CoSTR

2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations

Executive Summary

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Introduction

The International Liaison Committee on Resuscitation (ILCOR) was formed in 1992 with the goal of creating global consensus on evidence-based emergency cardiovascular care, cardiopulmonary resuscitation (CPR), and first aid, providing a resource for regional councils crafting clinical guidelines. ILCOR currently includes representatives from the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, the Australia and New Zealand Committee on Resuscitation, the Resuscitation Council of Southern Africa, the InterAmerican Heart Foundation, the Resuscitation Council of Asia, and the Indian Resuscitation Council Federation, also benefitting from a collaboration with the International Federation of Red Cross and Red Crescent Societies. ILCOR's vision is to save more lives globally through resuscitation, and the ILCOR mission is to promote, disseminate, and advocate international implementation of evidence-informed resuscitation and first aid, using transparent evaluation and consensus summary of scientific data.

Resuscitation includes all responses necessary to treat sudden life-threatening events affecting the cardiovascular and respiratory systems, with a focus on sudden cardiac arrest. For newborns, there is also a focus on prevention of cardiac arrest by promoting initial lung aeration and other critical adaptations to extrauterine life. First aid is also included as it encompasses a wide range of treatment, including potentially lifesaving interventions that can be delivered by lay rescuers.

ILCOR work is divided into 6 task forces: Basic Life Support (BLS); Advanced Life Support (ALS); Pediatric Life Support (PLS); Neonatal Life Support (NLS); Education, Implementation, and Teams (EIT); and First Aid. This *2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations* (CoSTR) includes separate publications from each of the 6 task forces, this Executive Summary, and a publication detailing the evidence evaluation process and management of potential conflicts of interest. The task force papers detail work completed in the past year. They also summarize topics reviewed since 2020 to provide a comprehensive 5-year update. This Executive Summary summarizes select topics each task force wanted to highlight as being of particular interest. Not all relevant references are cited here, although studies are cited when discussed individually; refer to each task force publication in this issue for details of each of the reviews and task force deliberations and citations for all individual studies included in the reviews. The task force papers provide additional information on these and many other important topics. Because the task force papers are also summaries of a large body of work and must be concise, readers are directed to the full online versions and to published systematic reviews (SysRevs) when available.

Selected Highlights Since 2020

Basic Life Support

A new recommendation suggests that CPR techniques do not need to be modified in obese people. Dispatcher-assisted automated external defibrillator (AED) retrieval and use is supported, while possible negative consequences are also discussed. The avoidance of locks, or the use of clear instructions for unlocking cabinets, for public access AEDs is encouraged. Prior recommendations on topics including use of a firm surface for CPR, resuscitation of a drowning person, and pad size and placement for defibrillation have been updated. Head-up CPR continues to be discouraged except in the context of research. The importance of providing training in defibrillation of women, including pad placement around breast tissue, is emphasized, and the task force states that repositioning a bra rather than removing it may be adequate, as long as defibrillation pads are placed on bare skin.

Advanced Life Support

Recommendations for postcardiac arrest temperature control changed in 2022 a normothermic target of ≤37.5° C is now suggested. Treatment with insulin and glucose is newly suggested for cardiac arrest caused by hyperkalemia, while the evidence for calcium or bicarbonate in cardiac arrest from hyperkalemia is insufficient to support a recommendation. Several recommendations address prognostication of favorable neurological outcome after cardiac arrest, adding to existing guidance on the prognostication of poor outcome. Double sequential external defibrillation or vector change defibrillation are now suggested for ventricular fibrillation refractory to 3 consecutive shocks. The task force continues to suggest not routinely using mechanical CPR devices, while acknowledging their utility in specific situations. Extracorporeal CPR is similarly not suggested for routine use but may be considered in select patients when conventional CPR is failing, in settings where this can be implemented. The intravenous route continues to be preferred instead of the intraosseous route as the initial access attempt during CPR.

Pediatric Life Support

The PLS Task Force has added specific diastolic blood pressure targets during CPR for infants <1 year and for children 1 to 18 years with invasive blood pressure monitoring in place at the time of cardiac arrest. A good practice statement states that either a compression-first or ventilation-first approach for starting CPR in children is reasonable, with another good practice statement instructing rescuers to start CPR for any unresponsive child not breathing and without signs of life, without attempting a pulse check first. Several new recommendations for the use of clinical exam, biomarkers, imaging, and electroencephalography were created in 2023, with new recommendations for prediction of poor neurological outcome updated in 2025.

