explode all trees
#40 (defibrillat*):ti,ab,kw
#41 #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40
#42 #12 and #41

Databases searched: Medline, Embase, Cochrane
Time Frame: April 2023 – April 2024
Date Search Completed: April 14th 2024
Search Results:
Articles identified by the search: 669; relevant articles: 0

Summary of Evidence Update:
No new relevant articles were identified

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR 2024 (Berg 2024, 195)	Systematic review	CCO vs conventional CPR	2 retrospective observational studies	no difference in survival with favorable neurological outcome or ROSC	See above TR

RCT: none

Nonrandomized Trials, Observational Studies: none

Reviewer Comments:
No new studies were identified over the search interval. There are no new data to challenge current guidelines or to warrant a further review.

Reference list:
Berg KM, Bray JE, Ng K-C, et al. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Resuscitation* 2024; **195**. https://www.resuscitationjournal.com/article/S0300-9572(23)00306-4/fulltext

2025 Evidence Update
BLS 2707 – Drowning: Prehospital Oxygen

Worksheet Author(s): Gavin Perkins, Janet Bray
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	In adults and children who are submerged in water
Intervention	pre-hospital oxygen administration
Comparison	no pre-hospital oxygen administration
Outcomes	Any clinical outcome (e.g. survival, survival with a favourable neurological outcome, hospitilisation), CPR quality, physiological end-points
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Manikin studies will only be included if no human studies are available.
Timeframe	From April 2023 onward. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

Year of last full review: 2023

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
When available, we recommend that trained providers use the highest possible inspired oxygen concentration during resuscitation for adults and children in cardiac arrest after drowning (good practice statement).

Current Search Strategy:
NOTE: several PICOST questions addressed topics related to drowning (BLS2702, BLS 2703, BLS 2704, BLS2705, BLS2706, BLS2707). To prevent unnecessary duplication of screening a single common search strategy addressing all of the PICOST questions was utilised. This approach meant first-pass screening needed to be completed once only. Selected manuscripts were then assessed and interpreted within their respective PICOST questions.

MEDLINE
1 exp Near Drowning/ or exp Drowning/ or drowning.mp.
2 drown*.mp.
3 exp Immersion/
4 immers*.mp.
5 submer*.mp.
6 ships/
7 (boat or boats).mp.
8 in-water.mp.
9 exp Fresh water/ or exp Seawater/ or exp Saline water/
10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11 exp Resuscitation/ or resuscitat*.mp.
12 cpr.mp. or exp Cardiopulmonary Resuscitation/
13 exp Extracorporeal Membrane Oxygenation/ or ecmo.mp.
14 aed.mp.
15 ARDS.mp.
16 exp Respiratory Distress Syndrome, Adult/
17 intubation.mp. or exp Intubation/ or exp Intubation, Intratracheal/
18 airway management.mp. or exp Airway Management/

19 artificial respiration.mp. or exp Respiration, Artificial/
20 (oxygen adj3 (therapy or delivery or additional)).mp. or exp Oxygen Inhalation Therapy/
21 positive pressure ventilation.mp. or exp Positive-Pressure Respiration/
22 (Peep or positive end expiratory pressure).mp.
23 (niv or non-invasive ventilation or non invasive ventilation or noninvasive ventilation).mp.
24 hospital admission.mp. or exp Hospitalization/
25 Defibrillators/ or defibrillat*.mp.
26 exp patient discharge/
27 ((patient or hospital) adj3 discharg*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
28 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
29 10 and 28
30 limit 29 to yr="2000 -Current"
31 exp animals/ not humans.sh.
32 30 not 31

Embase

1 exp near drowning/ or exp drowning/
2 drown*.mp.
3 exp immersion/ or exp water immersion/
4 immers*.mp.
5 submer*.mp.
6 exp ship/
7 (boat or boats).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
8 exp fresh water/
9 exp sea water/
10 exp salt water/
11 in-water.mp.
12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 exp resuscitation/ or resuscitat*.mp.
14 cpr.mp.
15 cardiopulmonary resuscitation.mp.
16 exp extracorporeal oxygenation/ or ecmo.mp.
17 aed.mp. or exp automated external defibrillator/
18 ards.mp. or exp adult respiratory distress syndrome/
19 intubation.mp. or exp endotracheal intubation/ or exp intubation/
20 airway management.mp. or exp respiration control/
21 artificial respiration.mp. or exp artificial ventilation/
22 oxygen inhalation therapy.mp. or exp oxygen therapy/
23 (oxygen adj3 (therapy or delivery or additional)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
24 positive pressure ventilation.mp. or exp positive end expiratory pressure/
25 peep.mp.
26 positive pressure respiration.mp.
27 exp noninvasive ventilation/ or niv.mp.
28 hospital admission.mp. or exp hospital admission/
29 exp hospitalization/ or hospitalisation.mp.
30 exp hospital discharge/
31 ((hospital or patient) adj3 discharg*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
32 exp defibrillator/ or defibrillat*.mp. or exp defibrillation/
33 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32

