Evidence Update Worksheet
Public Access Defibrillation program
BLS 2121 (BLS 347)

Worksheet author(s): Sung phil Chung
Task Force: BLS (old BLS347)
Date Submitted to SAC rep for peer review and approval: Jan 2024
SAC rep:

PICOST / Research Question:
Among adults and children who are in cardiac arrest outside of a hospital (P), does implementation of a public access AED program (I), compared with traditional EMS response (C), improve any clinical outcome?
Outcomes: Survival with favorable neurologic outcome, Survival only at discharge, 30 days, 60 days, 180 days AND/OR 1 year, ROSC, bystander CPR rates, time to first compressions, time to first shock, CPR quality
Type (intervention, diagnosis, prognosis): Intervention

Year of last full review: *2020*

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We recommend the implementation of public-access defibrillation programs for patients with OHCAs.
(Strong recommendation, low-certainty evidence)

Current Search Strategy (for an existing PICOST) included in the attached approved PICOST:
("Out-of-Hospital Cardiac Arrest"[Mesh] OR “Out of Hospital Cardiac Arrest” [TIAB] OR “Out-of-Hospital Cardiac Arrest” [TIAB] OR “Out of Hospital Cardiac Arrests” [TIAB] OR “Out-of-Hospital Cardiac Arrests” [TIAB] OR (("out-of-hospital"[TIAB] OR “out of hospital”[TIAB] OR “outside of hospital”[TIAB]) AND cardiac[TIAB] AND arrest*[TIAB]) OR "Heart Arrest"[Mesh:NoExp] OR “heart arrest”[TIAB] OR "heart arrests"[TIAB] OR "cardiac arrest"[TIAB] OR "cardiac arrests"[TIAB] OR "cardiovascular arrest"[TIAB] OR "cardiovascular arrests"[TIAB] OR "asystole"[TIAB] OR "Heart Failure"[Mesh] OR “heart failure”[TIAB] OR "cardiopulmonary arrest"[TIAB] OR "cardiopulmonary arrests"[TIAB] OR "cardio-pulmonary arrest"[TIAB] OR "cardio-pulmonary arrests"[TIAB] OR "Ventricular Fibrillation"[Mesh] OR “Ventricular Fibrillation”[TIAB] OR "Tachycardia, Ventricular"[Mesh] OR “pulseless ventricular tachycardia”[TIAB] OR (Pulseless[TIAB] AND (V-tach[TIAB] OR VT[TIAB])) OR "Cardiopulmonary Resuscitation"[Mesh] OR "cardiopulmonary resuscitation"[TIAB] OR CPR[TIAB] OR “Resuscitation"[Mesh] OR resuscitat*[TIAB]) AND (“early defibrillation”[TIAB] OR “automatic external defibrillator”[TIAB] OR “automatic external defibrillators”[TIAB] OR “automated external defibrillator”[TIAB] OR “automated external defibrillators”[TIAB] OR AED[TIAB] OR AEDs[TIAB] OR “automatic external defibrillation”[TIAB] OR “public access defibrillation program”[TIAB] OR “public access defibrillation programs”[TIAB] OR ((“Electric Countershock”[Mesh] OR “electric countershock”[TIAB] OR countershock*[TIAB] OR electroversion*[TIAB] OR cardioversion*[TIAB] OR “Defibrillators”[Mesh] OR defibrillator*[TIAB] OR defibrillation*[TIAB]) AND (public[TIAB] OR bystander*[TIAB] OR "first responder"[TIAB] OR "first responders"[TIAB] OR "firstresponder"[TIAB] OR "first-responders"[TIAB] OR Layperson*[TIAB] OR “lay people”[TIAB] OR “lay rescuer”[TIAB] OR “lay rescuers”[TIAB] OR witness*[TIAB] OR Firefighter*[TIAB] OR “fire fighter” OR “fire fighters” OR "Firefighters"[Mesh] OR "Police"[Mesh] OR Police[TIAB] OR “non-healthcare professionals”[TIAB] OR “non-healthcare professional”[TIAB] OR "Emergency Medical Technicians"[Mesh] OR “emergency medic”[TIAB] OR “emergency medical”[TIAB] OR “EMS”[TIAB] OR “EMT”[TIAB] OR paramedic*[TIAB]))) NOT (animals[Mesh] NOT humans[Mesh]) NOT ("letter"[Publication Type] OR "comment"[Publication Type]OR "editorial"[Publication Type] or Case Reports[Publication Type] OR “case series”[TIAB])

Database searched: PubMed
Time Frame: (existing PICOST) – December 1, 2022 to January 6, 2024
Date Search Completed: January 6, 2024

Search Results (Number of articles identified and number identified as relevant):
PubMed: 281 articles identified/19 selected for full text review/3 identified as relevant

Summary of Evidence Update: Two retrospective studies were identified as relevant to this PICOST.

Haskins et al [3] reported that in OHCA patients with shockable rhythm, the rate of good functional recovery at 12 months was higher when defibrillation was performed by bystander than when performed by paramedic. This is consistent with the previous evidences. Komori et al [2] compared AED shock by bystander with shock by EMS in patients with OHCA of non-cardiac origin, and there was no difference in 1-month neurological outcome. This is inconsistent with existing evidence. However, because the bystander shock group consisted of only 57 patients, it is difficult to suggest that AED use is not necessary in patients with OHCA of non-cardiac origin.