Neonatal Life Support

The NLS Task Force provides updated recommendations for cord management for preterm and term infants that support deferring cord clamping for at least 60 seconds in vigorous infants of all gestational ages, and for all infants ≥28 weeks, milking of the intact umbilical cord in circumstances where deferred cord clamping is precluded. Support for supraglottic airway devices as an alternative to face mask ventilation or tracheal intubation continues, and they are now also suggested during chest compressions, in a good practice statement. While the recommendation continues to be that preterm infants have resuscitation initiated with a fraction of inspired oxygen (F_{IO_2}) of ≥0.3 and term infants with 0.21, the recommendation against starting resuscitation with an F_{IO_2} of 1.0 for term and late preterm infants has been withdrawn.

Education, Implementation, and Teams

The EIT Task Force now suggests that prehospital critical care teams attend out-of-hospital cardiac arrest events where emergency medical services (EMS) systems have sufficient resources. There is sufficient evidence that patient outcomes improve when a team member has attended an accredited CPR course. Resuscitation training should be adapted to the needs of special populations, and family presence during CPR helps cosurvivors cope with the impact of the situation, but resuscitation teams and families need proper care when families are present at these events. The use of feedback devices during training is strongly recommended. Debriefing after clinical resuscitation and CPR coaching are helpful interventions. In situ CPR training and gamified learning improves learning. Augmented reality might support CPR training, but no evidence was found for virtual reality applications. No new evidence was found on clinical decision rules to facilitate in-hospital decisions on do-not-attempt resuscitation orders.

First Aid

The First Aid Task Force now suggests manual uterine massage immediately after birth in the first aid setting to prevent postpartum hemorrhage. For first aid providers trained in the use of supplemental oxygen, titration of oxygen to a peripheral blood oxygen saturation of 88% to 92% is suggested for patients who report a history of chronic obstructive pulmonary disease. For people assisting someone who is choking, the task force recommends an escalating strategy of encouraging cough and then using back slaps, and using abdominal thrusts if back slaps are ineffective. To improve the chances of successful replantation of an amputated or avulsed body part, the task force recommends wrapping the body part in a moist cloth and plastic bag and then cooling it.

BASIC LIFE SUPPORT

Head-Up CPR

Although head-up CPR (slight elevation of the head and torso of the patient while performing CPR) is not in widespread use, it has garnered significant attention over the past several years and is used by some EMS systems for out-of-hospital cardiac arrest (OHCA). The BLS Task Force conducted a SysRev of this topic in 2021, at which point a single pre-post study was identified.[1] In that study, outcomes when supine CPR—with a mechanical CPR device—was standard practice were compared with outcomes after a new bundle was implemented. This bundle included (1) applied oxygen but deferred positive-pressure ventilation for several minutes, (2) a pit crew approach for rapid mechanical CPR device placement, and (3) elevation of the patient's head and torso by approximately 20°. While that study reported increased event survival with the head-up CPR bundle, there was no improvement in favorable neurological outcome at hospital discharge, and the task force concluded that this practice should be used only in the context of research, including clinical trials. In the 2025 SysRev, 2 more studies were identified, both of which compared patients in a registry of those receiving head-up CPR with patients from past clinical trials in which supine CPR was used.[2,3] One of these trials found no significant difference in return of spontaneous circulation (ROSC), survival, or neurological outcome.[2] The other found no improvement in ROSC, but more survival and favorable neurological outcome at hospital discharge with the head-up CPR bundle.[3] The head-up CPR intervention uses an automated device that gradually elevates the patient's head and torso during CPR. Based on the inconsistent findings and the concern about bias in the available studies (pre-post studies, in some cases with the supine CPR group having their event several years before), the recommendation continues to be that this intervention be used only in the context of research until its effects are clarified.

Optimization of Dispatcher-Assisted Recognition, CPR, and Automated External Defibrillator Retrieval and Use

Dispatchers play a vital role in resuscitation for OHCA, both in helping a caller recognize that someone is in cardiac arrest and in coaching them to start CPR. ILCOR has not previously reviewed how to optimize these key dispatcher roles, and this prompted the BLS Task Force to undertake Scoping reviews (ScopRevs) on the topics of dispatcher-assisted recognition of cardiac arrest, dispatcher-assisted CPR, and dispatcher-assisted AED retrieval and use. The ScopRevs were initially done for the 2024 CoSTR summary[4,5] and were updated with evidence updates (EvUps) for 2025.