34 12 and 33
35 (exp animal/ or nonhuman/) not exp human/
36 34 not 35
37 limit 36 to yr="2000 -Current"
38 limit 37 to (article or article in press or "review")

Cochrane

#1 MeSH descriptor: [Near Drowning] explode all trees
#2 MeSH descriptor: [Drowning] explode all trees
#3 (drown*):ti,ab,kw
#4 MeSH descriptor: [Immersion] explode all trees
#5 (immers* or submer*):ti,ab,kw
#6 MeSH descriptor: [Ships] explode all trees
#7 (boat or boats):ti,ab,kw
#8 ("in-water"):ti,ab,kw
#9 MeSH descriptor: [Fresh Water] explode all trees
#10 MeSH descriptor: [Seawater] explode all trees
#11 MeSH descriptor: [Saline Waters] explode all trees
#12 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 MeSH descriptor: [Resuscitation] explode all trees
#14 (resuscitat*):ti,ab,kw
#15 (cpr):ti,ab,kw
#16 MeSH descriptor: [Cardiopulmonary Resuscitation] explode all trees
#17 (ecmo):ti,ab,kw
#18 MeSH descriptor: [Extracorporeal Membrane Oxygenation] explode all trees
#19 (aed):ti,ab,kw
#20 MeSH descriptor: [Respiratory Distress Syndrome, Adult] explode all trees
#21 (ards):ti,ab,kw
#22 (intubation):ti,ab,kw
#23 MeSH descriptor: [Intubation] explode all trees
#24 MeSH descriptor: [Intubation, Intratracheal] explode all trees
#25 (airway management):ti,ab,kw
#26 MeSH descriptor: [Airway Management] explode all trees
#27 (artificial respiration):ti,ab,kw
#28 MeSH descriptor: [Respiration, Artificial] explode all trees
#29 MeSH descriptor: [Oxygen Inhalation Therapy] explode all trees
#30 (oxygen near/3 (therapy or delivery or additional)):ti,ab,kw
#31 (positive pressure ventilation):ti,ab,kw
#32 MeSH descriptor: [Positive-Pressure Respiration] explode all trees
#33 (peep or positive pressure expiratory pressure):ti,ab,kw
#34 (niv or non-invasive ventilation or noninvasive ventilation or non invasive ventilation):ti,ab,kw
#35 (hospital admission):ti,ab,kw
#36 MeSH descriptor: [Hospitalization] explode all trees
#37 (patient or hospital) near/3 discharg*
#38 MeSH descriptor: [Patient Discharge] explode all trees
#39 MeSH descriptor: [Defibrillators] explode all trees
#40 (defibrillat*):ti,ab,kw
#41 #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40
#42 #12 and #41

Databases searched: Medline, Embase, Cochrane
Time Frame: April 2023 – April 2024
Date Search Completed: April 14th 2024
Search Results:
Articles identified by the search: 669; relevant articles: 0

Summary of Evidence Update:
No new relevant articles were identified

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR 2024 (Berg 2024, 195)	Systematic review	Prehospital O2 vs no prehospital O2	0	NA	See above TR

RCT: none

Nonrandomized Trials, Observational Studies: none

Reviewer Comments:
No new studies were identified over the search interval. There are no new data to challenge current guidelines or to warrant a further review.

Reference list:
Berg KM, Bray JE, Ng K-C, et al. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Resuscitation* 2024; **195**. https://www.resuscitationjournal.com/article/S0300-9572(23)00306-4/fulltext

2025 Evidence Update
BLS 2708 – Drowning: AED Use

Worksheet Author(s): Gavin Perkins, Janet Bray
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	In adults and children who are submerged in water
Intervention	AED administered before CPR
Comparison	CPR administered before AED
Outcomes	Survival with favourable neurological outcome to discharge / 30 days or later Survival to discharge / 30 days or later Return of spontaneous circulation (ROSC)
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Manikin studies will only be included if no human studies are available.
Timeframe	From April 2023 onward. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

Year of last full review: 2023

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We recommend that CPR should be started first and continued until an AED has been obtained and is ready for use for adults and children in cardiac arrest caused by drowning (good practice statement).