Relevant Guidelines or Systematic Reviews

Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings
Brooks et al for ILCOR; 2022	ILCOR Scientific Statement	Optimizing Outcomes After Out-of-Hospital Cardiac Arrest with Innovative Approaches to Public-Access Defibrillation: A Scientific Statement from the International Liaison Committee on Resuscitation	N/A	Despite imperfect implementation, public-access defibrillation has saved countless lives. AEDs remain underused so that many salvageable individuals die without the benefit of having an AED available to them. There are multiple barriers to more consistent AED use; however, there are also multiple opportunities to address those barriers with new approaches to PAD program implementation, including changing the behavior of potential users; improving availability; improving integration with existing emergency dispatch; enhancing AED housing, signage, and device technology; and exploring novel AED delivery vectors. Specific policy suggestions made in Table 1. Knowledge gaps identified for future research in Table 2. Continued evolution of the approach to PAD with increased early CPR, rhythm detection, and defibrillation will improve cardiac safety in our communities and ultimately increase survival after OHCA.
Elhussain et al; 2023 [1]	Systematic review	Evaluate the impact of public access defibrillators (PAD) on the outcomes of out-of-hospital cardiac arrest	30 studies (2000-2022)	Significant increase in survival rates when AED interventions are carried out by bystanders compared to those by EMS. (meta-analysis not performed) The results of this systematic review underscore the critical significance of PAD in improving survival outcomes in OHCA settings.

RCT: 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)
Ishii 2022	Study Type: Interrupted time series analysis of the official Japanese Government Statistics database	Inclusion Criteria: People aged five years and older in the Japanese demographic statistics	1° endpoint: Interrupted time series data stratified by age and sex to evaluate changes in trends of rates of annual SCDs after the	After the PAD introduction in 2004, a significant decrease in trends of annual SCD rates was observed for those aged 5–19 years (the ratio of trends between pre

		(1995–2015)	introduction of a PAD program in Japan.	and post PAD introduction (RT) = 0.886, 95%CI: 0.801 to 0.980), 20–34 years (RT = 0.932; 95%CI: 0.906, 0.958), 35–49 years (RT = 0.953; 95%CI: 0.929, 0.977) and 50–64 years (RT = 0.971; 95%CI: 0.971, 0.991). However, the decrease was not observed for those aged 65 years and older. In the age and sex stratified analysis, there was a significant decrease in RT among males aged 5–64 years, and among females 35–49 years.
Heidet 2022	International, multicenter, retrospective cohort study	OHCA cases from Metro Vancouver, Canada included in the CanROC Registry (CanROC) and from Rhone County, France in the Registre Électronique des Arrêts Cardiaques (RéAC)	2° endpoint: In Metro Vancouver, Canada univariate models demonstrated that AED access time of ≥ 3 minutes was associated with a lower probability of ROSC at hospital arrival (OR 0.39, 95 % CI [0.24, 0.64]) and survival at hospital discharge (OR 0.19, 95 % CI [0.10, 0.36]) (all $p < 0.001$). In multivariate models, 1-way access time of ≥ 3 minutes was associated with lower survival at hospital discharge (OR 0.41, 95 % CI [0.23, 0.74], $p = 0.003$) but not with ROSC (Table 3 and Supp. Table 2).	These findings emphasize the need for rapid and efficient access to public AEDs. Nevertheless, these associations warrant cautious interpretation as outcomes depend on a complex chain of survival in which the organization and efficiency of EMS systems and in-hospital practices play important roles.
Komori, 2023 [2]	Study Type: retrospective cohort study using data from the All-Japan Utstein registry between 2013 and 2017; 245,759 OHCA patients with non-cardiac cause	1,053 patients with witnessed, shockable rhythm were included. 57 (5.4%) were bystander AED shock group and 996 (94.6%) in the EMS shock group.	There was no statistically significant difference in the rate of favorable neurological outcome at one month between groups [9 (15.8%) vs 109 (10.9%), $p = 0.26$]. Logistic regression analysis showed no association between bystander AED shock and favorable neurological outcome [OR (95% CI): 1.63 (0.70–3.77), $p = 0.25$].	Defibrillation with AED by bystander before defibrillation by EMS personnel was not associated with the favorable outcomes of OHCA of presumed non-cardiac cause.

Haskins, 2023 [3]	retrospective study included adult nontraumatic OHCA with initial shockable rhythms between 2010 and 2019 57,750 OHCA attended by EMS	6,050 OHCA with shockable rhythm; 636 (10.5%) bystander defibrillation vs 542 (9%) first responder defibrillation vs 4,872 (80.5%) paramedic defibrillation	Primary outcome: good functional recovery at 12 months after arrest, measured by the Glasgow Outcome Scale-Extended (GOS-E). Survivors shocked by bystanders were most likely to report a 'GOS-E upper good recovery' (41.7% vs 30.4% for first responder-defibrillated vs 30.6% for paramedic-defibrillated survivors, p=0.002)	This study reinforces the importance of defibrillation prior to paramedic arrival for OHCA. Bystander-defibrillated patients reported better functional recovery and higher rates of both returning to work and living at home without care.

Reviewer Comments: ***(including whether this PICOST should have a systematic or scoping review*****)**

A retrospective study by Komori et al [2] reported no difference in 1-month neurological outcome between AED shock by bystander with shock by EMS in patients with OHCA of non-cardiac origin. Perform a subgroup analysis of the group of non-cardiac cause in the next systematic review.

