2021 Evidence Update Worksheet
Appendix B3 EIT 1

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Date Submitted: 9th February 2021

PICO / Research Question: ***EMS practitioner's experience or exposure (EIT 437)***

Population: Adults and children who are in cardiac arrest in the out-of-hospital setting
Intervention: Resuscitation by experienced emergency medical service practitioners or practitioners with higher exposure to resuscitation
Comparators: Resuscitation by less experienced or lower exposed practitioners
Outcomes: Improved patient outcomes. OHCA patient outcomes include:
1) Good neurological outcome at discharge/30days;
2) Survival to hospital discharge/30days;
3) Survival to hospital (event survival);
4) Return of spontaneous circulation (ROSC)

Study design: RCTs, nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies), original research articles (both prospective and retrospective) were included with no language restrictions. Unpublished studies (eg, conference abstracts, trial protocols) were excluded.
Time frame: All years and all languages were included if there was an English abstract up to October 14, 2019.

PROSPERO Registration: CRD42019153599 submitted to PROSPERO on 9th October 2019.

Publication title: A systematic review of the impact of emergency medical service practitioner experience and exposure to out of hospital cardiac arrest on patient outcomes.[1]
Publication date: 4th August 2020

Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2010 / 2015 / New question: New Question -2019

Last ILCOR Consensus on Science and Treatment Recommendation:
We suggest that EMS systems (1) monitor their clinical personnel's exposure to resuscitation and (2) implement strategies, where possible, to address low exposure or ensure that treating teams have members with recent exposure (weak recommendation, very low-certainty evidence).

2010/2015 Search Strategy: N/A

2020 Search Strategy: Database: Ovid MEDLINE(R) ALL <1946 to February 9, 2021>

1 advanced trauma life support care/
2 emergency medical service*.ti,ab.
3 EMS.ti,ab.
4 exp Emergency Medical Technicians/
5 Emergency Medical Technician*.ti,ab.

6 EMT.ti,ab.
7 "transportation of patients"/
8 ambulance*.ti,ab.
9 paramedic*.ti,ab.
10 prehospital.ti,ab.
11 pre-hospital.ti,ab.
12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 CPR.ti,ab.
14 exp Heart Massage/
15 exp cardiopulmonary resuscitation/
16 exp Electric Countershock/
17 13 or 14 or 15 or 16
18 exp Heart Arrest/
19 exp Ventricular Fibrillation/
20 exp Tachycardia, Ventricular/
21 18 or 19 or 20
22 exp Intubation, Intratracheal/
23 exp Laryngeal Masks/
24 Noninvasive Ventilation/
25 exp Epinephrine/
26 exp Drug Therapy/
27 22 or 23 or 24 or 25 or 26
28 21 and 27
29 17 or 28
30 experien*.ti,ab.
31 exposure*.ti,ab.
32 exp Health Knowledge, Attitudes, Practice/
33 exp Physician's Practice Patterns/
34 exp professional practice/
35 exp Nurse's Practice Patterns/
36 exp "Practice (Psychology)"/
37 novice*.ti,ab.
38 expert*.ti,ab.
39 exp Workload/
40 exp Professional Competence/
41 exp Benchmarking/
42 exp Psychomotor Performance/
43 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42
44 12 and 29 and 43
45 letter.pt.
46 comment.pt.
47 editorial.pt.
48 45 or 46 or 47

49 44 not 48
50 limit 49 to yr="2019 -Current"
Results 2019 through 09 Feb 2021 = 97 – 1 duplicate

Database searched: Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) 1946 to current
Date Search Completed: Tuesday 9th February 2021
Search Results (Number of articles identified / number identified as relevant): 96[2-97] / 0
Inclusion/Exclusion Criteria: Non-randomised (cohort) studies (prospective and retrospective), prognosis studies based on RCT data, case-control studies, are eligible for inclusion. All original research articles (both prospective and retrospective) will be included with no language restrictions. Unpublished studies (e.g., conference abstracts, trial protocols) will be excluded. Studies will be excluded if they are editorials, commentaries, case studies and case reports.

Link to Article Titles and Abstracts (if available on PubMed): Links to individual articles available in Appendix 1.

Summary of Evidence Update:
Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

No studies met the criteria, therefore no further evidence is available.

Relevant Guidelines or Systematic Reviews: 0

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations

RCT: 0

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: 0

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 (including whether meet criteria for formal review):

The search for this PICO was run up to 10th April 2020. The search for this Evidence Update was run from 2019-2021 and no further relevant papers were identified. Therefore, the results of this search do not meet the criteria for a formal review.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 5 Feb 2021 and 9 Feb 2021

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96. Jung H, Lee MJ, Cho JW, Lee SH, Lee SH, Mun YH, et al. External validation of multimodal termination of resuscitation rules for out-of-hospital cardiac arrest patients in the COVID-19 era. Scandinavian journal of trauma, resuscitation and emergency medicine. 2021;29(1):19.
97. Oude Alink MB, Moors XRJ, Karrar S, Houmes RJ, Hartog DD, Stolker RJ. Characteristics, management and outcome of prehospital pediatric emergencies by a Dutch HEMS. European journal of trauma and emergency surgery : official publication of the European Trauma Society. 2021.

Appendix One

Ref No.	PMID	Title	1st Author	Journal/Book	Relevant
1	31401135	One year experience with fast track algorithm in patients with refractory out-of-hospital cardiac arrest	Adler C	Resuscitation	No
2	30661423	Unexpected High Prevalence of Cardiovascular Disease Risk Factors and Psychiatric Disease Among Young People With Sudden Cardiac Arrest	Allan KS	Journal of the American Heart Association	No
3	31289342	Association of Prehospital Epinephrine Administration With Survival Among Patients With Traumatic Cardiac Arrest Caused By Traffic Collisions	Aoki M	Scientific reports	No
4	30412719	Early On-Scene Management of Pediatric Out-of-Hospital Cardiac Arrest Can Result in Improved Likelihood for Neurologically-Intact Survival	Banerjee PR	Resuscitation	No
5	31323120	Community first responders for out-of-hospital cardiac arrest in adults and children	Barry T	The Cochrane database of systematic reviews	No
6	30912467	Timing of Advanced Airway Placement after Witnessed Out-of-Hospital Cardiac Arrest	Benoit JL	Prehospital emergency care	No
7	31076474	Resuscitative endovascular balloon occlusion of the aorta (REBOA) in non-traumatic out-of-hospital cardiac arrest: evaluation of an educational programme	Brede JR	BMJ open	No
8	31862028	Seat belt use in the ambulance patient compartment by emergency medical services professionals is low regardless of patient presence, seating position, or patient acuity	Cash RE	Journal of safety research	No
9	31427472	Phenomenological study exploring ethics in prehospital research from the paramedic's perspective: experiences from the Paramedic-2 trial in a UK ambulance service	Charlton K	EMJ	No
10	31413055	Respiratory arrest requiring resuscitation as a rare presentation of obstructive sleep apnoea and hypothyroidism	Chiang KY	BMJ case reports	No
11	30060961	Long-Term Outcomes of Out-of-Hospital Cardiac Arrest Care at Regionalized Centers	Elmer J	Annals of emergency medicine	No
12	31198133	Expert consensus on the first responder of the first aid	First Aid Professional Committee Of Chinese Aging Well	Zhonghua Wei Zhong Bing Ji Jiu Yi Xue (Chinese Critical Care Medicine)	No
13	30192687	Feasibility of Out-of-Hospital Cardiac Arrest Ultrasound by EMS Physicians	Fitzgibbon JB	Prehosp Emerg Care	No
14	31204644	Predictors of Prehospital On-Scene Time in an Australian Emergency Retrieval Service	Fok PT	Prehospital and disaster medicine	No

15	30420231	Hypothermic Cardiac Arrest With Full Neurologic Recovery After Approximately Nine Hours of Cardiopulmonary Resuscitation: Management and Possible Complications	Forti A	Annals of emergency medicine	No
16	30427769	Intra-Arrest Induction of Hypothermia via Large-Volume Ice-Cold Saline for Sudden Cardiac Arrest: The New York City Project Hypothermia Experience	Freese J	Therapeutic hypothermia and temperature management	No
17	31753873	Experiences among firefighters and police officers of responding to out-of-hospital cardiac arrest in a dual dispatch programme in Sweden: an interview study	Hasselqvist-Ax I	BMJ open	No
18	30914082	Chinese expert consensus on the clinical application of innovative first-aid resuscitation technology for traumatic shock in 2019	Health Emergency Committee Of Chinese Research Hospital	Zhonghua Wei Zhong Bing Ji Jiu Yi Xue (Chinese Critical Care Medicine)	No
19	31448300	Medical Supervision of High School Athletics in Chicago: A Follow-up Study.	Jones NS	Orthopaedic journal of sports medicine	No
20	30737554	Sign of Life is Associated with Return of Spontaneous Circulation After Resuscitative Thoracotomy: Single Trauma Center Experience of Republic of Korea	Kang BH	World journal of surgery	No
21	30001817	Prehospital advanced cardiac life support by EMT with a smartphone-based direct medical control for nursing home cardiac arrest	Kim C	The American journal of emergency medicine	No
22	31791962	Paramedic attitudes and experiences of enrolling patients into the PARAMEDIC-2 adrenaline trial: a qualitative survey within the London Ambulance Service	Lazarus J	BMJ open	No
23	30639789	The effect of dispatcher-assisted cardiopulmonary resuscitation on early defibrillation and return of spontaneous circulation with survival	Lee SY	Resuscitation	No
24	29200138	Dispatcher-Assisted Cardiopulmonary Resuscitation Program and Outcomes After Pediatric Out-of-Hospital Cardiac Arrest	Lee YJ	Pediatric emergency care	No
25	31323187	A centralized system for providing dispatcher assisted CPR instructions to 9-1-1 callers at multiple municipal public safety answering points	Lerner EB	Resuscitation	No
26	31420707	Analysis of a first responder system for emergency medical care in rural areas: first results and experiences	Lichtenhahn A	Anaesthesist	No
27	31946179	ECG-based Random Forest Classifier for Cardiac Arrest Rhythms	Manibardo E	Annual International Conference of the IEEE Engineering in	No

				Medicine and Biology Society	
28	30375018	Public knowledge and expectations about dispatcher assistance in out-of-hospital cardiac arrest	Mathiesen WT	J Adv Nurs	No
29	31150086	Sex Disparities in Receipt of Bystander Interventions for Students Who Experienced Cardiac Arrest in Japan	Matsui S	JAMA network open	No
30	30562597	Maternal out-of-hospital cardiac arrest: A retrospective observational study	Maurin O	Resuscitation	No
31	33328822	Awareness of CPR-induced consciousness by UK paramedics	Mays B	British paramedic journal	No
32	30643596	Randomized Controlled Trial of Simulation vs. Standard Training for Teaching Medical Students High-quality Cardiopulmonary Resuscitation	McCoy CE	West J Emerg Med	No
33	31687999	Implementation of a Team-Focused High-Performance CPR (TF-HP-CPR) Protocol Within a Rural Area EMS System	McHone AJ	Advanced emergency nursing journal	No
34	30759497	Human factors influencing out-of-hospital cardiac arrest survival	Morgan DP	EMA	No
35	30612478	Community-Wide Dissemination of Bystander Cardiopulmonary Resuscitation and Automated External Defibrillator Use Using a 45-Minute Chest Compression-Only Cardiopulmonary Resuscitation Training	Nishiyama C	Journal of the American Heart Association	No
36	30395025	A National Survey on Interhospital Transport of Children in Cardiac Arrest	Noje C	Pediatric critical care medicine	No
37	31842928	First-response treatment after out-of-hospital cardiac arrest: a survey of current practices across 29 countries in Europe	Oving I	Scand J Trauma Resusc Emerg Med	No
38	30863269	The Effect of Transport Time Interval on Neurological Recovery after Out-of-Hospital Cardiac Arrest in Patients without a Prehospital Return of Spontaneous Circulation	Park JH	J Korean Med Sci	No
39	30760298	Challenges of helicopter mountain rescue missions by human external cargo: need for physicians onsite and comprehensive training	Pietsch U	Scand J Trauma Resusc Emerg Med	No
40	30677440	Association between county-level cardiopulmonary resuscitation training and changes in Survival Outcomes after out-of-hospital cardiac arrest over 5 years: A multilevel analysis	Ro YS	Resuscitation	No
41	30736841	Design and implementation of a large and complex trial in emergency medical services	Robinson MJ	Trials	No
42	30953710	Sports activity and paediatric out-of-hospital cardiac arrest at schools in Japan	Sado J	Resuscitation	No
43	30961651	Drone delivery of an automated external defibrillator - a mixed method simulation study of bystander experience	Sanfridsson J	Scand J Trauma Resusc Emerg Med	No
44	31148319	Study Monitoring in Emergency Care Trials: Lessons from the Resuscitation Outcomes Consortium Continuous Chest Compressions Trial	Schmicker RH	Academic emergency medicine	No

45	31243246	A case of post-cardiac arrest syndrome presenting with lateralized periodic discharges evolving to a cyclic seizure pattern on electroencephalogram	Shimozono K	Rinsho shinkeigaku = Clinical neurology	No
46	30976922	Comparison of Miller laryngoscope and UEScope videolaryngoscope for endotracheal intubation in four pediatric airway scenarios: a randomized, crossover simulation trial	Smereka J	European journal of pediatrics	No
47	30760297	Comparison of two different intraosseous access methods in a physician-staffed helicopter emergency medical service - a quality assurance study	Sorgjerd R	Scand J Trauma Resusc Emerg Med	No
48	31350237	Citizen bystander-patient relationship and 1-month outcomes after out-of-hospital cardiac arrest of cardiac origin from the All-Japan Utstein Registry: a prospective, nationwide, population-based, observational study	Suematsu Y	BMJ open	No
49	31610226	The effects of route of admission to a percutaneous coronary intervention centre among patients with out-of-hospital cardiac arrest	Suh J	Resuscitation	No
50	30827315	Clinical effect of cardiopulmonary resuscitation with active abdominal compression-decompression	Zhan F	Zhonghua Wei Zhong Bing Ji Jiu Yi Xue (Chinese Critical Care Medicine)	No
51	31494073	Willingness and obstacles of healthcare professionals to perform bystander cardiopulmonary resuscitation in China	Zhou G	International emergency nursing	No
52	32000691	To strengthen self-confidence as a step in improving prehospital youth laymen basic life support	Abelsson A	BMC emergency medicine	No
53	3301034	Treatment of out-of-hospital cardiac arrest in the COVID-19 era: A 100 days experience from the Lombardy region	Baldi E	PloS one	No
54	32580006	Improving response to out-of-hospital cardiac arrest: The verified responder program pilot	Blackwood J	Resuscitation	No
55	32944473	Emergency Clinician Experiences Using a Standardized Communication Tool for Cardiac Arrest	Carr C	Cureus	No
56	32191212	Mutual-Aid Mobile App for Emergency Care: Feasibility Study	Chien S-C	JMIR formative research	No
57	32161078	Toxic inhalational injury	Davies V	BMJ case reports	No
58	32185765	Assessment of firearm injuries undergoing advanced airway management: Role II hospital experience	Eksert S	Ulus Travma Acil Cerrahi Derg	No
59	32930759	Association of Intra-arrest Transport vs Continued On-Scene Resuscitation With Survival to Hospital Discharge Among Patients With Out-of-Hospital Cardiac Arrest	Grunau B	JAMA	No
60	32720767	Public willingness to perform cardiopulmonary resuscitation: Knowledge, attitudes, and barriers	Hanassi E	Harefuah	No
61	31335406	Oligoanalgesia in Patients With an Initial Glasgow Coma Scale Score >=8 in a Physician-Staffed Helicopter Emergency Medical Service: A Multicentric Secondary Data Analysis of >100,000 Out-of-Hospital Emergency Missions	Helm M	Anesthesia and analgesia	No

62	32142489	A National Survey on Physician Trainee Participation in Pediatric Interfacility Transport	Herrup EA	Pediatric critical care medicine	No
63	32986490	Predictive Utility of End-Tidal Carbon Dioxide on Defibrillation Success in Out-of-Hospital Cardiac Arrest	Hubble MW	Prehospital emergency care	No
64	32282707	Prognostic factors for neurological outcomes in Korean targeted temperature management recipients with return of spontaneous circulation after out-of-hospital cardiac arrests: A nationwide observational study	Kim JG	Medicine	No
65	32502575	Association between hourly call volume in the emergency medical dispatch center and dispatcher-assisted cardiopulmonary resuscitation instruction time in out-of-hospital cardiac arrest	Kim TH	Resuscitation	No
66	32507572	Rapid outdoor non-compression intubation (RONCI) of cardiac arrests to mitigate COVID-19 exposure to emergency department staff	Kinney B	The American journal of emergency medicine	No
67	31870923	Effect of awareness time interval for out-of-hospital cardiac arrest on outcomes: A nationwide observational study	Ko SY	Resuscitation	No
68	32445305	Survival from Out-of-Hospital Cardiac Arrest - Comparing the Automated LUCAS-2 Device and Manual CPR	Kupershmidt S	South Dakota medicine	No
69	32088981	Telecommunicator Cardiopulmonary Resuscitation: A Policy Statement From the American Heart Association	Kurz MC	Circulation	No
70	31779716	Dispatcher Identification of Out-of-Hospital Cardiac Arrest and Neurologically Intact Survival: A Retrospective Cohort Study	Mapp JG	Prehospital and disaster medicine	No
71	32664127	Novel airway device Vie Scope in several pediatric airway scenario: A randomized simulation pilot trial	Maslanka M	Medicine	No
72	32348041	Emergency Medical Services: COVID-19 crisis	Maudet L	Rev Med Suisse	No
73	32497484	myResponder Smartphone Application to Crowdsource Basic Life Support for Out-of-Hospital Cardiac Arrest: The Singapore Experience	Ming Ng W	Prehospital emergency care	No
74	31813404	The Effect of Operator Position on the Quality of Chest Compressions Delivered in a Simulated Ambulance	Mullin S,	Prehospital and disaster medicine	No
75	33014759	Indicators Related to Cardiopulmonary Resuscitation According to Occupation Among Family Members of Coronary Heart Disease Patients	Oh G-J	Chonnam medical journal	No
76	32211207	Factors Associated with High-Quality Cardiopulmonary Resuscitation Performed by Bystander	Park HJ	Emergency medicine international	No
77	32711548	Mechanical chest compression devices in the helicopter emergency medical service in Switzerland	Pietsch U	Scand J Trauma Resusc Emerg Med	No

78	32154386	Brought in dead cases to a tertiary referral paediatric emergency department in India: a prospective qualitative study	Praveen K	BMJ paediatrics open	No
79	32293276	Comparison of videolaryngoscopy and direct laryngoscopy by German paramedics during out-of-hospital cardiopulmonary resuscitation; an observational prospective study	Risse J	BMC emergency medicine	No
80	32918983	Survival after dispatcher-assisted cardiopulmonary resuscitation in out-of-hospital cardiac arrest	Riva G	Resuscitation	No
81	30601348	Use of Capnography and Cardiopulmonary Resuscitation Feedback Devices Among Prehospital Advanced Life Support Providers	Sahyoun C	Pediatric emergency care	No
82	31669756	Effectiveness of a community based out-of-hospital cardiac arrest (OHCA) interventional bundle: Results of a pilot study	Tay PJM	Resuscitation	No
83	32634172	Optimal paramedic numbers in resuscitation of patients with out-of-hospital cardiac arrest: A randomized controlled study in a simulation setting	Tsai BM	PloS one	No
84	3219295	Aeromedical helicopter transport of prisoners: The Mexico City experience	Urquieta E	The American journal of emergency medicine	No
85	33320725	Prehospital Providers' Perspectives about Online Medical Direction in Emergency End-of-Life	Waldrop DP	Prehospital emergency care	No
86	33350794	Intravenous vs intraosseous adrenaline administration in cardiac arrest: A protocol for systematic review and meta-analysis	Zhang W	Medicine	No
87	31982506	Intravenous versus intraosseous adrenaline administration in out-of-hospital cardiac arrest: A retrospective cohort study	Zhang Y	Resuscitation	No
88	33227397	Impact of perceived inappropiate cardiopulmonary resuscitation on emergency clinicians' intention to leave the job: Results from a cross-sectional survey in 288 centres across 24 countries	Druwe P	Resuscitation	No

Ref No.	PMID	Title	1st Author	Journal/Book	Relevant
89	30839376	Cardiac Arrest in Special Circumstances-Recent Advances in Resuscitation	Cimpoesu D	American Journal of Therapeutics	No
90	33504366	External validation of multimodal termination of resuscitation rules for out-of-hospital cardiac arrest patients in the COVID-19 era	Jung H	Scandinavian journal of trauma, resuscitation and emergency medicine	No
91	33326454	Effectiveness of bystander cardiopulmonary resuscitation in improving the survival and neurological recovery of patients with out-of-hospital cardiac arrest: A nationwide patient cohort study	Lee J	PloS one	No

92	30630680	Nighttime is associated with decreased survival for out of hospital cardiac arrests: A meta-analysis of observational studies	Lin P	The American journal of emergency medicine	No
93	33002969	Uses and pitfalls of measurement of end-tidal carbon dioxide during cardiac arrest	Nicholson TC	Current opinion in critical care	No
94	33543366	Characteristics, management and outcome of prehospital pediatric emergencies by a Dutch HEMS	Oude Alink MB	European journal of trauma and emergency surgery : official publication of the European Trauma Society	No
95	31751104	EMS, Flight Stressors and Corrective Action	Salzman SM	https://www.statpearls.com/	No
96	30722802	What is the impact of physicians in prehospital treatment for patients in need of acute critical care? - An overview of reviews	Valentin G	International journal of technology assessment in health care	No

2021 Evidence Update Worksheet
Appendix B3 EIT 2

Worksheet author(s): Sebastian Schnaubelt
Date Submitted: 26 January 2021

PICO / Research Question:
High-fidelity training (EIT 623: EvUp 2020)

Population: For participants undertaking advanced life support training in an education setting
Intervention: does the use of high-fidelity manikins
Comparators: compared with the use of low-fidelity manikins
Outcomes: change improve patient outcomes, skill performance in actual resuscitations, skill/knowledge at 1 year, skill/knowledge at time between course conclusion and 1 year, skill/knowledge at course conclusion
Study Designs: Screening of and data extraction from: Guidelines, reviews, meta-analyses, randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies). Unpublished studies (e.g., conference abstracts, trial protocols) were excluded.
Timeframe: From 1/1/2019 and all languages were included as long as there is an English abstract. The search was performed on 25 January 2021.

Outcomes: As above
Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2019

Last ILCOR Consensus on Science and Treatment Recommendation:
We suggest the use of high-fidelity manikins when training centers/organizations have the infrastructure, trained personnel, and resources to maintain the program (weak recommendations based on very-low-quality evidence). If high-fidelity manikins are not available, we suggest that the use of low-fidelity manikins is acceptable for standard ALS training in an educational setting (weak recommendations based on low-quality evidence).

2019 Search Strategy:
(((("education"[Subheading] OR "education"[All Fields] OR "educational status"[MeSH Terms] OR ("educational"[All Fields] AND "status"[All Fields]) OR "educational status"[All Fields] OR "education"[All Fields] OR "education"[MeSH Terms]) AND (("resuscitation"[MeSH Terms] OR "resuscitation"[All Fields]) OR (("life"[MeSH Terms] OR "life"[All Fields]) AND support[All Fields]))) AND (simulator[All Fields] OR ("manikins"[MeSH Terms] OR "manikins"[All Fields] OR "mannequin"[All Fields]) OR ("manikins"[MeSH Terms] OR "manikins"[All Fields] OR "manikin"[All Fields]))) AND (fidelity[All Fields] OR high-fidelity[All Fields] OR (("physical examination"[MeSH Terms] OR ("physical"[All Fields] AND "examination"[All Fields]) OR "physical examination"[All Fields] OR "physical"[All Fields]) AND ("World AIDS Day Features"[Journal] OR "features"[All Fields])))
2021 Search Strategy:

((("education"[Subheading] OR "education"[All Fields] OR "educational status"[MeSH Terms] OR ("educational"[All Fields] AND "status"[All Fields]) OR "educational status"[All Fields] OR "education"[All Fields] OR "education"[MeSH Terms]) AND (("resuscitation"[MeSH Terms] OR "resuscitation"[All Fields]) OR (("life"[MeSH Terms] OR "life"[All Fields]) AND support[All Fields]))) AND (simulator[All Fields] OR ("manikins"[MeSH Terms] OR "manikins"[All Fields] OR "mannequin"[All Fields]) OR ("manikins"[MeSH Terms] OR "manikins"[All Fields] OR "manikin"[All Fields]))) AND (fidelity[All Fields] OR high-fidelity[All Fields] OR (("physical examination"[MeSH Terms] OR ("physical"[All Fields] AND "examination"[All Fields]) OR "physical examination"[All Fields] OR "physical"[All Fields])))

Database searched: PubMed, Scopus, Embase
Date Search Completed: 25 January 2021
Search Results (Number of articles identified / number identified as relevant): 76, of which 5 are relevant
Inclusion Criteria: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies). Reviews were screened for additional literature.
Exclusion: Letters, editorials, comments, case reports, studies not comparing high-fidelity training with lower-fidelity models (e.g. high-fidelity vs. no additional training).

Link to Article Titles and Abstracts (if available on PubMed):
[1] https://pubmed.ncbi.nlm.nih.gov/30928503
[2] https://pubmed.ncbi.nlm.nih.gov/31151450
[3] https://pubmed.ncbi.nlm.nih.gov/30665397
[4] https://pubmed.ncbi.nlm.nih.gov/30643596
[5] https://pubmed.ncbi.nlm.nih.gov/32163038
[6] https://pubmed.ncbi.nlm.nih.gov/33098918/

Summary of Evidence Update: PubMed, Scopus and Embase were searched to identify eligible studies providing new information between 01/01/2019 and 25/01/2021. Almost the same search strategy was used ("World AIDS day" was left out) as in the last Evidence Update 2019. After removing duplicates, 76 abstracts were screened. Most studies did not meet inclusion criteria, either due to not reporting on advanced life support, or due to not comparing high-fidelity with low-fidelity training. One new systematic review was identified [1]. However, it did not provide additional information that had not been assessed in the previous Evidence Update. Three randomized controlled trials [2-4] reported comparisons of high- and low-fidelity training in medical students: One study [4] reported on technical CPR skills (with the high-fidelity group mostly performing better), a second one [3] on non-technical skills such as self-assessment (suggesting over-confidence induced by high-fidelity training), and a third [2] compared low-fidelity training with a combination of high-fidelity training and problem-based learning (reporting a higher percentage of overall "sufficient" CPR and shorter hands-off times both at time of the course and six months later). One prospective observational study [5] compared virtual reality training with high-fidelity training, concluding on better cost-effectiveness of virtual reality, but on more valuable feedback in the high-fidelity training group as felt by the participants.

Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Relevant Guidelines or Systematic Reviews (2)

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
Greif, 2020 [6]	Guideline (Education, Implementation, and Teams: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations)	Same as current update	3 (Evidence Update)	See treatment recommendations	We suggest the use of high-fidelity manikins when training centers/organizations have the infrastructure, trained personnel, and resources to maintain the program (weak recommendations, very low-quality evidence). If high-fidelity manikins are not available, we suggest that the use of low-fidelity manikins is acceptable for standard ALS training in an educational setting (weak recommendations, low-quality evidence).
Au, 2019 [1]	Improving Skills Retention after Advanced Structured Resuscitation Training: A Systematic Review of Randomized Controlled Trials	Interventions improving skills retention following structured resuscitation training programs	3	No additional information as the review only assessed literature already included in the last Evidence Update	Merely having a high-fidelity mannequin alone for simulation was found to have minimal effect on skills retention.

RCT (3)

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
Berger, 2019 [2]	Evaluation of effects of "classic" CPR education compared with bilateral approach (problem-based learning PLUS high-fidelity training); prospective, randomised, single-blinded interventional study; N=112	Medical students	45-minutes problem-based learning PLUS 45-minutes high-fidelity training / 90-minutes tutor-guided CPR training	52% (intervention) vs. 13% (controls), p=0.007) met "criteria of sufficient CPR" at course and 71% vs. 55% (p=0.550) at 6-months follow-up; 24% vs. 28% hands-off time (p=0.007) at course and 24% vs. 31% (p=0.006) at 6-months follow-up; no difference in details regarding compression	Comparison of high-fidelity training only together with problem-based learning, ergo no "pure" comparison

Massoth, 2019 [3]	Evaluation of the intervention of "improved realism" ant its impact on personal confidence and self-assessment; Prospective randomized trial; N=135	Medical students	High-fidelity training / Low-fidelity training	Self-assessment on whether participants considered themselves to be advantaged based on their group allocation before- and after training; Before training (but after group allocation), 84% of high-fidelity participants vs 69% of low-fidelity participants (p=0.038) believed there was a correlation between the extent of fidelity and learning success; After training, 88% of high-fidelity participants vs. 38% of low-fidelity participants (p<0.001) considered high-fidelity training to be superior	Secondary endpoints: Practical performance (high-fidelity group performing significantly worse in breathing control, chest compressions while defibrillator charging, ECG analysis, time interval between shocks) & growth in theoretical knowledge (no difference) before- and after training; High-fidelity training led to equal or even worse performance compared to low-fidelity training, also inducing over-confidence. High-fidelity training was described as an "adverse learning tool".
McCoy, 2019 [4]	Comparison of effectiveness of high-fidelity training vs. "standard training" in "high-quality CPR" education; Prospective randomized trial; N=70	Medical Students	High-fidelity training / Low-fidelity training	CPR quality (compression rate/depth/recoil/fraction); Compression depth 4.6cm [4.3-4.8] (high-fidelity) vs 3.9cm [3.5-4.3] (low-fidelity), p=0.02; Compression fraction 0.72 [0.70-0.75] vs 0.68 [0.66-0.70], p=0.01; No difference in compression rate or recoil;	Time to EMS activation; 24.7sec [15.7-40.8] (high-fidelity) vs 79.5 [44.8-119.6] (low-fidelity), p=0.007;

Nonrandomized Trials, Observational Studies (1)

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)
Katz, 2020 [5]	Comparison of virtual reality vs high-fidelity training; Prospective observational study; N=23		year-2-residents	self-reported satisfaction (no difference), utility scores (no difference), technical skills (no difference), subjective grading of given feedback (points given: high-fidelity 99 [89-100] vs virtual reality 79 [71-88], p<0.001)	virtual reality is more cost-effective, high-fidelity training provides better feedback

Abbreviations: RCT = randomized controlled trial; CPR = cardiopulmonary resuscitation; EMS = emergency medical services.