Dispatcher-Assisted Recognition of Cardiac Arrest

Evidence consists mostly of observational studies that document the percentage of cardiac arrest cases that are recognized as such by dispatchers, and what factors are associated with successful recognition. Determining whether a patient is breathing normally, with agonal breathing being a key indicator of the likely presence of cardiac arrest, continues to be a key challenge for dispatchers. Various strategies to determine if someone is breathing normally have been evaluated (although not in randomized trials); thus far, none appear more effective than the often-used 2-question strategy (ie, “Is the person conscious?” and “Are they breathing normally?”).[6]

Dispatcher-Assisted CPR

Dispatcher-assisted CPR instructions are currently recommended, but the most effective way to do this is not known. Multiple strategies have been investigated to optimize dispatcher-assisted CPR, but several of these (eg, metronome use, use of prerecorded instructions, inclusion of instructions to undress the patient) have too few published studies to support a recommendation. Studies focusing on simplifying the language used to coach CPR (eg, "Push as hard as you can") and those using video calls to enable direct feedback on CPR performance found a suggestion of improvement in hand positioning and compression depth and rate.[7,8]

Dispatcher-Assisted AED Retrieval and Use

Dispatcher-assisted AED retrieval and use have become more common, but the evidence consists mostly of observational and simulation studies. Findings are somewhat inconsistent, with some reporting that rescuers are more likely to retrieve and use an AED if dispatchers include instructions on retrieval or that dispatcher instructions helped rescuers use AEDs properly, while other studies found that dispatcher instructions on AED use sometimes confused rescuers and potentially delayed use. The task force decided to make good practice statements on this topic in 2024 because of the need for guidance around this increasingly common practice. The task force states that dispatchers should ask if an AED is present in the immediate vicinity; if not, and there is more than 1 rescuer, they should offer instruction on how to find the nearest one. They should also provide instructions on AED use once it is present.[9]

Drone AED Delivery

The use of drones to deliver AEDs was first evaluated in a ScopRev[10,11] for the 2023 CoSTR summary,[12,13] and an EvUp was done for 2025. Several simulation studies and real-life feasibility studies have compared dispatched drones with a traditional EMS response. A prospective observational study included in the 2025 EvUp found that in the minority of 211 suspected OHCA cases in which a drone was dispatched at the same time as the traditional EMS response, a drone was successfully delivered 81% of the time, and the AED arrived earlier than EMS (by an average of 3 minutes) 67% of the time.[14] These findings were similar to a much smaller pilot study identified in the 2023 ScopRev.[15] The BLS Task Force concluded that there continues to be too little data to support a SysRev or good practice statement.

AED Accessibility: Locked Cabinets

The BLS Task Force reviewed the effect of locking cabinets that hold public access AEDs to ascertain if this delayed AED use in cases of OHCA, and to evaluate the actual occurrence of AED theft or damage.[16] Limited observational studies report that theft rates are low (<2%) and do not differ significantly between locked and unlocked cabinets. Simulation studies suggest that retrieval of an AED takes longer when a cabinet is locked. The BLS Task Force, therefore, made a good practice statement suggesting these cabinets not be locked. If they are locked, then instructions to unlock them must be clearly visible. They also emphasized that EMS should endeavor to return AEDs to the owner organization after use.[17]

Removal of Bra Before Defibrillation

The task force conducted a ScopRev on this topic for 2025 because bra removal for defibrillation has not been reviewed previously and there is a lack of clarity on best practice.[18] Some guidelines recommend bra removal for pad placement and defibrillation,[19] but this is not universal. Studies have also reported that women are less likely to receive CPR and defibrillation, and there is concern that reluctance to expose the female chest may be part of the reason.[20,21] The ScopRev identified very limited evidence from a single animal study and 2 simulation studies. No reports of harm to patient, rescuer, or defibrillator from defibrillation use with a bra in place were found, and the animal study using defibrillation with underwire in direct contact did not find any harm (abstract only).[22] A simulation study found that men were less likely to remove all clothing from female manikins than women were.[23] The task force issued good practice statements acknowledging that we don't know if it is better to remove the bra before defibrillation but that pads should be adhered to bare skin, and this can often be done with repositioning a bra rather than removing it. They also emphasized that CPR and defibrillation training should include female manikins and should address the topic of bra repositioning or removal.