Reference list: ***(List by ILCOR ref standard (last name first author, year of publication, first page number) and insert hyperlink to all articles identified as relevant (if available on PubMed)***

1. Elhussain MO, Ahmed FK, Mustafa NM, Mohammed DO, Mahgoub IM, Alnaeim NA, Ali R, Bushra N, Ahamed HK, Abdelrahman N. The Role of Automated External Defibrillator Use in the Out-of-Hospital Cardiac Arrest Survival Rate and Outcome: A Systematic Review. Cureus. 2023 Oct 26;15(10):e47721. https://pubmed.ncbi.nlm.nih.gov/38021997/
2. Komori A, Iriyama H, Abe T. Impact of defibrillation with automated external defibrillator by bystander before defibrillation by emergency medical system personnel on neurological outcome of out-of-hospital cardiac arrest with non-cardiac etiology. Resusc Plus. 2023 Feb 7;13:100363. https://pubmed.ncbi.nlm.nih.gov/36814461/
3. Haskins B, Nehme Z, Andrew E, Bernard S, Cameron P, Smith K. One-year quality-of-life outcomes of cardiac arrest survivors by initial defibrillation provider. Heart. 2023 Aug 24;109(18):1363-1371. https://pubmed.ncbi.nlm.nih.gov/36928241/

Evidence Update Worksheet

CPR Ratios
BLS 2202

Worksheet author(s): Ziad Nehme
Task Force: BLS
Date Submitted to SAC rep for peer review and approval: 10/01/2024
SAC rep: Theresa Olasveengen

PICOST / Research Question:

The PICOST (Population, Intervention, Comparator, Outcome, Study Designs and Timeframe)

Population: Patients of all ages (i.e., neonates, children, adults) with cardiac arrest from any cause and across all settings (in-hospital and out-of-hospital). Studies that included animals were not eligible.

Intervention: All manual CPR methods including Compression-only CPR (CO-CPR), Continuous Compression CPR (CC-CPR), and CPR with different compression-to-ventilation ratios. CO-CPR included compression with no ventilations, while CC-CPR included compression with asynchronous ventilations or minimally interrupted cardiac resuscitation (MICR). Studies that mentioned the use of a mechanical device during CPR were only considered if the same device was used across all relevant intervention arms and would therefore not confound the observed effect.

Comparators: Studies had to compare at least two different CPR methods from the eligible interventions; studies without a comparator were excluded.

Outcomes: The primary outcome was favorable neurological outcomes, measured by cerebral performance or a modified Rankin Score. Secondary outcomes were survival, ROSC, and quality of life.

Study Designs: Randomised controlled trials (RCTs) and non-randomised studies (non-randomised controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Study designs without a comparator group (e.g., case series, cross-sectional studies), reviews, and pooled analyses were excluded.

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: 2017

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We suggest a compression–ventilation ratio of 30:2 compared with any other compression–ventilation ratio in patients with cardiac arrest (weak recommendation, very low-quality evidence).

Current Search Strategy (for an existing PICOST) included in the attached approved PICOST
Ovid MEDLINE(R) and Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations -same search as 2017 review.

Database searched: Medline

Time Frame: (existing PICOST) –Updated to the end of 2023

Date Search Completed: 09/01/2024

Search Results (Number of articles identified and number identified as relevant):

1. 995 new titles identified.
2. 22 duplicate titles were removed, leaving 973 titles for screening
3. 14 titles were potentially relevant, but only 4 articles met eligibility criteria after abstract review
4. 2 systematic reviews and 2 observational studies underwent full review and are summarised below

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
Sun; 2023 https://doi.org/10.1016/j.ajem.2022.11.003	Systematic review & meta-analysis	To compare outcomes between continuous chest compressions with asynchronous ventilation (CCC-CPR) and interrupted chest compressions CPR with synchronous ventilation (ICC-CPR) performed by professional rescuers in cardiac arrest.	8 human studies and 12 animal studies (findings from human studies summarised here). Human studies included 5 observational trials and 3 RCTs.	No difference between CCC-CPR vs ICC-CPR: 1) ROSC: OR 1.07; 95% CI 0.86–1.32 (8 studies) 2) STD: OR 1.04; 95% CI 0.77–1.42 (8 studies) 3) 1-month survival: OR 1.07; 95% CI 0.84–1.36 (5 studies) 4) Good neurological outcome: OR 0.92; 95% CI 0.84–1.01 (5 studies)	N/A Note: No additional human studies were included from searching reference lists. 3 new studies published since last full review (2017).
Bielski; 2023 DOI: 10.5603/CJ.a2021.0115	Systematic review & meta-analysis	To compare outcomes between standard CPR with mouth-to-mouth ventilations (30:2) and continuous chest compression-only CPR (CCC) performed by bystanders on OHCA.	3 RCTs and 12 non-RCTs trials met the inclusion criteria.	No difference between sCPR and CCC: 1) STD: OR 1.04; 95% CI: 0.93–1.16; p = 0.46). 2) STD with CPC ½: OR 1.00; 95% CI: 0.84–1.20. 3) ROSC: OR 1.13; 95% CI: 0.91–1.39. 4) Survival to admission: OR 1.20; 95% CI: 0.89–1.63.	N/A Note: No additional human studies were included from searching reference lists. 6 new studies published since last full review (2017).

