

AHA FOCUSED UPDATE

2019 American Heart Association Focused Update on Systems of Care: Dispatcher-Assisted Cardiopulmonary Resuscitation and Cardiac Arrest Centers

An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

ABSTRACT: Survival after out-of-hospital cardiac arrest requires an integrated system of care (chain of survival) between the community elements responding to an event and the healthcare professionals who continue to care for and transport the patient for appropriate interventions. As a result of the dynamic nature of the prehospital setting, coordination and communication can be challenging, and identification of methods to optimize care is essential. This 2019 focused update to the American Heart Association systems of care guidelines summarizes the most recent published evidence for and recommendations on the use of dispatcher-assisted cardiopulmonary resuscitation and cardiac arrest centers. This article includes the revised recommendations that emergency dispatch centers should offer and instruct bystanders in cardiopulmonary resuscitation during out-of-hospital cardiac arrest and that a regionalized approach to post-cardiac arrest care may be reasonable when comprehensive postarrest care is not available at local facilities.

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This 2019 focused update to the American Heart Association (AHA) guidelines on systems of care for dispatcher-assisted (DA) cardiopulmonary resuscitation (CPR) and cardiac arrest centers (CACs) is based on the systematic reviews commissioned by the International Liaison Committee on Resuscitation (ILCOR) to identify the evidence supporting the use of DA-CPR¹ and CACs.² Additional information can be found in the “2019 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations” summary on these topics published by ILCOR,³ in the web-based Consensus on Science With Treatment Recommendations on dispatcher instruction in CPR for adults,⁴ and in the web-based Consensus on Science With Treatment Recommendations on CACs.⁵

The expert writing group for this 2019 systems of care focused update reviewed the studies and analysis of the 2019 Consensus on Science With Treatment Recommendations evidence summaries and carefully considered the ILCOR consensus recommendations³ in light of the structure and resources of the out-of-hospital and in-hospital resuscitation systems and the providers who use these guidelines. In addition, the writing group determined Classes of Recommendation and Levels of Evidence according to the most recent recommendations of the American College of Cardiology/AHA Task Force on Clinical Practice Guidelines (Table)⁶ by using the process detailed in the “2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.”⁷

This 2019 systems of care focused update includes only recommendations for the use of dispatcher instructions in CPR and for the use of specialized CACs. These

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■ cardiopulmonary resuscitation
■ emergency medical dispatcher
■ heart arrest

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Table. Applying Class of Recommendation and Level of Evidence to Clinical Strategies, Interventions, Treatments, or Diagnostic Testing in Patient Care (Updated August 2015)*

CLASS (STRENGTH) OF RECOMMENDATION	LEVEL (QUALITY) OF EVIDENCE‡
CLASS 1 (STRONG) Benefit >>> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is recommended • Is indicated/useful/effective/beneficial • Should be performed/administered/other • Comparative-Effectiveness Phrases†: <ul style="list-style-type: none"> – Treatment/strategy A is recommended/indicated in preference to treatment B – Treatment A should be chosen over treatment B 	LEVEL A <ul style="list-style-type: none"> • High-quality evidence‡ from more than 1 RCT • Meta-analyses of high-quality RCTs • One or more RCTs corroborated by high-quality registry studies
CLASS 2a (MODERATE) Benefit >> Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is reasonable • Can be useful/effective/beneficial • Comparative-Effectiveness Phrases†: <ul style="list-style-type: none"> – Treatment/strategy A is probably recommended/indicated in preference to treatment B – It is reasonable to choose treatment A over treatment B 	LEVEL B-R (Randomized) <ul style="list-style-type: none"> • Moderate-quality evidence‡ from 1 or more RCTs • Meta-analyses of moderate-quality RCTs
CLASS 2b (WEAK) Benefit ≥ Risk Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • May/might be reasonable • May/might be considered • Usefulness/effectiveness is unknown/unclear/uncertain or not well-established 	LEVEL B-NR (Nonrandomized) <ul style="list-style-type: none"> • Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies • Meta-analyses of such studies
CLASS 3: No Benefit (MODERATE) Benefit = Risk (Generally, LOE A or B use only) Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Is not recommended • Is not indicated/useful/effective/beneficial • Should not be performed/administered/other 	LEVEL C-LD (Limited Data) <ul style="list-style-type: none"> • Randomized or nonrandomized observational or registry studies with limitations of design or execution • Meta-analyses of such studies • Physiological or mechanistic studies in human subjects
Class 3: Harm (STRONG) Risk > Benefit Suggested phrases for writing recommendations: <ul style="list-style-type: none"> • Potentially harmful • Causes harm • Associated with excess morbidity/mortality • Should not be performed/administered/other 	LEVEL C-EO (Expert Opinion) <ul style="list-style-type: none"> • Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).
 A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR 1 and 2a; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

‡ The method of assessing quality is evolving, including the application of standardized, widely-used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

updated recommendations are intended to supplement “Part 4: Systems of Care and Continuous Quality Improvement” in the 2015 AHA guidelines update.⁸ All other recommendations about DA-CPR in the “2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care”⁹ remain the official recommendations of the AHA Emergency Cardiovascular Care Science Subcommittee and writing groups.