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

Current Search Strategy:
NOTE: several PICOST questions addressed topics related to drowning (BLS2702, BLS 2703, BLS 2704, BLS2705, BLS2706, BLS2707). To prevent unnecessary duplication of screening a single common search strategy addressing all of the PICOST questions was utilised. This approach meant first-pass screening needed to be completed once only. Selected manuscripts were then assessed and interpreted within their respective PICOST questions

MEDLINE
1 exp Near Drowning/ or exp Drowning/ or drowning.mp.
2 drown*.mp.
3 exp Immersion/
4 immers*.mp.
5 submer*.mp.
6 ships/
7 (boat or boats).mp.
8 in-water.mp.
9 exp Fresh water/ or exp Seawater/ or exp Saline water/
10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11 exp Resuscitation/ or resuscitat*.mp.
12 cpr.mp. or exp Cardiopulmonary Resuscitation/
13 exp Extracorporeal Membrane Oxygenation/ or ecmo.mp.
14 aed.mp.

15 ARDS.mp.
16 exp Respiratory Distress Syndrome, Adult/
17 intubation.mp. or exp Intubation/ or exp Intubation, Intratracheal/
18 airway management.mp. or exp Airway Management/
19 artificial respiration.mp. or exp Respiration, Artificial/
20 (oxygen adj3 (therapy or delivery or additional)).mp. or exp Oxygen Inhalation Therapy/
21 positive pressure ventilation.mp. or exp Positive-Pressure Respiration/
22 (Peep or positive end expiratory pressure).mp.
23 (niv or non-invasive ventilation or non invasive ventilation or noninvasive ventilation).mp.
24 hospital admission.mp. or exp Hospitalization/
25 Defibrillators/ or defibrillat*.mp.
26 exp patient discharge/
27 ((patient or hospital) adj3 discharg*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
28 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
29 10 and 28
30 limit 29 to yr="2000 -Current"
31 exp animals/ not humans.sh.
32 30 not 31

Embase

1 exp near drowning/ or exp drowning/
2 drown*.mp.
3 exp immersion/ or exp water immersion/
4 immers*.mp.
5 submer*.mp.
6 exp ship/
7 (boat or boats).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
8 exp fresh water/
9 exp sea water/
10 exp salt water/
11 in-water.mp.
12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 exp resuscitation/ or resuscitat*.mp.
14 cpr.mp.
15 cardiopulmonary resuscitation.mp.
16 exp extracorporeal oxygenation/ or ecmo.mp.
17 aed.mp. or exp automated external defibrillator/
18 ards.mp. or exp adult respiratory distress syndrome/
19 intubation.mp. or exp endotracheal intubation/ or exp intubation/
20 airway management.mp. or exp respiration control/
21 artificial respiration.mp. or exp artificial ventilation/
22 oxygen inhalation therapy.mp. or exp oxygen therapy/
23 (oxygen adj3 (therapy or delivery or additional)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
24 positive pressure ventilation.mp. or exp positive end expiratory pressure/
25 peep.mp.
26 positive pressure respiration.mp.
27 exp noninvasive ventilation/ or niv.mp.
28 hospital admission.mp. or exp hospital admission/
29 exp hospitalization/ or hospitalisation.mp.
30 exp hospital discharge/

31 ((hospital or patient) adj3 discharg*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
32 exp defibrillator/ or defibrillat*.mp. or exp defibrillation/
33 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34 12 and 33
35 (exp animal/ or nonhuman/) not exp human/
36 34 not 35
37 limit 36 to yr="2000 -Current"
38 limit 37 to (article or article in press or "review")