Effectiveness of Ultraportable/Pocket AEDs

Ultraportable AEDs have become available, but there is a lack of evidence on how they perform in comparison with standard AEDs. A ScopRev of this new topic was initially included in the 2024 CoSTR summary.[4,5] The ScopRev identified no studies evaluating the effectiveness of these ultraportable devices, and the task force concluded that there is an urgent need for research assessing their effectiveness because they are already being marketed and sold to the public.[24,25]

CPR in Obese People

Obesity is increasing in prevalence globally, and whether the effects of obesity on chest wall compliance and impedance necessitate alterations in standard CPR protocols has not been reviewed. A ScopRev on this topic was, therefore, undertaken by the BLS Task Force for 2025, as a nodal review with involvement of the ALS, PLS, and EIT Task Forces.[26] Observational studies in adults were inconsistent in finding any relationship between obesity and cardiac arrest outcomes. Only 2 pediatric studies were found, and these both reported worse outcomes in children with obesity compared with normal-weight children. There were no studies investigating variations in CPR protocols in obese patients or differences in rescuer outcomes such as injuries related to performance of resuscitation. The limited data, with significant heterogeneity in definitions of obesity and in results, led the task force to conclude that there is currently no reason to deviate from standard CPR protocols when resuscitating obese patients.[27]

ADVANCED LIFE SUPPORT

Mechanical CPR

Mechanical CPR devices have been available for many years. This topic was last reviewed by ILCOR in 2015, at which time use of mechanical CPR was suggested only in situations in which manual CPR was not feasible or compromised rescuer safety (eg, in a procedural setting, prolonged resuscitation, for CPR during transport).[28,29] Use of mechanical

CPR devices increased during the COVID-19 pandemic and has remained more common than in prepandemic practice. This updated SysRev focused on randomized controlled trials (RCTs) only and identified 5 new trials since the 2015 review.[30-34] Unfortunately, the heterogeneity of available trials (in type of device, inclusion criteria, timing of mechanical CPR initiation, and variability in co-interventions) made meta-analyses inadvisable. However, most studies, including all large trials, have found no difference in outcomes between mechanical and manual CPR.[35] Potential delays in initial defibrillation with mechanical CPR use can be avoided by delaying setup of the device until after the first rhythm assessment and shock, if indicated. While these devices continue to be useful and reasonable alternatives for situations in which manual CPR is difficult or unsafe to continue, the ALS Task Force highlights that there is no evidence that mechanical CPR is superior to manual CPR.

Double Sequential External Defibrillation

Double sequential external defibrillation (DSED) was investigated in an RCT[36] published in 2022, and an updated SysRev was completed for the 2023 CoSTR summary.[12,13] In the cluster RCT , which included OHCA patients who remained in ventricular fibrillation after 3 consecutive shocks, more patients survived to hospital discharge in the DSED group compared with the standard defibrillation group (27.4% versus 11.2%; adjusted relative risk, 2.21; 95% CI, 1.26, 3.88). Survival with favorable neurological outcome and ROSC were also higher in the DSED group. A third group of patients were randomized to vector change defibrillation, in which the pads were changed from the anterolateral orientation to an anteroposterior orientation after 3 consecutive shocks. This group also had better survival to hospital discharge, but ROSC and survival with favorable neurological outcome were not significantly better compared with the standard defibrillation group.

This topic generated considerable discussion by the ALS Task Force. The trial had significant limitations and, because no comparison was done between DSED and vector change, no conclusions about one approach being superior to the other could be made. Either a DSED or a vector change strategy were suggested as reasonable considerations for refractory ventricular fibrillation arrest.[37]

Intravenous Versus Intraosseous Route for Initial Access Attempt

Intraosseous access devices have become popular recently and are used in both the out-of-hospital and in-hospital settings. They are promoted for their ability to help a rescuer gain vascular access quickly in emergencies such as cardiac arrest. The ALS Task Force updated the ILCOR SysRev on this topic in response to publication of 3 RCTs comparing initial intravenous (IV) attempts with initial intraosseous attempts for OHCA.[38-40] Meta-analysis of the 3 trials demonstrated no difference in survival or survival with favorable neurological outcome or ROSC at any time. The odds of sustained ROSC, an outcome reported in 2 of the RCTs, were slightly lower in the group randomized to initial intraosseous access (odds ratio, 0.89; 95% CI, 0.80–0.99).[41] Treatment recommendations continue to support IV as the initial route for access, with intraosseous as an alternative if IV access cannot be obtained quickly. Task force discussions included concerns about the widespread use of these devices, with the significantly higher cost compared with IVs and no evidence for benefit.