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
None	**Study Aim:** **Study Type:**	**Inclusion Criteria:**	**Intervention:** **Comparison:**	**1° endpoint:**	**Study Limitations:**

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)
Idris; 2023	**Study Type:** Secondary analysis of the ROC CCC study; n=1976. Objective was to compare the incidence of ventilation and outcomes in 2 groups: patients with ventilation waveforms in <50% of pauses (group 1) versus those with waveforms in ≥50% of pauses (group 2).	**Inclusion Criteria:** Adult non-traumatic OHCA patients randomised to the 30:2 arm of the CCC trial. (1177 in group 1 and 799 in group 2).	**1° endpoint:** STD Group 2 vs Group 1 STD AOR 2.2 (95% CI 1.6-3.0) ROSC AOR 1.3 (95% CI: 1.2-1.5) Survived to hospital AOR 1.4 (95% CI 1.2-1.6) STD with MRS <=3 AOR 2.8 (95% CI 1.8-4.3)	**Conclusion:** Lung inflation in ≥50% of pauses was associated with improved return of spontaneous circulation, survival, and survival with favorable neurological outcome. **Comments:** Lung inflation measured on defib bioimpedance. Trial analysed data from 1976 of 7190 (27%) patients randomised to the 30:2 arm with various reasons for exclusions (site related, missing data, crossover etc.). Analysed patient data before an advanced airway was placed.
Benoit; 2023	**Study Type:** Retrospective cohort; n= 314. Objective was to evaluate the utility of continuous capnography to measure ventilation rates and the association with ROSC.	**Inclusion Criteria:** Adult non-traumatic OHCA. Compared guideline compliant ventilation (either 6-10/min or 8-10/min vs other)	**1° endpoint:** Sustained prehospital ROSC 6-10/min vs other ROSC OR 1.502 (95% CI 0.844–2.673) 8-10/min vs other ROSC OR 0.908 (95% CI 0.460–1.790)	**Conclusion:** We failed to detect an association between intra-arrest ventilation rates measured by continuous capnography and proximal patient outcomes after OHCA. Capnography has poor reliability as a measure of ventilation rate. **Comments:** Analysed 314 of 790 (39%) possible cases with capnography data.

Reviewer Comments: ***(including whether this PICOST should have a systematic or scoping review*****)**
Two new articles met the inclusion criteria – both observational. Both articles investigate the effect of ventilation compliance rather than differences in compression-ventilation ratio/strategies. On the basis of two other systematic reviews, a number of new articles have been published since the last full review of the PICOST in 2017. Of these, all are observational studies.

Reference list: ***(List by ILCOR ref standard (last name first author, year of publication, first page number) and insert hyperlink to all articles identified as relevant (if available on PubMed)***

1. Benoit JL, Lakshmanan S, Farmer SJ, et al. Ventilation rates measured by capnography during out-of-hospital cardiac arrest resuscitations and their association with return of spontaneous circulation. Resuscitation. 2023;182:109662. https://dx.doi.org/10.1016/j.resuscitation.2022.11.028
2. Bielski K, Smereka J, Chmielewski J, et al. Meta-analysis of chest compression-only versus conventional cardiopulmonary resuscitation by bystanders for adult with out-of-hospital cardiac arrest. Cardiology journal. 2023;30(4):606-613. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10508072/
3. Idris AH, Aramendi Ecenarro E, Leroux B, et al. Bag-Valve-Mask Ventilation and Survival From Out-of-Hospital Cardiac Arrest: A Multicenter Study. Circulation. 2023;148(23):1847-1856. https://www.ahajournals.org/doi/epdf/10.1161/CIRCULATIONAHA.123.065561
4. Sun M, Zhu A, Tang Y. Continuous compression with asynchronous ventilation improves CPR prognosis? A meta-analysis from human and animal studies. The American Journal of Emergency Medicine. 2023;64:26-36. https://pubmed.ncbi.nlm.nih.gov/36435007/

Evidence Update Worksheet

CPR prior to defibrillation
BLS 2203

Worksheet author(s): Violetta Raffay
Task Force: BLS
Date Submitted to SAC rep for peer review and approval: 27/1/2023
SAC rep: Theresa Olasveengen

PICOST / Research Question:

The PICOST (Population, Intervention, Comparator, Outcome, Study Designs and Timeframe)

Population: Adults and children in any setting (in-hospital or out-of-hospital) with cardiac arrest and a shockable rhythm at initiation of cardiopulmonary resuscitation (CPR)

Intervention: A prolonged period of chest compressions before defibrillation

Comparators: A short period of chest compressions before defibrillation

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 Designs: 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.

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: 2019

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We suggest a short period of CPR until the defibrillator is ready for analysis and/or defibrillation in unmonitored cardiac arrest. (weak recommendation, low-certainty evidence).