DISPATCHER INSTRUCTION IN CPR—UPDATED 2019

A variety of terms have been used to identify the individuals at an emergency telephone call center who are

charged with answering the call, interacting with the caller, and assigning the needed care providers to the incident scene (traditionally called *dispatchers*). Terminology is similarly varied for the process the dispatcher uses to provide real-time CPR instructions to bystanders who are at the scene of an out-of-hospital cardiac arrest (OHCA). To remain consistent with the ILCOR evidence review, the term *DA-CPR* (dispatcher-assisted CPR) is used to describe such coaching in this update, recognizing that other terms (such as *telecommunicator CPR* and *telephone CPR*) could be substituted.

The ILCOR systematic review analyzed the published evidence about the effectiveness of DA-CPR from 3 perspectives.¹ The first included studies comparing outcomes of patients for whom emergency calls were

handled by dispatch centers where DA-CPR was offered with outcomes of patients whose emergency calls were handled at centers where DA-CPR was not offered. The second perspective included studies comparing the case-based outcomes of patients who actually received DA-CPR with those who did not receive bystander CPR. The third perspective included studies comparing the case-based outcomes of patients who actually received DA-CPR with those who received bystander CPR without dispatcher assistance. Separate analyses were performed from each of these perspectives, the results of which were largely concordant across the different approaches.

Evidence Review—Updated 2019

Comparing Outcomes in OHCA Handled by Dispatch Centers Offering DA-CPR With Outcomes Handled by Dispatch Centers Not Offering DA-CPR

The ILCOR systematic review identified no randomized controlled trials comparing clinical outcomes when emergency calls were directed to dispatch centers offering DA-CPR with outcomes from centers not offering such instruction.¹ Evidence for such an association was derived from 16 observational and cohort studies,^{10–25} with the overall certainty of effect rated as very low for all clinical outcomes. Because the evidence is limited to observational studies, any outcomes reported can be noted only to be associated with the treatment (ie, DA-CPR versus no DA-CPR) rather than caused by the treatment.

Six observational studies evaluated the association of DA-CPR and survival with favorable neurological outcome, defined as a Cerebral Performance Category 1 to 2,²⁶ at time points that ranged from hospital discharge to several months after cardiac arrest.^{11,14,15,20,21,25} Two studies found an association between offering DA-CPR and increased survival with favorable neurological outcome at 1 month after discharge, even after adjustment for multiple variables (adjusted odds ratio [AOR], 1.47 [95% CI, 1.03–2.09]).^{15,20} Two additional studies reported an association of increased survival with favorable neurological outcome at hospital discharge when DA-CPR was offered (odds ratio, 1.70 [95% CI, 1.21–2.37])^{11,14} that persisted in the study that adjusted for multiple variables (AOR, 1.67 [95% CI, 1.13–2.47]).¹¹ A fifth study reported unadjusted favorable neurological outcome at 1 month in association with offering DA-CPR,²⁵ and a sixth study described the association between offering DA-CPR and improved survival with Cerebral Performance Category 1 to 2 at 90 days.²¹

Three studies found an association between improved survival to either hospital discharge¹¹ or 1 month^{15,20} when OHCA calls were handled by centers that offered DA-CPR compared with OHCA outcomes when calls were handled by centers that did not. Nine

observational studies that provided only unadjusted analyses did not report improved outcomes in centers offering DA-CPR.^{10–13,15–17,20,21}

A meta-analysis of 8 observational studies reported an association of DA-CPR availability and an increased likelihood of return of spontaneous circulation in unadjusted analysis,^{11,13–15,21–23,25} but this association did not persist in the single study that adjusted for confounding variables.¹⁵ The 6 studies reporting survival to hospital admission found no difference associated with systems offering DA-CPR.^{11,13–15,22,23}

Nine studies evaluated the association between DA-CPR availability and the actual provision of bystander CPR,^{10–13,15,18,19,21,24} as well as the promptness of its initiation.²⁰ In adjusted analyses, DA-CPR availability was associated with a >5-fold increase in likelihood of bystander CPR (AOR, 5.74 [95% CI, 2.4–13.72]),^{11,20,22} and CPR was initiated 7 minutes sooner when DA-CPR was offered.²⁰

Prompt initiation of CPR is hypothesized to delay the degeneration of a shockable rhythm to a nonshockable rhythm. Therefore, OHCA populations receiving prompt DA-CPR may demonstrate a higher incidence of a shockable rhythm on arrival of professional responders compared with patients not receiving DA-CPR. Unadjusted data from 5 observational studies found an association between a higher proportion of initial shockable rhythms for calls handled at centers where DA-CPR was offered.^{11,13,15,20,25}

Clinical Outcomes in OHCA When DA-CPR Was Provided Versus No Bystander CPR

The ILCOR systematic review identified no randomized controlled trials comparing clinical outcomes of patients receiving bystander DA-CPR with outcomes of those not receiving bystander CPR. The available evidence for these comparisons is from observational and cohort studies, so outcomes reported here can be described only as associated with receiving bystander DA-CPR or no bystander CPR.^{19,20,24,25,27–31} The certainty of evidence in these studies was rated as very low.