Cochrane

#1 MeSH descriptor: [Near Drowning] explode all trees
#2 MeSH descriptor: [Drowning] explode all trees
#3 (drown*):ti,ab,kw
#4 MeSH descriptor: [Immersion] explode all trees
#5 (immers* or submer*):ti,ab,kw
#6 MeSH descriptor: [Ships] explode all trees
#7 (boat or boats):ti,ab,kw
#8 ("in-water"):ti,ab,kw
#9 MeSH descriptor: [Fresh Water] explode all trees
#10 MeSH descriptor: [Seawater] explode all trees
#11 MeSH descriptor: [Saline Waters] explode all trees
#12 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 MeSH descriptor: [Resuscitation] explode all trees
#14 (resuscitat*):ti,ab,kw
#15 (cpr):ti,ab,kw
#16 MeSH descriptor: [Cardiopulmonary Resuscitation] explode all trees
#17 (ecmo):ti,ab,kw
#18 MeSH descriptor: [Extracorporeal Membrane Oxygenation] explode all trees
#19 (aed):ti,ab,kw
#20 MeSH descriptor: [Respiratory Distress Syndrome, Adult] explode all trees
#21 (ards):ti,ab,kw
#22 (intubation):ti,ab,kw
#23 MeSH descriptor: [Intubation] explode all trees
#24 MeSH descriptor: [Intubation, Intratracheal] explode all trees
#25 (airway management):ti,ab,kw
#26 MeSH descriptor: [Airway Management] explode all trees
#27 (artificial respiration):ti,ab,kw
#28 MeSH descriptor: [Respiration, Artificial] explode all trees
#29 MeSH descriptor: [Oxygen Inhalation Therapy] explode all trees
#30 (oxygen near/3 (therapy or delivery or additional)):ti,ab,kw
#31 (positive pressure ventilation):ti,ab,kw
#32 MeSH descriptor: [Positive-Pressure Respiration] explode all trees
#33 (peep or positive pressure expiratory pressure):ti,ab,kw
#34 (niv or non-invasive ventilation or noninvasive ventilation or non invasive ventilation):ti,ab,kw
#35 (hospital admission):ti,ab,kw
#36 MeSH descriptor: [Hospitalization] explode all trees
#37 (patient or hospital) near/3 discharg*
#38 MeSH descriptor: [Patient Discharge] explode all trees
#39 MeSH descriptor: [Defibrillators] explode all trees
#40 (defibrillat*):ti,ab,kw

#41 #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40
#42 #12 and #41

Databases searched: Medline, Embase, Cochrane
Time Frame: April 2023 – April 2024
Date Search Completed: April 14th 2024
Search Results:
Articles identified by the search: 669; relevant articles: 0

Summary of Evidence Update:
No new relevant articles were identified

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
ILCOR 2024 (Berg 2024, 195)	Systematic review	AED before CPR vs CPR before AED	0	NA	See above TR

RCT: none

Nonrandomized Trials, Observational Studies: none

Reviewer Comments:
No new studies were identified over the search interval. There are no new data to challenge current guidelines or to warrant a further review.

Reference list:
Berg KM, Bray JE, Ng K-C, et al. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Resuscitation* 2024; **195**. https://www.resuscitationjournal.com/article/S0300-9572(23)00306-4/fulltext

2025 Evidence Update
BLS 2715 – CPR During Transport

Worksheet Author(s): Mike Smyth
Task Force: Basic Life Support
Date Approved by SAC Representative: November 2024
Conflicts of Interest: none

PICOST / Research Question:

PICOST	Description
Population	Adults and children receiving CPR following out of hospital cardiac arrest
Intervention	Transport with ongoing CPR
Comparison	Completing CPR on scene
Outcomes	Survival to hospital discharge with favourable neurologic outcome (critical), Survival to hospital discharge (critical), return of spontaneous circulation (important). Quality of CPR metrics on scene versus during transport (reported outcomes may include rate of chest compressions, depth of chest compressions, chest compression fraction, interruptions to chest compressions, leaning/incomplete release, rate of ventilation, volume of ventilation, duration of ventilation, pressure of ventilation)
Study Design	Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion. Manikin studies will only be included if no human studies are available.
Timeframe	From November 2020 to April 2024. All languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded

Year of last full review: 2020

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
ILCOR 2020 COSTR:[1]
We suggest that providers deliver resuscitation at the scene rather than undertake ambulance transport with ongoing resuscitation unless there is an appropriate indication to justify transport (eg, extracorporeal membrane oxygenation; weak recommendation, very low–certainty evidence).

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

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

Current Search Strategy:
MEDLINE and EMBASE combined, via the OVID interface. Search completed on 27/07/2019

1 cardiac arrest.mp. or exp Heart Arrest/

2 myocardial arrest.mp.

3 exp Heart Arrest/ or cardiac standstill.mp.

4 out of hospital.mp.