Current Search Strategy (for an existing PICOST) included in the attached approved PICOST:
("Ventricular Fibrillation"[Mesh] OR "Ventricular Fibrillation"[TW] OR "pulseless VT"[TW] OR "pulseless ventricular tachycardia"[TW] OR "Electrocardiography"[Mesh:NoExp]) AND (("Cardiopulmonary Resuscitation"[Mesh] OR "chest compressions"[TW] OR "chest compression"[TW] OR "thorax compression"[TW] OR "Heart Massage"[Mesh] OR "cardiopulmonary resuscitation"[TW] OR "cardio-pulmonary resuscitation"[TW] OR CPR[TW]) AND ("Electric Countershock"[Mesh] OR "Defibrillators"[Mesh:NoExp] OR "electric countershock"[TW] OR "cardiac electroversion"[TW] OR defibrillator*[TW] OR defibrillation*[TW]))) NOT ("Defibrillators, Implantable"[Mesh])) NOT "Atrial Fibrillation"[Mesh])))) AND (("Time Factors"[Mesh] OR "Emergencies"[Mesh] OR "Emergency Medical Services"[Mesh:NoExp] OR "Emergency Medical Technicians"[Mesh] OR "Treatment Outcome"[Mesh] OR "Fatal Outcome"[Mesh] OR "Outcome Assessment (Health Care)"[Mesh] OR "Outcome and Process Assessment (Health Care)"[Mesh] OR "Survival"[Mesh] OR "Mortality"[Mesh] OR "mortality"[Subheading] OR "Disease-Free Survival"[Mesh] OR "Survival Analysis"[Mesh] OR "Survival Rate"[Mesh] OR "Outcome"[All Fields] OR "outcomes"[All Fields] OR "Survivors"[Mesh] OR "return of spontaneous circulation"[TIAB] OR "ROSC"[TIAB])))) NOT (((animals[mh] NOT humans[mh]) NOT ("letter"[pt] OR "comment"[pt] OR "editorial"[pt] or Case Reports[ptyp]))))

Database searched: Pubmed
Time Frame: 27 October 2019 -31 Dec 2023
Date Search Completed: 13 Jan 2024
Search Results (Number of articles identified and number identified as relevant):
48 results
Title screening: 15 identified as relevant

Summary of Evidence Update: 7 new articles 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

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
	Study Aim: **Study Type:**	**Inclusion Criteria:**	**Intervention:** **Comparison:**	**1° endpoint:**	**Study Limitations:**

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)

Reviewer Comments:
No studies found

Evidence Update Worksheet

Timing of rhythm check
BLS 2211

Worksheet author(s): Ziad Nehme
Task Force: BLS
Date Submitted to SAC rep for peer review and approval: 10/01/2024
SAC rep: Theresa Olasveengen

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

The PICOST (Population, Intervention, Comparator, Outcome, Study Designs and Timeframe)

Population: Adults in any setting (in-hospital or out-of-hospital) with cardiac arrest

Intervention: Analysis of cardiac rhythm during chest compressions

Comparators: Standard care (analysis of cardiac rhythm during pauses in chest compressions).

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. CPR quality metrics such time chest compression fraction, pauses in compressions, compressions per minute, time to commencing CPR, or time to first shock etc. were included as important outcomes.

Study Designs: 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) are excluded.

It is anticipated that there will be insufficient studies from which to draw a conclusion; case series will be included in the initial search and included as long as they contain ≥ 5 cases.

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: 2020

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

1. We suggest against the routine use of artifact-filtering algorithms for analysis of electrocardiographic rhythm during CPR (weak recommendation, very-low-certainty evidence).
2. We suggest that the usefulness of artifact-filtering algorithms for analysis of electrocardiographic rhythm during CPR be assessed in clinical trials or research initiatives (weak recommendation, very-low-certainty evidence).

Current Search Strategy (for an existing PICOST) included in the attached approved PICOST

((((((((((("continuous compressions"[TIAB] OR "Continuous chest compression"[TIAB] OR "Continuous chest-compressions"[TIAB] OR "uninterrupted compressions"[TIAB] OR "uninterrupted chest compression"[TIAB] OR "uninterrupted chest-compressions"[TIAB] OR "ongoing compressions"[TIAB] OR "ongoing chest compression"[TIAB] OR "ongoing chest-compressions"[TIAB] OR "instantaneous chest compression"[TIAB] OR "instantaneous chest compression"[TIAB])))) OR ((("Heart Arrest"[Mesh] OR "cardiac arrest"[TIAB] OR "cardiovascular arrest"[TIAB] OR "heart arrest"[TIAB] OR "asystole"[TIAB] OR "pulseless electrical activity"[TIAB] OR "Ventricular Fibrillation"[Mesh:noexp] OR "cardiopulmonary arrest"[TIAB]) AND ("cardiopulmonary resuscitation"[TIAB] OR "Advanced Cardiac Life Support"[TIAB] OR "ACLS"[TIAB] OR "cardiopulmonary resuscitation"[Mesh] OR "advanced cardiac life support"[Mesh] OR "Heart Massage"[Mesh] OR cardiac massage[ti] OR CPR[ti] OR "basic life support"[ti] OR chest compression[TIAB] OR chest compressions[TIAB])))))) AND (("Electrocardiography/instrumentation"[Mesh:NoExp] OR "Electrocardiography/methods"[Mesh:NoExp] OR "Artifacts"[Mesh] OR "Continuous ECG monitoring"[TIAB] OR "ECG analysis"[TIAB] OR "ECG rhythm analysis"[TIAB] OR "Electrocardiogram analysis"[TIAB] OR "rhythm analyses"[TIAB] OR "rhythm

analysis"[TIAB] OR "rhythm assessment"[TIAB] OR "rhythm check"[TIAB] OR "rhythm evaluation"[TIAB] OR "rhythm monitoring"[TIAB] OR "shock advisory system"[TIAB] OR"nonshockable rhythm"[TIAB] OR "non-shockable rhythms"[TIAB] OR "non-shockable rhythm"[TIAB] OR "shockable rhythm"[TIAB] OR "nonshockable rhythms"[TIAB] OR "shockable rhythms"[TIAB])))) OR (("rhythm analysis"[TIAB] AND algorithm[TIAB])))))) NOT ((((animals[mh] NOT humans[mh]) NOT ("letter"[pt] OR "comment"[pt] OR "editorial"[pt] or Case Reports[ptyp])))