Reviewer Comments (including whether meet criteria for formal review):

A systematic review of studies up until 2015 found a moderate benefit of high-fidelity training for skill improvement immediately following course completion. An Evidence Update in 2019 found additional RCTs with either no difference or improved knowledge retention. Since then, two RCTs strengthen the evidence towards slightly improved learning outcomes in high-fidelity groups. However, another RCT suggested possible over-confidence induced in participants. This evidence does not trigger another systematic review or a change in the wording / strength of recommendation or level of evidence.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn: ILCOR SAC member (EIT T/F) on 6 Feb 2021

Reference list

1. Au K, Lam D, Garg N, Chau A, Dzwonek A, Walker B, et al. Improving skills retention after advanced structured resuscitation training: A systematic review of randomized controlled trials. Resuscitation. 2019;138:284-296.
2. Berger C, Brinkrolf P, Ertmer C, Becker J, Friederichs H, Wenk M, et al. Combination of problem-based learning with high-fidelity simulation in CPR training improves short and long-term CPR skills: a randomised single blinded trial. BMC Med Educ. 2019;19(1):180.
3. Massoth C, Roeder H, Ohlenburg H, Hessler M, Zarbock A, Poepping DM, et al. High-fidelity is not superior to low-fidelity simulation but leads to overconfidence in medical students. BMC Med Educ. 2019;19(1):29.
4. McCoy CE, Rahman A, Rendon JC, Anderson CL, Langdorf MI, Lotfipour S, et al. Randomized Controlled Trial of Simulation vs. Standard Training for Teaching Medical Students High-quality Cardiopulmonary Resuscitation. West J Emerg Med. 2019;20(1):15-22.
5. Katz D, Shah R, Kim E, Park C, Shah A, Levine A, et al. Utilization of a Voice-Based Virtual Reality Advanced Cardiac Life Support Team Leader Refresher: Prospective Observational Study. J Med Internet Res. 2020;22(3):e17425.
6. Greif R, Bhanji F, Bigham BL, et al. Education, Implementation, and Teams: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation. 2020;156:A188-A239.

2021 Evidence Update Worksheet
Appendix B3 EIT 3

Worksheet author(s): Joyce Yeung
Date Submitted: 08/02/2021

PICO / Research Question: Cardiac Arrest Centers (EIT 624)
Population: Adults with attempted resuscitation after non-traumatic in-hospital (IHCA) or out-of-hospital cardiac arrest (OHCA).
Intervention: Care at a specialized cardiac arrest centre.
Comparator: Care in an institute not designated as a specialized cardiac arrest centre.
Outcomes: Primary outcomes were Survival at 30 days with favorable neurological outcome (CRITICAL) and
Survival at hospital discharge with favorable neurological outcome (CRITICAL). Secondary outcomes were: Return of spontaneous circulation (ROSC) post hospital admission for patients with ongoing CPR (IMPORTANT), Survival at 30 days (CRITICAL) and Survival at hospital discharge (CRITICAL)
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. Unpublished studies (e.g., conference abstracts, trial protocols) were excluded. Studies reporting paediatric cardiac arrests (≤18 years old) and cardiac arrest secondary to trauma were excluded.
Timeframe:
All years and all languages were included provided there was an English abstract. The literature search was updated from 1st Aug 2018 to 2nd Feb 2021

Additional Evidence Reviewer(s): NA
Conflicts of Interest (financial/intellectual, specific to this question): None

Year of last full review: Systematic review search date 1st Aug 2018

Last ILCOR Consensus on Science and Treatment Recommendation:
We suggest that adult patients with non-traumatic OHCA cardiac arrest be cared for in CACs rather than in non-CACs (weak recommendation, very low certainty of evidence).
We cannot make a recommendation for or against regional triage by primary EMS transport of patients with OHCA to a CAC by primary EMS transport (bypass protocols) or secondary interfacility transfer to a CAC. The current evidence is inconclusive and confidence in the effect estimates is currently too low to support an EIT and ALS Task Force recommendation.
For patients with in-hospital cardiac arrest, we found no evidence to support an EIT and ALS Task Force recommendation.
For the subgroup of patients with shockable or non-shockable initial cardiac rhythm, the current evidence is inconclusive, and the confidence in the effect estimates is currently too low to support an EIT and ALS Task Force recommendation.

2018 Search Strategy:
Sample search strategy provided in Appendix of Yeung J, Matsuyama T, Bray J, Reynolds J, Skrifvars MB. Does care at a cardiac arrest centre improve outcome after out-of-hospital cardiac arrest? - A systematic review. Resuscitation. 2019;137:102-115.(1)

2021 Search Strategy:
Ovid MEDLINE(R) ALL <1946 to February 4, 2021>

[“Cardiac Care Facilities/” OR “Cardiology Service, Hospital/” OR “Regional Medical Programs/” OR (Heart attack Centre* or Heart Attack Center* or cardiac arrest centre* or cardiac arrest center*).ab,kf,ti.OR fifth link.ab,kf,ti. OR (cardiac resuscitation center* or cardiac resuscitation centre* or regional cardiac resuscitation).ab,kf,ti. OR (CRC or CRC*).ab,kf,ti. OR (regional system* or network or hospital volume or patient volume).ab,kf,ti. OR (Cardiac Receiving Center* or Cardiac Receiving Centre*).ab,kf,ti. OR (post cardiac arrest adj1 (care or treatment)).ab,kf,ti. OR (postcardiac arrest adj1 (care or treatment)).ab,kf,ti. OR (post resuscitation adj1 (care or treatment)).ab,kf,ti. OR (postresuscitation adj1 (care or treatment)).ab,kf,ti. OR "Cardiac Care Facilit*".ab,kf,ti. OR (Cardiac adj2 (Centre* or Center*)).ab,kf,ti. OR (Cardiology adj1 (Service or care) adj2 Hospital).ab,kf,ti. OR (Cardiovascular adj1 (Centre or Center)).ab,kf,ti. OR cardiac catheterisation laboratory.ab,kf,ti. OR (CAC or CACs).ab,kf,ti. OR Tertiary Care Centers/ OR (Tertiary adj1 (care or Center* or Centre*)).ab,kf,ti. OR Cardiac Arrest Registry.ab,kf,ti. OR ("Critical care medical center*" or "Critical care medical centre*").ab,kf,ti. OR ("critical care centre*" or "critical care center*").ab,kf,ti.] AND [heart arrest/ or out-of-hospital cardiac arrest/ OR cardiopulmonary resuscitation/ or advanced cardiac life support/ OR Death, Sudden, Cardiac/ OR Out of Hospital Cardiac Arrest.ab,kf,ti. OR OHCA.ab,kf,ti. OR return of spontaneous circulation.ab,kf,ti.OR ROSC.ab,kf,ti. OR ((heart or cardiac or cardiovascular) adj1 arrest).ab,kf,ti. OR asystole.ab,kf,ti. OR pulseless electrical activity.ab,kf,ti. OR Advanced Cardiac Life Support.ab,kf,ti. OR ACLS.ab,kf,ti. OR Ventricular Fibrillation/ OR (cardiopulmonary arrest or cardiopulmonary resuscitation).ab,kf,ti. OR (Cardio-pulmonary arrest or cardio-pulmonary resuscitation or CPR).ab,kf,ti. OR code blue.ab,kf,ti.] NOT [exp Organ Transplantation/ or "transplant*".ab,kf,ti. OR Animals/ not (Animals/ and Humans/) OR (letter or comment or editorial).pt.]

Embase <1947 to 2021 February 4>

[heart center/ OR cardiology service/ OR "Regional Medical Program*".ab,hw,ti. OR (Heart attack Centre* or Heart Attack Center* or cardiac arrest centre* or cardiac arrest center*).ab,hw,ti. OR "Cardiology Service*".ab,hw,ti. OR fifth link.ab,hw,ti. OR (cardiac resuscitation center* or cardiac resuscitation centre* or regional cardiac resuscitation).ab,hw,ti.

OR (CRC or CRC*).ab,hw,ti. OR (regional system* or network or hospital volume or patient volume).ab,hw,ti.OR (Cardiac Receiving Center* or Cardiac Receiving Centre*).ab,hw,ti. OR (post cardiac arrest adj1 (care or treatment)).ab,hw,ti. OR (postcardiac arrest adj1 (care or treatment)).ab,hw,ti. OR (post resuscitation adj1 (care or treatment)).ab,hw,ti. OR (postresuscitation adj1 (care or treatment)).ab,hw,ti. OR "Cardiac Care Facilit* ".ab,hw,ti. OR (Cardiac adj2 (Centre* or Center*)).ab,hw,ti. OR (Cardiology adj1 (Service or care) adj2 Hospital).ab,hw,ti. OR (Cardiovascular adj1 (Centre or Center)).ab,hw,ti. OR cardiac catheterisation laboratory.ab,hw,ti. OR (CAC or CACs).ab,hw,ti. OR tertiary care center/ OR (Tertiary adj1 (care or Center* or Centre*)).ab,hw,ti. OR Cardiac Arrest Registry.ab,hw,ti. OR ("Critical care medical center*" or "Critical care medical centre*").ab,hw,ti. OR ("critical care centre*" or "critical care center*").ab,hw,ti.] AND [heart arrest/ or cardiopulmonary arrest/ or "out of hospital cardiac arrest"/ or sudden cardiac death/ OR cardiac life support.ab,hw,ti. OR OHCA.ab,hw,ti. OR "return of spontaneous circulation"/ OR ((heart or cardiac or cardiovascular) adj1 arrest).ab,hw,ti. OR asystole.ab,hw,ti. OR pulseless electrical activity.ab,hw,ti. OR ACLS.ab,hw,ti. OR heart ventricle fibrillation/ OR (cardiopulmonary arrest or cardiopulmonary resuscitation).ab,hw,ti. OR (Cardio-pulmonary arrest or cardio-pulmonary resuscitation or CPR).ab,hw,ti. OR code blue.ab,hw,ti.] NOT [exp organ transplantation/ or "transplant*".ab,hw,ti.OR exp animal/ not (exp animal/ and human/) OR(Conference abstract or conference paper or conference review or book or editorial or letter).pt.]

Cochrane <search date 2021 February 4>

[MeSH [Cardiac Care Facilities] exp OR MeSH [Cardiology Service, Hospital] exp OR (Heart attack Centre* or Heart Attack Center* or cardiac arrest centre* or cardiac arrest center*):ti,kw,ab OR MeSH: [Regional Medical Programs] exp OR ("fifth link"):ti,kw,ab OR (cardiac resuscitation center* or cardiac resuscitation centre* or regional cardiac resuscitation):ti,kw,ab OR (regional system* or network or hospital volume or patient volume or Cardiac Receiving Center* or Cardiac Receiving Centre*):ti,kw,ab OR

("post cardiac arrest care" or "post cardiac arrest treatment"):ti,kw,ab OR (postcardiac arrest care or postcardiac arrest treatment):ti,kw,ab OR ("post resuscitation care" or "post resuscitation treatment"):ti,kw,ab OR (postresuscitation care or postresuscitation treatment):ti,kw,ab OR (Cardiac Care Facilit*):ti,kw,ab OR

(Cardiac centre* or Cardiac center*):ti,kw,ab OR (Cardiovascular centre* or Cardiovascular center*):ti,kw,ab OR (cardiac catheterisation laboratory):ti,kw,ab OR MeSH: [Tertiary Care Centers] exp OR

(Tertiary care or Tertiary center* or Tertiary centre*):ti,kw,ab OR (Cardiac Arrest Registry):ti,kw,ab OR

(Critical care medical center* or Critical care medical centre* or critical care centre* or critical care center*):ti,kw,ab] AND [MeSH: [Heart Arrest] exp OR MeSH: [Cardiopulmonary Resuscitation] exp OR (Hospital Cardiac Arrest or OHCA or return of spontaneous circulation or ROSC or asystole):ti,kw,ab OR

("heart arrest" or "cardiac arrest" or "cardiovascular arrest"):ti,kw,ab OR (pulseless electrical activity or cardiopulmonary arrest or cardiopulmonary resuscitation or Cardio-pulmonary arrest or cardio-pulmonary resuscitation or CPR or ACLS):ti,kw,ab OR MeSH: [Ventricular Fibrillation] exp] NOT [MeSH: [Organ Transplantation] exp OR (transplant*):ti,kw,ab]

Database searched: OVID Medline, Embase, Cochrane
Date Search Completed: 4th Feb 2021
Search Results (Number of articles identified / number identified as relevant): 1680 articles identified/12 articles identified as relevant

Inclusion/Exclusion Criteria: Published randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) reporting data from adult patients were included.

Link to Article Titles and Abstracts (if available on PubMed):
Sinning 2020 https://pubmed.ncbi.nlm.nih.gov/33327761/
Kelham 2020 https://pubmed.ncbi.nlm.nih.gov/33241716/
Park 2020 https://pubmed.ncbi.nlm.nih.gov/32114072/
von Vopelius-Feldt 2021 (in press)
Amagasa 2019 https://pubmed.ncbi.nlm.nih.gov/30802557/
Balian 2019 https://pubmed.ncbi.nlm.nih.gov/30771450/
Kashiura 2020 https://pubmed.ncbi.nlm.nih.gov/32466859/
Akintoye 2020 https://pubmed.ncbi.nlm.nih.gov/31945429/
Czarnecki 2019 https://pubmed.ncbi.nlm.nih.gov/31822122/
Chien 2020 https://pubmed.ncbi.nlm.nih.gov/32458720/
Choi 2020 https://pubmed.ncbi.nlm.nih.gov/32599840/
Platt 2020 https://pubmed.ncbi.nlm.nih.gov/33456384/

Summary of Evidence Update:
Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Relevant Guidelines or Systematic Reviews

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
Association for Acute Cardiovascular Care of European Society of Cardiology, European Association of Percutaneous Coronary Interventions, European Heart Rhythm Association, ERC, European Society of Emergency Medicine, European Society of	Position paper, narrative review	The cardiac arrest centre for the treatment of sudden cardiac arrest due to presumed cardiac cause	NA	The minimum requirements of therapy modalities for CAC are 24/7 on-site coronary angiography laboratory, ED, ICU, imaging facilities, and a protocol outlining transfer of selected patients to CAC with additional resources (OHCA hub hospitals).	NA

Intensive Care Medicine; Sinning; 2020 (2)					

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)
	Study Type:	Inclusion Criteria:	1° endpoint:	
Specialised CAC vs non-specialised centres - OHCA				
Kelham; 2020 (3)	Retrospective cohort study before and after CAC set up; 728 patients	Adults OHCA with confirmed STEMI or presumed cardiac cause	In-hospital mortality In-hospital mortality was lower after CAC was set up OR 0.84, 95%CI 0.68-0.98	Formation of centralized CAC was associated with improved survival in OHCA patients.
Park; 2020 (4)	Retrospective cohort study using national registry; 7804 patients	Adults OHCA initially transported to non-CAC with ROSC	Transfer to CAC Patients on medical aid were less likely to be transferred OR 0.75, 95% CI 0.59-0.95 compared with patients with national health insurance.	Transfer to CAC was significantly associated with a lower risk of death OR 0.38, 95% CI 0.33-0.45 and better neurologic recovery (CPC1 or 2) OR 0.46, 95% CI, 0.38-0.56
von Vepelius-Feldt; 2021 (5)	Retrospective cohort study with propensity score matching; 10650 patients	Adults with OHCA presumed cardiac cause, transported to hospital	Survival to hospital discharge. 24/7 PPCI: OR 1.69, 95%CI 1.28-2.23 High volume: OR 1.41, 95%CI 1.14-1.75 No statistical difference between low, medium and high volume CAC hospitals with 24/7 PPCI capability with OR 1 (reference), 0.86 95% CI 0.56-1.31), and 1.27 (95% CI 0.88-1.83)	Admission to CAC is associated with a moderate improvement in survival to hospital discharge. In subgroup analyses, improved rates of survival was mainly seen in patients with OHCA due to shockable rhythms.
High volume vs low volume - OHCA				
Amagasa; 2019 (6)	Retrospective cohort; 282 patients	OHCA patients <18 yrs (enrolled in SOS-KANTO)	30-day survival High-volume center significantly higher 30-day survival rate compared with low-volume centres, OR 2.55 95%CI 1.05–6.17, p=0.038	Pediatric OHCA case volume was associated with survival at 1 month after cardiac arrest
Balian; 2019 (7)	Retrospective cohort using registry data; 3512 patients	Adult OHCA evaluated by EMS	Survival to hospital discharge and good neurological outcome (CPC1,2) Highest volume centres is associated with improved hospital survival OR, 1.43; 95% CI 1.08–1.89 and good neurological outcomes	Hospital case volume is associated with improved patient outcomes

			OR, 1.51; 95% CI 1.11–2.04, compared to lowest volume centres	
Kashiura; 2020 (8)	Post-hoc analysis of prospective observational study; 2699 patients	Adult OHCA with ROSC	Good neurological outcome at 30 days compared to low volume centers, transport to a middle- or high-volume center was not significantly associated with a favorable neurologic outcome at 30 days OR 1.21; 95%CI 0.84–1.75, p=0.068	Institutional volume was not significantly associated with favorable 30-day neurologic outcomes or 30-day survival in OHCA.
High volume vs low volume - IHCA				
Akintoye; 2020 (9)	Retrospective cohort using registry data; 125082 patients	Adult IHCA	Survival to hospital discharge There was a non-linear association between CPR volume and survival: a non-significant trend towards better survival was observed with increasing annual CPR volume that reached a plateau at 51-55 cases per year, after which survival began to drop and became significantly lower after 75 cases per year (p for non-linearity<0.001).	Low CPR volume is an indicator of good performing hospitals and increasing CPR case volume does not translate to improve survival for IHCA
Teaching vs non-teaching hospital - OHCA				
Czarnecki; 2019 (10)	Retrospective cohort using national database; 25346 patients	Adult OHCA with ROSC excluding STEMI	30-day survival Hospital teaching status was associated with a significantly higher 30-day survival OR 1.38, 95% CI, 1.14– 1.67, p<0.001	Patients with OHCA treated at teaching hospitals were more likely to survive to 30 days.
Direct transport vs inter-hospital transfer - OHCA				
Chien; 2020 (11)	Retrospective cohort study with propensity score matching; 5156 patients	Adult OHCA transported by EMS	Good neurological outcome at hospital discharge Regardless of transport time, transportation to a CAC is associated with good neurological outcome at discharge (<8 min: OR, 2.70; 95% CI, 1.40–5.22; ≥8 min: OR, 2.20; 95% CI, 1.29–3.75) in OHCA patients with shockable rhythms but not in patients with non-shockable rhythms	OHCA patients with shockable rhythms transported to CACs demonstrated higher probabilities of good neurological outcome at discharge and survival to Discharge.
Choi; 2020 (12)	Retrospective cohort study; 1326 patients	Adults OHCA with ROSC in a coma with TTM (enrolled in KORHN-pro registry)	Poor neurological outcome (CPC 3-5) at 6 months No significant difference between different types of hospital visits (transferred vs direct visit) OR 0.85, 95%CI 0.508-14.22, p=0.536	Interhospital transfer after achieving ROSC was not associated with neurologic outcomes at 6 months in patients treated with TTM, even though TTM induction was delayed in transferred patients.

Platt; 2020 (13)	Retrospective cohort study; 478 patients	Adults OHCA with ROSC (enrolled in Airways 2)	30-day survival Descriptive statistics only: Patients taken directly to pPCI were most likely to survive to 30 days (25/39, 53.8%), compared to patients taken to an emergency department (ED) at a pPCI-capable hospital (34/126, 27.0%), or an ED at a non-pPCI-capable hospital (50/310, 16.1%)	30-day survival is highest in patients taken directly to pPCI

Reviewer Comments (including whether meet criteria for formal review):

This evidence update found 12 relevant articles (1 position statement and 11 original research articles). There was no randomized controlled trial identified. Number of studies that reported on Critical outcomes of survival to hospital discharge with favorable neurological outcome were 3 studies, survival to 30 days favorable neurological outcome 2 studies, survival to discharge 5 studies and survival to 30 days 3 studies. There was one study on pediatric cardiac arrest and one study on in-hospital cardiac arrest. There were three studies comparing direct and indirect transport.

The new evidence will not change the 2018/2020 treatment recommendation. EIT and ALS taskforce should consider updating the systematic review in the next cycle of evidence updates.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn (ILCOR SAC member - EIT T/F Rep) on 17 Feb 2021.

Reference list

1. Yeung J, Matsuyama T, Bray J, Reynolds J, Skrifvars MB. Does care at a cardiac arrest centre improve outcome after out-of-hospital cardiac arrest? - A systematic review. Resuscitation. 2019;137:102-15.
2. Sinning C, Ahrens I, Cariou A, Beygui F, Lamhaut L, Halvorsen S, et al. The cardiac arrest centre for the treatment of sudden cardiac arrest due to presumed cardiac cause - aims, function and structure: Position paper of the Association for Acute CardioVascular Care of the European Society of Cardiology (AVCV), European Association of Percutaneous Coronary Interventions (EAPCI), European Heart Rhythm Association (EHRA), European Resuscitation Council (ERC), European Society for Emergency Medicine (EUSEM) and European Society of Intensive Care Medicine (ESICM). European heart journal Acute cardiovascular care. 2020;9(4_suppl):S193-S202.
3. Kelham M, Jones TN, Rathod KS, Guttmann O, Proudfoot A, Rees P, et al. An observational study assessing the impact of a cardiac arrest centre on patient outcomes after out-of-hospital cardiac arrest (OHCA). European heart journal Acute cardiovascular care. 2020;9(4_suppl):S67-S73.
4. Park CH, Ahn KO, Shin SD, Park JH, Lee SY. Association between health insurance status and transfer of patients with return of spontaneous circulation after out-of-hospital cardiac arrest. Resuscitation. 2020;149:143-9.
5. von Vepelius-Feldt J, Perkins GD, Benger J. Association between admission to a cardiac arrest centre and survival to hospital discharge for adults following out-of-hospital cardiac arrest: A multi-centre observational study. Resuscitation. 2021;In press.
6. Amagasa S, Kashiura M, Moriya T, Uematsu S, Shimizu N, Sakurai A, et al. Relationship between institutional case volume and one-month survival among cases of paediatric out-of-hospital cardiac arrest. Resuscitation. 2019;137:161-7.
7. Balian S, Buckler DG, Blewer AL, Bhardwaj A, Abella BS, Group CS. Variability in survival and post-cardiac arrest care following successful resuscitation from out-of-hospital cardiac arrest. Resuscitation. 2019;137:78-86.

8. Kashiura M, Amagasa S, Moriya T, Sakurai A, Kitamura N, Tagami T, et al. Relationship Between Institutional Volume of Out-of-Hospital Cardiac Arrest Cases and 1-Month Neurologic Outcomes: A Post Hoc Analysis of a Prospective Observational Study. The Journal of emergency medicine. 2020;59(2):227-37.
9. Akintoye E, Adegbala O, Egbe A, Olawusi E, Afonso L, Briasoulis A. Association between Hospital volume of cardiopulmonary resuscitation for in-hospital cardiac arrest and survival to Hospital discharge. Resuscitation. 2020;148:25-31.
10. Czarnecki A, Qiu F, Koh M, Cheskes S, Dorian P, Scales DC, et al. Association Between Hospital Teaching Status and Outcomes After Out-of-Hospital Cardiac Arrest. Circulation Cardiovascular quality and outcomes. 2019;12(12):e005349.
11. Chien C-Y, Tsai S-L, Tsai L-H, Chen C-B, Seak C-J, Weng Y-M, et al. Impact of Transport Time and Cardiac Arrest Centers on the Neurological Outcome After Out-of-Hospital Cardiac Arrest: A Retrospective Cohort Study. Journal of the American Heart Association. 2020;9(11):e015544.
12. Choi YH, Lee DH, Oh JH, Min JH, Jang TC, Kim WY, et al. Inter-Hospital Transfer after Return of Spontaneous Circulation Shows no Correlation with Neurological Outcomes in Cardiac Arrest Patients Undergoing Targeted Temperature Management in Cardiac Arrest Centers. Journal of clinical medicine. 2020;9(6).
13. Platt A. A service evaluation of transport destination and outcome of patients with post-ROSC STEMI in an English ambulance service. British paramedic journal. 2020;5(1):32-6.

2021 Evidence Update Worksheet
Appendix B3 EIT 4

Worksheet author(s): Catherine Patocka
Date Submitted: Jan 25, 2021

PICO / Research Question: *EIT 628 - Timing for retraining*

Population: Among students who are taking BLS courses
Intervention: does any specific interval for update or retraining
Comparators: compared with standard practice (ie. 12 or 24 monthly)
Outcomes: Improve patient outcomes, skill performance in actual resuscitations, skill performance at 1 year, skill performance at course conclusion, cognitive knowledge
Study Designs: 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. Unpublished studies (e.g., conference abstracts, trial protocols), animal studies, case series, and simulation studies were excluded.
Timeframe: Articles published between January 7, 2020 and January 11, 2021, and all languages were included as long as there is an English abstract.
Outcomes:

9-Critical	improve patient outcomes
8-Critical	skill performance in actual resuscitations
6-Important	skill performance at 1 year
5-Important	skill performance at course conclusion
4-Important	cognitive knowledge

Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): N/A
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2010 / 2015 / New question: EvUP in 2020

Last ILCOR Consensus on Science and Treatment Recommendation:
The treatment recommendation from 2015 (below) is unchanged.
There is insufficient evidence to recommend the optimum interval or method for BLS retraining for laypeople. Because there is evidence of skills decay within 3 to 12 months after BLS training and evidence that frequent training improves CPR skills, responder confidence, and willingness to perform CPR, we suggest that individuals likely to encounter cardiac arrest consider more frequent retraining (weak recommendation, very low-quality evidence)

2010/2015 Search Strategy:
Medline Keyword: ""advanced life support.mp. or exp Advanced Cardiac Life Support" OR "exp Advanced Cardiac Life Support or pediatric advanced life support.mp."" AND ""learn$.mp." OR "educat$.mp."" AND ""reten$.mp." OR "memor$.mp." OR "interval.mp." OR "skill acquisition.mp.""(36)
CINAHL Keyword: "Advanced Life Support" AND "learn" (11), Keyword: "Advanced Life Support" AND "retention" (25)
Cochrane Keyword: "Advanced Life Support in Title, Abstract or Keywords" AND "learn in Title, Abstract or Keywords" in Cochrane
Central Register of Controlled Trials (19): Keyword: "Advanced Life Support in Title, Abstract or Keywords" AND "retention in Title, Abstract or Keywords" in **Cochrane Central Register of Controlled Trials** (8) PudMed Keyword: "skill retention" AND "advanced life support" (14) Searched 2010, Jan. 24

2020 – Evidence update completed by Cheng-Heng Liu, Chih-Wei Yang, Matthew Huei-Ming Ma with a search date of 2020/01/07.