Three studies reported an association between outcomes of those who receive DA-CPR (versus no bystander CPR) and improved survival with favorable neurological outcome at hospital discharge (AOR, 1.54 [95% CI, 1.35–1.76]) and at 1 month (AOR, 1.81 [95% CI, 1.23–2.67])^{27,28,32}; this association persisted in the study that adjusted for multiple variables.²⁰ DA-CPR also was associated with higher survival to hospital discharge^{27,28,30–32} and survival at 1 month.²⁰

Receiving DA-CPR was associated with a higher likelihood of sustained return of spontaneous circulation compared with no bystander CPR.²⁴ There were insufficient data to address the association of DA-CPR (versus no bystander CPR) and the likelihood of an initial shockable rhythm at emergency medical services arrival

or the likelihood of reduced time interval to initiation of bystander CPR.

Clinical Outcomes in OHCA When DA-CPR Is Provided Versus Bystander CPR Without Dispatcher Assistance

The ILCOR systematic review identified no randomized controlled trials comparing clinical outcomes of patients receiving bystander CPR performed with dispatcher assistance (ie, DA-CPR) and those receiving bystander CPR that was performed without dispatcher assistance. The available evidence for these comparisons consists of (nonrandomized) observational and cohort studies.^{19,20,25,27–32} The certainty of effects in these studies was rated as very low. In addition, the prognostic features of patients who received bystander CPR with and without dispatcher assistance differed markedly in these observational studies, so the ILCOR Task Force³ and this writing group considered only adjusted outcomes in this evidence evaluation.

There was no difference in survival with good neurological function at hospital discharge or at 1 month between patients who received bystander DA-CPR and those who received bystander CPR performed without dispatcher assistance.^{19,32} Although receiving bystander DA-CPR (versus unassisted CPR) was associated with increased survival at 1 month,^{19,29} no significant differences were observed in survival to hospital discharge between those receiving DA-CPR and those receiving unassisted CPR.³²

Receiving bystander DA-CPR was associated with increased survival to hospital admission compared with receiving bystander CPR without dispatcher assistance.¹⁹ However, no significant differences in the frequency of shockable rhythms were associated with DA-CPR.^{25,29,32} No studies addressed differences in the time interval to initiation of bystander CPR in these patients.

Recommendations—Updated 2019

- 1. We recommend that emergency dispatch centers offer CPR instructions and empower dispatchers to provide such instructions for adult patients in cardiac arrest (Class 1; Level of Evidence C-LD).**
- 2. Dispatchers should instruct callers to initiate CPR for adults with suspected OHCA (Class 1; Level of Evidence C-LD).**

The writing group acknowledges that the strong recommendations for DA-CPR are accompanied by relatively limited evidence. Although clear outcome benefits from DA-CPR were not demonstrated in all reviewed trials, it is unlikely that a rigorous randomized controlled trial on DA-CPR will be performed. Thus, the recommendations were based on the overwhelming preponderance of existing evidence from tens of thou-

sands of patients from a number of countries indicating an association between DA-CPR and improved clinical outcomes after OHCA. The writing group also noted the similarity in outcomes when bystander CPR was provided with dispatcher assistance (ie, DA-CPR) and when CPR was provided by a bystander who was sufficiently skilled to initiate CPR spontaneously (ie, without dispatcher assistance), suggesting that dispatcher instruction can serve to support the effectiveness of CPR performed by a bystander who is unskilled in CPR. Considering these findings with the reported association of DA-CPR with a >5-fold likelihood of bystander CPR (a recognized predictor of improved survival), the writing group agrees that the overall benefit from DA-CPR merits a strong endorsement. Although not specifically addressed by this evidence review, the writing group also believes there is merit in dispatchers not only initiating CPR instruction but also continuing to coach callers in delivering high-quality CPR until the arrival of professional rescuers and their assumption of patient care.

This evidence review focused on comparing clinical outcomes of dispatch systems that provide DA-CPR with those that do not and comparing outcomes of OHCA patients receiving DA-CPR with those who did not. This review did not address issues pertaining to the experience of the bystander performing CPR, the ability of dispatchers to recognize OHCA, the protocols or verbiage used to instruct callers to perform CPR, or the quality of CPR ultimately provided. This review also did not address the impact of providing DA-CPR instructions to lay rescuers previously trained in CPR. Furthermore, the educational components of a DA-CPR program such as its curriculum, frequency of training, and potential challenges in recognizing cardiac arrest or dealing with caller distress and language barriers were not included in any of the comparisons evaluated. System-based factors such as call routing and volumes, staffing, and response plans also fell outside the scope of this evidence evaluation. These areas represent important knowledge gaps for further research.