Database searched: Pubmed

Time Frame: (existing PICOST) – updated from end of last search (please specify) Literature search updated to end of 2023

Date Search Completed: 10/01/2024

Search Results (Number of articles identified and number identified as relevant):
155 titles met the search criteria, but 154 were irrelevant
1 article underwent full-text review

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
None					

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
None	**Study Aim:** **Study Type:**	**Inclusion Criteria:**	**Intervention:** **Comparison:**	**1° endpoint:**	**Study Limitations:**

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)
De Graaf 2021	**Study Type:** Observational (before and after) (n=890)	**Inclusion Criteria:** Cardiac arrest victims treated by Amsterdam Police and Fire Fighters between 2016-2017	**1° endpoint:** Sensitivity of the intervention AED was 96%, (LCPL 93%) and specificity was 98% (LCL 97%),	CONCLUSION: Compared to conventional AEDs, cprINSIGHT leads to a significantly shorter

		(control) and 2018-2019 (intervention).	both not significantly different from control. Intervention cases had a shorter median pre-shock pause compared to control cases (8 s vs 22 s, $p < 0.001$) and higher median CCF (86% vs 80%, $P < 0.001$).	pre-shock pause and a significant increase in CCF.
Didon 2021	**Study Type:** Observational (n=2916)	**Inclusion Criteria:** Out-of-hospital cardiac arrest (OHCA) patients treated with AEDs (DEFIGARD TOUCH7, Schiller Médical, France) were subjected patient-wise to Analyze Whilst Compressing (AWC) training (8559 strips, 1604 patients) and validation (7498 strips, 1312 patients).	**1° endpoint:** "Standard Analysis Stage" presented ventricular fibrillation (VF) sensitivity Se = 98.3% and non-shockable rhythm specificity Sp>99%; "AWC Stage" decision after Step2 reconfirmation achieved Se = 92.1%, Sp>99%. AWC required hands-off reconfirmation in 34.4% of cases	AWC presented similar performances to other AED algorithms during CPR, fulfilling performance goals recommended by standards. AWC provided advances in the challenge for
Kwok 2022	**Study Type:** Observational (n=432)	**Inclusion Criteria:** Out-of-hospital cardiac arrest (OHCA) patients treated by EMS. Patients were included if they received at least one defibrillation attempt and the defibrillator recording with ECG and transthoracic impedance signals was available.	**1° endpoint:** Accuracy of rhythm interpretation. Compared to manual review during period with an without CPR, the algorithm correctly classified 0.88 (95% CI 0.85–0.91) for asystole, 0.98 (95% CI 0.98–0.99) for organised rhythm, and 0.97 (95% CI 0.96–0.97) for ventricular fibrillation.	A novel algorithm continuously classified resuscitation rhythms with 88–98% accuracy, enabling accurate shock advisory guidance during most two-minute CPR cycles. Note: 43% of rhythms were classified as Inconclusive and could not be assessed by the algorithm.
Krasteva 2023	**Study Type:** Observational (n=2838)	**Inclusion Criteria:** Out-of-hospital cardiac arrest (OHCA) patients treated by fire-fighters in France using AEDs. 13,570 extracted rhythm analysis periods were analysed and separated into learning and testing datasets. A 30 second period before and 10 second period after a rhythm analysis pause were analysed by a deep learning algorithm. AED decision to shock and manual review of the ECG by cardiologists was used as the reference standard.	**1° endpoint:** Accuracy of rhythm interpretation. Compared to manual review, the algorithm achieved a mean sensitivity range of 88–98% and specificity range of 91.5-100%.	The presented technology for sliding shock advisory decision during CPR achieved substantial performance improvement in short hands-off periods (>2 s), such as insufflations or pre-shock pauses. Note: No clinical outcomes recorded.

Reviewer Comments: ***(including whether this PICOST should have a systematic or scoping review*****)**

The 2020 Evidence Update identified 2 observational studies (De Graaf and Didon) evaluating analysis during compressions in clinical settings. Another observational study (Kwok) was identified following the 2023 Evidence Update. This 2024 Evidence Update has identified another observational study (Krasteva) which reports on the accuracy of a novel deep learning algorithm designed to analyse rhythms during CPR with and without pauses. This study does not consider any clinically relevant outcomes as detailed by the PICOST. As such, there is no new evidence informing this PICOST since the 2023 Update.