2021 Search Strategy:
PubMed:
(((((((("Cardiopulmonary Resuscitation/education"[Mesh:NoExp]) OR ((((("Basic Life Support"[TI] OR BLS[TI] OR CPR[TI] OR cardiopulmonary resuscitation[TI] OR AED[TI] OR defibrillator[TI] OR defibrillation[TI] OR heartsaver[TI])))) AND (("lay person"[TIAB] OR "lay persons"[TIAB] OR layperson[TIAB] laypersons[TIAB] OR laypeople[TIAB] OR "lay people"[TIAB] OR "lay rescuer"[TIAB] OR "lay rescuers"[TIAB] OR "lay rescuers"[TIAB] OR "lay responder"[TIAB] or "lay responders"[TIAB] OR "lay volunteers"[TIAB] OR "Emergency Responders/education"[Mesh] OR "Emergency Treatment/education"[Mesh] OR "education"[TIAB] OR teach[TIAB] OR teaching[TIAB] OR teacher[TIAB] OR teachers[TIAB] OR "Inservice Training"[Mesh] OR learning[TIAB] OR Inservice[TIAB] OR Train[TIAB] OR Training[TIAB] OR "course"[TIAB] OR "program"[TIAB] OR student[TIAB] OR students[TIAB] OR instruction[TIAB])))))) AND ((Refresher[TIAB] OR Retention[TIAB] OR retain[TIAB] OR retained[TIAB] OR update[TIAB] OR retraining[TIAB] OR retrain[TIAB] OR recertify[TIAB] OR recertification[TIAB] OR "Certification"[Mesh] OR "Clinical Competence"[Mesh] OR "Educational Measurement"[Mesh] OR "Professional Competence"[Mesh] OR "Health Knowledge, Attitudes, Practice"[Mesh] OR "Retention (Psychology)"[Mesh] OR "Mental Recall"[Mesh]))))) NOT ((animals[mh] NOT humans[mh]) NOT ("letter"[pt] OR "comment"[pt] OR "editorial"[pt] or Case Reports[ptyp])))))
EMBASE: 'basic life support':ab,ti OR bls:ab,ti OR cpr:ab,ti OR 'cardiopulmonary resuscitation':ab,ti OR aed:ti OR defibrillator:ti OR defibrillation:ti OR heartsaver:ti OR resuscitation:ti AND ('lay person':ab,ti OR 'lay persons':ab,ti OR layperson:ab,ti OR laypersons:ab,ti OR laypeople:ab,ti OR 'lay people':ab,ti OR 'lay rescuer':ab,ti OR 'lay rescuers':ab,ti OR 'lay responder':ab,ti OR 'lay responders':ab,ti OR 'lay volunteers':ab,ti OR 'medical education'/exp OR 'nursing education'/exp OR 'emergency medical services education'/exp OR 'paramedical education'/exp OR 'educational model'/exp OR 'curriculum'/exp OR 'education program'/exp OR 'education'/exp OR 'education':ab,ti OR 'teaching'/exp OR teach*:ab,ti OR 'in service training'/exp OR inservice:ab,ti OR 'training'/exp OR train*:ab,ti OR 'learning'/exp OR learn:ab,ti OR course:ab,ti OR program:ab,ti OR student*:ab,ti OR instruction:ab,ti) AND (refresher:ab,ti OR retention:ab,ti OR retain:ab,ti OR retained:ab,ti OR update:ab,ti OR retraining:ab,ti OR retrain:ab,ti OR recertify:ab,ti OR recertification:ab,ti OR 'clinical competence'/exp OR 'professional competence'/exp OR 'recall'/exp OR 'skill retention'/exp OR 'long term memory'/exp OR 'recertification'/exp OR 'certification'/exp OR 'professional knowledge'/exp) NOT ('animal'/exp NOT 'human'/exp) NOT ([editorial]/lim OR [letter]/lim OR 'case report'/de) AND [embase]/lim

Database searched: Pubmed and EMBASE
Date Search Completed: January 11, 2021 (January 7, 2020 to January 11, 2021)
Search Results (Number of articles identified / number identified as relevant): 336/4
PubMed:150
EMBASE: 233
Duplicates: 47
Total: 336

Inclusion/Exclusion Criteria: Excluded studies that involved animal subjects, letters, editorials, and comments.
Link to Article Titles and Abstracts (if available on PubMed):
1. Xu, 2020, 10345. 1 https://pubmed.ncbi.nlm.nih.gov/31734218/
2. Zhou, 2020, 73. https://pubmed.ncbi.nlm.nih.gov/31005392/
3. Oermann, 2020, e0226786. https://pubmed.ncbi.nlm.nih.gov/31945074/
4. Panchal, 2020, 26. https://pubmed.ncbi.nlm.nih.gov/31730899/

Summary of Evidence Update:
Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

A total of four additional studies were identified: 3 RCTs (Ref 1-3) and one observational study (Ref 4) – as shown below. No additional systematic reviews/guidelines were found.

Relevant Guidelines or Systematic Reviews

Organisation (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
Xu, 2020 (1)	**Study aim:** To evaluate the effectiveness of audio-visual review model and audio-visual-practice review model on cardiopulmonary resuscitation skill retention 12 months after training **Study Type:** Randomized, double-blind, placebo controlled, and three arm parallel study **Study size** N = 641	**Inclusion**: family members who reside with a 'high risk' patient (adults with coronary heart disease, hypertension, diabetes, hyperlipidemia, and obesity) and aged 18-75 **Exclusion:** Families who received cardiopulmonary resuscitation training during the last 2 years and hold a job as healthcare professionals.	**Study intervention**: Audio-visual group (N = 214): given the cardiopulmonary resuscitation instructional booklet and DVD, asked to review skills every 3 months by reading and watching telephone calls were made every 3 months Audio-visual-practice (N= 274): received booklet, instruction-DVD, human-shaped throw pillow asked to review and practice, telephone reminder q 3 months Control (N=153): received a cardiopulmonary resuscitation instruction booklet and a placebo-DVD without a telephone reminder	**Outcome:** cardiopulmonary resuscitation skill retention rate, percentage of subjects whose overall cardiopulmonary resuscitation performance was rated as adequate at 12 months after training Retention rates in AV and AVP groups were higher than in the control group p<0.001	**Limitations:** skills were assessed by a self-developed cardiopulmonary resuscitation skill assessment scale (no objective feedback device)
Zhou, 2020 (2)	**Study aim:** to compare the training quality and long-term retention of CC skills by bystanders between those	**Inclusions:** 3rd year medical students at one hospital in China	**Study interventions**: 45 min chest compression only CPR training each participant needed to perform 5 (2 min	**Outcome:** CC quality was improved after 3 sessions in both groups, repeated testing at 3 months showed	**Limitations:only lo**oked at chest compressions (not ventilation and other

	using repetitive practice with instructor feedback versus repetitive practice with audio-visual feedback **Study type:** Randomized controlled trial **Study size:** N = 97	**Exclusions:** participants with underlying health problems	/cycle) cycles of CC then randomized to 30 min repetitive practice with either AVF or instructor feedback on day 1, 3 and 7	that the proportions of appropriate CC rate and correct hand position were significantly decreased in the RP group but this same decrease was not observed in the RP=AVF group. Proportions of CC rate, depth and recoil were significantly decreased in both groups at 12 months.	resuscitation skills), refresher training was all within the first week.
Oermann 2020 (3)	**Study aim:** To compare nursing students' CPR skills with 4 different spaced training intervals (daily, weekly, monthly and quarterly **Study type:** nursing students randomly assigned into 4 training intervals **Study size**: 475	**Inclusions**: first year prelicensure nursing program study, certified in BLS from the AHA or American Red Cross **Exclusions:** health condition at the time of the study that precluded their performing CPR	**Study intervention**: CPR training on a QCPR on the RQI mobile simulation station in each school's simulation or skills lab.pretest-training session, practice session-posttest 4 intervals (daily, weekly, monthly, quarterly)	**Outcome**: quality of compressions and ventilations as measured by the RQI program. Composite scores 0-100% for compressions and ventilations. Overall compression scores improved from session 1-4, shorter intervals (daily training) resulted in larger increases in compression scores by session 4.	**Limitations:** only looked at time to proficiency, did not look at retention.

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)
Panchal 2020 (4)	**Study Type:** Prospective before and after intervention study N=155 Each quarter (3 month) participants were required to perform different	**Inclusion Criteria:** quality improvement project so no subjects per se, all clinical staff on two cardiology hospital floors (non-ICU) in a tertiary care medical centre	**1° endpoint:** CPR skills, participant compliance with the training method, CPR performance during IHCA Increased compression and adequate rate quarter 2 83% to qurter 4 90%, decreased tidal volume, ventilation rate and breaths with adequate ventilations. Clinical compression data from IHCA compression fraction improved 83%	Includes some actual CPR performance data.

	activities to enhance baseline CPR training		to 93%, compressions per minute increased 109 to 120	

Reviewer Comments (including whether meet criteria for formal review):
For the critical outcome of improved patient outcomes, we found no published evidence.
For the critical outcome of skill performance in actual resuscitation, we found one prospective before and after intervention where Resuscitation Quality Improvement (RQI) training was implemented for all staff (health care providers) on two hospital cardiology (non-ICU) floors (4). They collected clinical data on in-hospital CPR quality metrics 6 months before the 1-year implementation of RQI and then 6 months following the implementation. The compression fraction pre-RQI was 83% while the post-RQI compression fraction was 93% ($p<0.001$), also compressions per minute increased pre-RQI to post-RQI (Pre:109 and Post: 120, $p=0.008$) (4)
For skill performance at one-year, Xu (2020) performed a randomized trial examining the impact of prompts for self-booster training among lay people (1). They determined that audio-visual or audio-visual-practice models prompted by a telephone call improved 12-month retention rates (2).
For skill performance at course conclusion, Oermann (2020) looked at the use of various training intervals (daily, weekly, monthly or quarterly) among first year nursing students in attaining proficiency in CPR performance and found that shorter intervals of training (daily) resulted in larger increases in compression scores by the 4th training session, this study unfortunately only looked at proficiency rather than retention (3).

Whereas previous versions of this PICO have found evidence almost exclusively looking at BLS skills training among lay people, there now appear to be studies examining timing of retraining among healthcare providers. Given that since Jan 2020 there has only been one non-randomized before and after study examining the critical outcome of skill performance in actual resuscitation (4) the conclusion of which remains in line with the previous treatment recommendation from 2015 and 2020, we recommend that repeat systematic review be delayed until more evidence is available.

Knowledge gaps

- Our search identified many studies still focusing on demonstrating decay in skills (already clearly described in the evidence)
- Studies looking at retention tend to only look at a 3–6-month interval which was not one of the defined important outcomes.
- Many of the studies are still not using feedback devices to measure skill performance.
- There were a number of conference abstracts in late 2020 examining the value of RQI in CPR skills/cardiac arrest performance so it is expected that more evidence about the use of this modality which facilitates frequent retraining will be forthcoming.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 10 Feb 2021

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2021 Evidence Update Worksheet
Appendix B3 EIT 5

Worksheet author(s): Elaine Gilfoyle
Date Submitted: January 29, 2021

PICO / Research Question: *EIT 629 – Cognitive aids during Resuscitation* (former use of checklist during ACLS or PALS)
Population: In patients requiring resuscitation or providers learning to deliver resuscitation
Intervention: Does the use of a cognitive aid
Comparators: Compared to no use of cognitive aid
Outcomes: Improve:

1. Patient survival
2. Quality of performance in actual resuscitations
3. Skill performance 1 year after course conclusion
4. Time to starting CPR between course conclusion and 1 year in simulated resuscitations
5. Chest compression rate between course conclusion and 1 year in simulated resuscitations
6. Chest compression depth between course conclusion and 1 year in simulated resuscitations
7. Chest compression fraction between course conclusion and 1 year in simulated resuscitations
8. Ventilation between course conclusion and 1 year in simulated resuscitations
9. Time to starting CPR at course conclusion in simulated resuscitations
10. Chest compression rate at course conclusion in simulated resuscitations
11. Chest compression depth at course conclusion in simulated resuscitations
12. Chest compression fraction at course conclusion in simulated resuscitations
13. Ventilation at course conclusion in simulated resuscitations
14. Knowledge at course conclusion

Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): N/A
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2010 / 2015 / New question: Dec 31, 2019

Last ILCOR Consensus on Science and Treatment Recommendation:
We recommend against the use of cognitive aids for the purposes of lay providers initiating CPR (weak recommendation, low-certainty evidence).
We suggest the use of cognitive aids for healthcare providers during trauma resuscitation (weak recommendation, very low-certainty evidence). In the absence of studies on CPR, no evidence-based recommendation can be made.
There are insufficient data to suggest for or against the use of cognitive aids in lay provider training.
We suggest the use of cognitive aids for training of healthcare providers in resuscitation (weak recommendation, very low-certainty evidence).

2010/2015 Search Strategy:
Medline: ("Heart Arrest"[Mesh] OR "Resuscitation"[Mesh] OR "Emergency Treatment"[Mesh] OR "Surgical Procedures, Operative"[Mesh]) AND ("checklist"[text word] OR "mnemonic*"[text word] OR "cognitive aid"[text word] OR "prompter"[text word] OR "aide memoire"[text word] OR "reminder"[text word] OR "Mental Recall"[Mesh]).

EMBASE search via Health Information Resources (formerly National Library for Health): “heart arrest" [as major descriptor] OR "resuscitation" [as major descriptor] OR "emergency treatment" [as major descriptor] OR surgery [as major descriptor] AND {"checklist" [text word] or "mnemonic*" [text word] OR “cognitive aid” [text word] OR "prompter" [text word] OR "aide memoire" [text word] OR “mental recall” [text word] OR "reminder" [text word] OR "recall" [as major descriptor] OR “reminder system” [as major descriptor] . Cochrane database for systematic reviews. AHA endnote library. No date limits.

2019 Search Strategy:

Medline: (Resuscitation/ OR (Cardiopulmonary Resuscitation/ for advanced cardiac life support/) OR Heart Massage/ OR (Respiration, Artificial/ of advanced trauma life support care/) OR (resuscitat*.tw,kf.) OR Heart Arrest/ OR (((cardiac or heart or cardio pulmonary or cardio pulmonary) adj2 arrest).tw,kf.) OR (Anesthesia, General/ae or Anesthesia, Local/ae or Anesthetics, Local/ae or Anesthetics, General/ae)) AND (Checklist/ OR ((check list* or checklist* or mnemonic*).tw,kf.) OR Algorithms/ OR (algorithm*.tw,kf.) OR ((prom t or prompts).tw,kf.) OR (“cognitive aid*.tw,kf.) OR Reminder Systems/ OR (reminder*.tw,kf.) OR (aide memoire.mp.) OR Decision Support Techniques/ OR Decision Trees/ OR ((decision adj3 (support or tree* or aid*)).tw,kf.) OR Medical Errors/pc OR ((error* adj4 (prevent* or manag* or decreas*)).tw,kf.))

Embase: (resuscitation/ OR heart massage/ OR advanced trauma life support care/ OR resuscitat*.ti,ab,kw. OR heart arrest/ OR ((cardiac or heart or cardiopulmonary or cardio-pulmonary) adj2 arrest).tw,kw. OR anesthetic agent/ae, to, tm [Adverse Drug Reaction, Drug Toxicity, Unexpected Outcome of Drug Treatment] OR local anesthetic agent/ae, to [Adverse Drug Reaction, Drug Toxicity] OR (an?esthesi* adj3 (adverse or crisis or crises or emergenc* or complication* or stabiliz* or stabilis*)).mp. OR general anesthesia/ae, to OR local anesthesia/ae, to) AND ((Checklist/ OR checklist*.tw,kw. OR check list*.tw,kw. OR mnemonic*.tw,kw. OR algorithm/ or learning algorithm/ OR algorithm*.tw,kw. OR (prompt or prompts).tw,kw. OR cognitive aid*.tw,kw. OR reminder system/ OR reminder*.tw,kw. OR aide memoire.mp. OR decision support system/ or clinical decision support system/ OR "decision tree"/ OR (decision adj3 (support or tree* or aid*)).tw,kw. OR medical error/pc [Prevention] OR surgical error/ OR "near miss (health care)"/ OR (error* adj4 (prevent* or manag* or decreas*)).tw,kw.)

Database searched: Medline

Date Search Completed: Jan 26 2021 (Jan 1 2020 to Jan 26 2021)

Search Results (Number of articles identified / number identified as relevant): 503 excl. duplicates identified, 9 studies found plus 1 from other source=10

Inclusion Criteria

- Studies examining use of cognitive aid during either 1) real-life resuscitation event or 2) assessment of provider resuscitation skills in a simulated resuscitation environment
- Cognitive aid must be used during event or skill assessment, not ahead of/in preparation for event
- Study design may be either: 1) Randomized controlled trials or 2) non-randomized studies (interrupted time series, controlled before and after studies, cohort studies)
- No restriction on publication date

Exclusion Criteria

- No available English abstract
- Unpublished (conference abstract, trial protocols)
- Case series
- Studies examining effect of providers using CPR feedback devices or metronome only
- Outcomes do not include one of: 1) patient survival 2) provider or team performance during real-life or simulated resuscitation events or 3) Provider CPR quality metrics

Link to Article Titles and Abstracts (if available on PubMed):

Pub Med links

Brune, 2020, 986. https://pubmed.ncbi.nlm.nih.gov/33087406/

Corazza, 2020, e19070. https://pubmed.ncbi.nlm.nih.gov/32788142/

Crabb, 2020, https://pubmed.ncbi.nlm.nih.gov/32291164/

De Bie Dekker, 2020, 3. https://pubmed.ncbi.nlm.nih.gov/33027620/
Hall, 2020, 1. https://pubmed.ncbi.nlm.nih.gov/31915029/
Hejjaji, 2020, e15762. https://pubmed.ncbi.nlm.nih.gov/32427115/
Hulfish, 2021, 23. https://pubmed.ncbi.nlm.nih.gov/29489608/
Marquez-Hernandez, 2020, 460. https://pubmed.ncbi.nlm.nih.gov/32444161/
Roitsch, 2020, 243. https://pubmed.ncbi.nlm.nih.gov/32168290/
Siebert, 2020, e17792. https://pubmed.ncbi.nlm.nih.gov/32292179/
Journal Links
https://hosppeds.aappublications.org/content/10/11/986
https://mhealth.jmir.org/2020/10/e19070
https://www.ajemjournal.com/article/S0735-6757(20)30149-2/fulltext
https://www.resuscitationjournal.com/article/S0300-9572(20)30495-0/fulltext
https://human-resources-health.biomedcentral.com/articles/10.1186/s12960-019-0441-x
https://mhealth.jmir.org/2020/5/e15762
https://journals.lww.com/pec-online/Abstract/2021/01000/The_Impact_of_a_Displayed_Checklist_on_Simulated.5.aspx
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https://journals.lww.com/simulationinhealthcare/Abstract/2020/08000/Tablet_Based_Decision_Support_Tool_Improves.4.aspx
https://www.jmir.org/2020/5/e17792/

Summary of Evidence Update:

Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Relevant Guidelines or Systematic Reviews: None

A total of 10 additional studies were identified (8 RCTs and 2 non-RCTs) – as shown below.

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
Brune 2020[1] (abstract review only, full text N/A)	Study Aim: Use of CA by RN improve accuracy of epi dose prep in neonatal resusc Study Type: Sim, neonatal, focus on epi dose prep only, n=100	Inclusion Criteria: Neonatal RN	Intervention: Printed CA to assist with epi dose calculation & prep Comparison: control	1° endpoint: % correctly prepared doses (4% CA vs 50% control; P = .01	Study Limitations: -secondary: Correct conc of dose 12% CA vs 44% control; P < .001 -not blinded
Crabb 2020[2]	Study Aim:	Inclusion Criteria:	Intervention:	1° endpoint:	Study Limitations:

	Use of CA improves time to completion key clinical ACLS tasks Study Type: Simulation, particip in 4 ACLS scenarios, 2 with CA & 2 without, n=8 teams, 56 participants	Interprofessional ED team members	CA=decision support tool, web based app projected on big screen in resusc bay Comparison: No CA	Time deviation from q2min rhythm check, with CA 12.8s variance from 2min goal, without CA 17.6s variance, p<0.04, time to defib NS	-good methods re randomization -clinical relevance of primary outcome? -small #s
Hall 2020[3]	Study Aim: Effect of handbook on team error rate during sim resusc Study Type: Simulation 4 resusc-randomized teams 2/4 scenarios with handbook N=21 teams, 75 participants	Inclusion Criteria: General hospital ED MD & RN teams	Intervention: CA=handbook, locally developed Comparison: No use of handbook	1° endpoint: "error rate" really just checklist score/rate items missing on checklist, Handbook used=17.9% Handbook not used=38.9%, p<0.001 (used general mixed modelling to assess effect of handbook)	Study Limitations: -good methods re randomization -used 4 very different clinical scenarios & found reduction of errors in each -Error rate based on checklist created by investigators, no prior validity evidence, -blinding of raters not possible, -was available prior to study but "not part of standard of care"
Hejjaji 2020[4]	Study Aim: Effect of mobile app use by resident on CPR quality & adherence to ACLS guidelines Study Type: Simulation: 2 ACLS scenarios randomized resident to use app vs not, n=53 participants	Inclusion Criteria: Residents in IM program	Intervention: CA=mobile app Comparison: No mobile app	1° endpoint: 2 co-primary: CCF & checklist adherence to ACLS guidelines, -CCF 90.9% with app vs 89.0% without, CI difference 0.6-3.4%, p=0.007 -checklist adherence: # correct inteventions mean 6.2 with app vs 5.1 without, CI difference 0.6-1.6 p<0.001 # incorrect interventions mean 0.3 with app, 1.0 without, CI difference 0.3 to 1.0 p<0.001)	Study Limitations: -good randomization procedure -not complete teams: resident with 2 confederates -not blinded by raters -clinical relevance in tiny difference in CCF
Hulfish 2021[5]	Study Aim: Use of handheld vs displayed vs no	Inclusion Criteria:	Intervention:	1° endpoint: Time to completion of primary & secondary surveys	Study Limitations: Secondary: adherence to elements on checklist: some

	checklist on adherence to ATLS guidelines Study Type: Simulation pediatric trauma, 6 scenarios, randomized to scenario & CA, n=131 scenarios, unsure how many teams	Interprofessional ped trauma team members	CA=locally developed checklist, displayed vs handheld by leader Comparison: No checklist available to team	Primary: no 76.51s vs handheld 76.18s vs displayed 77.18s NS Secondary: No 136.64s vs Handheld 167.34s vs Displayed 166.61s NS	better with checklist but not consistent, not sure if accounted for multiple comparisons? -not blinded -good randomization
Marquez-Hernandez 2020[6]	Study Aim: Impact on adherence to BLS guidelines on use of mobile app vs telephone assistance Study Type: Simulation, BLS & CPR on mannequin x 5 min, n=128	Inclusion Criteria: Nursing students	Intervention: Mobile app Comparison: Telephone assistance	1° endpoint: Checklist score-adherence to BLS guideline App overall score 5.93 vs telephone 3.82, p<0.001, individual items some better with app some NS	Study Limitations: -Secondary CPR quality: NS except better CCF in app group -not blinded -not realistic scenario: RN with telephone advice while doing BLS/CPR?[6]
Roitsch 2020[7]	Study Aim: Adherence to NRP improved by use of decision support tool? Study Type: Simulations x 2, neonatal resusc, 2x2 factorial (DST vs control, team size 2 vs 3), n=109, 44 teams	Inclusion Criteria: Neonatal HCPs (attending MDs, fellows, NPs, RNs, RRTs)	Intervention: Tablet-based DST to follow NRP guidelines Comparison: control	1° endpoint: Adherence to NRP via commonly used checklist Improved with DST in 1 scenario not other Scenario B 78.4% DST vs 71.4% control, p=0.015	Study Limitations: -not blinded -why study team size as a factor? Is size of 2 realistic? -if "real" effect would see in both scenarios?
Siebert 2020[8]	Study Aim: Adherence to PALS guidelines improved by using app?	Inclusion Criteria: Pediatric residents	Intervention: Mobile app Comparison: Control (availability of PALS pocket card)	1° endpoint: Time to 1st defib attempt in VF sim scenario App: 121.4 sec, 95% CI 105.3-137.5 vs control 211.5 sec, 95% CI 162.5-260.6, P<.001	Study Limitations: -small study -not real teams -significant difference, very likely clinical relevant

	Study Type: Simulation, pediatric resusc, n=26				

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)
Corazza 2020[9]	Study Type: Obs, pilot development of app for ped resusc, n=16 teams of ped residents, 48 particip	Inclusion Criteria: Pediatric residents	1° endpoint: NASA raw TLX NS (67.5 vs 66.7), secondary adherence to PALS guidelines (CPT) NS, delay in 1st dose epi in intervention group (254s vs 165s)	-Small pilot, main goal to test usability of app, -not realistic teams, -lots of work went into app development, should test with broader study with realistic teams -need to determine if delays in intervention real vs small #s
De Bie Dekker 2020[10]	Study Type: CA=app, Non-randomized before-after, 3 scenarios without CA then 3 different scenarios with CA, n=32 teams, 101 participants	Inclusion Criteria: Internal medicine staff members (resident, med student, RN, NP)	1° endpoint: Team performance by Mayo: improved score 21.37 vs 23.33, mean diff 1.97, p<0.001, 95% CI 1.34-2.60	Particip randomized to teams, blinding by raters not possible, learning possible between pre-post (same team will have worked together 3 scenarios together already when start to use CA), Mayo score improvement <2: clinically relevant? (total score possible 32)

Reviewer Comments (including whether meet criteria for formal review):

3 parts of 2020 TR:

1. Lay providers: recommend against CA for initiation CPR (EvUp - no new evidence). No evidence for training (EvUp - no new evidence)
2. Trauma resuscitation: suggest use of CA for HCP teams (EvUp -1 study but sim only[5], not real patient outcomes, 1 study with very minor likely not clinically relevant shortening in time to completion of primary & secondary surveys in pediatric trauma)
3. HCP cardiac arrest: weak recommendation (EvUp - several new studies, all simulation studies (RCT[1-4, 6-8] & obs[9, 10]) suggesting improvement in outcomes).

The Task force recommends to redo the Systematic Review given the significant amount of new evidence specifically found for health care providers dealing with simulated cardiac arrest.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 6 Feb 2021

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2021 Evidence Update Worksheet
Appendix B3 EIT 6

Worksheet author(s): Kasper G. Lauridsen
Date Submitted: February 5, 2021

PICO / Research Question:
Termination of Resuscitation for In-hospital Cardiac Arrest (EIT 634)

Population: For adults and children with in-hospital cardiac arrest
Intervention: Does use of any clinical decision rule
Comparators: Compared to no clinical decision rule
Outcomes: Change or predict no return of spontaneous circulation, death before hospital discharge, survival with unfavorable neurological outcome, death within 30 days.
Study Designs: Randomized controlled trials and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies). We excluded editorials, commentaries, opinion papers, non-published studies, and studies not having an abstract in English.
Timeframe: 01/11/2019 to 01/02/2021.

Outcomes: As above
Type (intervention, diagnosis, prognosis): Diagnosis
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2019

Last ILCOR Consensus on Science and Treatment Recommendation:
We did not identify any clinical decision rule that was able to reliably predict death following in-hospital cardiac arrest. We recommend against use of the UN10 rule as a sole strategy to terminate in-hospital resuscitation (strong recommendation, very low quality of evidence).

2019 Search Strategy:
(("Heart Arrest"/ OR "Ventricular Fibrillation"/ OR exp "Tachycardia, Ventricular"/ OR "heart arrest" OR "cardiac arrest" OR "cardiopulmonary arrest" OR "cardio-pulmonary arrest" OR "circulatory arrest" OR "cardiac standstill" OR "cardiac stand still" OR "ventricular fibrillation" OR "ventricular tachycardi*" OR asystol* OR pulseless OR pea OR shockable OR non-shockable OR "non shockable" OR nonshockable) AND ("Inpatients"/ OR "Hospitalization"/ OR "Hospitals"/ OR "Cardiac Care Facilities"/ OR "Coronary Care Units"/ OR in-hospital OR inhospital OR inpatient* OR in-patient* OR hospitaliz* OR hospitalis* OR "hospital provider*" OR ((cardiac OR heart OR coronary OR cardiolog*) adj (facility OR facilities OR center OR centers OR centre* OR unit OR units)) OR "Hospital Mortality"/ OR "hospital mortality")) OR IHCA) AND (Resuscitation Orders/ OR exp "Resuscitation"/ OR exp "Life Support Care"/ OR resuscitat* OR "heart massag*" OR "cardiac massag*" OR "heart compression*" OR "cardiac compression*" OR "chest compression*" OR CPR OR "basic cardiac life support" OR BCLS OR "basic life support" OR BLS OR "advanced life support" OR ALS OR defibrillat*) AND ("Medical Futility"/ OR "Decision Support Systems, Clinical"/ OR "Decision Support Techniques"/ OR exp "Prognosis"/ OR terminat* OR cease OR cessation OR stop OR stopping OR withdraw* OR withhold* OR withheld OR TOR OR DNAR OR futile OR futility OR rule* OR algorithm* OR decease* OR prognosis OR validation OR "clinical decision" OR "decision process" OR "decision aid" OR "prediction tool*" OR "prediction aid*" OR (predict* adj2 (outcome* OR likelihood OR survival))) NOT ((Animals/ OR "Animal Experimentation"/ OR "Models, Animal"/ OR "Disease Models, Animal"/) NOT (Humans/ OR "Human Experimentation"/))
2021 Search Strategy:

Same as above

Database searched: PubMed
Date Search Completed: February 03, 2021
Search Results (Number of articles identified / number identified as relevant): 59 of which none were relevant.
Inclusion Criteria: We included studies on clinical decision rules defined as a set of different criteria (variables) e.g. witnessed status, presenting rhythm etc. to predict a binary outcome (death or unfavorable neurologic outcome) during resuscitation.
Exclusion: Studies utilizing pre-arrest factors (e.g. age and comorbidities) to identify patients at low risk of surviving a cardiac arrest in order to discuss do-not-resuscitate orders and studies on clinical decision rules used to predict survival after ROSC were excluded.

Link to Article Titles and Abstracts (if available on PubMed):

Summary of Evidence Update: PubMed was searched to identify eligible studies providing new information between 01/11/2019 and 01/02/2021. Overall, 59 abstracts were screened. None of these met the inclusion criteria as they were either on a wrong population (e.g. out-of-hospital cardiac arrest) or did not include a clinical decision rule for termination of resuscitation.

Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Reviewer Comments (including whether meet criteria for formal review):
This Evidence Update did not identify any new studies. Accordingly, there is no available evidence to change or update the treatment recommendation from 2020, nor prompt any new systematic review.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 6 Feb 2021

2021 Evidence Update Worksheet
Appendix B3 EIT 7

Worksheet author(s): Jan Breckwoldt
Date Submitted: Jan 9th 2021

PICO / Research Question: ***Precourse preparation for advanced courses (EIT 637)***
Population: Among students who are taking advanced life support courses in an educational setting,
Intervention: does precourse preparation for advanced courses (eg. e-learning or pre-testing combined with face to face training),
Comparator: compared with a traditional course (face to face training),
Outcomes: change cognitive knowledge, skill performance at course conclusion, skill performance at 1 year, skill performance in actual resuscitations, increase survival rates, skill performance at time between course conclusion and 1 year.
Study designs: Randomized controlled trials (RCTs) and non-randomized studies, controlled before-and-after studies, cohort studies) are eligible for inclusion. Unpublished studies (e.g., conference abstracts) are excluded.

Type (intervention, diagnosis, prognosis): intervention
Additional Evidence Reviewer(s): none
Conflicts of Interest (financial/intellectual, specific to this question): none
Year of last full review: 2010 / 2015 / New question: 2019/2020

Last ILCOR Consensus on Science and Treatment Recommendation: 2020
We recommend distributing precourse learning formats preceding face-to-face training for participants of ALS courses (weak recommendation, very low- to low-certainty evidence). In addition, we strongly recommend providing the option of eLearning as part of a blended learning approach to reduce face-to-face training time ALS courses (strong recommendation, very low- to low certainty evidence).

2010/2015 Search Strategy:
PubMed: (Search Completed: June 24, 2014) June 17 2014: 262 results
("technology-based"[TIAB] OR "computer-based"[TIAB] OR "internet-based"[TIAB] OR "web-based"[TIAB] OR "multimedia"[TIAB] OR "multi-media"[TIAB] OR "Internet"[Mesh] OR "computer simulation"[Mesh] OR "computer assisted instruction"[Mesh] OR "self-directed"[TIAB] OR "self directed"[TIAB] OR "elearning"[TIAB] OR "e-learning"[TIAB] OR "preinstruction"[TIAB] OR "pre-instruction"[TIAB] OR "pretest"[TIAB] OR "pre-test"[TIAB] OR "pretraining"[TIAB] OR "pre-training"[TIAB] OR "prepare"[TIAB] OR "preparation"[TIAB] OR "preparatory"[TIAB] OR "precourse"[TIAB] OR "pre-course"[TIAB] OR "precourses"[TIAB] OR "flipped"[TIAB] OR "before"[TIAB] OR "prior"[TIAB]) AND (("Advanced Cardiac Life Support "[Mesh] OR "ACLS"[TIAB] OR "advanced cardiac life support"[TIAB] OR "advanced life support"[TIAB] OR "advanced cardiopulmonary resuscitation"[TW] OR "advanced cardiovascular life support"[TW] OR "advanced resuscitation"[TW] OR "paediatric life support"[TIAB] OR "pediatric life support"[TIAB] OR "APLS"[TIAB] OR "paediatric advanced life support"[TIAB] OR "PALS"[TIAB] OR "pediatric advanced life support"[TIAB] OR "advanced trauma life support care"[Mesh] OR "advanced trauma life support"[TIAB] OR "ATLS"[TIAB]) AND ("advanced cardiac life support/education"[Mesh] OR "resuscitation/education"[Mesh] OR "Emergency Medicine/education"[Mesh] OR "Medicine/education"[Mesh] OR "Nursing/education"[Mesh] OR "Emergency Responders/education"[Mesh] OR "Emergency Medical Technicians/education"[Mesh] OR "Emergency Nursing/education"[Mesh] OR "Internal Medicine/education"[Mesh] OR "Emergency

Treatment/education"[Mesh] OR "Education, Medical"[Mesh] OR "Education, Graduate"[Mesh] OR "Education, Medical, Undergraduate"[Mesh] OR "education"[mesh] OR "education"[TIAB] OR "Teaching"[Mesh] OR teach[TIAB] OR "teaching"[TIAB] OR "teacher"[TIAB] OR "teachers"[TIAB] OR "Learn"[TIAB] OR "Learning"[Mesh] OR "Train"[TIAB] OR "Training"[TIAB] OR "course"[TIAB] OR "courses"[TIAB] OR "class"[TIAB] OR "classes"[TIAB] OR "program"[TIAB] OR "programs"[TIAB] OR "Models, Educational"[Mesh] OR "Health Education/methods"[Mesh] OR "Curriculum"[Mesh])) NOT ("animals"[MeSH Terms] NOT "humans"[MeSH Terms]) NOT ("letter"[pt] OR "comment"[pt] OR "editorial"[pt] OR Case Reports[ptyp])

Embase: (Search Completed: June 24, 2014) June 17 2014: 480 results

'technology-based':ab,ti OR 'computer-based':ab,ti OR 'internet-based':ab,ti OR 'web-based':ab,ti OR multimedia:ab,ti OR 'multi-media':ab,ti OR 'internet'/exp OR 'computer simulation'/exp OR 'self-directed':ab,ti OR 'self directed':ab,ti OR elearning:ab,ti OR 'e-learning':ab,ti OR preinstruction:ab,ti OR 'pre-instruction':ab,ti OR pretest:ab,ti OR 'pre-test':ab,ti OR pretraining:ab,ti OR 'pre-training':ab,ti OR prepare:ab,ti OR preparation:ab,ti OR preparatory:ab,ti OR precourse:ab,ti OR 'pre-course':ab,ti OR precourses:ab,ti OR flipped:ab,ti OR before:ab,ti OR prior:ab,ti AND (acls:ab,ti OR 'advanced cardiac life support':ab,ti OR 'advanced life support':ab,ti OR 'advanced cardiopulmonary resuscitation':ab,ti OR 'advanced cardiovascular life support':ab,ti OR 'advanced resuscitation':ab,ti OR 'paediatric life support':ab,ti OR 'pediatric life support':ab,ti OR apls:ab,ti OR 'paediatric advanced life support':ab,ti OR pals:ab,ti OR 'pediatric advanced life support':ab,ti OR 'advanced trauma life support care'/exp OR 'advanced trauma life support':ab,ti OR atls:ab,ti) AND ('emergency medical services education'/exp OR 'medical education'/exp OR 'education'/exp OR education:ab,ti OR 'teaching'/exp OR teach:ab,ti OR teaching:ab,ti OR teacher:ab,ti OR teachers:ab,ti OR learn:ab,ti OR train:ab,ti OR training:ab,ti OR course:ab,ti OR courses:ab,ti OR class:ab,ti OR classes:ab,ti OR program:ab,ti OR programs:ab,ti OR 'educational model'/exp OR 'learning'/exp) NOT ('animal'/exp NOT 'human'/exp) NOT ([editorial]/lim OR [letter]/lim OR 'case report'/de) AND [embase]/lim

Cochrane: (Search Completed: June 24, 2014) June 17 2014: 76 Results

("technology-based":ab,ti or "computer-based":ab,ti or "internet-based":ab,ti or "web-based":ab,ti or multimedia:ab,ti or "multi-media":ab,ti or [mh Internet] or [mh "computer simulation"] or [mh "computer assisted instruction"] or "self-directed":ab,ti or "self directed":ab,ti or elearning:ab,ti or "e-learning":ab,ti or preinstruction:ab,ti or "pre-instruction":ab,ti or pretest:ab,ti or "pre-test":ab,ti or pretraining:ab,ti or "pre-training":ab,ti or prepare:ab,ti or preparation:ab,ti or preparatory:ab,ti or precourse:ab,ti or "pre-course":ab,ti or precourses:ab,ti or flipped:ab,ti or before:ab,ti or prior:ab,ti) and ([mh "Advanced Cardiac Life Support "] or "ACLS":ab,ti or "advanced cardiac life support":ab,ti or "advanced life support":ab,ti or "advanced cardiopulmonary resuscitation":ab,ti or "advanced cardiovascular life support":ab,ti or "advanced resuscitation":ab,ti or "paediatric life support":ab,ti or "pediatric life support":ab,ti or APLS:ab,ti or "paediatric advanced life support":ab,ti or PALS:ab,ti or "pediatric advanced life support":ab,ti or [mh "advanced trauma life support care"] or "advanced trauma life support":ab,ti or ATLS:ab,ti) and ([mh "advanced cardiac life support"/ED] or [mh resuscitation/ED] or [mh "Emergency Medicine"/ED] or [mh Medicine/ED] or [mh Nursing/ED] or [mh "Emergency Responders"/ED] or [mh "Emergency Medical Technicians"/ED] or [mh "Emergency Nursing"/ED] or [mh "Internal Medicine"/ED] or [mh "Emergency Treatment"/ED] or [mh "Education, Medical"] or [mh "Education, Graduate"] or [mh "Education, Medical, Undergraduate"] or [mh education] or education:ab,ti or [mh Teaching] or teach:ab,ti or teaching:ab,ti or teacher:ab,ti or teachers:ab,ti or Learn:ab,ti or [mh Learning] or Train:ab,ti or Training:ab,ti or course:ab,ti or courses:ab,ti or class:ab,ti or classes:ab,ti or program:ab,ti or programs:ab,ti or [mh "Models, Educational"] or [mh "Health Education"/MT] or [mh Curriculum])

2019 Search Strategy:

Search: ("technology-based"[TIAB] OR "computer-based"[TIAB] OR "internet-based"[TIAB] OR "web-based"[TIAB] OR "multimedia"[TIAB] OR "multi-media"[TIAB] OR "Internet"[Mesh] OR "computer simulation"[Mesh] OR "computer assisted instruction"[Mesh] OR "self-directed"[TIAB] OR "self directed"[TIAB] OR "elearning"[TIAB] OR "e-learning"[TIAB] OR "preinstruction"[TIAB] OR "pre-instruction"[TIAB] OR "pretest"[TIAB] OR "pre-test"[TIAB] OR "pretraining"[TIAB] OR "pre-training"[TIAB] OR "prepare"[TIAB] OR "preparation"[TIAB] OR "preparatory"[TIAB] OR "precourse"[TIAB] OR "pre-course"[TIAB] OR "precourses"[TIAB] OR "flipped"[TIAB] OR "before"[TIAB] OR "prior"[TIAB]) AND (("Advanced Cardiac Life Support "[Mesh] OR "ACLS"[TIAB] OR "advanced cardiac life support"[TIAB] OR "advanced life support"[TIAB] OR "advanced cardiopulmonary resuscitation"[TW] OR "advanced cardiovascular life support"[TW] OR "advanced resuscitation"[TW] OR "paediatric life support"[TIAB] OR "pediatric life support"[TIAB] OR "APLS"[TIAB] OR "paediatric advanced life support"[TIAB] OR "PALS"[TIAB] OR "pediatric advanced life support"[TIAB] OR "advanced trauma life support care"[Mesh] OR "advanced trauma life support"[TIAB] OR "ATLS"[TIAB]) AND ("advanced cardiac life support/education"[Mesh] OR "resuscitation/education"[Mesh] OR "Emergency Medicine/education"[Mesh] OR "Medicine/education"[Mesh] OR "Nursing/education"[Mesh] OR "Emergency Responders/education"[Mesh] OR "Emergency Medical Technicians/education"[Mesh] OR "Emergency Nursing/education"[Mesh] OR "Internal

Medicine/education"[Mesh] OR "Emergency Treatment/education"[Mesh] OR "Education, Medical"[Mesh] OR "Education, Graduate"[Mesh] OR "Education, Medical, Undergraduate"[Mesh] OR "education"[mesh] OR "education"[TIAB] OR "Teaching"[Mesh] OR teach[TIAB] OR "teaching"[TIAB] OR "teacher"[TIAB] OR "teachers"[TIAB] OR "Learn"[TIAB] OR "Learning"[Mesh] OR "Train"[TIAB] OR "Training"[TIAB] OR "course"[TIAB] OR "courses"[TIAB] OR "class"[TIAB] OR "classes"[TIAB] OR "program"[TIAB] OR "programs"[TIAB] OR "Models, Educational"[Mesh] OR "Health Education/methods"[Mesh] OR "Curriculum"[Mesh])) NOT ("animals"[MeSH Terms] NOT "humans"[MeSH Terms]) NOT ("letter"[pt] OR "comment"[pt] OR "editorial"[pt] OR Case Reports[ptyp])

Database searched: PubMed - using the 2019 search strategy above

Date Search Completed: Feb 8th 2021

Search Results (Number of articles identified / number identified as relevant): 19 articles were found between Jan 1st 2020 and Feb 8th 2021, two of these met the inclusion criteria of the PICOST. (Chaves, 2020 7681; Phungoen 2020 e16987)

Inclusion/Exclusion Criteria: Included: Randomized controlled trials (RCTs) and non-randomized studies, controlled before-and-after studies, cohort studies). Excluded: letters, commentaries, case reports, unpublished studies (e.g., conference abstracts).

Link to Article Titles and Abstracts (if available on PubMed):

Chaves, 2020 7681: https://pubmed.ncbi.nlm.nih.gov/33096768/

Phungoen 2020 e16987: https://pubmed.ncbi.nlm.nih.gov/32149711/

Summary of Evidence Update:

Two new eligible studies were found, one RCT and one non-RCT. The RCT (Phungoen 2020 e16987) compared the distribution of a serious game on smartphones of 5th year medical students before an ALS course to the effects of not distributing the serious game prior the course. The study found no statistically significant differences for most of the outcomes; only for the 'algorithm knowledge score' a difference was found ($p<.01$), however this accounts for less than a 5% difference in the score and is therefore questionable in respect to clinical relevance. The non-RCT (Chaves 2020 7681) compared a 'mixed-methodology' ALS course which included e-learning to a traditional face to face ALS course, and found no differences for knowledge and skills at course conclusion. Results at 6 months after course conclusion were flawed by a loss to follow-up of around 50%. However, in the 'mixed-methodology' ALS course the face to face time was significantly reduced.

Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Relevant Guidelines or Systematic Reviews

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
none					

RCTs:

	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

Pre-course smartphone game; Phungoen; 2020; Thailand	Study Aim: Compare the use of a serious game for smartphone prior to an ALS course vs. the ALS course without the smartphone game Study Type: RCT	Inclusion Criteria: 5th year medical students attending a 2-day ALS course	Intervention: pre-course serious game prior to a 2-day ALS course (n=52) Comparison: 2-day ALS course without the serious game (n=53)	1° endpoint: Knowledge at course conclusion: 'Algorithm knowledge' score 17.33 (i) vs. 16.6 (c), p = .01; 'General knowledge' score 22.88.(i) vs. 23.45 (c), p = .45; Skills at course conclusion: 'ALS skill test' pass rate: 41% (i) vs. 35% (c), p = .09	Study Limitations: knowledge scores not validated; very early study endpoint

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)
Blended Learning vs. traditional ALS course; Chaves; 2020; Spain	Study Aim: Compare a mixed-methodology ALS course (including e-learning) vs. a traditional ALS course Study Type: Non-RCT	Inclusion Criteria: 1st year resident physicians attending a 2.5-day ALS course Intervention: Mixed-methodology ALS course (includ. e-learning) (n=52) Comparison: 2.5-day ALS course without the serious game (n=58)	1° endpoint: Knowledge 6 mon after course conclusion: 'test of knowledge' score 20.72 (i) vs. 20.14 (c), n.s.; Skills at course conclusion: 'mean of techniques performed improperly': n=3.03 (i) vs. 3.19 (c), p = .623	Study Limitations: Loss to follow-up at 6 months: 50% for (i) and (c) groups

Reviewer Comments (including whether meet criteria for formal review):

In 2020, the evidence for an effect of precourse preparation was still limited. The EIT task force nonetheless recommended providing learning formats as precourse preparation for advanced courses, as desirable consequences probably outweigh undesirable consequences in most settings. Furthermore, the task force strongly recommended providing the option of e-learning as part of a blended learning approach to reduce face to face training.

The two new studies identified in the current search, support the recommendation made in 2020. Given the limited quality of new evidence, coupled with the heterogeneity of the studies, the low sample sizes, and the early endpoints, the new studies are unlikely to change the recommendations given in 2020. Therefore, the new evidence does not trigger a new systematic review or a new ILCOR recommendation.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 10 Feb 2021

Reference list

Chaves J, Lorca-Marín AA, Delgado-Algarra EJ. Methodology of Specialist Physicians Training: From Traditional to e-Learning. Int J Environ Res Public Health. 2020 Oct 21;17(20):7681. doi: 10.3390/ijerph17207681.
Phungoen P, Promto S, Chanthawatthanarak S, Maneepong S, Apiratwarakul K, Kotruchin P, Mitsungnern T.
Precourse Preparation Using a Serious Smartphone Game on Advanced Life Support Knowledge and Skills: Randomized Controlled Trial. J Med Internet Res. 2020 Mar 9;22(3):e16987. doi: 10.2196/16987.

2021 Evidence Update Worksheet
Appendix B3 EIT 8

Worksheet author(s): Ming-Ju Hsieh
Date Submitted: Feb 1, 2021

PICO / Research Question: System Performance Improvement (EIT 640)
Population: Among resuscitation systems who are caring for patients in cardiac arrest in any setting. **Intervention:** System performance improvement.
Comparators: No system performance improvement.
Outcomes: Survival with favorable neurologic outcome at discharge (critical); Survival to hospital discharge (critical); Skill performance in actual resuscitations (important); Survival to admission (important); System level improvement (important)
Type (intervention, diagnosis, prognosis): intervention**.**

Additional Evidence Reviewer(s): Ying-Chih Ko
Conflicts of Interest (financial/intellectual, specific to this question): none.
Year of last full review: 2019
Last ILCOR Consensus on Science and Treatment Recommendation:
We recommend that organizations or communities that treat cardiac arrest evaluate their performance and target key areas with the goal to improve performance (strong recommendation, very low-certainty evidence). (ILCOR 2020 CoSTR)

Search Strategy for 2020 ILCOR CoSTR:
Pubmed: (("Cardiopulmonary Resuscitation/organization and administration"[Mesh] AND performance)) OR (((((("Cardiopulmonary Resuscitation"[Mesh] OR "Heart Arrest"[Mesh] OR "cardiac arrest"[TIAB] OR resuscitation[TIAB] OR "Ventricular Fibrillation/drug therapy"[Mesh] OR "Ventricular Fibrillation/therapy"[Mesh])) AND ("Feedback"[Mesh:NoExp] OR "Feedback, Sensory"[Mesh]OR feedback[TIAB] OR feed back[TIAB]OR "Clinical Audit"[Mesh] OR audit*[TIAB] OR "Benchmarking"[Mesh] OR benchmark*[TIAB] OR "quality control"[TIAB] OR "Total Quality Management"[Mesh] OR "Program Evaluation"[Mesh] OR "Program Evaluation"[TIAB] OR "Programme Evaluation"[TIAB] OR "Task Performance and Analysis"[Mesh:NoExp] OR "Audiovisual Aids"[Mesh:NoExp] OR "Video Recording"[Mesh] OR "quality improvement" OR "Quality improvement"[Mesh:NoExp]) AND ("Outcome and Process Assessment Health Care"[Mesh] OR "quality of healthcare" OR "Quality of Health Care"[Mesh] OR "clinical competence" OR "Clinical Competence"[Mesh] OR "Treatment Outcome"[Mesh] OR "Mortality"[Mesh] OR "Morbidity"[Mesh] OR "return of spontaneous circulation"[TIAB] OR ROSC[TIAB] OR "health outcome" OR "health outcomes" OR mortality[TIAB] OR morbidity[TIAB] OR "change of practice" [TIAB] OR "practice change"[TIAB] OR "Heart Arrest/mortality"[Mesh]))))) NOT ("letter"[pt] OR "comment"[pt] OR "editorial"[pt] or Case Reports[ptyp])
EMBASE: 'resuscitation'/exp OR resuscitation:ab,ti OR 'heart arrest'/exp OR 'cardiac arrest':ab,ti OR 'heart ventricle fibrillation'/exp/dm_dt,dm_th AND ('feedback system'/exp OR feedback:ab,ti OR 'feed back':ab,ti OR 'medical audit'/exp OR audit*:ab,ti OR 'total quality management'/exp OR benchmark*:ab,ti OR 'performance measurement':ab,ti OR 'measuring performance':ab,ti OR 'performance measures':ab,ti OR performance:ti OR 'quality control'/exp OR 'quality control':ab,ti OR (program* NEAR/2 evaluat*):ab,ti OR (program* NEAR/2 effective*):ab,ti) AND ('outcome assessment'/exp OR 'health care quality'/exp OR 'clinical competence'/exp OR 'treatment outcome'/exp OR 'mortality'/exp OR 'morbidity'/exp OR 'return of spontaneous circulation'/exp OR 'return of spontaneous circulation':ab,ti OR rosc:ab,ti OR (health* NEAR/2 outcome*):ab,ti OR mortality:ab,ti OR morbidity:ab,ti OR (chang* NEAR/2 practice):ab,ti) NOT ([editorial]/lim OR [letter]/lim OR 'case report'/de) AND [embase]/lim
Cochrane: ([mh "Cardiopulmonary Resuscitation"] or [mh "Heart Arrest"] or "cardiac arrest":ti,ab or resuscitation:ti,ab or [mh "Ventricular Fibrillation"/DT] or [mh "Ventricular Fibrillation"/TH]) and ([mh ^Feedback] or [mh "Feedback, Sensory"] or feedback:ti,ab or feed back:ti,ab or [mh "Clinical Audit"] or audit*:ti,ab or [mh Benchmarking] or benchmark*:ti,ab or "quality control":ti,ab or "performance measurement":ti,ab or "measuring performance":ti,ab or "performance measures":ti,ab or

performance:ti or [mh "Total Quality Management"] or [mh "Program Evaluation"] or "Program Evaluation":ti,ab or "Programme Evaluation":ti,ab or [mh ^"Task Performance and Analysis"] or [mh ^"Audiovisual Aids"] or [mh "Video Recording"]) and ([mh "Outcome and Process Assessment Health Care"] or "quality of healthcare" or [mh "Quality of Health Care"] or "clinical competence" or [mh "Clinical Competence"] or [mh "Treatment Outcome"] or [mh Mortality] or [mh Morbidity] or "return of spontaneous circulation":ti,ab or ROSC:ti,ab or "health outcome" or "health outcomes" or mortality:ti,ab or morbidity:ti,ab or "change of practice":ti,ab or "practice change":ti,ab)

2021 Search Strategy: same as 2019 (last search date for ILCOR 2020 CoSTR: 2019/11/14).
Database searched: PubMed, EMBASE, Cochrane
Date Search Completed: 2021/01/31
Search Results (Number of articles identified / number identified as relevant): 685/7
Inclusion/Exclusion Criteria:
Inclusion: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion.
Exclusion: Letters, editorials, comments, case reports.

Link to Article Titles and Abstracts (if available on PubMed):
Kim GW, 2020, 46. **https://pubmed.ncbi.nlm.nih.gov/31166220/**
Higashi, 2020. **https://pubmed.ncbi.nlm.nih.gov/32549988/**
Blewer, 2020, e428. **https://pubmed.ncbi.nlm.nih.gov/32768435/**
Kim JY, 2020, 46. **https://pubmed.ncbi.nlm.nih.gov/31806058/**
Lee, 2020, e0241804. https://pubmed.ncbi.nlm.nih.gov/33156868/
Bartos, 2020, 29. https://pubmed.ncbi.nlm.nih.gov/33437949/
Auricchio, 2020. (No Pub Med link) **https://www.sciencedirect.com/science/article/pii/S2666520420300382**

Summary of Evidence Update:
We searched PubMed, Ovid EMBASE, and the Cochrane Central Register of Controlled Trials (CENTRAL) databases to identify studies associated with system performance improvement published from Nov. 14, 2019 to Jan. 31, 2021. We used the same searching strategy of the systematic review for 2020 ILCOR CoSTR. After duplicates were removed, there were 685 records found. Finally, seven nonrandomized trials were included. One study was performed in Singapore [3], three in Korea [4-6], one in the US [7], one in Japan [8], and one in Switzerland [9]. Interventions were performed for patients with out-of-hospital cardiac arrest (OHCA) in six studies [3-7, 9], and one study was for patients with in-hospital cardiac arrest (IHCA) [8]. Six studies [3,4,6-9] concluded that their interventions to improve system performance were associated with better clinical outcomes of patients except that one study [5] showed that there were no observed improvements in outcomes of patients with OHCA after intervention.

Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Relevant Guidelines or Systematic Reviews

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
Greif R (2020) [1]	Education, Implementation, and Teams: 2020 International Consensus on	Same with the current update	27		Organizations or communities that treat cardiac arrest evaluate their performance and target key areas with the

	Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations				goal to improve performance (strong recommendation, very low-certainty evidence).
Ko YC (2020) [2]	Systematic review	Same with the current update	27		Recommend that organizations or communities evaluate their performance and target key areas with the goal to improve performance because of no known risks and the potential for a large beneficial effect.

RCT(0):

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(6)

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)
Blewer AL (2020, Singapore) [3]	Before- and after-intervention study. (National Intervention: EMS intervention, DA-CPR, training program for AED, first responder mobile application)	Adult, non-traumatic, non-EMS witnessed OHCAs (2011/1-2014/12) (N=6788)	Survival to hospital discharge increased after the addition of all interventions, compared with no intervention (OR 3.10 [95% CI 1·53–6·26]; p<0·0001).	National bystander-focused public health interventions were associated with an increased likelihood of bystander CPR, and an increased survival to hospital discharge.
Lee DE (2020, Korea) [4]	Before- and after-intervention study. (Citywide interventions: Phase1 (2008–2011): baseline, phase2 (2012-2014): Mandatory CPR and AED training, DA-CPR, Establishment and action of Daegu Emergency Medical Collaboration Committee. Phase3 (2015-2017): Public access defibrillation program, team CPR program, dual-patch system, standardized post- cardiac arrest treatment, education program for medical staff, regional OHCA registry and Public report and feedback to provinces, hospitals and EMTs)	Adult, non-traumatic OHCA with presumed medical etiology in Daegu Metropolitan City (2008/1-2017/12) (N=6203)	For 10 years (2008–2017), the rate of survival to discharge and the good neurologic outcomes increased from 2.6% to 8.7% and from 1.5% to 6.6%, respectively. For patients with an initial shockable rhythm, these changes in outcomes were more pronounced: survival to discharge: 23.3% in 2008 to 55.0% in 2017, good neurologic outcomes: 13.3% to 46.0%.	City-wide improvement was observed in the good neurologic outcomes after OHCAs of medical origin, and the citywide intervention was significantly associated with better outcomes, particularly in those with initial shockable rhythm.

Kim JY (2020, Korea) [5]	Before- and after-intervention study. (Intervention: Implementing the PDSA("Plan-Do-Study-Act") model for quality improvement: bystander CPR education and dispatcher training. Regular skills training sessions for EMTs. Detailed data collection instrument. Medical director assignment.	Adult with OHCA of presumed cardiac etiology assessed by EMS providers of the Ansan Fire Department (2008/1-2013/12, pre: 2008-2011 (n=777), post: 2012-2013 (n=378))	Rates of documented bystander CPR increased from 13% to 37%. The overall rate of ROSC decreased from 18.4% to 14.3% (risk difference −4.1%; 95% CI, −7.1%–1.0%) Survival to hospital discharge increased from 3.9% to 5.0% (risk difference 1.1%; 95% CI, −1.8%–3.8%) Survival with good neurologic outcome increased from 0.8% to 1.6% (risk difference 0.8%; 95% CI, −0.8%–2.4%). In multivariable analyses, there was no association between the intervention and the rate of ROSC or survival to hospital discharge. The designated level of the treating hospital was a significant predictor of both survival and ROSC.	In this case study, there were no observed improvements in outcomes from OHCA after the targeted intervention to improve out-of-hospital CPR. However, utilizing the PDSA model for quality improvement, the designated level of the treating hospital was found to be a significant predictor of survival in the post-period, identifying the next target for intervention.
Kim GW (2020, Korea) [6]	Before- and after-intervention study (Intervention: re-education of BLS, simulation training for ALS, real-time medical direction via video call, and two-tier dispatch)	All adult EMS-treated OHCA patients transported to the hospital by a single EMS dispatch center in Suwon. (N=634) (pre: 2013/1-2013/12 (n=314), post: 2014/8-2015/7 (n=320))	There were 248/320 (77.5%) cases of smartphone video-assisted advanced life support during the post-intervention period. For patients in the pre- and post-intervention groups, pre-hospital ROSC was 6.7 and 20%, respectively (aOR 3.3, 95% CI 1.6–6.8, p < 0.01). Favorable neurological outcomes were ascertained in 1.9 and 6.9%, respectively (aOR 23.6, 95% CI 3.4–164.0, p< 0.01).	A multidisciplinary approach including the re-education of BLS, simulation training for ALS, real-time medical direction via video call, and dispatching two teams rather than one team improved the outcome of OHCA.
Bartos JA (2020, US) [7]	Observational cohort study. (Intervention: ECMO-facilitated resuscitation program.)	Standardized OHCA patient selection criteria 1) adults (aged 18-75) 2) VF/VT OHCA 3) no ROSC following three shocks 4) automated CPR with a Lund University Cardiac Arrest System (LUCASTM), and 5) estimated transfer time of < 30 min. (2019/12/01-2020/04/01) (N=58)	Survival to hospital discharge occurred in 27/58 (47%) and 25/58(43% [CI: 31-56%]) had functionally favorable survival (CPC of 1 or 2).	Community-wide ECMO-facilitated resuscitation program in the US demonstrated 100% successful cannulation, 43% functionally favorable survival rates at hospital discharge and 3 months, as well as safety. The program provides a potential model of this approach for other communities.
Higashi A (2020, Japan) [8]	Retrospective observational study (Intervention: RRS and ECMO programs in 2011, which was revised in 2013.)	IHCA patients who underwent ECPR (2003/1-2017/12) (N=117)	In the multivariate logistic regression, IHCA patients with shorter LFD (Low-flow duration) experienced significantly increased 90-day survival and favorable neurological outcomes (LFD per minute, 90-day survival: OR = 0.97, 95% CI = 0.94–1.00, p = 0.032; 90-day favorable neurological outcome: OR = 0.97, 95% CI = 0.94–1.00, p = 0.049).	The quality improvement in administering ECPR over time, including the RRS program and the ECMO program, appeared to ameliorate clinical outcomes.