TRANSPORT TO SPECIALIZED CACs

For purposes of this focused update, the term CAC (cardiac arrest center) is used to indicate a specialized center that provides contemporary and comprehensive evidence-based resuscitation and post-cardiac arrest care, including emergent cardiac catheterization, targeted temperature management, and multimodal prognostication.^{33,34} A variety of terms have been used to identify these specialized centers, including *cardiac arrest receiving centers*, *comprehensive cardiac centers*, and *cardiac resuscitation centers*. For the sake of consistency with the terminology used during the ILCOR evidence review, the term CACs is used in this document.

A 2019 ILCOR systematic review evaluated whether transport of patients with nontraumatic OHCA to a specialized CAC compared with an undesignated center improves outcomes.² The topic was prioritized for review as the result of the success of other regional systems of care for the management of other critical, time-sensitive diseases, including ST-segment–elevation myocardial infarction, stroke, and trauma, for which comprehensive management is not possible at all institutions. This review was based on the 2019 systematic review² and an analysis of all relevant studies.

An interim feasibility report of a randomized trial included evidence from 40 patients that demonstrated no difference in clinical outcomes; however, this report was excluded from the review because the trial has not concluded.³⁵ Therefore, the evidence evaluating the use of specialized CACs consisted of 18 observational studies.^{36–53} The evidence to support each evaluated outcome was of very low certainty.²

Evidence Review—Updated 2019

Adjusted analyses from 2 observational studies (45 956 patients) found that treatment at CACs was not associated with increased survival to 30 days with favorable neurological outcome.^{36,37} However, admission to a CAC was associated with improved survival to hospital discharge with good neurological outcome in 2 studies (AOR, 2.22 [95% CI, 1.74–2.84]).^{39,40} In addition, treatment at CACs was associated with increased survival to 30 days^{43,44} and survival to hospital discharge^{39,40,47–49} compared with treatment at non-CACs.

In subjects with ongoing CPR at the time of hospital arrival, adjusted and unadjusted data from 2 observational studies involving 41 447 adults with OHCA showed no difference in rates of return of spontaneous circulation for patients cared for at CACs compared with those cared for at non-CACs.^{36,37}

Subgroup analyses based on initial presenting rhythm (shockable versus nonshockable) and direct transport versus secondary transfer to a CAC were prespecified. There were insufficient data to perform either of the preplanned pooled subgroup analyses.

Eight studies reported outcomes associated with treatment at CACs stratified by shockable or nonshockable rhythms.^{37,38,40,45,47,48,50,53} Heterogeneity in the data prevented a meta-analysis. In patients with shockable rhythms, 5 studies reported better outcomes at CACs,^{37,40,45,48,53} whereas 3 studies reported no difference.^{38,47,50} In patients with nonshockable rhythms, CACs were associated with improved outcomes in 1 study⁵³ and no difference in 2 others.^{40,47}

Four studies examined outcomes in patients with OHCA who were transferred to a CAC from a non-CAC.^{37,45,51,52} Two of the studies reported no difference in outcomes^{37,45}; a third study⁵² reported better survival

associated with direct transport to a CAC compared with secondary transfer; and the fourth study⁵¹ reported better survival associated with secondary transfer to a CAC compared with remaining at the original receiving facility. There were insufficient data to perform a pooled analysis for direct comparison.

Recommendation—Updated 2019

1. A regionalized approach to post–cardiac arrest care that includes transport of resuscitated patients directly to specialized CACs is reasonable when comprehensive post–cardiac arrest care is not available at local facilities (Class 2a; Level of Evidence C-LD).

Evidence-based, comprehensive post–cardiac arrest care, including the availability of emergent cardiac catheterization, targeted temperature management, hemodynamic support, and neurological expertise, is critically important for resuscitated patients with cardiac arrest. Important considerations in this decision-making process must include the stability of the resuscitated patient and the transport time required to arrive at a distant center offering comprehensive services. Although supportive evidence for comprehensive post–cardiac arrest interventions remains largely observational (particularly when they are administered together as “bundled care” at specialized centers), they may nonetheless represent a logical clinical link between successful resuscitation and ultimate survival. Taken together with experience from regionalized approaches to other emergencies such as trauma, stroke, and ST-segment–elevation acute myocardial infarction, the consensus of the writing group is that when a suitable complement of post–cardiac arrest services is not available locally, direct transport of the resuscitated patient to a regional center offering such support may be beneficial and is a reasonable approach to ongoing care when feasible and possible to accomplish in a timely manner.

ARTICLE INFORMATION

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

This statement was approved by the American Heart Association Science Advisory and Coordinating Committee on July 19, 2019, and the American Heart Association Executive Committee on August 9, 2019. A copy of the document is available at <https://professional.heart.org/statements> by using either “Search for Guidelines & Statements” or the “Browse by Topic” area. To purchase additional reprints, call 843-216-2533 or e-mail kelle.ramsay@wolterskluwer.com.