Reference list: ***(List by ILCOR ref standard (last name first author, year of publication, first page number) and insert hyperlink to all articles identified as relevant (if available on PubMed)***

1. de Graaf C, Beesems SG, Oud S, Stickney RE, Piraino DW, Chapman FW, Koster RW. Analyzing the heart rhythm during chest compressions: Performance and clinical value of a new AED algorithm. Resuscitation. 2021 Jan 16:S0300-9572(21)00009-5. doi: 10.1016/j.resuscitation.2021.01.003.
2. Didon JP, Ménétré S, Jekova I, Stoyanov T, Krasteva V. Analyze Whilst Compressing algorithm for detection of ventricular fibrillation during CPR: A comparative performance evaluation for automated external defibrillators. Resuscitation. 2021 Jan 30;160:94-102. doi: 10.1016/j.resuscitation.2021.01.018. Online ahead of print.
3. Kwok H, Coult J, Blackwood J, Sotoodehnia N, Kudenchuk P, Rea T. A method for continuous rhythm classification and early detection of ventricular fibrillation during CPR. Resuscitation. 2022;176:90-7.
4. Krasteva V, Didon JP, Ménétré S, Jekova I. Deep Learning Strategy for Sliding ECG Analysis during Cardiopulmonary Resuscitation: Influence of the Hands-Off Time on Accuracy. Sensors (Basel). 2023;23.

Evidence Update Worksheet

Hand Positioning
BLS 2502

Worksheet author(s): Bridget Dicker
Task Force: BLS
Date Submitted to SAC rep for peer review and approval:
SAC rep:

PICOST / Research Question: *(Attach SAC representative approved completed PICOST template)*
The PICOST (Population, Intervention, Comparator, Outcome, Study Designs and Timeframe)

Population: Adults and children in any setting (in-hospital or out-of-hospital) with cardiac arrest

Intervention: Any other location for chest compressions

Comparators: Delivery of chest compressions on the lower half of the sternum

Outcomes: Any clinical outcome. 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. Physiological outcomes including blood pressure, coronary perfusion pressure or EtCO2 were also considered important outcomes.

Study Designs: Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) reporting clinical outcomes are eligible for inclusion.

Timeframe: All years and all languages were included as long as there was an English abstract. Mannikin studies and unpublished studies (e.g., conference abstracts, trial protocols) were excluded. Literature search conducted 21 December 2022.

Year of last full review: (*insert year where this PICOST was most recently reviewed)* *2021*

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

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

Current Search Strategy (for an existing PICOST) included in the attached approved PICOST :
("hand"[Mesh] OR "Hand placement"[TIAB] OR "hand position"[TIAB] OR "hand positioning"[TIAB] OR "finger placement"[TIAB] OR "finger position"[TIAB] OR "finger positioning"[TIAB] OR "alternative position" OR "alternative compression") AND ("Resuscitation"[Mesh] OR resuscitat*[TIAB] OR "cardiopulmonary resuscitation"[Mesh] OR "heart massage"[Mesh] OR "cardiopulmonary resuscitation"[TIAB] OR CPR[TIAB] OR "chest compression"[TIAB] OR "chest compressions"[TIAB] OR "heart massage"[TIAB] OR "cardiac massage"[TIAB] OR "cardiac compression"[TIAB] OR "cardiac compressions"[TIAB] OR "thoracic compression"[TIAB] OR "thoracic compressions"[TIAB]) NOT (animal[Mesh] NOT humans[Mesh]) NOT ("News" [Publication Type] OR "letter"[Publication Type] OR "comment"[Publication Type] OR "editorial"[Publication Type] or Case Reports[Publication Type])

New Search strategy: (for a new PICOST should be outlined here as per Evidence Update Process)
Database searched: Pubmed
Time Frame: (existing PICOST) – updated from end of last search (please specify) 31 Dec 2021
Time Frame: (new PICOST) – at the discretion of the Task Force (please specify) 1 Jan 2023 to 31 December 2023.
Date Search Completed: 17 Jan 2024
Search Results (Number of articles identified and number identified as relevant):
Title screening: 0 identified as relevant

Summary of Evidence Update: No new articles 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

RCT: mannequin only

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
	Study Aim: **Study Type:**	**Inclusion Criteria:**	**Intervention:** **Comparison:**	**1° endpoint:**	**Study Limitations:**

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)
	Study Type:	**Inclusion Criteria:**	**1° endpoint:**	

Reviewer Comments: *No new studies identified.*

Reference list: ***n/a***

Evidence Update Worksheet

Head Up CPR
BLS 2503

Worksheet author(s): Tatsuya Norii
Task Force: BLS
Date Submitted to SAC rep for peer review and approval:
SAC rep:

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

Population: Adults in any setting (in-hospital or out-of-hospital) with cardiac arrest

Intervention: Heads-up CPR

Comparators: Standard or compression-only CPR in supine position

Outcomes: Any clinical outcome.

Study Designs: Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies), case series with ≥ 5 patients are eligible for inclusion. Unpublished studies (e.g., conference abstracts, trial protocols) are excluded.

Timeframe: All years and all languages are included as long as there is an English abstract.

Year of last full review: 2021

Current ILCOR Consensus on Science and Treatment Recommendation for this PICOST:
We suggest against the routine use of head-up CPR during CPR (weak recommendation, very-low-certainty evidence).
We suggest that the usefulness of head-up CPR during CPR be assessed in clinical trials or research initiatives (weak recommendation, very-low-certainty evidence).