Auricchio A (2020, Switzerland) [9]	Retrospective analysis (Intervention: recording of out-of-hospital cardiac arrests; initiatives on AED density, bystander and layperson recruitment; first responder network)	OHCA patients, aged >1 year old in the Ticino Canton, Switzerland (2002/1/1 - 2018/12/31) (N=2481)	Time from call to CPR decreased from 9-min in 2002-2006 to 5-min in 2015-2018 (p<0.01). Survival to discharge increased overall from 11% in 2002-2006 to 23% in 2015-2018 (p<0.001).	State-wide initiatives can significantly increase the chances of survival in both male and female victims of OHCAs, by increasing the probability to receive CPR in a shorter time span.

Abbreviations: EMS, emergency medical service; DA-CPR, dispatch-assisted cardiopulmonary resuscitation; AED, automated external defibrillator; OHCA, out-of-hospital cardiac arrest; OR, odds ratio; ROSC, return of spontaneous circulation; EMT, emergency medical technician; CI, confidence interval; BLS, basic life support; ALS, advanced life support; ECMO, extracorporeal membrane oxygenation; ECPR, extracorporeal cardiopulmonary resuscitation; IHCA, in-hospital cardiac arrest; RRS, rapid response system.

Reviewer Comments (including whether meet criteria for formal review):

In our evidence-updated review, seven new nonrandomized trials were included. Most of them showed interventions to improve system performance were associated with improved clinical outcomes of patients with cardiac arrest. After reviewing these seven studies published in 2020, the evidence triggers did not change in the wording, the strength of the recommendation, or level of evidence of the treatment recommendation for system performance improvement (EIT 640) published in ILCOR 2020 CoSTR. As such, we do not consider that another systematic review is required at this stage.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 6 Feb 2021

Reference list

[1] Greif R, Bhanji F, Bigham BL, et al. Education, Implementation, and Teams: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation. 2020;156:A188-A239.

[2] Ko YC, Hsieh MJ, Ma MHM, et al. The effect of system performance improvement on patients with cardiac arrest: A systematic review. Resuscitation. 2020;157:156-65.

[3] Blewer AL, Ho AFW, Shahidah N, et al. Impact of bystander-focused public health interventions on cardiopulmonary resuscitation and survival: a cohort study. Lancet Public Health. 2020;5:e428-e36.

[4] Lee DE, Ryoo HW, Moon S, et al. Effect of citywide enhancement of the chain of survival on good neurologic outcomes after out-of-hospital cardiac arrest from 2008 to 2017. PLoS ONE. 2020;15.

[5] Kim JY, Cho H, Park JH, et al. Application of the "Plan-Do-Study-Act" Model to Improve Survival after Cardiac Arrest in Korea: A Case Study. Prehosp Disaster Med. 2020;35:46-54.

[6] Kim GW, Lee DK, Kang BR, et al. A multidisciplinary approach for improving the outcome of out-of-hospital cardiac arrest in South Korea. Eur J Emerg Med. 2020;27:46-53.

[7] Bartos JA, Frascone RJ, Conterato M, et al. The Minnesota mobile extracorporeal cardiopulmonary resuscitation consortium for treatment of out-of-hospital refractory ventricular fibrillation: Program description, performance, and outcomes. EClinicalMedicine. 2020;29-30.

[8] Higashi A, Nakada TA, Imaeda T, et al. Shortening of low-flow duration over time was associated with improved outcomes of extracorporeal cardiopulmonary resuscitation in in-hospital cardiac arrest. J Intensive Care. 2020;8:39.
[9] Auricchio A, Caputo ML, Baldi E, et al. Gender-specific differences in return-to-spontaneous circulation and outcome after out-of-hospital cardiac arrest: Results of sixteen-year-state-wide initiatives. Resusc Plus. 2020;4:100038.

2021 Evidence Update Worksheet
Appendix B3 EIT 9

Worksheet author(s):Tasuku Matsuyama
Date Submitted: 02/10/2021

PICO / Research Question: Community initiatives to promote BLS implementation (EIT 641)

***Population*:** Within the general population of children and adults suffering an OHCA
***Intervention*:** Community initiatives to promote BLS implementation
***Comparison*:** Current practice
***Outcomes*:** Survival to hospital discharge with good neurological outcome, survival to hospital discharge, ROSC, time to first compressions, bystander CPR rate, and proportion of population trained
***Study design*:** RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) are eligible for inclusion.
***Time Frame*:** From November 10, 2019 to February 01, 2021

Outcomes: As above
Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: Scoping Review (search ended November 10, 2019)

Last ILCOR Consensus on Science and Treatment Recommendation:
The treatment recommendation (below) remains unchanged from 2015. We recommend implementation of resuscitation guidelines within organizations that provide care for patients in cardiac arrest in any setting (strong recommendation, very low quality of evidence).

2010/2015 Search Strategy:
2019 Search Strategy:
PubMed : ((("Heart Arrest"[Mesh] OR "heart arrest*"[TIAB] OR "cardiac arrest*"[TIAB] OR "cardiovascular arrest*"[TIAB] OR "cardiopulmonary arrest*"[TIAB] OR "cardio-pulmonary arrest*"[TIAB] OR "Out-of-Hospital Cardiac Arrest*"[Mesh] OR OHCA OR "Out of Hospital Cardiac Arrest*"[TIAB] OR "out-of-hospital cardiac arrest*" [TIAB] OR "Outside-of-Hospital Cardiac Arrest"[TIAB]) OR (resuscitation [Mesh] OR resuscitation* [TIAB] OR "cardiopulmonary resuscitation"[Mesh] OR "cardiopulmonary resuscitation"[TIAB] OR "Cardio-Pulmonary Resuscitation" OR "Cardio Pulmonary Resuscitation" OR CPR [TIAB] OR "Life Support Care"[Mesh] OR "Basic Cardiac Life Support" OR "basic life support" OR "Cardiac Life Support" [TIAB] OR "cardiorespiratory resuscitation"[TIAB] OR "Heart Massage*"[Mesh] OR “heart massage*”[TIAB] OR “cardiac massage*” [TIAB] OR “chest compression*”[TIAB] OR “cardiac compression*”[TIAB]) OR (defibrillators [Mesh] OR defibrillator* [TIAB] OR “automated external defibrillator*” OR AED OR “External Defibrillator*” OR “Electric Shock Cardiac Stimulator*” OR “Electric Defibrillation” OR Electric Countershock [Mesh] OR “Electrical Cardioversion*” [TIAB] OR “Cardiac Electroversion*”))AND (bystander*[TIAB] OR "first responder*"[TIAB] OR "first-responder*"[TIAB] OR Layperson*[TIAB] OR “lay people”[TIAB] OR “lay rescuer*”[TIAB] OR “lay public” OR witness*[TIAB] OR “non-healthcare professional” [TIAB])) AND (((community OR public OR local OR social OR population* OR citizen*) AND (initiative* OR intervention* OR action* OR participation OR involvement* OR engagement OR preparation* OR implement* OR project* OR strategy* OR program OR programs OR network* OR training* OR campaign* OR education OR coaching OR information* OR learning OR instruction* OR guidance*

OR response* OR responsiveness OR reply OR reaction OR awareness OR alertness OR realization OR sensibility OR sensitivity OR consciousness) OR "community-based initiative*" OR "community-driven initiative*")) • Search performed on 10/11/2019 • Filters: Only humans

COCHRANE: (MeSH descriptor: [Heart Arrest] OR ("cardiac arrest" OR "cardiovascular arrest*" OR "cardiopulmonary arrest*" OR "cardio-pulmonary arrest*"):ti,ab,kw OR MeSH descriptor: [Out-of-Hospital Cardiac Arrest] OR ("cardiopulmonary resuscitation" OR "Cardio Pulmonary Resuscitation" OR CPR OR "Life Support Care" OR "Basic Cardiac Life Support" OR "basic life support" OR "Cardiac Life Support" OR "cardiorespiratory resuscitation"):ti,ab,kw OR MeSH descriptor: [Heart Massage] OR ("cardiac massage*" OR "chest compression*" OR "cardiac compression"):ti,ab,kw OR defibrillator* OR "automated external defibrillator*" OR AED OR "External Defibrillator*" OR "Electric Shock Cardiac Stimulator*" OR "Electric Defibrillation" OR Electric Countershock OR "Electrical Cardioversion*" OR "Cardiac Electroversion*"):ti,ab,kw) AND ((bystander* OR "first responder*" OR "first-responder*" OR Layperson* OR "lay people" OR "lay rescuer*" OR "lay public" OR witness* OR "non-healthcare professional"):ti,ab,kw) AND (community OR public OR local OR social OR population* OR citizen* OR person OR people):ti,ab,kw AND (initiative* OR intervention* OR action* OR participation OR involvement* OR engagement OR preparation* OR implement* OR project* OR strategy* OR program OR programs OR network* OR training* OR campaign* OR education OR coaching OR information* OR learning OR instruction* OR guidance* OR response* OR responsiveness OR reply OR reaction OR awareness OR alertness OR realization OR sensibility OR sensitivity OR consciousness OR "community-based initiative*" OR "community-driven initiative*"):ti,ab,kw

Database searched: Pubmed, Cochrane
Date Search Completed: February 1 2021
Search Results (Number of articles identified / number identified as relevant): 208/ 2
Inclusion/Exclusion Criteria:
Inclusion Criteria:
1) Studies were eligible if they addressed the research question, reporting the impact of community initiatives (i.e. training, video-based CPR courses, media broadcasts, etc.) involving laypersons on OHCAs outcomes,
2) Peer reviewed journal papers,
3) Written in English
4) Involving human participants,
5) All study designs
Exclusion Criteria:
1) Studies not addressing the research question
2) Abstract only studies, To avoid overlapping with other PICOs:
3) Public access defibrillation (PAD) programs or other automated external defibrillator (AED) dissemination and deployment programs including use of drones,
4) Dispatched and/or Telephone CPR including use of Apps for first responder dispatch and/or AED localization,
5) Impact of social or economic factors in bystander's engagement, including geographical areas, neighborhoods differences, ethnic background,
6) Effect of different CPR Techniques or protocols including changes in resuscitation guidelines

Link to Article Titles and Abstracts (if available on PubMed):
Tay 2020, 220: **https://pubmed.ncbi.nlm.nih.gov/31669756/**
Blewer 2020, e428: **https://pubmed.ncbi.nlm.nih.gov/32768435/**
Yu 2020, e209256: **https://pubmed.ncbi.nlm.nih.gov/32609351/**

Summary of Evidence Update:
Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.
As shown in the Tables below, this EvUp identified one systematic review (Ref 1) and two non-randomised relevant articles[2,3] We found no randomized controlled trial.

Relevant Guidelines or Systematic Reviews

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
Yu, 2020 [1]	Systematic Review	P: OHCA patients I: Community intervention programs aimed to improve bystander CPR and survival following OHCA. Community interventions were defined as interventional programs that included community-based intervention alone or community intervention combined with changes in health services O: survival to hospital discharge or 30 days and bystander CPR.	15	Meta-analysis of 9 studies including 21 266 patients with OHCA found that community interventions were associated with increased survival to discharge or 30-day survival (OR, 1.34; 95%CI, 1.14-1.57; I2 = 33%) and greater bystander CPR rate (OR, 1.28; 95%CI, 1.06- 1.54; I2 = 82%).	NA

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)
	Study Type:	Inclusion Criteria:	1° endpoint:	
Tay, 2020 [2]	Initial implementation of a stepped-wedge, before-after, real-world interventional bundle	all adult patients who experienced OHCA in Singapore from 2011 to 2016 within study regions, excluding EMS-witnessed cases and cases due to rauma/drowning/ electrocution.	The intervention group had higher survival (3.3% [12/361] vs. 2.2% [19/880]). After adjusting for age, gender, race and significant covariates, the intervention was associated with increased odds ratio (OR) for survival (OR 2.39 [1.02 _5.62]).	The OHCA interventional bundle (SAL [Save-A-life] initiative, DA-CPR, myResponder [mobile application]) significantly improved survival and is being scaled up as a national program.
Blewer, 2020 [3]	a secondary analysis of a prospective cohort	adult, non-traumatic OHCAs, through the Singapore registry between Jan 1, 2011, and Dec	Compared with no intervention, likelihood of bystander CPR was not significantly altered by the addition of	National bystander-focused public health interventions were associated with an increased

	registry study, examining differences in likelihood of bystander CPR and survival after the implementation of national bystander interventions in Singapore	31, 2016. Paediatric arrests, arrests witnessed by emergency medical services, and healthcare-facility arrests were excluded,	emergency medical services interventions (odds ratio [OR] 1·33 [95% CI 0·98–1·79]; p=0·065), but increased with implementation of dispatch assisted CPR (3·72 [2·84–4·88]; p<0·0001), with addition of the CPR and automated external defibrillator training programme (6·16 [4·66–8·14]; p<0·0001), and with addition of the myResponder application (7·66 [5·85–10·03]; p<0·0001). Survival to hospital discharge increased after the addition of all interventions, compared with no intervention (OR 3·10 [95% CI 1·53–6·26]; p<0·0001).	likelihood of bystander CPR, and an increased survival to hospital discharge.

Reviewer Comments (including whether meet criteria for formal review):

Two of the articles identified in this EvUp were published from the same database and study period in Singapore[2,3]. These studies reported critical outcomes of survival to hospital discharge and important outcomes such as bystander CPR, but if we performed systematic review, we can only include one of these studies. Therefore, this additional evidence does not trigger a systematic review or a change of the current ILCOR recommendation.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn (SAC rep for EIT T/F) on 11 Feb 2021.

Reference list

1. Yu Y, Meng Q, Munot S, Nguyen TN, Redfern J, Chow CK. Assessment of Community Interventions for Bystander Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest: A Systematic Review and Meta-analysis. JAMA network open. 2020;3(7):e209256.
2. Tay PJM, Pek PP, Fan Q, Ng YY, Leong BS, Gan HN, et al. Effectiveness of a community based out-of-hospital cardiac arrest (OHCA) interventional bundle: Results of a pilot study. Resuscitation. 2020;146:220-8.
3. Blewer AL, Ho AFW, Shahidah N, White AE, Pek PP, Ng YY, et al. Impact of bystander-focused public health interventions on cardiopulmonary resuscitation and survival: a cohort study. The Lancet Public health. 2020;5(8):e428-e36.

2021 Evidence Update Worksheet
Appendix B3 EIT 10

Worksheet author(s): Kasper G. Lauridsen
Date Submitted: February 8, 2021

PICO / Research Question:
Prehospital termination of resuscitation (TOR) rules (EIT 642)

Population: Adults and children in cardiac arrest who do not achieve return of spontaneous circulation (ROSC) in the out-of-hospital environment
Intervention: TOR rules
Comparators: In-hospital outcomes (died/survived), and favorable/unfavorable neurological outcome
Outcomes: Ability of TOR to predict death in hospital (critically important) and unfavorable neurological outcome (critically important).
Study Designs: Randomized controlled trials and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies). We excluded editorials, commentaries, opinion papers, non-published studies, and studies not having an abstract in English.
Timeframe: 01/06/2019 to 05/02/2021.

Outcomes: As above
Type (intervention, diagnosis, prognosis): Diagnosis
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2019

Last ILCOR Consensus on Science and Treatment Recommendation:
We conditionally recommend the use of TOR rules to assist clinicians in deciding whether to discontinue resuscitation efforts out of hospital or to transport to hospital with ongoing CPR (conditional recommendation/very low-certainty evidence).

2019 Search Strategy (EMBASE):
((‘out-of-hospital cardiac arrest’/exp OR ‘ohca’ OR ((‘Heart Arrest’/exp OR ‘Heart Arrest.mp.’/ OR 'ventricular fibrillation.mp.' OR 'heart ventricle fibrillation'/exp OR 'ventricular tachycardia.mp.' OR 'heart ventricle tachycardia'/exp OR ‘cardiopulmonary arrest’/exp OR ‘cardiopulmonary arrest.mp.’ OR ‘circulatory arrest.mp.’ OR ‘cardiac standstill.mp.’ OR ‘pulseless electrical activity.mp.’ OR ‘pea.mp.’ OR ‘pulseless.mp.’ OR ‘shockable.mp.’ OR ‘non-shockable’ OR ‘non shockable’ OR ‘cardiac arrest.mp.’) AND (prehospital OR ‘pre hospital’ OR ‘pre-hospital/ OR ‘out-of-hospital’ OR ‘out of hospital’ OR ‘emergency health service'/exp OR 'emergency medical service*.mp.’ 'paramedic*.mp.' OR 'paramedical personnel'/exp ‘emergency medical technician.mp.’ OR ‘rescue personnel’ OR ‘air medical transport’/exp OR ‘air ambulance*.mp.’ OR ‘hems.mp.’ OR ambulance/exp OR ambulance*.mp. OR ems OR emt OR field)) AND (resuscitation/exp OR resuscitat*.mp. OR ‘Resuscitation Orders’ OR ‘cardiopulmonary resuscitation’ or CPR OR ‘Life Support Care’ OR ‘heart massage.mp.’ OR ‘heart massage’/exp OR ‘chest compression’ OR ‘basic life support’ OR BLS OR ‘advanced life support’ OR ALS OR ‘advanced cardiac life support’) AND (Prognosis/exp OR (terminat* OR cease OR cessation OR withdraw* OR withhold* OR withheld OR futile OR futility OR TOR OR rule* OR decision* OR algorithm* OR stop)) NOT (letter or editorial)) limit to human.

2021 Search Strategy:
Same as above

Database searched: OVID Medline, Embase
Date Search Completed: February 07, 2021
Search Results (Number of articles identified / number identified as relevant): 432 studies were identified, 4 studies were identified for possible inclusion, and one included relevant outcomes.
Inclusion Criteria: We included studies on TOR rules used to predict survival or death for patients in out-of-hospital cardiac arrest.
Exclusion: Studies utilizing pre-arrest factors (e.g. age and comorbidities) to identify patients at low risk of surviving a cardiac arrest and studies on clinical decision rules used to predict survival after ROSC were excluded.

Link to Article Titles and Abstracts (if available on PubMed):
Caputo, 2019, 62. **https://pubmed.ncbi.nlm.nih.gov/30447262/**
Amnuaypattanapon, 2020, e13502. **https://pubmed.ncbi.nlm.nih.gov/32187434/**
Teefy, 2020, 254. **https://pubmed.ncbi.nlm.nih.gov/31924467/**
Jung, 2021, 19. **https://pubmed.ncbi.nlm.nih.gov/33504366/**

Summary of Evidence Update: OVID Medline and EMBASE were searched to identify eligible studies providing new information between 01/06/2019 and 05/02/2021. Overall, 432 abstracts were screened and 11 were full-text reviewed. Among the 11 studies for full-text review, 4 were excluded as they were already included in previous ILCOR review and 3 were excluded as they were on post-arrest prediction of survival. Among the 4 included studies, two studies concerned scores aimed at predicting ROSC without being able to predict death and be used for TOR.[1,2] One study described how the implementation of the Basic Life Support TOR Rule affected high priority transports,[3] and one study evaluated the performance of 9 different TOR rules in a cohort of 170 out-of-hospital cardiac arrests (OHCA).[4]

Nonrandomized Trials, Observational Studies (4)

Study Acronym; Author; Year Published	Aim of Study; Study Type/Design; Study Size (N)	Patient Population	Study Intervention	Primary Endpoint and Results (include P value; OR or RR; & 95% CI)	Summary/Conclusion Comment(s)
Caputo 2019[1] NOT RELEVANT	Cohort study aiming to test the ability of the RACA score to predict probability of ROSC in two different regions with different local resuscitation networks.	All adult OHCAs from January 1, 2015 until December 31, 2017 in the Swiss Canton Ticino and the Italian Province of Pavia.	The RACA Score including: gender, first rhythm, witnessed arrest, CPR before EMS arrival, and the time of ambulance arrival	2,041 patients included. The RACA Score showed good discrimination for ROSC (AUC 0.76) and calibration, without significant interaction (p 0.28) between regions and the probability of ROSC. The probability of ROSC was 15% for RACA scores <0.28. Overall RACA score reliably predicted ROSC with a specificity of 90% and a sensitivity of 39%.	There was no significant difference in performance of the RACA Score between regions. The score performed well in predicting ROSC but is not aimed for termination of resuscitation.
Amnuaypattanapon, 2020[2] NOT RELEVANT	Cohort study aiming to identify predictors of sustained ROSC and to develop a predictive score	Adult and pediatric OHCAs arriving in a University hospital in Thailand from July 2014- March 2018, either by EMS transportation or non-EMS transportation (private or public vehicle).	Derived a "WATCH-CPR Score" including: witnessed arrest, time from arrest to chest compression <15 min and chest compression duration <30 min	347 patients included. The optimal score for predicting sustained ROSC was a score ≥2 with a sensitivity of 72.2% (95% CI 63.4-79.6%), specificity of 76.0% (95% CI 69.8-81.4%), PPV of 63.2% (95% CI 54.7-71.0%), NPV of 82.8% (95% CI 76.7-87.5%). A score of 3 had a sensitivity of 18.3 (12.2-26.3), a specificity of 97.3 (93.9-98.9), an NPV of 79.3 (59.7-91.3)	The derived score had an area under the ROC curve of 0.775 (95% CI 0.724-0.825), indicating good discrimination between sustained ROSC and death but could not reliably predict no ROSC.

				and a PPV of 67.6 (62.1-72.7) for predicting ROSC.	
Teefy, 2020[3] NOT RELEVANT	Cohort study aimed to assess compliance rates, barriers to use, and effect on ambulance transport rates after implementing a TOR rule.	Adult OHCAs over a 1-year period from a regional EMS database.	The BLS TOR rule: no ROSC prior to transportation, 3 rhythm analyses of non-shockable rhythm and the arrest was not witnessed by EMS	552 OHCAs of which 91 met TOR criteria. Paramedics requested TOR in 81 (89%) cases and physicians granting requests in 65 (80.2%) cases. Reasons for physician refusal of TOR included hospital proximity, patient not receiving epinephrine, and poor communication connection. Total high priority transports decreased 15.6% after implementation of a TOR rule.	Application of a TOR rule led to reduction in high-priority ambulance transports. However, the study did not assess predictive values of survival or impact on survival.
Jung, 2021[4] RELEVANT	Cohort study aiming to externally validate the BLS and ALS TOR rules in predicting survival outcomes in the COVID-19 era	Adult OHCAs from a city-wide South Korean registry collected during February 18–March 31, 2020.	Evaluated 9 different TOR rules including the BLS TOR Rule, the ALS TOR Rule, and the KoCARC TOR rule.	170 OHCAs included. When the traditional BLS TOR Rule and KoCARC TOR rule II were applied, one patient met the TOR criteria but survived at hospital discharge (BLS TOR Rule: 85% specificity, 74% sensitivity, 0.8% FPV, and 99% PPV for predicting death). The KoCARC TOR Rule I and the ALS TOR Rule both had a 100% PPV and 0% FPV.	In this small cohort of OHCA during the covid-19 pandemic, the PPVs of the different TOR rules ranged from 98.9%-100%.

Abbreviations: CPR = cardiopulmonary resuscitation; OHCA: out-of-hospital cardiac arrest; ROSC: return of spontaneous circulation; RACA Score: ROSC After Cardiac Arrest Score; ROC: receiver operating characteristic. BLS: basic life support; ALS: advanced life support; KoCARC: Korean Cardiac Arrest Research Consortium; PPV: positive predictive value; NPV: negative predictive value; FPV: false positive value.

Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Reviewer Comments (including whether meet criteria for formal review):

This Evidence Update identified 4 new studies for possible inclusion of which only one cohort study (Jung, 2021, 19) of 170 OHCAs during the covid-19 pandemic described the predictive values of different TOR rules. The identified studies are insufficient to change the treatment recommendation from 2020, nor prompt any new systematic review.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 9 Feb 2021

Reference list

1. Caputo ML, Baldi E, Savastano S, et al. Validation of the return of spontaneous circulation after cardiac arrest (RACA) score in two different national territories. *Resuscitation*. 2019;134:62-68. doi:10.1016/j.resuscitation.2018.11.012

2. Amnuaypattanapon K, Thanachartwet V, Desakorn V, et al. Predictive model of return of spontaneous circulation among patients with out-of-hospital cardiac arrest in Thailand: The WATCH-CPR Score. *Int J Clin Pract*. 2020;74(7):e13502.
3. Teefy J, Cram N, Van Zyl T, Van Aarsen K, McLeod S, Dukelow A. Evaluation of the Uptake of a Prehospital Cardiac Arrest Termination of Resuscitation Rule. *J Emerg Med*. 2020;58(2):254-259. doi:10.1016/j.jemermed.2019.11.018
4. Jung H, Lee MJ, Cho JW, et al. External validation of multimodal termination of resuscitation rules for out-of-hospital cardiac arrest patients in the COVID-19 era. *Scand J Trauma Resusc Emerg Med*. 2021;29(1):19. doi:10.1186/s13049-021-00834-0

2021 Evidence Update Worksheet
Appendix B3 EIT 11

Worksheet author(s): Jonathan Duff
Date Submitted: January 29th, 2021

PICO / Research Question: *EIT 648 - CPR feedback devices during training*
Population: Among students who are receiving resuscitation training
Intervention: does use of a CPR feedback/guidance device
Comparison: compared with no use of a CPR feedback/guidance device
Outcomes:

1. Patient survival [CRITICAL]
2. Quality of performance in actual resuscitations [CRITICAL]
3. Skill performance 1 year after course conclusion [IMPORTANT]
4. Skill performance between course conclusion and 1 year [IMPORTANT]
5. Skill performance at course conclusion [IMPORTANT]
6. Knowledge at course conclusion [IMPORTANT]

Study Designs: 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. Unpublished studies (e.g., conference abstracts, trial protocols), animal studies, and case series, were excluded.
Timeframe: All years and all languages were included as long as there is an English abstract. The search was run to include studies published between July 2019 and 22 January 2021.

Type: Intervention
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2010 / 2015 / New question: 2020 (Search ran July 2019)

Last ILCOR Consensus on Science and Treatment Recommendation:
We suggest the use of feedback devices that provide directive feedback on compression rate, depth, release, and hand position during CPR training (weak recommendation, low certainty evidence). If feedback devices are not available, we suggest the use of tonal guidance (examples include music or metronome) during training to improve compression rate only (weak recommendation, low-certainty evidence).