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and Emergency Cardiovascular Care. *Circulation*. 2019;140:e895–e903. doi: 10.1161/CIR.0000000000000733.

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Disclosures

Writing Group Disclosures

Writing Group Member	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Expert Witness	Ownership Interest	Consultant/Advisory Board	Other
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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be “significant” if (a) the person receives \$10 000 or more during any 12-month period, or 5% or more of the person’s gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns \$10 000 or more of the fair market value of the entity. A relationship is considered to be “modest” if it is less than “significant” under the preceding definition.

*Modest.

†Significant.

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This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives \$10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns \$10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

REFERENCES

- Nikolaou N, Dainty KN, Couper K, Morley P, Tijssen J, Vaillancourt C; on behalf of the International Liaison Committee on Resuscitation's (ILCOR) Basic Life Support and Pediatric Task Forces. A systematic review and meta-analysis of the effect of dispatcher-assisted CPR on outcomes from sudden cardiac arrest in adults and children. *Resuscitation*. 2019;138:82–105. doi: 10.1016/j.resuscitation.2019.02.035
- 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. doi: 10.1016/j.resuscitation.2019.02.006
- Soar J, Maconochie I, Wyckoff MH, Olasveengen TM, Singletary EM, Greif R, Aickin R, Bhanji F, Donnino MW, Mancini ME, et al. 2019 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. *Circulation*. 2019;140:e826–e880. doi: 10.1161/CIR.0000000000000734
- Olasveengen TM, Mancini ME, Vaillancourt C, Brooks SC, Castren M, Chung SP, Couper K, Dainty KN, Escalante R, Gazmuri RJ, et al. Emergency care: dispatcher instruction in CPR: Consensus on Science With Treatment Recommendations. International Liaison Committee on Resuscitation (ILCOR) Basic Life Support Task Force. February 25, 2019. <https://costr.ilcor.org/document/emergency-care-dispatcher-instruction-in-cpr>. Accessed August 23, 2019.
- Yeung J, Bray J, Reynolds J, Matsuyama T, Skrifvars M, Lang E, Singletary E, Lockey A, Pellegrino J, Gilfoyle E, et al; on behalf of the ALS and EIT Task Forces. Cardiac arrest centers versus non-cardiac arrest centers—adults: Consensus on Science With Treatment Recommendations. International Liaison Committee on Resuscitation (ILCOR) EIT and ALS Task Forces. April 15, 2019. <https://costr.ilcor.org/document/cardiac-arrest-centers-versus-non-cardiac-arrest-centers-adults>. Accessed August 23, 2019.
- Halperin JL, Levine GN, Al-Khatib SM, Birtcher KK, Bozkurt B, Brindis RG, Cigarroa JE, Curtis LH, Fleisher LA, Gentile F, et al. Further evolution of the ACC/AHA Clinical Practice Guideline Recommendation Classification System: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2016;133:1426–1428. doi: 10.1161/CIR.0000000000000312
- Morrison LJ, Gent LM, Lang E, Nunnally ME, Parker MJ, Callaway CW, Nadkarni VM, Fernandez AR, Billi JE, Egan JR, et al. Part 2: evidence evaluation and management of conflicts of interest: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2015;132(suppl 2):S368–S382. doi: 10.1161/CIR.0000000000000253
- Kronick SL, Kurz MC, Lin S, Edelson DP, Berg RA, Billi JE, Cabanas JG, Cone DC, Diercks DB, Foster JJ, et al. Part 4: Systems of care and continuous quality improvement: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2015;132(suppl 2):S397–S413. doi: 10.1161/CIR.0000000000000258
- Field JM, Hazinski MF, Sayre MR, Chameides L, Schexnayder SM, Hemphill R, Samson RA, Kattwinkel J, Berg RA, Bhanji F, et al. Part 1: executive summary: 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2010;122(suppl 3):S640–S656. doi: 10.1161/CIRCULATIONAHA.110.970889
- Culley LL, Clark JJ, Eisenberg MS, Larsen MP. Dispatcher-assisted telephone CPR: common delays and time standards for delivery. *Ann Emerg Med*. 1991;20:362–366. doi: 10.1016/s0196-0644(05)81655-5
- Song KJ, Shin SD, Park CB, Kim JY, Kim DK, Kim CH, Ha SY, Eng Hock Ong M, Bobrow BJ, McNally B. Dispatcher-assisted bystander cardiopulmonary resuscitation in a metropolitan city: a before-after population-based study. *Resuscitation*. 2014;85:34–41. doi: 10.1016/j.resuscitation.2013.06.004
- Stipulante S, Tubes R, El Fassi M, Donneau AF, Van Troyen B, Hartstein G, D'Orio V, Ghuyssen A. Implementation of the ALERT algorithm, a new dispatcher-assisted telephone cardiopulmonary resuscitation protocol, in non-Advanced Medical Priority Dispatch System (AMPDS) emergency medical services centres. *Resuscitation*. 2014;85:177–181. doi: 10.1016/j.resuscitation.2013.10.005
- Vaillancourt C, Verma A, Trickett J, Crete D, Beaudoin T, Nesbitt L, Wells GA, Stiell IG. Evaluating the effectiveness of dispatch-assisted cardiopulmonary resuscitation instructions. *Acad Emerg Med*. 2007;14:877–883. doi: 10.1197/j.aem.2007.06.021
- Besnier E, Damm C, Jardel B, Veber B, Compere V, Dureuil B. Dispatcher-assisted cardiopulmonary resuscitation protocol improves diagnosis and resuscitation recommendations for out-of-hospital cardiac arrest. *Emerg Med Australas*. 2015;27:590–596. doi: 10.1111/1742-6723.12493
- Harjanto S, Na MX, Hao Y, Ng YY, Doctor N, Goh ES, Leong BS, Gan HN, Chia MY, Tham LP, et al; on behalf of the PAROS Study Group. A before-after interventional trial of dispatcher-assisted cardio-pulmonary resuscitation for out-of-hospital cardiac arrests in Singapore. *Resuscitation*. 2016;102:85–93. doi: 10.1016/j.resuscitation.2016.02.014
- Bång A, Biber B, Isaksson L, Lindqvist J, Herlitz J. Evaluation of dispatcher-assisted cardiopulmonary resuscitation. *Eur J Emerg Med*. 1999;6:175–183.
- Kuisma M, Boyd J, Väyrynen T, Repo J, Nousila-Wiik M, Holmström P. Emergency call processing and survival from out-of-hospital ventricular fibrillation. *Resuscitation*. 2005;67:89–93. doi: 10.1016/j.resuscitation.2005.04.008