Current Search Strategy (for an existing PICOST) included in the attached approved PICOST
(("field"[All Fields] OR "field s"[All Fields] OR "fields"[All Fields] OR "heads-up"[All Fields] OR "head up"[All Fields] OR "head-up"[All Fields]OR "tilt"[All Fields]) AND (("life support care"[MeSH Terms] OR "life support"[Title/Abstract] OR "cardiopulmonary resuscitation"[MeSH Terms] OR "cardiopulmonary resuscitation"[Title/Abstract] OR "CPR"[Title/Abstract] OR "return of spontaneous circulation"[Title/Abstract] OR "ROSC"[Title/Abstract] OR "heart arrest"[MeSH Terms] OR "cardiac arrest"[Title/Abstract]) NOT ("animals"[MeSH Terms] NOT "humans"[MeSH Terms])))

Database searched: PubMed

Time Frame: 7/1/2022-12/31/2023

Date Search Completed: 10th January 2024
Search Results (Number of articles identified and number identified as relevant): 14 titles, no relevant systematic review, 1 cadaver study and 1 survey-based study

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
Tan 2022 515	Systematic review	Search to May 2021 Whether head-up CPR (HU-CPR) improved survival and surrogate outcomes as compared to standard CPR (S-CPR).	13 (11 animal, 1 cadaver, 1 human)	The human study (n=2,322) reported increased return of spontaneous circulation with HU-CPR in OHCA (17.9% versus 34.2%, P<0.0001).	Human study included in 2021 ILCOR SR.
Varney 2022 e644	Systematic review	Search to Feb 2021 investigate the safety and efficacy of heads-up CPR versus supine CPR.	7 animal studies	No human studies	n/a

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)
Moore 2022 159	**Study Type:** Prospective observational. Intervention group bundle: (1) active compression-decompression CPR and/or automated CPR, (2) an impedance threshold device, and (3) automated controlled elevation of the head and thorax (ACE)	**Inclusion Criteria:** Adults in OHCA. Comparator group taken from 3 RCTS in high performance CPR EMS.	**1° endpoint:** After propensity score matching overall outcomes with ACE-CPR and C-CPR were comparable for the overall probabilities of ROSC (33% [74/222] versus 33% [282/860], OR, 1.02, 95% CI, 0.75–1.49), survival to hospital discharge (9.5% [21/222] versus 6.7% [58/860], OR, 1.44, 95% CI, 0.86–2.44) and survival to hospital discharge with favorable neurological status (5.9% [13/222] versus 4.1% [35/860], OR, 1.47, 95% CI, 0.76–2.82). Rapid initiation of ACE-CPR was associated with higher adjusted odds of survival to hospital discharge with favorable neurological function compared with C-CPR patients.	High risk of bias. No different on outcomes overall.
Kim 2022 159	**Study Type:** Prospective pilot study. Intervention: alternating head-up and supine positions at 4-minute intervals while performing CPR in ED.	**Inclusion Criteria:** Adults in non-traumatic OHCA (n=28) receiving ALS care.	**1° endpoint:** The median increase in cerebral blood flow (CBF) in the prefrontal area in the head-up position was 14.6% (Interquartile range, 8.8–65.0), more than that in the supine position. An increase in CBF was observed in the head-up position compared with the supine position in 83.3% of the patients included in the analysis.	Small sample size.
Segond 2023	**Study Type:** A human cadaver experimental study/CPR was performed, in the following order: horizontal (FLAT), at 18° and then at 35° head-thorax elevation. /n=10	**Inclusion Criteria:** Thawed fresh-frozen cadavers. Age at death was 89.5 ± 7.3 years with the BMI of 23.6 ± 4.2 kg/m2.	**1° endpoint:** Thoracic position and positive end-expiratory pressure (PEEP) significantly impacted net tidal volume (VT) adjusted to predicted body weight (VTPBW) ($p < 0.001$ for each).	In a cadaver study, head and torso up CPR was found to increase the ventilation ability. Tidal volume was lower when the thorax was positioned at 35° (compared to flat or 18° position).

			The insufflation time, thoracic position and PEEP significantly affected the reversed airflow ($p < 0.001$ for each) and minimum airway pressure (Pmax) ($p < 0.001$). In subgroup analysis, at 35° VTPBW and Pmax were significantly reduced compared with the flat or 18° position.	
Raitt 2023	**Study Type:** A survey-based study asking about the use of the Head Up Position (HUP), Active Compression/Decompression (ACD) CPR, and the Impedance Threshold Device (ITD).	**Inclusion Criteria:** All 27 pre-hospital critical care services in UK	**1° endpoint:** Among 14 pre-hospital critical care services that responded to the survey (52% response rate), no service was using HUP.	A survey-based study showed that there is no widespread use of HUP. No patient outcome data was collected in the study.

Reviewer Comments: The search identified one cadaver study and one survey-based study since the last ILCOR evidence update in 2022. An update of the systematic review is not urgently needed.

Reference list: ***(List by ILCOR ref standard (last name first author, year of publication, first page number) and insert hyperlink to all articles identified as relevant (if available on PubMed)***

Segond 2023 185 Mechanical ventilation during cardiopulmonary resuscitation: influence of positive end-expiratory pressure and head-torso elevation.
Resuscitation. 2023 Apr;185:109685.
https://www.resuscitationjournal.com/article/S0300-9572(22)00758-4/fulltext

Raitt 2023 12 Cardiac Arrest Bundle of cARE Trial (CABARET) survey of current UK neuroprotective CPR practice.
Resusc Plus. 2023 Sep 12;16:100472.
https://www.sciencedirect.com/science/article/pii/S2666520423001157?via%3Dihub