2010/2015 Search Strategy: on file
2019 Search Strategy:
((("feedback, sensory"[mesh] OR "feedback device"[tiab]) OR "feedback"[MeSH Terms]) OR feedback[tiab]) OR feed-back[tiab]) OR guidance[tiab]) OR e-learning[tiab]) OR elearning[tiab]) OR prompt[tiab]) OR prompts[tiab]) OR prompting[tiab]) OR prompted[tiab]) OR "real-time"[tiab]) OR video[tiab]) OR "Video Recording"[mesh]) OR "audio visual"[tiab]) OR "audiovisual"[tiab]) OR "audiovisual aids"[tiab]) OR "audio-visual aids"[tiab]) OR "virtual realities"[tiab]) OR "virtual reality"[tiab]) OR "virtual reality"[tiab]) OR "cpr-plus"[tiab]) OR "q-cpr"[tiab]) OR "cpr-sensing"[tiab]) OR "cprezy"[tiab]) OR "cpr-ezy"[tiab]) OR "phone"[tiab]) OR "telephone"[tiab]) OR "Telephone"[Mesh]) OR "smartphone"[Mesh]) OR "smartphone"[tiab]) OR "smart phone"[tiab]) OR "smart-phone"[tiab]) OR "computer assisted instruction"[tiab]) OR "computer-assisted instruction"[tiab]) OR "Reinforcement, Verbal"[mesh]) OR "cardiopulmonary Resuscitation/instrumentation"[mesh]) OR "metronomes"[tiab]) OR metronome[tiab]) OR "cell phone"[mesh]) OR "smartphone"[mesh]) OR "patient simulation"[mesh]))) AND ((((((("patient simulation"[mesh]) OR

"computer simulation"[mesh]) OR "high fidelity simulation training"[mesh]) OR "simulation training"[mesh])) OR ((((((((((((("cardiopulmonary resuscitation"[tiab]) OR "cardiopulmonary resuscitation"[mesh]) OR "cardio-pulmonary resuscitation"[tiab]) OR "cpr"[tiab]) OR "advanced cardiac life support"[tiab]) OR "acls"[tiab]) OR "basic life support"[tiab]) OR "bls"[tiab]) OR "mock cardiac arrest"[tiab]) OR "simulated cardiac arrest"[tiab]) OR "advanced life support"[tiab]) OR "cardiac arrest"[tiab]) OR "pediatric advanced life support"[tiab]) OR "paediatric advanced life support"[tiab]) OR "pals"[tiab])))) AND ((((((((((((((((((((training[tiab]) OR "learning acquisition"[tiab]) OR "skill acquisition"[tiab]) OR retention[tiab]) OR "Retention (Psychology)"[mesh]) OR curriculum[mesh]) OR learners[tiab]) OR learner[tiab]) OR learning[tiab]) OR learn[tiab]) OR education[tiab]) OR "Learning"[mesh]) OR "Education, Professional"[mesh]) OR "Professional Competence"[mesh]) OR "students, health occupations"[mesh]) OR ("internship and residency"[mesh])) OR "Health Occupations/education"[mesh]) OR "Allied Health Occupations/education"[Mesh]) OR "Schools, health occupations"[mesh]) OR "Clinical competence"[mesh]) OR "Cardiopulmonary Resuscitation/education"[mesh])))) NOT ((((((("humans"[Mesh Terms]) OR "animals"[mesh terms]) OR letter[pt]) OR comment[pt]) OR editorial[pt]) OR "Case Reports"[ptyp])

Database searched: Pubmed
Date Search Completed: January 22nd, 2021
Search Results (Number of articles identified / number identified as relevant): 135 identified / 5 relevant
Link to Article Titles and Abstracts (if available on PubMed):
Gonzalez-Santano, 2020, 577. **https://pubmed.ncbi.nlm.nih.gov/33142973/**
Jang, 2020, 206. https://pubmed.ncbi.nlm.nih.gov/33028064/
Katipoglu, 2019. https://pubmed.ncbi.nlm.nih.gov/31565794/
Suet, 2020, 270. https://pubmed.ncbi.nlm.nih.gov/32536496/
Wilson, 2020. https://pubmed.ncbi.nlm.nih.gov/33242153/

Summary of Evidence Update:
Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

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
Gonzalez-Santano, 2020 (1)	**Study Aim:** Comparison b/w 2 feedback devices (app, mannequin (FT) vs.	**Inclusion Criteria:** Lay rescuers (lifeguards)	**Intervention:** App training (n=10)	**1° endpoint:** Overall quality*: App 46.5(10.6)	**Study Limitations:** Very small numbers Short retention time

	no feedback (TT) during 12 minute training **Study Type:** Non-blinded RCT (3 arms)	Outcomes measured 7-15 days post training	Mannequin fb (n=10) **Comparison:** Mannequin no fb (n=10)	FT 68.0 (18.6) TT 49.4 (17.3) %Correct depth*: App 40.5 (34.2) FT 68.2 (32.6) TT 30.8 (30.4) *p<0.05	
Jang 2020 206 (2)	**Study Aim:** Comparison b/w real time feedback mannequin (BT-SEEM; real time VisFB) vs. no feedback **Study Type:** RCT	**Inclusion Criteria:** Laypeople (university students) Outcomes measured 3, 6, 9 months post-training	**Intervention:** RTFG (n=48) **Comparison:** NFG (n=47)	**1° endpoint:** %Correct depth: RTFG Imm 51.0 (4.11) 3mo 42.3 (4.11) 6mo 31.8 (4.29) 9mo 30.1 (4.29) Control Imm 26.9 (4.15) 3mo 22.9 (4.24) 6mo 22.5 (4.24) 9mo 25.0 (4.29) *Group p<0.05 *Time p<0.05	**Study Limitations:** No major limitations
Katipoglu 2019 (3)	**Study Aim:** Compare two mannequin feedback vs. no feedback in BLS course **Study Type:** RCT; Multi-centre	**Inclusion Criteria:** First year medical students (n=115)	**Intervention:** Mannequin feedback during BLS course (n=55) **Comparison:** No feedback provided (n=56)	**1° endpoint:** Total score: Post-training* FB: 93 (87-100) Cont: 74 (51-85) 1mo post* FB: 90 (84-100) Cont: 74 (50-79)	**Study Limitations:** Training done with feedback (including assessment at the end). 1 month post-assessment done without access to feedback
Suet 2020 270 (4)	**Study Aim:** Compare feedback (Pocket CPR or SkillReporter vs. no feedback on immediate and 3mo performance **Study Type:** RCT	**Inclusion Criteria:** Second year medical students (n=64) in half-day CPR training course	**Intervention:** PocketCPR - iPhone app (Group 2) QCPR (Group 3) **Comparison:** No feedback (Group 1)	**1° endpoint:** Depth Immediate 1: 43 (35-49) 2: 49 (46-52) 3: 48 (42-53) 3 month 1: 48 (39-54) 2: 49 (44-55) 3: 48 (40-52) No difference b/w groups	**Study Limitations:** Loss of some students to follow-up for retention

				Control rate too high at immediate, all groups good rate at 3 months	
Wilson 2020 (5)	**Study Aim:** Comparison of automated feedback (no instructor) vs. instructor led feedback **Study Type:** Randomized crossover study	**Inclusion Criteria:** 56 resident medical officers	**Intervention:** Novel CC/BLS training course with crossover between instructor-led feedback vs. automated mannequin feedback	**1° endpoint:** Higher rate of CC with automated feedback	**Study Limitations:** Comparing instructor vs. no instructor present. Feedback provided in both groups Little data presented

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:	

Summary of evidence:

Of the 135 studies initially identified, only 5 RCTs were included. Several were excluded for comparing one specific feedback device vs. another.

One RCT (Gonzalez-Santano 2020[1]) looked at CC performance 7-15 days post training with a CPR feedback app, a feedback mannequin or no feedback. Feedback devices were associated with improved performance of CPR, with the group using the feedback mannequin having the largest gains.

Jang et al (Jang 2020 206[2]) compared real-time visual feedback to no feedback in University students and its effect on long-term retention. Real-time feedback was associated with improved performance up to 6 months of training, but not at 9 months of training (no effect on rate or hand position).

Katipoglu et al (Katipoglu 2019[3]) had 115 medical students take an AHA BLS course, one group with feedback from a QCPR mannequin. The feedback group had improved CPR on an end-of-course assessment (but had access to feedback during this assessment). However, at one month, the feedback group had significantly improved CPR performance with neither group having access to a feedback device.

A randomized trial (Suet 2020 270[4]) compared no feedback to the SkillReporter (Laerdal) and an iPhone app (Pocket CPR) in second year medical students undergoing a half-day of CPR training. The control group had excessively high chest compression rates compared to the feedback groups immediately after the course. There were no differences between the groups at a 3-month assessment.

Finally, a randomized cross-over study examining the use of automated feedback vs. instructor led feedback showed improved chest compression performance after automated mannequin feedback (Wilson 2020[5]).

Reviewer Comments (including whether meet criteria for formal review):

One crossover study (Wilson 2020[5]) focused on instructor vs. mannequin provided feedback and adds little to the PICO. The remaining four studies are randomized control trials that compare no feedback to various feedback strategies in CPR training. Three of the studies (Gonzalez-Santano 2020[1], Jang 2020 206[2], Katipoglu 2019[3], Suet 2020 270[4]) showed benefit in performance post-course (from 7 days to 9 months post training). The last study (Suet 2020 270[4]) showed some improvement in CC rate during training but no benefit in overall retention.

Overall, the studies are consistent with the previous literature review and the CoSTR as written in 2020. A formal review is not recommended at this time.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 6 Feb 2021

Reference list

1. González-Santano D, Fernández-García D, Silvestre-Medina E, Remuiñán-Rodríguez B, Rosell-Ortiz F, Gómez-Salgado J, et al. Evaluation of Three Methods for CPR Training to Lifeguards: A Randomised Trial Using Traditional Procedures and New Technologies. Medicina (Kaunas). 2020;56(11).
2. Jang TC, Ryoo HW, Moon S, Ahn JY, Lee DE, Lee WK, et al. Long-term benefits of chest compression-only cardiopulmonary resuscitation training using real-time visual feedback manikins: a randomized simulation study. Clin Exp Emerg Med. 2020;7(3):206-12.
3. Katipoglu B, Madziala MA, Evrin T, Gawlowski P, Szarpak A, Dabrowska A, et al. How should we teach cardiopulmonary resuscitation? Randomized multi-center study. Cardiol J. 2019.
4. Suet G, Blanie A, de Montblanc J, Roulleau P, Benhamou D. External Cardiac Massage Training of Medical Students: A Randomized Comparison of Two Feedback Methods to Standard Training. J Emerg Med. 2020;59(2):270-7.
5. Wilson C, Furness E, Proctor L, Sweetman G, Hird K. A randomised trial of the effectiveness of instructor versus automated manikin feedback for training junior doctors in life support skills. Perspectives on medical education. 2020.

2021 Evidence Update Worksheet
Appendix B3 EIT 12

Worksheet author(s): Janet Bray
Date Submitted: 09th February 2021

PICO / Research Question: Is targeting basic life support (BLS) training to the likely rescuers of those at high-risk of out-of-hospital arrest (OHCA) effective? (EIT 649)
Population: Adults and children at high-risk of out-of-hospital cardiac arrest (OHCA).
Intervention: Focused BLS training of likely rescuers (e.g. family or care-givers)
Comparator: no such training (or pre-intervention)
Outcomes:
Patient outcomes: Good neurological outcome at hospital discharge/30-days; Survival at hospital discharge/30-days; Return of spontaneous circulation (ROSC); Rates of bystander CPR; Bystander CPR quality during an OHCA (any available CPR metrics); Rates of automated external defibrillator (AED) use.
Educational outcomes: at the end of training and within 12 months: CPR quality (chest compression depth and rate; chest compression fraction; full chest recoil, ventilation rate, overall CPR competency) and AED competency; CPR and AED knowledge; Confidence and willingness to perform CPR; and secondary training.

Outcomes: As above.
Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): Susie Cartledge and Marion Leary
Conflicts of Interest (financial/intellectual, specific to this question): Janet Bray, Marion Leary and Susie Cartledge have intellectual COI.
Year of last full review: 2010 / 2015 / New question: 2015

Last ILCOR Consensus on Science and Treatment Recommendation:
We recommend the use of BLS training interventions that focus on high-risk populations, based on the willingness to be trained and the fact that there is low harm and high potential benefit (strong recommendation, low-quality evidence).

2015 Search Strategy: Database inception to June 24 2014.
PUBMED: (“Patient education as topic”[MeSH] OR Train*[TIAB] OR teach*[TIAB] OR learn*[TIAB] OR "Education"[Mesh:NoExp] OR "Teaching"[Mesh] OR "education"[Subheading]) AND ("Drug Users"[Mesh] OR “drug user”[TIAB] OR “drug users”[TIAB] OR addict*[TIAB] OR “Family”[MeSH] OR Family[TIAB] OR Families[TIAB] OR “Parents”[MeSH] OR Parent*[TIAB] OR caregiver*[TIAB] OR care-giver*[TIAB] OR care giver*[TIAB] OR mother*[TIAB] OR father*[TIAB] OR spouse*[TIAB] OR ((bystander*[TIAB] OR Layperson*[TIAB] OR “lay people”[TIAB] OR “lay rescuer”[TIAB] OR “lay rescuers”[TIAB] OR witness*[TIAB]) AND ((private[TIAB] AND location*[TIAB]) OR home*[TIAB] OR residence*[TIAB]))) AND (CPR[TIAB] OR "resuscitation"[Mesh] OR resuscitat*[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] OR “basic life support”[TIAB]) NOT (“animals”[Mesh] NOT “humans”[Mesh]) NOT ("letter"[pt] OR "comment"[pt] OR "editorial"[pt] or Case Reports[ptyp]).
EMBASE: ('patient education'/exp OR Train*:ti,ab OR teach*:ti,ab OR learn*:ti,ab OR 'education'/de OR 'health education'/de OR 'teaching'/de) AND ('high risk patient'/exp OR 'drug dependence'/exp OR “drug user”:ti,ab OR “drug users”:ti,ab OR addict*:ti,ab OR 'family'/de OR 'nuclear family'/exp OR Family:ti,ab OR Families:ti,ab OR Parent*:ti,ab OR caregiver*:ti,ab OR care+giver*:ti,ab OR care giver*:ti,ab OR mother*:ti,ab OR father*:ti,ab OR spouse*:ti,ab OR ((bystander*:ti,ab OR Layperson*:ti,ab OR (lay NEXT (person OR people OR rescuer* OR individual* OR provider*):ti,ab OR witness*:ti,ab))) AND (CPR:ti,ab OR 'resuscitation'/exp OR resuscitat*:ti,ab OR 'heart massage'/exp OR “chest compression”:ti,ab OR “chest compressions”:ti,ab OR “heart massage”:ti,ab OR “cardiac massage”:ti,ab OR “cardiac

compression”:ti,ab OR “cardiac compressions”:ti,ab OR “thoracic compression”:ti,ab OR “thoracic compressions”:ti,ab OR “basic life support”:ti,ab) NOT ('animal'/exp NOT 'human'/exp) NOT ([editorial]/lim OR [letter]/lim OR 'case report'/de) AND [embase]/lim).
Cochrane: ([mh “Patient education as topic”] OR Train*:ti,ab OR teach*:ti,ab OR learn*:ti,ab OR [mh ^"Education"] OR [mh "Teaching"]) AND ([mh "Drug Users"] OR “drug user”:ti,ab OR “drug users”:ti,ab OR addict*:ti,ab OR [mh “Family”] OR Family:ti,ab OR Families:ti,ab OR [mh “Parents”] OR Parent*:ti,ab OR caregiver*:ti,ab OR care-giver*:ti,ab OR care giver*:ti,ab OR mother*:ti,ab OR father*:ti,ab OR spouse*:ti,ab OR ((bystander*:ti,ab OR Layperson*:ti,ab OR “lay people”:ti,ab OR “lay rescuer”:ti,ab OR “lay rescuers”:ti,ab OR witness*:ti,ab OR “lay provider”:ti,ab) AND ((private:ti,ab AND location*:ti,ab) OR home*:ti,ab OR residence*:ti,ab))) AND (CPR:ti,ab OR [mh "resuscitation"] OR resuscitat*:ti,ab OR “chest compression”:ti,ab OR “chest compressions”:ti,ab OR “heart massage”:ti,ab OR “cardiac massage”:ti,ab OR “cardiac compression”:ti,ab OR “cardiac compressions”:ti,ab OR “thoracic compression”:ti,ab OR “thoracic compressions”:ti,ab OR “basic life support”:ti,ab) NOT ([mh “animals”] NOT [mh “humans”])
CINHAL: ((MH "Patient Discharge Education") OR (MH "Patient Education") OR (MH "Education") OR TI Train* OR AB Train* OR (MH "Teaching") OR TI teach* OR AB teach* OR TI learn* OR AB learn* OR MW "ED") AND ((MH "Substance Abusers+") OR TI “drug user” OR AB “drug user” OR TI “drug users” OR AB “drug users” OR TI addict* OR AB addict* OR (MH "Nuclear Family+") OR (MH "Family") OR TI Family OR AB family OR TI Families OR AB families OR TI Parent* OR AB parent* OR TI caregiver* OR AB caregiver* OR TI care-giver* OR AB care-giver* OR TI care NEXT giver* OR AB care NEXT giver* OR TI mother* OR AB mother* OR TI father* OR AB father* OR TI spouse* OR AB spouse* OR TI bystander* OR AB bystander* OR TI Layperson* OR AB Layperson* OR TI “lay people” OR AB “lay people” OR TI “lay rescuer” OR AB “lay rescuer” OR TI “lay rescuers” OR AB “lay rescuers” OR TI “lay provider” OR AB “lay provider” OR TI “lay providers” OR AB “lay providers” OR TI witness* OR AB witness*) AND (TI CPR OR AB CPR OR (MH "Bystander CPR") OR (MH "Heart Massage") OR (MH "Resuscitation") OR (MH "Resuscitation, Cardiopulmonary") OR TI resuscitat* OR AB resuscitat* OR TI “chest compression” OR AB “chest compression” OR TI “chest compressions” OR AB “chest compressions” OR TI “heart massage” OR AB “heart massage” OR TI “cardiac massage” OR AB “cardiac massage” OR TI “cardiac compression” OR AB “cardiac compression” OR TI “cardiac compressions” OR AB “cardiac compressions” OR TI “thoracic compression” OR AB “thoracic compression” OR TI “thoracic compressions” OR AB “thoracic compressions” OR TI “basic life support” OR AB “basic life support”) NOT ((MH "Animals+") NOT (MH "Human")) NOT (PT letter OR PT commentary OR PT editorial or PT Case Study).

2021 Search Strategy: as above between June 25th 2014 and December 10th 2020.
Database searched: PUBMED, EMBASE, COCHRANE and CINHAL
Date Search Completed: 10 December 2020

Search Results (Number of articles identified / number identified as relevant): 1535 identified/12 relevant.
Inclusion/Exclusion Criteria:
Inclusion criteria: 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 provided there was an English abstract and the intervention included providing BLS training to likely rescuers of high-risk groups. We included studies that compared different methods of training between groups, and those with no control group if outcomes from an appropriate comparator (e.g. pre-intervention or CPR guideline standards) was possible.
Exclusion criteria: Unpublished studies (e.g., conference abstracts, trial protocols) and studies training only high-risk patients were excluded.

Link to Article Titles and Abstracts (if available on PubMed):
Blewer 2016 https://pubmed.ncbi.nlm.nih.gov/27703033/
Blewer 2020 https://pubmed.ncbi.nlm.nih.gov/32376347/
Cartledge 2018 https://pubmed.ncbi.nlm.nih.gov/28699772/
Gonzalez-Salvado 2019 https://pubmed.ncbi.nlm.nih.gov/30776898/
Han 2018 https://pubmed.ncbi.nlm.nih.gov/29786817/
Ikeda 2016 https://pubmed.ncbi.nlm.nih.gov/26776900/
Kim 2016 https://pubmed.ncbi.nlm.nih.gov/27411773/

Michel 2020 https://pubmed.ncbi.nlm.nih.gov/31834244/
Raaj 2016 DOI 10.5958/0974-9357.2016.00141.0 http://www.ijone.org/issues.html
Tomatis Souverbielle 2019 https://pubmed.ncbi.nlm.nih.gov/30937419/
Varalakshmi 2016 https://pubmed.ncbi.nlm.nih.gov/30937419/

Summary of Evidence Update:
Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

The updated search identified n=12 additional studies relevant to the PICO: one systematic review (Cartledge, 2016), 5 non-RCT interventional studies (Blewer 2016 740; Blewer 2020 28; Gonzalex-Salvado 2019 795; Kim 2016 465; Raaj 2016 142). 3 before-after studies (Han 2018 224; Tomatis-Souverbielle 2019 e141; Varalakshmi 2016 574), 2 prospective single arm studies (Cartledge 2017 148; Michel 2020 e114) and 1 (survey Ikeda 2016 45) as described in the Table below.

Relevant Guidelines or Systematic Reviews

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	• Key findings	Treatment recommendations
Cartledge (2016)	Systematic review	BLS training to family members of high-risk cardiac patients.	26 of 1172	• insufficient evidence to indicate a benefit of this intervention • the majority of trained individuals were able to competently perform BLS skills, reported a willingness to use these skills and experienced lower anxiety.	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)
Blewer (2016)	Non-RCT* (RCT comparing two methods of BLS training); n=1464	Adult cardiac patients	Compression rates and depth below guideline standard at 6-months (n=522).	Video kits better educational outcomes compared to video only.
Blewer (2020)	Non-RCT* (RCT comparing two methods of BLS training); n=1325	Adult cardiac patients	Compression rates and depth below guideline standard at 6-months (n=541).	Video kits better educational outcomes compared to mobile app.
Cartledge (2017)	Prospective single arm; n=83	Adult cardiac patients	Compression rates at guideline standard, compression depth below guideline standard (n=47).	Supports BLS training.

Gonzalez-Salvado (2019)	Non-RCT* (RCT comparing two methods of BLS training); n=79	Adult cardiac patients	CPR and AED competency and skills improved (n=66).	Supports BLS training.
Han (2018)	Prospective before and after study; n=203	Adult cardiac patients	CPR skills and knowledge improved (n=203).	Supports BLS training.
Kim (2016)	Non-RCT* (RCT comparing two methods of BLS training); n=54	Adult cardiac patients	Overall CPR competency and knowledge (n=54)	Supports BLS training.
Ikeda (2016)	Survey; n=769 (of patients enrolled in Blewer 2016).	Adult cardiac patients	53% of those trained passed training materials on to others (video kits).	Supports BLS training.
Michel (2020)	Prospective single arm; n=56	Children admitted to NICU	Compression rates and depth at guideline standard (n=56).	Supports BLS training.
Raaj (2016)	Non-RCT* (RCT comparing two methods of BLS training); n=120	Adult cardiac and pulmonary patients	CPR competency and knowledge improved with training (n=69)	Supports BLS training. Comparable skills with video kit to instructor-led.
Tomatis Souverbielle (2019)	Prospective before and after study; n=106	Children admitted with an acute life-threatening event	Good patient outcomes for 4 events who received bystander CPR from trained caregivers. CPR knowledge improved after training (n=93).	Supports BLS training.
Varalakshmi (2016)	Prospective before and after study; n=60	Adult cardiac patients	Skill levels were adequate after training (no pre-training data). CPR BLS knowledge increase after training.	Supports BLS training.

* original studies were RCTs but were conducted to compare different methods of BLS training with no control group relevant to this SR –therefore treated as non-RCT for this review.

Reviewer Comments (including whether meet criteria for formal review):

While the new evidence is unlikely to change the main treatment recommendation, there may be additional treatment recommendations (e.g. optimal mode of BLS training, subgroups) that could be made with an updated systematic review.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 10 Feb 2021

Reference list

Blewer, A. L., M. E. Putt, L. B. Becker, B. J. Riegel, J. Li, M. Leary, J. A. Shea, J. N. Kirkpatrick, R. A. Berg, V. M. Nadkarni, P. W. Groeneveld, B. S. Abella and C. S. Group* (2016). "Video-Only Cardiopulmonary Resuscitation Education for High-Risk Families Before Hospital Discharge: A Multicenter Pragmatic Trial." Circulation. Cardiovascular Quality & Outcomes 9(6): 740-748.

Blewer, A. L., M. E. Putt, S. K. McGovern, A. D. Murray, M. Leary, B. Riegel, J. A. Shea, R. A. Berg, D. A. Asch, A. J. Viera, R. M. Merchant, V. M. Nadkarni, B. S. Abella and C. S. Group (2020). "A pragmatic randomized trial of cardiopulmonary resuscitation training for families of cardiac patients before hospital discharge using a mobile application." Resuscitation 152: 28-35.

Cartledge, S., J. E. Bray, M. Leary, D. Stub and J. Finn (2016). "A systematic review of basic life support training targeted to family members of high-risk cardiac patients." Resuscitation 105: 70-78.

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2021 Evidence Update Worksheet
Appendix B3 EIT 13

Worksheet author(s): Kathryn Eastwood
Date Submitted: 10th February 2021

PICO / Research Question: EIT 878
In out of hospital cardiac arrest does the use of technology to engage first responders impact on patient's survival or bystander CPR rates?

Population: Adults and children in out-of-hospital with cardiac arrest
Intervention: having a citizen CPR responder notified of the event via technology or social media
Comparators: no such notification
Outcomes: survival to hospital discharge with good neurological outcome, survival to hospital discharge/30-day survival, hospital admission, ROSC, bystander CPR rate, time to first compression/shock
Study Designs: 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. Unpublished studies (e.g., conference abstracts, trial protocols), animal studies, case series, and simulation studies were excluded.
Timeframe: All years and all languages were included as long as there is an English abstract. The search strategy was performed on the same day (25/10/2019) for the three databases.
PROSPERO Registration: submitted to PROSPERO on 11/12/2019. PROSPERO 2020 CRD42020160694

Outcomes: As above
Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2010 / 2015 / New question: New Question -2020

Last ILCOR Consensus on Science and Treatment Recommendation:
We recommend that citizen/individuals who are in close proximity to a suspected Out-Of-Hospital Cardiac Arrest (OHCA) event and willing to be engaged/notified by a smartphone app with mobile positioning system (MPS) or Text Message (TM)-alert system should be notified (strong recommendation, very low-certainty evidence).

2010/2015 Search Strategy: N/A
2020 Search Strategy:
((((("Heart Arrest"[Mesh] OR "heart arrest*"[TIAB] OR "cardiac arrest*"[TIAB] OR "cardiovascular arrest*"[TIAB] OR "cardiopulmonary arrest*"[TIAB] OR "cardio-pulmonary arrest*"[TIAB] OR "Out-of-Hospital Cardiac Arrest*"[Mesh] OR OHCA OR "Out of Hospital Cardiac Arrest*"[TIAB] OR "Out-of-Hospital Cardiac Arrest*"[TIAB] OR "outside of hospital Cardiac Arrest "[TIAB]) OR (resuscitation [Mesh] OR resuscitation* [TIAB] OR "cardiopulmonary resuscitation"[Mesh] OR "cardiopulmonary resuscitation"[TIAB] OR "Cardio-Pulmonary Resuscitation" OR "Cardio Pulmonary Resuscitation" OR CPR [TIAB] OR "Life Support Care"[Mesh] OR "Basic Cardiac Life Support" OR "basic life support" OR "Cardiac Life Support" [TIAB] OR "cardiorespiratory resuscitation"[TIAB] OR "Heart Massage*"[Mesh] OR heart massage*[TIAB] OR cardiac massage*[TIAB] OR chest compression*[TIAB] OR cardiac compression*[TIAB])) AND (public[TIAB] OR bystander*[TIAB] OR "first responder*"[TIAB] OR "first-responder*"[TIAB] OR Layperson*[TIAB] OR “lay people”[TIAB] OR “lay rescuer*”[TIAB] OR witness*[TIAB] OR "Firefighters"[Mesh] OR Firefighter*[TIAB] OR “fire fighter” OR “fire fighters” OR "Police"[Mesh] OR Police[TIAB] OR “non-healthcare professional*”[TIAB]) AND (((internet [Mesh] OR web) AND (technology OR app OR application

OR alert)) OR "global positioning system" OR "Social Media"[Mesh] OR"Social Media" OR "telecommunications"[tiab] OR "streaming video" OR "video streaming" OR twitter[tiab] OR Tweet[tiab] OR "social web" OR "social network" OR "social networking" OR "social software" OR "social medium" OR "instant messaging" OR "instant message" OR "IM"[tiab] OR "text message*" OR screencast* OR "video-sharing" OR "smart phone" OR "Phone app" OR "cell phone" OR VIMEO [tiab] OR "PulsePoint" OR "push technology" OR iGoogle[tiab] OR Web[tiab] OR "computer-generated phone call*" OR facebook OR instagram OR geolocalization OR geolocation OR "you tube" OR whatsapp OR Geofencing OR "Global Navigation Satellite System" OR GNSS OR "taxi driver"OR "virtual reality" OR "Recruitment system" OR "GoodSam app" OR DAE OR RespondER OR "smart watch" OR "AEDMAP"))))

Database searched: PubMed
Date Search Completed: Tuesday 9th February 2021
Search Results (Number of articles identified / number identified as relevant): 43[1-43] / 2[2,11]
Inclusion/Exclusion Criteria: 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. Unpublished studies (e.g., conference abstracts, trial protocols), animal studies, case series, and simulation studies were excluded.
Link to Article Titles and Abstracts (if available on PubMed):
Links to relevant individual articles available in Appendix 1.

Summary of Evidence Update:
Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

Relevant Guidelines or Systematic Reviews: 0

Organisation (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: 0

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: 2

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:	
Smartphone Activation of Citizen Responders to Facilitate Defibrillation in Out-of-Hospital Cardiac Arrest; Andelius L; 2020[2]	Prospective observational study; 435 OHCA included in study	"all suspected OHCAs in which citizen responders were activated from September 1 2017 to August 31, 2018." Exclusion: "OHCAs with obvious signs of death; trauma, drowning, or suicide; EMS-witnessed arrests; and OHCAs with a do-not-resuscitate order or without indication for continuing resuscitation by EMS. Cases in which EMS response time was missing and cases without any corresponding survey response were also excluded."	Outcome measure: bystander CPR and bystander defibrillation and citizen responder CPR and citizen responder defibrillation Comment: In this paper a bystander is different to a citizen responder. The latter are those dispatched via the activation system, bystanders are people who happen to be present at the OHCA. Results: "The percentage of bystander CPR was significantly higher when citizen responders arrived before EMS, 85.3% (157 of 184) compared with 76.8% (195 of 254), p=0.027, and a 3-fold increase in percentage of bystander defibrillation was observed, 21.2% (39 of 184) compared with 6.7% (17 of 254), p<0.001". "citizen responders performed CPR in 68.5% (126 of 184), applied an AED in 49.5% (91 of 184), and performed defibrillation in10.3% (19 of 184) of the OHCAs in which they arrived before EMS" "An increase in the percentage of 30-day survival was found when citizen responders arrived before EMS, although not statistically significant, 16.1% (29 of 184) versus 13.1% (32 of 254), p=0.38" Of 1630 citizen responders who completed the question regarding physical injury, one required hospital treatment for a fractured lower extremity when running to the OHCA scene. Three others reported minor injuries not requiring treatment, and two reported having been at risk of injury while responding to the OHCA. 1621 responded to the psychological impact question and 22 (1.4%) reported having been severly affects with three requiring professional follow-up. 99.0% (n=1602) wanted to continue to be enrolled as a citizen responder.	Conclusion: "Arrival of app-dispatched citizen responders before EMS was associated with increased odds for bystander CPR and a more than 3-fold increase in odds for bystander defibrillation."
Mobile Smartphone Technology Is Associated With Out-of-hospital Cardiac Arrest Survival Improvement:	Non-randomized single-center observational cohort study; intervention group 46 OHCA pts,	Inclusion: Intervention: all OHCA patients where a bystander responded and commenced BLS (comprising either or both of CPR and AED retrieval and use).	Outcome measures: compared cases where "Staying Alive" activation occurred to those where it wasn't for ROSC upon hospital admission and survival to discharge Results: "Approximately 226 (30%) of the 762 push notifications were acknowledged and accepted, prompting the responding bystander to rush to the site	"the SA application allowed not only to quickly identify nearby trained first responders, it also facilitated access to an AED. The 35% survival rate we observed in the intervention group is consistent with expected improvements previously anticipated elsewhere when using similar technology. Within a single year, we were able to show

The First Year "Greater Paris Fire Brigade" Experience; Derkenne C; 2020[11]	control group 320 OHCA pts	Control: OHCAs where no bystander was identified, no bystander responded, or did respond but didn't reach the scene, or did not provide BLS	of the OHCA"…."A total of 137 bystanders did arrive on site. Approximately 37 of them did not perform CPR as they arrived after the BLS team." "Among the 100 bystanders who did arrive before the BLS team, 52 attempted lifesaving maneuvers and/or used an AED for 46 patients allocated to the intervention group." "Patients with SA were more likely to demonstrate ROSC upon hospital admission (48% vs. 23%, p<0.001)." …."the survival rate on hospital discharge was greater in the intervention group than in the control group using univariate statistics (35% vs 16%, p=0.004)."	that SA activation was associated with a better outcome after OHCA…"

Reviewer Comments (including whether meet criteria for formal review):

There were 43 new articles identified in the PubMed search of which two were relevant to the PICO. These were non-randomized observational studies and the results of both of these studies support the ILCOR CoSTR recommendation.