5 out-of-hospital.mp.
6 prehospital.mp.
7 pre-hospital.mp.
8 ambulance.mp. or exp Ambulances/
9 exp Emergency Medical Services/ or EMS.mp.
10 cardiopulmonary resuscitation.mp. or exp Cardiopulmonary Resuscitation/
11 CPR.mp. or exp Cardiopulmonary Resuscitation/
12 exp Resuscitation/ or exp Cardiopulmonary Resuscitation/ or chest compressions.mp.
13 exp Cardiopulmonary Resuscitation/ or exp Resuscitation/ or basic life support.mp.
14 exp Resuscitation/ or advanced life support.mp. or exp Cardiopulmonary Resuscitation/
15 exp Cardiopulmonary Resuscitation/ or compression depth.mp.
16 exp Cardiopulmonary Resuscitation/ or compression rate.mp.
17 exp Cardiopulmonary Resuscitation/ or compression fraction.mp.
18 recoil.mp.
19 Heart Massage/ or leaning.mp.
20 exp Cardiopulmonary Resuscitation/ or duty cycle.mp.
21 exp Cardiopulmonary Resuscitation/ or perishock pause.mp.
22 duration.mp.
23 timing.mp.
24 transportation.mp. or exp TRANSPORTATION/
25 exp Cardiopulmonary Resuscitation/ or exp Heart Arrest/ or return of spontaneous circulation.mp. or exp Resuscitation/
26 exp Cardiopulmonary Resuscitation/ or exp Resuscitation/ or exp Heart Arrest/ or ROSC.mp.
27 1 or 2 or 3
28 4 or 5 or 6 or 7 or 8 or 9
29 10 or 11 or 12 or 13 or 14 or 25 or 26
30 15 or 16 or 17 or 18 or 19 or 20 or 21
31 22 or 23
32 27 and 28 and 29 and 30
33 27 and 28 and 29 and 31
34 24 and 27 and 28 and 29
35 32 or 33 or 34

Databases searched: Medline, Embase
Time Frame: Nov 2020 – April 2024
Date Search Completed: April 22nd 2024
Search Results:
Articles retrieved: 1968 titles of which 10 were relevant. Several manikin studies were identified but excluded due to availability of human data. The majority of manikin studies compared manual vs mechanical CPR during simulated extrication of transfer on boats

Summary of Evidence Update:

The EVIDENCE trial (Australian Clinical Trial Registry ACTRN12621000668808) is an ongoing RCT comparing expedited vs on scene ALS that appears to have completed recruitment but has not yet been published.

Relevant Guidelines or Systematic Reviews

Organization (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
Burns (2023) [2]	Systematic review	Expedited transfer vs resuscitation on scene	9	Early transfer was not predictive of survival to discharge (OR 1.16, 95% CI 0.53 to 2.53, I2 = 99%, p = 0. 65) nor favorable neurological outcome (OR 1.06, 95% CI 0.48 to 2.37, I2 = 99%, p = 0.85). Notable variation between Western and Eastern EMS outcomes. Eastern EMS systems reported improved outcomes with expedited transfer, while Western EMS systems reported better outcomes with on-scene resuscitation.	No evidence to support or refute the use of expedited transport of refractory OHCA

RCT:

Study Acronym; Author; Year Published	Aim of Study; Study Type; Study Size (N)	Patient Population	Study Intervention (# patients) / Study Comparator (# patients)	Endpoint Results (Absolute Event Rates, P value; OR or RR; & 95% CI)	Relevant 2° Endpoint (if any); Study Limitations; Adverse Events
Belohlavek (2022) [3]	RCT (n=256)	Adult, witnessed OHCA (presumed cardiac aetiology), and 5 minutes of resuscitation without ROSC	mCPR with transport to ECPR center (n=124) versus Standard ALS at scene (n=132)	Survival to 180 days with favourable neurologic outcome OR 1.63 [95% CI, 0.93 to 2.85]; difference, 9.5% [95% CI, −1.3% to 20.1%]; P = .09	May have been underpowered

Nonrandomized Trials, Observational Studies:

Study Acronym; Author; Year Published	Study Type/Design; Study Size (N)	Patient Population	Primary Endpoint and Results (include P value; OR or RR; & 95% CI)	Summary/Conclusion Comment(s)
Holmberg (2022) [4]	Propensity matched retrospective cohort (n=174)	Resuscitation at scene (n=87) vs Resuscitation during transport (n=87)	Authors report transport within the first 20 minutes of EMS arrival was associated with increased survival to 30 days, but the risk ratio, RR 1.55; 95%CI, 0.99 to 2.44; P = 0.06 did not reach significance.	Imbalanced groups with respect to % EMS & bystander witnessed as well as bystander CPR