18. Akahane M, Ogawa T, Tanabe S, Koike S, Horiguchi H, Yasunaga H, Imamura T. Impact of telephone dispatcher assistance on the outcomes of pediatric out-of-hospital cardiac arrest. *Crit Care Med*. 2012;40:1410–1416. doi: 10.1097/CCM.0b013e31823e99ae
19. Japanese Circulation Society Resuscitation Science Study Group. Chest-compression-only bystander cardiopulmonary resuscitation in the 30:2 compression-to-ventilation ratio era: nationwide observational study. *Circ J*. 2013;77:2742–2750.
20. Goto Y, Maeda T, Goto Y. Impact of dispatcher-assisted bystander cardiopulmonary resuscitation on neurological outcomes in children with out-of-hospital cardiac arrests: a prospective, nationwide, population-based cohort study. *J Am Heart Assoc*. 2014;3:e000499. doi: 10.1161/JAHA.113.000499
21. Hiltunen PV, Silfvast TO, Jääntti TH, Kuisma MJ, Kurola JO; on behalf of the FINNRESUSCI Prehospital Study Group. Emergency dispatch process and patient outcome in bystander-witnessed out-of-hospital cardiac arrest with a shockable rhythm. *Eur J Emerg Med*. 2015;22:266–272. doi: 10.1097/MEJ.0000000000000151
22. Fukushima H, Panczyk M, Hu C, Dameff C, Chikani V, Vadeboncoeur T, Spaite DW, Bobrow BJ. Description of abnormal breathing is associated with improved outcomes and delayed telephone cardiopulmonary resuscitation instructions. *J Am Heart Assoc*. 2017;6:e005058. doi: 10.1161/JAHA.116.005058
23. Moriwaki Y, Tahara Y, Kosuge T, Suzuki N. The effect of telephone advice on cardiopulmonary resuscitation (CPR) on the rate of bystander CPR in out-of-hospital cardiopulmonary arrest in a typical urban area. *Hong Kong J Emerg Med*. 2016;23:220–226. doi: 10.1177/102490791602300403
24. Ro YS, Shin SD, Song KJ, Hong KJ, Ahn KO, Kim DK, Kwak YH. Effects of dispatcher-assisted cardiopulmonary resuscitation on survival outcomes in infants, children, and adolescents with out-of-hospital cardiac arrests. *Resuscitation*. 2016;108:20–26. doi: 10.1016/j.resuscitation.2016.08.026
25. Takahashi H, Sagisaka R, Natsume Y, Tanaka S, Takyu H, Tanaka H. Does dispatcher-assisted CPR generate the same outcomes as spontaneously delivered bystander CPR in Japan? *Am J Emerg Med*. 2018;36:384–391. doi: 10.1016/j.ajem.2017.08.034
26. Jennett B, Bond M. Assessment of outcome after severe brain damage. *Lancet*. 1975;1:480–484. doi: 10.1016/s0140-6736(75)92830-5
27. Wu Z, Panczyk M, Spaite DW, Hu C, Fukushima H, Langlais B, Sutter J, Bobrow BJ. Telephone cardiopulmonary resuscitation is independently associated with improved survival and improved functional outcome after out-of-hospital cardiac arrest. *Resuscitation*. 2018;122:135–140. doi: 10.1016/j.resuscitation.2017.07.016
28. Chang I, Lee SC, Shin SD, Song KJ, Ro YS, Park JH, Kong SY. Effects of dispatcher-assisted bystander cardiopulmonary resuscitation on neurological recovery in paediatric patients with out-of-hospital cardiac arrest based on the pre-hospital emergency medical service response time interval. *Resuscitation*. 2018;130:49–56. doi: 10.1016/j.resuscitation.2018.06.029
29. Viereck S, Möller TP, Ersbøll AK, Bækgaard JS, Claesson A, Hollenberg J, Folke F, Lippert FK. Recognising out-of-hospital cardiac arrest during emergency calls increases bystander cardiopulmonary resuscitation and survival. *Resuscitation*. 2017;115:141–147. doi: 10.1016/j.resuscitation.2017.04.006
30. Shah M, Bartram C, Irwin K, Vellano K, McNally B, Gallagher T, Swor R. Evaluating dispatch-assisted CPR using the CARES Registry. *Prehosp Emerg Care*. 2018;22:222–228. doi: 10.1080/10903127.2017.1376133
31. Rea TD, Eisenberg MS, Cullley LL, Becker L. Dispatcher-assisted cardiopulmonary resuscitation and survival in cardiac arrest. *Circulation*. 2001;104:2513–2516. doi: 10.1161/hc4601.099468
32. Ro YS, Shin SD, Lee YJ, Lee SC, Song KJ, Ryoo HW, Ong MEH, McNally B, Bobrow B, Tanaka H, Myklebust H, Birkenes TS. Effect of dispatcher-assisted cardiopulmonary resuscitation program and location of out-of-hospital cardiac arrest on survival and neurologic outcome. *Ann Emerg Med*. 2017;69:52–61.e1. doi: 10.1016/j.annemergmed.2016.07.028
33. Callaway CW, Soar J, Aibiki M, Böttiger BW, Brooks SC, Deakin CD, Donnino MW, Drajer S, Kloeck W, Morley PT, et al; on behalf of the Advanced Life Support Chapter Collaborators. Part 4: advanced life support: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation*. 2015;132(suppl 1):S84–S145. doi: 10.1161/CIR.0000000000000273
34. Soar J, Callaway CW, Aibiki M, Böttiger BW, Brooks SC, Deakin CD, Donnino MW, Drajer S, Kloeck W, Morley PT, et al; on behalf of the Advanced Life Support Chapter Collaborators. Part 4: advanced life support: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation*. 2015;95:e71–e120. doi: 10.1016/j.resuscitation.2015.07.042