With regard to the Evidence to Decision Framework (undesirable effects), Adelius et al (2020)[2] reported upon the physical and psychological impact of engagement in an OHCA via technology. The EtD recorded a knowledge gap in this area. One of the two studies identified a significant difference in survival to discharge[11] (pertaining to EtD: Balance of effects), however aside from the study design, the sample size for the intervention group was small and varied largely from the control group. No other contribution was made to resources, cost effectiveness, equity, acceptability or feasibility.

Therefore, based on the limited additional results of this search, this EvUp does not meet the criteria for a formal review.

Additional note:

Upon review of the abstracts for relevance two studies[22,42] that did not meet the study design inclusion criteria used the term 'crowdsourcing' when referring to the use of technologies to notify citizens of a nearby cardiac arrest. One of these studies had this as a keyword.[42] The term was added to the end of the current search however no further papers were returned. Nonetheless, I would recommend the inclusion of this term in future searches.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 10 Feb 2021

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No.	PMID	Title	1st Author	Journal/Book	Relevant
1	32351583	Assessment on CPR Knowledge and AED Availability in Saudi Malls by Security Personnel: Public Safety Perspective	Al Haliq SA	J Environ Public Health	No
2	32961304	Collateral damage: Hidden impact of the COVID-19 pandemic on the out-of-hospital cardiac arrest system-of-care	Ball J	Resuscitation	No
3	33080730	Effects of positive dispatcher encouragement on the maintenance of bystander cardiopulmonary resuscitation quality	Hwang BN	Medicine (Baltimore)	No
4	32396128	Augmented Reality Learning Environment for Basic Life Support and Defibrillation Training: Usability Study	Ingrassia PL	J Med Internet Res	No
5	33183303	Naloxone administration by nonmedical providers- a descriptive study of County sheriff department training	Janssen A	Subst Abuse Treat Prev Policy	No
6	33166272	Emerging Trends and Hot Topics in Cardiopulmonary Resuscitation Research: A Bibliometric Analysis from 2010 to 2019	Jia T	Med Sci Monit	No
7	31400888	Public-access automated external defibrillator pad application and favorable neurological outcome after out-of-hospital cardiac arrest in public locations: A prospective population-based propensity score-matched study	Kishimori T	Int J Cardiol	No
8	32493504	Championing survival: connecting the unknown network of responders to address out-of-hospital cardiac arrest	McBride R	Scand J Trauma Resusc Emerg Med	No
9	32975134	Characteristics and Outcomes of In-Hospital Cardiac Arrest Events During the COVID-19 Pandemic: A Single-Center Experience From a New York City Public Hospital	Miles JA	Circ Cardiovasc Qual Outcomes	No
10	33187028	Hot off the Press: Mobile Smartphone Technology Is Associated With Out-of-hospital Cardiac Arrest Survival Improvement	Morgen-stern J	Acad Emerg Med	No
11	31753903	Rationale and design of the Lowlands Saves Lives trial: a randomised trial to compare CPR quality and long-term attitude towards CPR performance between face-to-face and virtual reality training with the Lifesaver VR app	Nas J	BMJ Open	No
12	33228900	Prehospital Management of Peripartum Neonatal Complications by Helicopter Emergency Medical Service in the South West of the Netherlands: An Observational Study	Oude Alink MB	Air Med J	No
13	33134932	Rationale and Strategies for Development of an Optimal Bundle of Management for Cardiac Arrest	Pepe PE	Crit Care Explor	No
14	32532235	The impact of cardiopulmonary resuscitation (CPR) training on schoolchildren and their CPR knowledge, attitudes toward CPR, and willingness to help others and to perform CPR: mixed methods research design	Pivač S	BMC Public Health	No
15	33252342	Evolution of Bystander Intention to Perform Resuscitation Since Last Training: Web-Based Survey	Regard S	JMIR Form Res	No
16	32751367	Effects of Prehospital Factors on Survival of Out-Of-Hospital Cardiac Arrest Patients: Age-Dependent Patterns	Rhee BY	Int J Environ Res Public Health	No
17	33247025	Enhancing Prehospital Outcomes for Cardiac Arrest (EPOC) study: sequential mixed-methods study protocol in Michigan, USA	Salhi RA	BMJ Open	No
18	33136599	VAD 911: Process Improvement for First Responders Treating Ventricular Assist Device Patients	Stewart SM	ASAIO J	No
19	33155574	A Short Intervention Followed by an Interactive E-Learning Module to Motivate Medical Students to Enlist as First Responders: Protocol for a Prospective Implementation Study	Suppan L	JMIR Res Protoc	No
20	33188832	Crowdsourcing to save lives: A scoping review of bystander alert technologies for out-of-hospital cardiac arrest	Valeriano A	Resuscitation	No
21	33526058	Smartphone-based dispatch of community first responders to out-of-hospital cardiac arrest - statements from an international consensus conference	Metelmann C	Scand J Trauma Resusc Emerg Med	No
22	33503964	Improving Psychological Comfort of Paramedics for Field Termination of Resuscitation through Structured Training	Bang C	Int J Environ Res Public Health	No

23	33490323	Data concerning the Copenhagen tool: A research tool for evaluation of basic life Support educational interventions	Jensen TW	Data Brief	No
24	33483437	Preferences for life-sustaining treatment in Korean adults: a cross-sectional study	Youn H	BMJ Open	No
25	33469407	Implementation of a smartphone-based first-responder alerting system	Ganter J	Notf Rett Med	No
26	33440102	Outcome and status of postcardiac arrest care in Korea: results from the Korean Hypothermia Network prospective registry	Kim SH	Clin Exp Emerg Med	No
27	33426536	Management of first responder programmes for out-of-hospital cardiac arrest during the COVID-19 pandemic in Europe	Andelius L	Resusc Plus	No
28	33407777	Double-blind, randomized, controlled, trial to assess the efficacy of allogenic mesenchymal stromal cells in patients with acute respiratory distress syndrome due to COVID-19 (COVID-AT): A structured summary of a study protocol for a randomised controlled trial	Payares-Herrera C	Trials	No
29	33403365	Bystanders are less willing to resuscitate out-of-hospital cardiac arrest victims during the COVID-19 pandemic	Grunau B	Resusc Plus	No
30	33401707	Comparison of Long-Term Effects between Chest Compression-Only CPR Training and Conventional CPR Training on CPR Skills among Police Officers	Cho BJ	Healthcare (Basel)	No
31	33399539	Mobile App Support for Cardiopulmonary Resuscitation: Development and Usability Study	Müller SD	JMIR Mhealth Uhealth	No
32	33394945	A National US Survey of Pediatric Emergency Department Coronavirus Pandemic Preparedness	Auerbach MA	Pediatr Emerg Care	No
33	32616163	Pivotal Role in the Community Response to Cardiac Arrest: The Smart Bystander	Chugh SS	J Am Coll Cardiol	No
34	32616162	Smartphone Activation of Citizen Responders to Facilitate Defibrillation in Out-of-Hospital Cardiac Arrest https:/pubmed.ncbi.nlm.nih.gov/32616162/	Andelius L	J Am Coll Cardiol	Yes
35	32578324	Outpatient management of kidney transplant recipients with suspected COVID-19-Single-center experience during the New York City surge	Mehta SA	Transpl Infect Dis	No
36	32532201	Factors associated with return of spontaneous circulation after out-of-hospital cardiac arrest in Poland: a one-year retrospective study	Czapla M	BMC Cardiovasc Disord	No
37	32445436	Mobile Smartphone Technology Is Associated With Out-of-hospital Cardiac Arrest Survival Improvement: The First Year "Greater Paris Fire Brigade" Experience https://pubmed.ncbi.nlm.nih.gov/32445436/	Derkenne C	Acad Emerg Med	Yes
38	32433068	Nurses' Attitude, Behavior, and Knowledge Regarding Protective Lung Strategies of Mechanically Ventilated Patients	Asmar IT	Crit Care Nurs Q	No
39	32291599	Cancer patients, physicians, and nurses differ in their attitudes toward the decisional role in do-not-resuscitate decision-making	Saltbæk L	Support Care Cancer	No
40	32243114	A comparison of trauma scoring systems for injuries presenting to a district-level urban public hospital in Western Cape	Mukonkole SN	S Afr J Surg	No
41	31785372	Characteristics and outcomes of AED use in pediatric cardiac arrest in public settings: The influence of neighborhood characteristics	Griffis H	Resuscitation	No
42	31734702	Effect of Face-to-Face vs Virtual Reality Training on Cardiopulmonary Resuscitation Quality: A Randomized Clinical Trial	Nas J	JAMA Cardiol	No
43	30149744	The scope and extent of exogenous surfactant utilization in Nigerian health care facilities: benefits of its regular use to outcome of premature babies	Okonkwo IR	J Matern Fetal Neonatal Med	No

2021 Evidence Update Worksheet
Appendix B3 EIT 14

Worksheet author(s): Andrew Lockey
Date Submitted: 25 January 2021

PICO / Research Question:
Patient outcomes as a result of a member of the resuscitation team attending an ALS course (EIT 4000)

Population: Adult in-hospital patients who have a cardiac arrest
Intervention: Prior participation of one or more members of the resuscitation team in an accredited advanced cardiac life support course (e.g. AHA ACLS, RC(UK)/ERC ALS)
Comparators: no such participation
Outcomes: ROSC; Survival to Discharge or 30-day survival; 1 year survival
Study Designs: 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. Unpublished studies (e.g., conference abstracts, trial protocols), animal studies, case series, and simulation studies were excluded.
Timeframe: All years and all languages were included as long as there is an English abstract. The search strategy was performed on 15 January 2021.

Outcomes: As above
Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): Vice President RCUK
Year of last full review: 2010 / 2015 / New question: 2019

Last ILCOR Consensus on Science and Treatment Recommendation:
We recommend the provision of accredited adult ALS training for healthcare providers (weak recommendation, very low certainty evidence).

2010/2015 Search Strategy: On file
2020 Search Strategy: Same as previous
Database searched: PubMed, EMBASE, CINAHL
Date Search Completed: 15 January 2021 (search from 1 January 2018 to 15 January 2021)
Search Results (Number of articles identified / number identified as relevant): 3 studies short listed – none relevant
Inclusion/Exclusion Criteria: 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. Unpublished studies (e.g., conference abstracts, trial protocols), animal studies, case series, and simulation studies were excluded.

Link to Article Titles and Abstracts (if available on PubMed):
1. https://pubmed.ncbi.nlm.nih.gov/29885353/ Adherence to advanced cardiovascular life support (ACLS) guidelines during in-hospital cardiac arrest is associated with improved outcomes.

Authors Honarmand, Kimia; Mepham, Chantal; Ainsworth, Craig; Khalid, Zahira
Source Resuscitation; Aug 2018; vol. 129 ; p. 76-81
Publication Date Aug 2018

2. https://pubmed.ncbi.nlm.nih.gov/31874777/ Frequency of Advanced Cardiac Life Support Medication Use and Association With Survival During In-hospital Cardiac Arrest.
Authors Benz, Paul; Chong, Stephen; Woo, Stephanie; Brenner, Nicole; Wilson, Matthew; Dubin, Jeffrey; Heinrichs, Dorothy; Titus, Sheryl; Ahn, Jaeil; Goyal, Munish
Source Clinical therapeutics; Jan 2020; vol. 42 (no. 1); p. 121-129
Publication Date Jan 2020
3. https://pubmed.ncbi.nlm.nih.gov/27749378/ Cardiac arrests within the emergency department: an Utstein style report, causation and survival factors.
Authors Tan, Sing C; Leong, Benjamin Sieu-Hon
Source European journal of emergency medicine : official journal of the European Society for Emergency Medicine; Feb 2018; vol. 25 (no. 1); p. 12-17
Publication Date Feb 2018

Summary of Evidence Update:

Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

No studies met the criteria, therefore no further evidence is available.

Relevant Guidelines or Systematic Reviews

Organisation (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)
	Study Type:	Inclusion Criteria:	1° endpoint:	

Reviewer Comments (including whether meet criteria for formal review):

There were 3 new articles identified in the updated search. They were all retrospective case note (medical record) reviews. The first looked at adherence to guidelines (not course participation), the second looked at one aspect of ACLS treatment (medication administration), and the third looked at demographics associated with survival. Therefore, the results of this search are not relevant and do not meet the criteria for a formal review. Proposal being prepared to expand the remit of this PICOST to other accredited advanced life support courses.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 6 Feb 2021

2021 Evidence Update Worksheet
Appendix B3 EIT 15

Worksheet author(s): Pellegrino JL.
Date Submitted: January 2021

PICO / Research Question: Opioid overdose first aid education (EIT 4001)
Population: *First aiders responding to opioid overdose.*
Intervention: *Education on response/care of individual in an opioid overdose emergency*
Comparators: *Another or no specialized education.*
Outcomes: *Any clinical or educational outcome; survival, first aid provided, skills, attitude, knowledge.*
Type (intervention, diagnosis, prognosis): *intervention*

Additional Evidence Reviewer(s): none
Conflicts of Interest (financial/intellectual, specific to this question): *previous worksheet author*
Year of last full review: 2010 / 2015 / New question: 2020 Scoping Review

Last ILCOR Consensus on Science and Treatment Recommendation: 2015/2020
We suggest offering opioid overdose response education, with or without naloxone distribution, to persons at risk for opioid overdose in any setting (weak recommendation, very low quality of evidence).
In making these recommendations, we place greater value on the potential for lives saved by recommending overdose response education, with or without naloxone, and lesser value on the costs associated with naloxone administration, distribution, or education.

2010/2015 Search Strategy:
2019 Search Strategy:
Database(s): EBM Reviews - Cochrane Database of Systematic Reviews 2005 to November 13, 2019, EBM Reviews - ACP Journal Club 1991 to October 2019, EBM Reviews - Database of Abstracts of Reviews of Effects 1st Quarter 2016, EBM Reviews - Cochrane Clinical Answers October 2019, EBM Reviews - Cochrane Central Register of Controlled Trials October 2019, EBM Reviews - Cochrane Methodology Register 3rd Quarter 2012, EBM Reviews - Health Technology Assessment 4th Quarter 2016, EBM Reviews - NHS Economic Evaluation Database 1st Quarter 2016, Embase 1974 to 2019 November 13, Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 1946 to November 13, 2019

#	Searches	Results
1	exp Opioid-Related Disorders/	45626
2	Heroin/ or Morphine/ or Opium/ or exp Narcotics/	444291
3	(narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora*	453541

	or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*).tw,kf.	
4	or/1-3 [OPIATES]	637226
5	Drug overdose/	37555
6	(overdose* or over-dose*).tw,kf.	50606
7	(toxic* or poison*).tw,kf.	1624325
8	(po or to).fs.	1526906
9	or/5-8 [OVERDOSE]	2789118
10	Naloxone/ or Narcotic Antagonists/	71029
11	(naloxone* or narcan* or evzio*).tw,kf.	54031
12	or/10-11 [NALOXONE]	83726
13	First Aid/ or Emergency Medical Services/	144460
14	exp Emergency Responders/	19828
15	(first aid* or first respon* or EMT or emergency medical technician* or paramedic* or para-medic* or ambulance* or firefighter* or fire-fighter* or police* or prehospital or pre-hospital or nonmedical* or non-medical* or peer or peers or lay* or bystander* or by-stander*).tw,kf.	1345539
16	((expand* or increas*) adj1 access adj5 (naloxone* or narcan* or evzio*)).tw,kf.	104
17	(take-home or THN).tw,kf.	8286
18	(opioid overdose prevention program* or OOPP or OEND).tw,kf.	173
19	(educat* or train* or teach* or instruct* or skill* or informat*).tw,kf.	5553244
20	(recogni* or knowledge* or competen* or confiden* or empower*).tw,kf.	4493494
21	ed.fs. or education*.hw.	1679328
22	or/13-21 [FIRST AID/EDUCATION]	10730025
23	4 and 9 and 12 and 22	3192
24	exp Animals/ not (exp Animals/ and Humans/)	17012499
25	23 not 24 [ANIMAL-ONLY REMOVED]	2078
26	(comment or editorial or news or newspaper article).pt.	2002759
27	(letter not (letter and randomized controlled trial)).pt.	2135263
28	25 not (26 or 27) [OPINION PIECES REMOVED]	2011
29	28 use ppez	868
30	exp narcotic dependence/	56965
31	exp opiate agonist/ or exp narcotic analgesic agent/	418781
32	(narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora*	457491

	or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*).tw,kw.	
33	or/30-32 [OPIATES]	702243
34	drug overdose/ or exp "drug toxicity and intoxication"/	195826
35	(overdose* or over-dose*).tw,kw.	51605
36	(toxic* or poison*).tw,kw.	1630043
37	to.fs.	938948
38	or/34-37 [OVERDOSE]	2376740
39	exp opiate antagonist/ or exp narcotic antagonist/	134380
40	(naloxone* or narcan* or evzio*).tw,kw.	54281
41	or/39-40 [NALOXONE]	145271
42	first aid/ or emergency treatment/ or emergency health service/ or emergency medical dispatch/	174437
43	rescue personnel/	7533
44	(first aid* or first respon* or EMT or emergency medical technician* or paramedic* or para-medic* or ambulance* or firefighter* or fire-fighter* or police* or prehospital or pre-hospital or nonmedical* or non-medical* or peer or peers or lay* or bystander* or by-stander*).tw,kw.	1350384
45	((expand* or increas*) adj1 access adj5 (naloxone* or narcan* or evzio*)).tw,kw.	104
46	(take-home or THN).tw,kw.	8294
47	(opioid overdose prevention program* or OOPP or OEND).tw,kw.	173
48	(educat* or train* or teach* or instruct* or skill* or informat*).tw,kw.	5570601
49	(recogni* or knowledge* or competen* or confiden* or empower*).tw,kw.	4504687
50	education*.hw.	1534182
51	or/42-50 [FIRST AID/EDUCATION]	10709354
52	33 and 38 and 41 and 51	3598
53	exp animal experimentation/ or exp animal model/ or exp animal experiment/ or nonhuman/ or exp vertebrate/	48942612
54	exp human/ or exp human experimentation/ or exp human experiment/	39030904
55	52 not (53 not 54) [ANIMAL-ONLY REMOVED]	3341
56	editorial.pt.	1143095
57	letter.pt. not (randomized controlled trial/ and letter.pt.)	2135473
58	55 not (56 or 57) [OPINION PIECES REMOVED]	3244
59	conference abstract.pt.	3646198
60	58 not 59 [CONFERENCE ABSTRACTS REMOVED]	2711
61	60 use oemezd	1667
62	exp Opioid-Related Disorders/	45626
63	Heroin/ or Morphine/ or Opium/ or exp Narcotics/	444291

64	(narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora* or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*).tw,kw.	457491
65	or/62-64 [OPIATES]	639284
66	Drug overdose/	37555
67	(overdose* or over-dose*).tw,kw.	51605
68	(toxic* or poison*).tw,kw.	1630043
69	(po or to).fs.	1526906
70	or/66-69 [OVERDOSE]	2800335
71	Naloxone/ or Narcotic Antagonists/	71029
72	(naloxone* or narcan* or evzio*).tw,kw.	54281
73	or/71-72 [NALOXONE]	83834
74	First Aid/ or Emergency Medical Services/	144460
75	exp Emergency Responders/	19828
76	(first aid* or first respon* or EMT or emergency medical technician* or paramedic* or para-medic* or ambulance* or firefighter* or fire-fighter* or police* or prehospital or pre-hospital or nonmedical* or non-medical* or peer or peers or lay* or bystander* or by-stander*).tw,kw.	1350384
77	((expand* or increas*) adj1 access adj5 (naloxone* or narcan* or evzio*)).tw,kw.	104
78	(take-home or THN).tw,kw.	8294
79	(opioid overdose prevention program* or OOPP or OEND).tw,kw.	173
80	(educat* or train* or teach* or instruct* or skill* or informat*).tw,kw.	5570601
81	(recogni* or knowledge* or competen* or confiden* or empower*).tw,kw.	4504687
82	ed.fs. or education*.hw.	1679328
83	or/74-82 [FIRST AID/EDUCATION]	10752344
84	65 and 70 and 73 and 83	3230
85	conference abstract.pt.	3646198
86	84 not 85 [CONFERENCE ABSTRACTS REMOVED]	2733
87	86 use cctr	107
88	86 use coch	24
89	86 use dare	3
90	86 use clhta	1
91	86 use cleed	1
92	86 use acp	1

93	86 use clcmr	0
94	29 or 61 or 87 or 88 or 89 or 90 or 91 or 92 or 93 [ALL DATABASES - NO DUPLICATES REMOVED]	2672
95	remove duplicates from 94 [TOTAL UNIQUE RECORDS]	1858
96	95 use ppez [MEDLINE UNIQUE RECORDS]	126
97	95 use oemezd [EMBASE UNIQUE RECORDS]	1640
98	95 use cctr [CENTRAL UNIQUE RECORDS]	62
99	95 use coch [COCHRANE DATABASE OF SYSTEMATIC REVIEWS UNIQUE RECORDS]	24
100	95 use dare [DATABASE OF ABSTRACTS OF REVIEWS OF EFFECTS UNIQUE RECORDS]	3
101	95 use clhta [HEALTH TECHNOLOGY ASSESSMENT DATABASE]	1
102	95 use cleed [NATIONAL HEALTH SERVICE ECONOMIC EVALUATION DATABASE]	1
103	95 use acp [ACP JOURNAL CLUB UNIQUE RECORDS]	1
104	95 use clcmr [COCHRANE METHODOLOGY REGISTER DATABASE]	0

CINAHL

#	Query	Results	
S18	S17 NOT (PT commentary OR PT letter OR PT editorial)	721	
S17	S16 NOT (MH "Animals+") NOT ((MH "Human") AND (MH "Animals+"))	763	
S16	S3 and S6 and S9 and S15	764	
S15	S10 or S11 or S12 or S13 or S14	1,766,410	
S14	TI (educat* or train* or teach* or instruct* or skill* or informat* or recogni* or knowledge* or competen* or confiden* or empower*) or AB (educat* or train* or teach* or instruct* or skill* or informat* or recogni* or knowledge* or competen* or confiden* or empower*)	1,158,938	
S13	TI ((expand* or increas*) N1 access N4 (naloxone* or narcan* or evzio*)) or AB ((expand* or increas*) N1 access N4 (naloxone* or narcan* or evzio*))	45	
S12	TI (first aid* or first respon* or EMT or emergency medical technician* or paramedic* or para-medic* or ambulance* or firefighter* or fire-fighter* or police* or prehospital or pre-hospital or nonmedical* or non-medical* or peer or peers or lay* or bystander* or by-stander* or take-home or THN or opioid overdose prevention program* or OOPP or OEND) or AB (first aid* or first respon* or EMT or emergency medical technician* or paramedic* or para-medic* or ambulance* or firefighter* or fire-fighter* or police* or prehospital or pre-hospital or nonmedical* or non-medical* or peer or peers or lay* or bystander* or by-stander* or take-home or THN or opioid overdose prevention program* or OOPP or OEND)	159,407	
S11	MH ("Education+")	830,788	
S10	MH ("First Aid" or "Emergency Treatment" or "Emergency Medical Services" or "Emergency Service" or "Emergency Medical Technicians")	79,634	
S9	S7 or S8	8,159	

S8	TI (naloxone* or narcan* or evzio*) or AB (naloxone* or narcan* or evzio*)	2,760	
S7	(MH "Narcotic Antagonists+")	7,176	
S6	S4 or S5	71,680	
S5	TI (overdose* or over-dose* or toxic* or poison*) or AB (overdose* or over-dose* or toxic* or poison*)	65,895	
S4	MH ("Overdose" or "Drug Toxicity")	12,198	
S3	S1 or S2	62,097	
S2	TI (narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora* or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*) or AB (narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora* or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*)	45,023	
S1	**MH ("Narcotics+" or "Analgesics, Opioid+")**	43,678	

ERIC

#	Query	Results
S8	S3 and S4 and S5	1
S7	S3 and S4 and S5	1
S6	S3 and S4 and S5	8
S5	TI (naloxone* or narcan* or evzio*) or AB (naloxone* or narcan* or evzio*)	18
S4	TI (overdose* or over-dose* or toxic* or poison*) or AB (overdose* or over-dose* or toxic* or poison*)	1,968
S3	S1 or S2	1,566
S2	TI (narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or	1,115

roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora* or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*) or AB (narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora* or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*)

S1 DE "Narcotics" 705

#	Query	Results	
S6	S3 and S4 and S5	7	
S5	TI (naloxone* or narcan* or evzio*) or AB (naloxone* or narcan* or evzio*)	17	
S4	TI (overdose* or over-dose* or toxic* or poison*) or AB (overdose* or over-dose* or toxic* or poison*)	1,900	
S3	S1 or S2	1,527	
S2	TI (narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora* or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*) or AB (narcotic* or opiate* or opioid* or oxycodone* or percocet* or percodan* or oxycontin* or hydrocodone* or hycodan* or hysingla* or robidone* or vantrela* or zohydro* or diamorphine* or heroin* or morphine* or arymo* or avinza* or depodur* or doloral* or duramorph* or infumorph* or kadian* or "m-ediat*" or "m-eslon*" or morphabond* or "ms contin*" or "ms.ir*" or opium* or oramorph* or paregoric* or roxanol* or statex* or zomorph* or astramorph* or codeine* or fentanyl* or fentanil* or phentanyl* or fentanest* or sublimaze* or duragesic* or durogesic* or fentora* or abstral* or actiq* or effentora* or oxaydo* or oxecta* or "oxy.ir" or hydromorphone* or dilaudid* or exalgo* or hydromorph* or vicodin* or tramadol* or conzip* or durela* or ralivia* or rybix* or ryzolt* or synapryn* or meperidine* or demerol*)	1,091	
S1	DE "Narcotics"	681	

N.B. Concept of first aid/education not searched as ERIC is an education database – by default all records are related to education.

FINAL database searches 2019-11-14

Database searched: CINAHL & ERIC
Date Search Completed: 15 Nov 2019 to 29 Jan 2021
Search Results (Number of articles identified / number identified as relevant): *301/10*
Inclusion/Exclusion Criteria: description of educational intervention; outcomes of intervention
Link to Article Titles and Abstracts (if available on PubMed):

Chen 2020, 108009: https://pubmed.ncbi.nlm.nih.gov/32580113/
Barbosa 2020, 1096: https://pubmed.ncbi.nlm.nih.gov/32828223/
Eswaren 2020, e324: https://pubmed.ncbi.nlm.nih.gov/32690447/
Giordano 2020, 104365: https://pubmed.ncbi.nlm.nih.gov/32088524/
Herbert 2020, 108160: https://pubmed.ncbi.nlm.nih.gov/32653721/
Katzman 2020, e200117 : https://pubmed.ncbi.nlm.nih.gov/32101312/
Lintzeris 2020, 155: https://pubmed.ncbi.nlm.nih.gov/31774221/
Litten 2020, 237 : No PubMed entry; https://journals.sagepub.com/doi/10.1177/8755122520954218
Winhusen 2020, 108265 : https://pubmed.ncbi.nlm.nih.gov/32919098/
Wright 2020, S56: https://pubmed.ncbi.nlm.nih.gov/31953118/

Summary of Evidence Update:

Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.
The updated search identified 10 additional studies: 2 systematic reviews (Barbosa et al., 2020; Chen et al., 2020); 2 RCTs (Giordano et al., 2020; Herbert et al., 2020); and 6 non-RCT/observational studies (Eswaran, Allen, Bottari, et al., 2020; Katzman et al., 2020; Lintzeris et al., 2020; Litten et al., 2020; Winhusen, Wilder, Kropp, et al., 2020; Wright et al., 2020), as shown in the Tables below.