Berry (2021) [5]	Retrospective cohort (n=145,153)	350,722 OOHCA cases in the CARES registry. Population was divided into quartiles based on scene time. Outcomes of were compared between the lower (short scene time, low termination rates) and upper (High scene times hight termination rates) quartiles	Cases from HiOST agencies had higher odds of survival in both the unadjusted (OR 2.239; 95% CI: 1.910, 2.625), and the adjusted analysis models (OR 2.715; 95% CI: 2.074, 3.556)	EMS agencies with longer on-scene times and higher rates of termination have higher rates of overall patient survival, ROSC, and survival with favorable neurologic function.
Jang (2021) [6]	Propensity matched retrospective cohort (n=3340)	Adult OHCA, presumed medical cause, CPC≤2 pre-arrest.	Scene time interval (STI) <19min versus STI≥19min Longer STI associated with pooprer neurologic outcome at hospital discharge adjusted OR 2.57 (95%CI 1.88-3.55)	EMS are required to transport all cases without ROSC in Korea, this may influence on scene decision making.
Park (2021) [7]	Retrospective cohort (n=344)	OHCA ≥15 years of age, presumed cardiac aetiology and shockable rhythm, 3 shocks and scene time > 10 minutes	STI ≥ 15 min was significantly associated with worse survival to discharge and good neurological outcome adjusted OR 0.33 (95% CI, 0.17–0.65) and aOR, 0.43 (95% CI, 0.22–0.86)	Longer transport time was also associated with worse outcome
Grunau (2020) [8]	Propensity matched retrospective cohort (n=27,705)	OHCA treated by EMS (10 ROC sites)	Transport assosciated with worse outcomes: Survival with favourable neurologic outcome absolute difference -4.2% (95%CI -4.9 to -3.5) survival to hospital discharge absolute difference -4.6% (95%CI -5.1 to -4.0) ROSC -23.2% (95%CI -24.2 to –22.1)	May not be applicable to non-ALS EMS systems
Choi (2022) [9]	Retrospective cohort (n=1,222)	Adult OHCA, presumed medical cause, without ROSC	No-flow fraction and guideline compliance were recorded each minute from 6 minutes before ambulance departure until 5 minutes after depature. Performance was categorised by residential and non-residential location of arrest. The mean no-flow fraction at 3 min and 2 min prior to ambulance departure differed according to location. In both	CPR quality deteriorated during the scene evacuation in both location types. The mean no-flow fractions were significantly higher in residential places than in non-residential places. The mean proportion of compliant chest compressions was lower in residential settings. Poorer quality CPR quality during extrication was more prominent when mechanical CPR devices were not used.

			minutes, the mean no-flow fractions were significantly higher in residential places than in non-residential places (3 min prior to departure: 32.5% vs 25.8%; p < 0.01, 2 min prior to departure: 37.6% vs 30.2%; p < 0.01). The mean proportion of adequate compression depth and rate were both constantly lower in cardiac arrest in residential places from 4 min prior to ambulance transport to 3 min after ambulance departure	
Lee (2022) [10]	Retrospective cohort (n=788)	Adult OOHCA without ROSC	No-flow fraction during 3 prehospital phases: i) First 2 min of CPR ii) 3 min to 1 min before ambulance depature iii) 1 min before to 1 minute after ambulance depature iv) 1 min after ambulance depature to hospital arrival	No-flow fraction is significantly worse during phases iii and iv Mead Diff 3.5% (2.0–5.0),p<0.01
Loaec (2020) [11]	Retrospective cohort (n=7)	Paediatric cardiac arrest (4 IHCA, 3 OHCA)	There were no differences in pre- vs. intra-transport CC rate (115 [95%CI 113, 118] vs. 118 [95%CI 114, 127]; *p* = 0.18), depth (cm) (3.2 [95%CI 2.7, 4.4] vs. 3.6 [95%CI 2.5, 4.6]; *p* = 0.50), or CCF (0.89 [95%CI 0.82, 0.90] vs. 0.92 [95%CI 0.79, 0.97]; *p* = 0.31).	Very small cohort

Reviewer Comments:

There are a number of recent publications that would strengthen the evidence if synthesized into an updated systematic review. However, these new data are unlikely to prompt a significant change in the existing treatment recommendation. If an updated systematic review is to be undertaken it may be appropriate to delay the review until after publication of the EVIDENCE trial results. In the interim, the systematic review by Burns et al would be suitable for adelopment.

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