35. Patterson T, Perkins GD, Joseph J, Wilson K, Van Dyck L, Robertson S, Nguyen H, McConkey H, Whittbread M, Fothergill R, et al. A Randomised trial of Expedited transfer to a cardiac arrest centre for non-ST elevation ventricular fibrillation out-of-hospital cardiac arrest: the ARREST pilot randomised trial. *Resuscitation*. 2017;115:185–191. doi: 10.1016/j.resuscitation.2017.01.020
36. Matsuyama T, Kiyohara K, Kitamura T, Nishiyama C, Nishiuchi T, Hayashi Y, Kawamura T, Ohta B, Iwami T. Hospital characteristics and favourable neurological outcome among patients with out-of-hospital cardiac arrest in Osaka, Japan. *Resuscitation*. 2017;110:146–153. doi: 10.1016/j.resuscitation.2016.11.009
37. Tagami T, Hirata K, Takeshige T, Matsui J, Takinami M, Satake M, Satake S, Yui T, Itabashi K, Sakata T, et al. Implementation of the fifth link of the chain of survival concept for out-of-hospital cardiac arrest. *Circulation*. 2012;126:589–597. doi: 10.1161/CIRCULATIONAHA.111.086173
38. Seiner J, Polasek R, Lejsek J, Strycek M, Karasek J. Cardiac arrest center: one-year experience of the Regional Hospital Liberec. *Cor et Vasa*. 2018;60:e234–e238.
39. Kragholm K, Malta Hansen C, Dupre ME, Xian Y, Strauss B, Tyson C, Monk L, Corbett C, Fordyce CB, Pearson DA, et al. Direct transport to a percutaneous cardiac intervention center and outcomes in patients with out-of-hospital cardiac arrest. *Circ Cardiovasc Qual Outcomes*. 2017;10:e003414. doi: 10.1161/CIRCOUTCOMES.116.003414
40. Spaite DW, Bobrow BJ, Stolz U, Berg RA, Sanders AB, Kern KB, Chikani V, Humble W, Mullins T, Stapczynski JS, et al; Arizona Cardiac Receiving Center Consortium. Statewide regionalization of postarrest care for out-of-hospital cardiac arrest: association with survival and neurologic outcome. *Ann Emerg Med*. 2014;64:496–506.e1. doi: 10.1016/j.annemergmed.2014.05.028
41. Couper K, Kimani PK, Gale CP, Quinn T, Squire IB, Marshall A, Black JJM, Cooke MW, Ewings B, Long J, et al. Patient, health service factors and variation in mortality following resuscitated out-of-hospital cardiac arrest in acute coronary syndrome: analysis of the Myocardial Ischaemia National Audit Project. *Resuscitation*. 2018;124:49–57. doi: 10.1016/j.resuscitation.2018.01.011
42. Søholm H, Kjaergaard J, Bro-Jeppesen J, Hartvig-Thomsen J, Lippert F, Køber L, Nielsen N, Engsig M, Steensen M, Wanscher M, et al. Prognostic implications of level-of-care at tertiary heart centers compared with other hospitals after resuscitation from out-of-hospital cardiac arrest. *Circ Cardiovasc Qual Outcomes*. 2015;8:268–276. doi: 10.1161/CIRCOUTCOMES.115.001767
43. Harnod D, Ma MHM, Chang WH, Chang RE, Chang CH. Mortality factors in out-of-hospital cardiac arrest patients: a nationwide population-based study in Taiwan. *Int J Gerontol*. 2013;7:216–220.
44. Søholm H, Wachtell K, Nielsen SL, Bro-Jeppesen J, Pedersen F, Wanscher M, Boesgaard S, Møller JE, Hassager C, Kjaergaard J. Tertiary centres have improved survival compared to other hospitals in the Copenhagen area after out-of-hospital cardiac arrest. *Resuscitation*. 2013;84:162–167. doi: 10.1016/j.resuscitation.2012.06.029
45. Elmer J, Rittenberger JC, Coppler PJ, Guyette FX, Doshi AA, Callaway CW; Pittsburgh Post-Cardiac Arrest Service. Long-term survival benefit from treatment at a specialty center after cardiac arrest. *Resuscitation*. 2016;108:48–53. doi: 10.1016/j.resuscitation.2016.09.008
46. Tranberg T, Lippert FK, Christensen EF, Stengaard C, Hjort J, Lassen JF, Petersen F, Jensen JS, Bäck C, Jensen LO, et al. Distance to invasive heart centre, performance of acute coronary angiography, and angioplasty and associated outcome in out-of-hospital cardiac arrest: a nationwide study. *Eur Heart J*. 2017;38:1645–1652. doi: 10.1093/eurheartj/ehx104
47. Cournoyer A, Notebaert É, de Montigny L, Ross D, Cossette S, Londei-Leduc L, Iseppon M, Lamarche Y, Sokoloff C, Potter BJ, et al. Impact of the direct transfer to percutaneous coronary intervention-capable hospitals on survival to hospital discharge for patients with out-of-hospital cardiac arrest. *Resuscitation*. 2018;125:28–33. doi: 10.1016/j.resuscitation.2018.01.048
48. Lick CJ, Aufderheide TP, Niskanen RA, Steinkamp JE, Davis SP, Nygaard SD, Bemenderfer KK, Gonzales L, Kalla JA, Wald SK, et al. Take Heart America: a comprehensive, community-wide, systems-based approach to the treatment of cardiac arrest. *Crit Care Med*. 2011;39:26–33. doi: 10.1097/CCM.0b013e3181fa7ce4
49. Stub D, Smith K, Bray JE, Bernard S, Duffy SJ, Kaye DM. Hospital characteristics are associated with patient outcomes following out-of-hospital cardiac arrest. *Heart*. 2011;97:1489–1494. doi: 10.1136/hrt.2011.226431