Relevant Guidelines or Systematic Reviews

Organisation (if relevant); Author; Year Published	Guideline or systematic review	Topic addressed or PICO(S)T	Number of articles identified	Key findings	Treatment recommendations
(Chen et al., 2020)	Systematic Review	opioid overdose interventions delivered within emergency departments	13	3 studies of take-home naloxone - 1 reported a lower incidence of non-fatal overdose (although none used naloxone); - 1 reported 72% accepted naloxone - 1 reported 8% use of naloxone w/in 30 days	Delivery of education may be better suited for non-Emergency Department staff given their other responsibilities.
(Barbosa et al., 2020)	Systematic Review	simulation modeling to support the economic evaluation of interventions targeting prevention, treatment, or management of opioid misuse or its direct consequences	18	5 evaluated naloxone distribution programs to reduce overdose deaths	economic evaluations should consider synergies between interventions and examine combinations of interventions to inform optimal policy response

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:
(Giordano et al., 2020)	Pilot test a 20-min Virtual Reality (VR) simulation education for opioid overdose	BSN student nurses	19 VR 31 High fidelity simulator	Opioid Overdose Knowledge Scale (OOKS) – no statistical difference Opioid Overdose Attitudes Scale (OOAS)- no statistical difference.	Pilot, convenience sample, single site
(Herbert et al., 2020)	Compare immersive video modality to standard in-person education	Patrons at randomly assigned libraries in Philadelphia	58 immersive video 37 control	Opioid Overdose Knowledge Scale (OOKS) – no statistical difference Opioid Overdose Attitudes Scale (OOAS)- no statistical difference.	Potential cost-saving with the immersive video; potentially avoids public stigma of attending in-person education.

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:	
(Katzman et al., 2020)	Observational, 390	Substance abuse opioid treatment program,	association of take-home naloxone with overdose reversals performed by patients with opioid use disorder enrolled in an opioid treatment program.	Seventy-three of the 395 study participants (18.0%) performed 114 overdose reversals in the community. All community reversals were heroin related. Most study participants (86.8%) stated that the person on whom they performed an overdose reversal was a friend, relative, acquaintance, or significant other
(Lintzeris et al., 2020)	Mixed methods approach to intervention design 10-30min edu intervention & naloxone supply	Clients with high risk for opioid overdoes due to opioid use disorder	overdose-related client knowledge, attitudes, behaviours and perspectives Nine participants (10%) reported administering naloxone in the 3 months follow-up period	significant improvements regarding attitudes and self-efficacy regarding responding to over- doses following the ORTHN intervention
(Eswaran, Allen, Cruz, et al., 2020)	Descriptive, 168 Take Home Naloxone (THN) kits dispensed	ED patients at risk of overdoes,	at least 3 instances in which a THN kit was administered in the community	Implementation barriers included funding ($13:kit) and facilitators included administrative support

(Winhusen, Wilder, Lyons, et al., 2020)	Secondary analysis of RCT, Outcomes from novel computer aided personally tailored Opioid Education and Naloxone Distribution (OEND), n=74	Adults, previous opioid use disorder @ risk for overdose	Knowledge about Opioid Overdose (OOD) and Medication for Opioid Use Disorder (MOUD) Naloxone utilization	significant increase from baseline to the Week 3 follow-up call in OOD knowledge, from a mean baseline score of 79.8 % to a mean week 3 score of 81.5 % correct (p = 0.03), and MOUD knowledge from a mean baseline score of 66.9 % to a mean week 3 score 75.0 % correct (p < 0.01) Of the 66 participants who provided naloxone utilization data, 43 (65 %) reported that the kit had been used; 37 (86 %) of those reporting kit use reported that the kit was used on someone else and 7 (16 %) of those reporting kit use re- ported that the kit had been used on themselves
(Wright et al., 2020)	Prospective assessment of the influence of pharmacist educating public on opioid overdoes and naloxone (n=57)	Participants at community wellness events in Alleghney County, PA, USA	Naloxone use: 2 reported using naloxone.	Pharmacists can educate and distribute naloxone in community settings.
(Litten et al., 2020)	Observational; N=94	Patients on long-term opioid therapy or diagnosis of opioid use disorder who were mailed an educational intervention	Mean knowledge score pre to post	8.7% improvement from pre to post; 1 new naloxone prescription written, 1 overdoes reversal reported.

Reviewer Comments (including whether meet criteria for formal review):
These 10 manuscripts add credence to the original scoping review but remain heterogeneous, thus not warranting a systematic review seeking meta-analysis. Evidence continues to mount for interprofessional strategies of educating those most at risk for witnessing an overdose.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn (SAC rep for EIT T/F) on 16 Feb 2021.

Reference list

Barbosa, C., Dowd, W. N., & Zarkin, G. (2020). Economic Evaluation of Interventions to Address Opioid Misuse: A Systematic Review of Methods Used in Simulation Modeling Studies. *Value in Health*, *23*(8), 1096–1108. https://doi.org/10.1016/j.jval.2020.03.015

Chen, Y., Wang, Y., Nielsen, S., Kuhn, L., & Lam, T. (2020). A systematic review of opioid overdose interventions delivered within emergency departments. *Drug & Alcohol Dependence*, *213*, N.PAG-N.PAG. https://doi.org/10.1016/j.drugalcdep.2020.108009

Eswaran, V., Allen, K. C., Bottari, D. C., Splawski, J. A., Bains, S., Aks, S. E., Swoboda, H. D., Moore, P. Q., Tran, T. H., Salisbury-Afshar, E., Lank, P. M., McCarthy, D. M., & Kim, H. S. (2020). Take-Home Naloxone Program Implementation: Lessons Learned From Seven Chicago-Area Hospitals. *Annals of Emergency Medicine*, *76*(3), 318–327. https://doi.org/10.1016/j.annemergmed.2020.02.013

Eswaran, V., Allen, K. C., Cruz, D. S., Lank, P. M., McCarthy, D. M., & Kim, H. S. (2020). Development of a take-home naloxone program at an urban academic emergency department. *Journal of the American Pharmacists Association: JAPhA*, *60*(6), e324–e331. https://doi.org/10.1016/j.japh.2020.06.017

Giordano, N. A., Whitney, C. E., Axson, S. A., Cassidy, K., Rosado, E., & Hoyt-Brennan, A. M. (2020). A pilot study to compare virtual reality to hybrid simulation for opioid-related overdose and naloxone training. *Nurse Education Today*, *88*, N.PAG-N.PAG. https://doi.org/10.1016/j.nedt.2020.104365

Herbert, N., Axson, S., Siegel, L., Cassidy, K., Hoyt-Brennan, A. M., Whitney, C., Herens, A., & Giordano, N. A. (2020). Leveraging immersive technology to expand access to opioid overdose reversal training in community settings: Results from a randomized controlled equivalence trial. *Drug & Alcohol Dependence*, *214*, N.PAG-N.PAG. https://doi.org/10.1016/j.drugalcdep.2020.108160

Katzman, J. G., Takeda, M. Y., Greenberg, N., Moya Balasch, M., Alchbli, A., Katzman, W. G., Salvador, J. G., & Bhatt, S. R. (2020). Association of Take-Home Naloxone and Opioid Overdose Reversals Performed by Patients in an Opioid Treatment Program. *JAMA Network Open*, e200117–e200117. https://doi.org/10.1001/jamanetworkopen.2020.0117

Lintzeris, N., Monds, L. A., Bravo, M., Read, P., Harrod, M. E., Gilliver, R., Wood, W., Nielsen, S., Dietze, P. M., Lenton, S., Shanahan, M., Jauncey, M., Jefferies, M., Hazelwood, S., Dunlop, A. J., Greenaway, M., Haber, P., Ezard, N., & Malcom, A. (2020). Designing, implementing and evaluating the overdose response with take-home naloxone model of care: An evaluation of client outcomes and perspectives. *Drug & Alcohol Review*, *39*(1), 55–65. https://doi.org/10.1111/dar.13015

Litten, K., Hill, L. G., Garza, A., & Srinivasa, M. (2020). Increasing Naloxone Knowledge and Use Through Direct-to-Patient Education. *Journal of Pharmacy Technology*, *36*(6), 237–242. https://doi.org/10.1177/8755122520954218

Winhusen, T., Wilder, C., Kropp, F., Theobald, J., Lyons, M. S., & Lewis, D. (2020). A brief telephone-delivered peer intervention to encourage enrollment in medication for opioid use disorder in individuals surviving an opioid overdose: Results from a randomized pilot trial. *Drug & Alcohol Dependence*, *214*, 108270. https://doi.org/10.1016/j.drugalcdep.2020.108270

Winhusen, T., Wilder, C., Lyons, M. S., Theobald, J., Kropp, F., & Lewis, D. (2020). Evaluation of a personally-tailored opioid overdose prevention education and naloxone distribution intervention to promote harm reduction and treatment readiness in individuals actively using illicit opioids. *Drug & Alcohol Dependence*, *216*, N.PAG-N.PAG. https://doi.org/10.1016/j.drugalcdep.2020.108265

Wright, Q. E., Higginbotham, S., Bunk, E., & Covvey, J. R. (2020). The impact of a pharmacist-led naloxone education and community distribution project on local use of naloxone. *Journal of the American Pharmacists Association: JAPhA*, *60*, S56–S60. https://doi.org/10.1016/j.japh.2019.11.027

2021 Evidence Update Worksheet
Appendix B3 EIT 16

Worksheet author(s): Jeffrey L. Pellegrino
Date Submitted: 2/7/21

PICO / Research Question: Do racial, ethnic, socioeconomic, or gender disparities impact resuscitation education and/or contribute to barriers in bystander CPR?
Outcomes: Bystander CPR, Education
Type (intervention, diagnosis, prognosis): Descriptive
Additional Evidence Reviewer(s): NA
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: 2010 / 2015 / New question: Evidence Update 2020

Last ILCOR Consensus on Science and Treatment Recommendation: 2020
The EvUp did not enable a treatment recommendation to be made.

2010/2015 Search Strategy:
2019 Search Strategy:
(((((("Cardiopulmonary Resuscitation"[MeSH Terms] OR "out-of-hospital cardiac arrest"[MeSH Terms] OR "Defibrillators"[Mesh] OR resuscitation[tiab] OR resuscitate[tiab] OR resuscitated[tiab] OR CPR[tiab] OR BCPR[tiab] OR AED[tiab] OR "Automated External Defibrillator"[tiab] OR "Automated External Defibrillators"[tiab] OR "out of hospital cardiac arrest"[tiab])))) AND ((Bystander[tiab] OR bystanders[tiab] OR layperson[tiab] OR laypeople[tiab] OR laypersons[tiab])))) AND ((((("Health education"[mesh] OR "Certification"[Mesh] OR Methods[sh] OR education[sh] OR education[tiab] OR training[tiab] OR trained[tiab] OR train[tiab] OR educated[tiab] OR educating[tiab] OR educates[tiab] OR educate[tiab] OR certification[tiab] OR certificate[tiab] OR certified[tiab] OR certify[tiab])))) AND (("Healthcare disparities"[mesh] OR "Sex factors"[mesh] OR "risk factors"[mesh] OR "Socioeconomic factors"[mesh] OR "Hispanic americans"[mesh] OR "African Americans"[mesh] OR disparity[tiab] OR disparities[tiab] OR socioeconomic[tiab] OR racial[tiab] OR race[tiab] OR ethnic[tiab] OR gender[tiab] OR cultural[tiab] OR "African American"[tiab] OR black[tiab] OR latino[tiab] OR latinos[tiab] OR Hispanic[tiab] OR latinx[tiab] OR Latina[tiab] OR Asian[tiab] OR income[tiab] OR wealth[tiab] OR poverty[tiab] OR barrier[tiab] OR barriers[tiab] OR education[tiab] OR educational[tiab] OR educated[tiab])))

Database searched: Pubmed
Date Search Completed: 4 Feb 21
Search Results (Number of articles identified / number identified as relevant): 109/ 5
Inclusion/Exclusion Criteria: Included: publication dates form 1 Oct 19 to 1 Feb 21. Excluded abstracts only, letters or editorials
Link to Article Titles and Abstracts (if available on PubMed):

Birkum, 2020, 133. https://pubmed.ncbi.nlm.nih.gov/32351644/
Dobbie, 2020, e0233675. https://pubmed.ncbi.nlm.nih.gov/32520938/
Griffis,2020, 146. https://pubmed.ncbi.nlm.nih.gov/31785372/
Nakagawa, 2021, 126. https://pubmed.ncbi.nlm.nih.gov/33007308/
Schiefer, 2020, e0237751. https://pubmed.ncbi.nlm.nih.gov/32817673/

Summary of Evidence Update:

Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

The updated search identified five non-randomized studies – as below.

Relevant Guidelines or Systematic Reviews

Organisation (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)**
	Study Type:	**Inclusion Criteria:**	**1° endpoint:**	
(Birkun et al., 2020)	cross-sectional study	Looked at Google promoted education courses in 3 countries	Frequency, cost, access	Population coverage of BLS education was 79x & 21x higher in the UK v. India or Nigeria.
(Dobbie et al., 2020)	Qualitative	Deprived parts of central Scotland	Perceived barriers to administering bystander CPR	Confidence/ self-efficacy; knowledge & awareness of when/how; bad previous experiences with CPR; relationship to victim; health of provider; personal safety.
(Nakagawa et al., 2021)	Observational, 2 arms	Children in Brazil	Educational outcomes for first aid knowledge (assessment, accessing help, CPR).	No sex/gender differences in outcomes between 40-min and 120-min programs.
(Griffis et al., 2020)	Observational	Pediatric OHCA in public spaces	Use of AED; patient outcome	AED use was more common in arrest locations with median household incomes of >$50,000 per year (12.3%; p =

				0.016), <10% unemployment (12.1%; p = 0.002), and >80% high school education (11.8%; p = 0.002), . . . There was a negative association between the neighborhood characteristic index and bystander AED use (Fig. 1): AEDs were used among 13.6% of OHCAs in neighborhoods with an index value of 0 compared to 5.3% of OHCAs in neighborhoods with an index value of 3 or 4 (p = 0.007).
(Schiefer et al., 2020)	Observational	all patients, visitors and medical personnel over 18 years of age in the emergency room of the University hospitals Munich (South of Germany) and Cologne-Merheim in the Western part of Germany (University of Witten/ Herdecke)	Knowledge check of first aid and BLS	There were differences between what the authors deemed rural & urban locations; however, there was no validation of these, and it was a convenience sample.

Reviewer Comments (including whether meet criteria for formal review):

The diversity of these studies in combination of previous studies does not lead to the ability to do any meta-analysis. There appears to be body of evidence that needs interpretation and structure to move the topic forward in research. This topic however is much more than education and needs an interprofessional lens of sociology, psychology, and ecology to understand how and where to make changes to increase helping behaviors. There are not enough studies however of one focus to justify a full Systematic Review.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 8Feb 2021

Reference list

Birkun, A., Trunkwala, F., Gautam, A., Okoroanyanwu, M., & Oyewumi, A. (2020). Availability of basic life support courses for the general populations in India, Nigeria and

the United Kingdom: An internet-based analysis. *World Journal of Emergency Medicine*, *11*(3), 133–139. https://pubmed.ncbi.nlm.nih.gov/32351644/

Dobbie, F., Uny, I., Eadie, D., Duncan, E., Stead, M., Bauld, L., Angus, K., Hassled, L., MacInnes, L., & Clegg, G. (2020). Barriers to bystander CPR in deprived communities: Findings from a qualitative study. *PLoS ONE*, *15*(6). https://doi.org/10.1371/journal.pone.0233675

Griffis, H., Wu, L., Naim, M., Bradley, R., Tobin, J., McNally, B., Vellano, K., Quan, L., Markenson, D., & Rossano, J. (2020). Characteristics and outcomes of AED use in pediatric cardiac arrest in public settings: The influence of neighborhood characteristics. *Resuscitation*, *146*, 126–131. https://pubmed.ncbi.nlm.nih.gov/31785372/

Nakagawa, N., Oliveira, K., Lockey, A., Semeraro, F., Aikawa, P., Macchione, M., Carvalho-Oliveira, R., Gouvêa, G., Boaventura, A., Maiworm, A., Calderaro, M., Hajjar, L., Motta, E., Souza, H., de André, C., Silva, L., Polastri, T., Timerman, S., Carmona, M., & Böttiger, B. (2021). Effectiveness of the 40-Minute Handmade Manikin Program to Teach Hands-on Cardiopulmonary Resuscitation at School Communities. *The American Journal of Cardiology*, *139*, 126–130. https://pubmed.ncbi.nlm.nih.gov/33007308/

Schiefer, J., Schuller, H., Fuchs, P., Bagheri, M., Grigutsch, D., Klein, M., & Schulz, A. (2020). Basic life support knowledge in Germany and the influences of demographic factors. *PloS One*, *15*(8), e0237751. https://pubmed.ncbi.nlm.nih.gov/32817673/

2021 Evidence Update Worksheet
Appendix B3 EIT 17

Worksheet author(s): Adam Cheng
Date Submitted: February 5, 2021

PICO / Research Question:
Virtual Reality, Augmented Reality and Gamified Learning (EIT 4005: EvUp 2020)

Population: For participants undertaking basic or advanced life support training in an education setting
Intervention: does the use of virtual reality, augmented reality or gamified learning
Comparators: compared with traditional training methods
Outcomes: improve patient outcomes, skill performance in actual resuscitations, skill/knowledge at 1 year, skill/knowledge at time between course conclusion and 1 year, skill/knowledge at course conclusion
Study Designs: Screening of and data extraction from: Guidelines, reviews, meta-analyses, randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies). Unpublished studies (e.g., conference abstracts, trial protocols) were excluded.
Timeframe: All years and all languages were included as long as there is an English abstract. The search was performed on 31 January 2021(from 30/09/2019).

Outcomes: As above
Type (intervention, diagnosis, prognosis): Intervention
Additional Evidence Reviewer(s): None
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: Evidence Update conducted in 2019

Last ILCOR Consensus on Science and Treatment Recommendation:
N/A

2019 Search Strategy:
("CPR Training"[All Fields] OR "cardiopulmonary resuscitation"[All Fields] OR "basic life support"[All Fields] OR "Advanced Life Support"[All Fields] OR "Chest compressions"[All Fields] OR "resuscitation"[All Fields] OR "Cardiac massage"[All Fields] OR "Cardiac life support"[All Fields] OR "Code blue"[All Fields] OR “cardiac arrest”[All Fields])
AND ("augmented reality"[All Fields] OR "virtual reality"[All Fields] OR "HTC Vive"[All Fields] OR "Oculus Rift"[All Fields] OR Cardboard[All Fields] OR "mixed reality"[All Fields] OR "hololens"[All Fields] OR "VR Sim"[All Fields] OR "VR/AR"[All Fields] OR “VR App”[All Fields] OR “Virtual scenarios“[All Fields] OR "gamified"[All Fields] OR "gamification"[All Fields] OR "serious games"[All Fields] OR "second life"[All Fields])
2021 Search Strategy:
Same search strategy as 2019.

Database searched: PubMed, Scopus, Embase
Date Search Completed: 31 January 2021
Search Results (Number of articles identified / number identified as relevant): 21, of which 3 are relevant

Inclusion Criteria: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies). Reviews were screened for additional literature.
Exclusion: Letters, editorials, comments, case reports, studies not comparing virtual reality, augmented reality or gamified learning with traditional training methods (e.g. virtual reality vs. no additional training).

Link to Article Titles and Abstracts (if available on PubMed):
Nas, 2020, 328. https://pubmed.ncbi.nlm.nih.gov/31734702/
Katz, 2020, e17425. https://pubmed.ncbi.nlm.nih.gov/32163038/
Jaskiewicz, 2020, 99. https://pubmed.ncbi.nlm.nih.gov/33235109/

Summary of Evidence Update: PubMed, Scopus and Embase were searched to identify eligible studies providing new information between 30/09/2019 and 31/01/2021. 21 abstracts in total were screened. Most studies did not meet inclusion criteria, either due to lack of an appropriate comparison (i.e. not comparing virtual reality, augmented reality or gamified learning with traditional training methods), lack of appropriate outcomes or inappropriate article type. Three new studies were identified, all of which reported the effect of virtual reality training[1-3]. There we no new studies related to augmented reality or gamified learning.
One randomized controlled trial reported a comparison of virtual reality vs. face-to-face, manikin-based training in lay providers, demonstrating the VR training was inferior to face-to-face training for CC depth, but non-inferior for CC rate[1]. Two prospective, observational studies with a cross-over design were identified. One study comparing VR training to high-fidelity training in year 2 residents showed improve technical scores in the high-fidelity training group, and no difference in nontechnical scores[2]. The other study compared VR training to manikin based training, demonstrating no difference in CC depth or CC rate between groups that participated in a 2-minute cardiac arrest scenario[3].

Evidence Update Process for topics not covered by ILCOR Task Forces
This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

RCT (1)

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
Nas, 2020[1]	Comparison of CPR quality between virtual reality CPR training and face-to-face CPR training; randomized noninferiority trial N=381	Lay providers (music festival attendees)	20 minute CPR scenario while wearing VR goggles; vs. 20 minute standard CPR training on Little Anne Mannequin	VR training was inferior to face-to-face training for CC depth (49.1 mm vs 56.8 mm, p = 0.99); VR training was non-inferior to face-to-face training for CC rate (114.3/min vs 108.6/min, p<0.001). CCF was better in face-to-face group compared to VR group (67% vs 61%, p=0.02).	Mostly young, highly educated group of participants, thus limiting generalizability of findings

Nonrandomized Trials, Observational Studies (2)

Study Acronym; Author;	Aim of Study; Study Type/Design; Study Size (N)	Patient Population	Study Intervention	Primary Endpoint and Results (include P value; OR or RR; & 95% CI)	Summary/Conclusion Comment(s)

Year Published					
Katz, 2020[2]	Comparison of virtual reality vs high-fidelity training; Prospective observational study (crossover); N=23	Year 2 Residents	VR training vs. high fidelity manikin-based training	Better technical skills scores in HFS group vs VR group (72.7 vs. 47; p<0.001), no difference in nontechnical scores between 2 groups.	Virtual reality is more cost-effective, high-fidelity training provides better feedback
Jaskiewicz, 2020[3]	Comparison of CPR quality between virtual reality CPR training and manikin-based CPR training; prospective observational study (crossover); N=91	Medical Students	VR training vs. manikin-based sudden cardiac arrest scenario (2 minutes)	No difference between VR training vs. manikin-based training for CC depth (47.8 mm vs. 49.3 mm; p>0.05) and CC rate (114.2/min vs. 114.9/min; p=0.48).	Limited by only 2 minutes of compressions in assessment scenario; only one participant per scenario

Abbreviations: RCT = randomized controlled trial; CPR = cardiopulmonary resuscitation; VR = virtual reality; CC = chest compressions; HFS = high fidelity simulation

Reviewer Comments (including whether meet criteria for formal review):

An Evidence Update in 2019 identified 9 articles exploring gamified learning and 4 articles studying virtual reality training[4, 5]. No treatment recommendation was issued as of January 31, 2020. Since then, one RCTs and two observational studies evaluating the effects of virtual reality compared to traditional, manikin-based training, with mixed results[1, 3]. This additional evidence does not trigger a systematic review or a formal ILCOR recommendation.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn : ILCOR SAC member (EIT T/F) on 6 Feb 2021

Reference list

1. Nas J, Thannhauser J, Vart P, van Geuns R-J, Muijsers HEC, Mol J-Q, et al. Effect of Face-to-Face vs Virtual Reality Training on Cardiopulmonary Resuscitation Quality. JAMA Cardiology. 2020;5(3):328.
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3. Jaskiewicz F, Kowalewski D, Starosta K, Cierniak M, Timler D. Chest compressions quality during sudden cardiac arrest scenario performed in virtual reality. Medicine. 2020;99(48):e23374.
4. Greif R, Bhanji F, Bigham BL, Bray J, Breckwoldt J, Cheng A, et al. Education, Implementation, and Teams: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation. 2020;142(16_suppl_1).
5. Cheng A, Magid DJ, Auerbach M, Bhanji F, Bigham B, Blewer AL, et al. Part 6: Resuscitation Education Science. 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020;142(suppl 2):S551-S79.

2021 Evidence Update Worksheet
Appendix B3 EIT 18

Worksheet author(s): Taylor Sawyer
Date Submitted: 02/9/2021

PICO / Research Question: In Situ Training (EIT 4007)
Population: healthcare providers
Intervention: in situ (workplace-based) simulation-based resuscitation training
Comparator: traditional training (i.e. classroom or laboratory-based training)
Outcomes: improved learning, performance, and patient outcomes
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.
Timeframe:
The literature searched from the date of last Evidence Update (20 Oct 2019 to 9 Feb 2021)

Type: Intervention
Additional Evidence Reviewer(s): Not applicable
Conflicts of Interest (financial/intellectual, specific to this question): None
Year of last full review: Not applicable
Last ILCOR Consensus on Science and Treatment Recommendation: Not applicable

2021 Search Strategy:
in situ AND simulation AND healthcare
Database searched: MEDLINE by EBSCO Connect
Date Search Completed: 9 Feb 2021

Search Results (Number of articles identified / number identified as relevant): 45 articles identified/ 4 articles identified as relevant

Inclusion/Exclusion Criteria: Published randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies) reporting data from adult patients were included.

Link to Article Titles and Abstracts (if available on PubMed):
Arul N (2021) https://pubmed.ncbi.nlm.nih.gov/33445638/; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7826853/
Nichols (2020) https://pubmed.ncbi.nlm.nih.gov/33403320/;
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7775030/
Gupta (2019) https://pubmed.ncbi.nlm.nih.gov/30811308/ ; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6394294/
Munzer (2020) https://pubmed.ncbi.nlm.nih.gov/33052819/

Summary of Evidence Update: This Evidence Update reviewed low-quality data from four nonrandomized trials, observational studies.

Evidence Update Process for topics not covered by ILCOR Task Forces

This evidence update process is only applicable to PICOs which are *not* being reviewed as ILCOR systematic and scoping reviews.

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	Study Type/Design; Study Size (N)	Patient Population	Primary Endpoint and Results (include P value; OR or RR; & 95% CI)	Summary/Conclusion Comment(s)
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)
Arul N (2021)	In situ simulation-based neonatal resuscitation training; 3 hospitals	NA	Decrease latent safety threats; significant shift in the median (>8 consecutive data points below the median) during PDSA cycle 2 towards the goal of ≤1	A multidisciplinary approach to quality improvement in neonatal resuscitation fostered engagement, enabled focus on patient safety, and led to identification of system issues
Nichols (2020)	In situ simulation with expert-driven debriefing; Video recording of the simulation disseminated to over 300 staff	NA	Consensus among expert critical care providers to develop the COVID-19 guideline and quickly adopt the new AHA COVID-19 recommendation	In situ simulation with expert-driven RCDP created a rapid consensus to develop COVID-19 guideline and quickly adopt the AHA COVID-19 recommendations.
Gupta (2019)	Ward-based simulated mock codes held monthly;37 interprofessional (physician and nursing) staff were trained in 16 small group sessions over four months.	NA	Most participants indicated that all parts of the program were either 'very useful' (should be kept in the program), or 'extremely useful' (definitely keep in the program)	Report describes the preliminary steps taken to create a curriculum intended to improve interprofessional resuscitation performance across an institution.
Munzer (2020)	in-situ simulation scenario to train physicians, nurses, and respiratory therapists in best practices for airway	NA	increased comfort in performing procedural tasks such as intubation, from 3.08 (2.80-3.35) to 4.38 (4.23-4.52) after the simulation, a difference of 1.30 points (1.06-1.54, $p < 0.001$).	In-situ simulation is an essential tool for both dissemination and onboarding, as well as process improvement, in the context of an epidemic or pandemic.

	management of patients with COVID-19			

Reviewer Comments (including whether meet criteria for formal review):

This evidence update found four relevant nonrandomized trials, observational studies. There were no randomized controlled trials identified, nor systematic reviews. The outcomes of three studies focused on learning outcomes and/or participant perceptions. One study (Arul, 2021) found that in situ simulation was associated with the identification of latent safety threats. No studies with patient outcomes were identified. Based on the low quality evidence, this Evidence Update did not meet criteria for formal review.

	Approval Date
Evidence Update coordinator	
ILCOR board	

*Once approval has been made by Evidence Update coordinator, worksheet will go to ILCOR Board for acknowledgement.

Checked by Judith Finn (ILCOR SAC member – EIT T/F rep) on 17 Feb 2021

Reference list

Nichols BE, McMichael ABV, Volk APD, Bhaskar P, Bowens CD. CPR during COVID-19: Use of Expert-driven Rapid Cycle Deliberate Practice to Implement PALS Guidelines. Pediatr Qual Saf. 2020;6(1):e374. Published 2020 Dec 28. doi:10.1097/pq9.0000000000000374

Arul N, Ahmad I, Hamilton J, Sey R, Tillson P, Hutson S, Narang R, Norgaard J, Lee HC, Bergin J, Quinn J, Halamek LP, Yamada NK, Fuerch J, Chitkara R. Lessons Learned from a Collaborative to Develop a Sustainable Simulation-Based Training Program in Neonatal Resuscitation: Simulating Success. Children (Basel). 2021 Jan 12;8(1):39. doi: 10.3390/children8010039. PMID: 33445638; PMCID: PMC7826853.

Gupta R, Fitzgibbons C, Ramsay C, Vanderheiden L, Toppozini C, Lobos AT. Development and pilot of an interprofessional pediatric resuscitation program for non-acute care inpatient providers. Med Educ Online. 2019;24(1):1581521. doi:10.1080/10872981.2019.1581521

Munzer BW, Bassin BS, Peterson WJ, Tucker RV, Doan J, Harvey C, Sefa N, Hsu CH. In-situ Simulation Use for Rapid Implementation and Process Improvement of COVID-19 Airway Management. West J Emerg Med. 2020 Sep 24;21(6):99-106. doi: 10.5811/westjem.2020.7.48159. PMID: 33052819; PMCID: PMC7673893.