50. Chocron R, Bougouin W, Beganton F, Juvin P, Loeb T, Adnet F, Lecarpentier E, Lamhaut L, Jost D, Marijon E, et al. Are characteristics of hospitals associated with outcome after cardiac arrest? Insights from the Great Paris registry. *Resuscitation*. 2017;118:63–69. doi: 10.1016/j.resuscitation.2017.06.019
51. Lai CY, Lin FH, Chu H, Ku CH, Tsai SH, Chung CH, Chien WC, Wu CH, Chu CM, Chang CW. Survival factors of hospitalized out-of-hospital cardiac arrest patients in Taiwan: a retrospective study. *PLoS One*. 2018;13:e0191954. doi: 10.1371/journal.pone.0191954
52. McKenzie N, Williams TA, Ho KM, Inoue M, Bailey P, Celenza A, Fatovich D, Jenkins I, Finn J. Direct transport to a PCI-capable hospital is associated with improved survival after adult out-of-hospital cardiac arrest of medical aetiology. *Resuscitation*. 2018;128:76–82. doi: 10.1016/j.resuscitation.2018.04.039
53. Mumma BE, Diercks DB, Wilson MD, Holmes JF. Association between treatment at an ST-segment elevation myocardial infarction center and neurologic recovery after out-of-hospital cardiac arrest. *Am Heart J*. 2015;170:516–523. doi: 10.1016/j.ahj.2015.05.020