Treatment of Hyperkalemia

Standard treatment of life-threatening arrhythmias in the setting of hyperkalemia often involves administration of calcium, beta agonists, and high-dose insulin therapy, but the ALS and PLS Task Forces questioned whether these treatments were evidence based and completed a SysRev of studies assessing the effect of different treatments to lower potassium values acutely.[42,43] Interventions studied in this nodal review included salbutamol, insulin and glucose, insulin plus salbutamol, calcium, and sodium bicarbonate. Evidence identified was limited, all studies were small, and all but one were in non–cardiac arrest patients. Salbutamol and insulin plus glucose both appeared to lower potassium values. In a study of non–cardiac arrest patients, calcium did not affect electrocardiogram changes, and in a retrospective study of patients with cardiac arrest and hyperkalemia, absolute mortality was higher in the group receiving calcium. The task force discussed the important lack of data in the cardiac arrest population, and the lack of any evidence to support calcium for cardiac arrest in the setting of hyperkalemia, although this is recommended in some guidelines.[19] Recognizing the very low certainty of the evidence, the task force suggests insulin and glucose, salbutamol (inhaled or IV) or the combination of these therapies for hyperkalemia without cardiac arrest, and insulin and glucose for hyperkalemia with cardiac arrest. The evidence for calcium was considered insufficient to support a recommendation for or against. It is suggested that bicarbonate not be given in non–cardiac arrest patients with hyperkalemia, and there is insufficient evidence to recommend for or against in cardiac arrest.

Mechanical Circulatory Support After ROSC

This topic was prioritized because the task force was aware of randomized trials of mechanical circulatory support (MCS) for cardiogenic shock, some of which included large subgroups of patients with post–cardiac arrest cardiogenic shock. Fourteen trials reported survival outcomes and found no benefit from MCS for all cardiogenic shock patients included.[44-57] A subgroup of post–cardiac arrest patients from 6 of the included trials[46,48,49,52,55,56] similarly found no difference in 30-day survival with the use of MCS devices compared with standard care. One RCT included only patients with cardiogenic shock after in-hospital cardiac arrest and, again, found no difference in survival with the use of MCS.[49] Trials also found no difference in favorable neurological outcome. Post–cardiac arrest subgroup data were not available for neurological outcome. The lack of benefit led to a treatment recommendation suggesting that MCS not be used routinely for post–cardiac arrest cardiogenic shock, but the task force acknowledged that there may be groups of patients who benefit from MCS. Limited subgroup data suggest those with a Glasgow Coma Scale score >8 at hospital arrival with infarct-related cardiogenic shock,[49] patients with ST-segment myocardial infarction without prior resuscitation before arrival of EMS, and those with a short duration of cardiac arrest (<10 minutes) could be reasonable candiates.[58]

Pediatric Life Support

Prediction of Survival With Poor Neurological Outcome After Return of Circulation Following Pediatric Cardiac Arrest

The task force conducted a 2-part SysRev on prognostication of neurological outcome in children after cardiac arrest. Prognostication of good outcome was included in the 2023 CoSTR summary,[12,13] and prognostication of poor outcome was included for 2025. For poor outcome, the false-positive rate was required to be <1% (corresponding to a specificity of 99%) for a test to be considered precise and reliable enough, prioritizing avoiding discontinuation of life-sustaining therapy in patients who could have had a good outcome. Tools for prognostication were broken down into categories that were reviewed separately, including biomarkers, clinical exam, neuroimaging, and electrophysiology testing. In all categories, the importance of using multiple tests in combination when prognosticating neurological outcome was emphasized.

Biomarkers

Limited evidence was from studies not primarily designed for testing biomarkers for prognostication. Lactate was not found to be a reliable biomarker for poor outcome, so the task force suggested not using it for this purpose, and the evidence for other biomarkers was insufficient to support a recommendation.

Clinical Exam

Absence of the pupillary light reflex before 24 hours was not a reliable prognostic test. At 48 and 72 hours after return of circulation, the false-positive rate was <1% but 95% CIs were wide. Glasgow Coma Scale score, including the total score and the motor score, was also not a reliable predictor of outcome. The task force suggests not using pupillary light response or Glasgow Coma Scale score at 24 hours, but that lack of pupillary light response at 48 to 72 hours may be considered as part of multimodal prognostication of poor outcome.

Electroencephalogram

Evidence for electroencephalogram is limited by the few studies, small sample sizes, and heterogeneity across studies, including in timing and methods of interpretation of electroencephalograms. Blinding was also rarely present. The presence of seizures on electroencephalogram was not a reliable predictor of poor outcome. Absence of normal background, sleep architecture or sleep spindles, and reactivity were also not reliable. Status epilepticus, burst suppression, burst attenuation, or generalized periodic epileptiform discharges between 4 to 72 hours and myoclonic status had much lower false-positive rates and were considered moderately reliable tests. Somatosensory evoked potential (bilaterally absent N20 waves) had a false-positive rate of 0%, but there was only 1 small study. The task force suggested that status epilepticus or a background pattern of burst suppression, burst attenuation, or generalized periodic epileptiform discharges could be useful as one part of multimodal prognostication.

Imaging

Loss of gray-white matter differentiation on a head computed tomography scan at 24 hours and magnetic resonance imaging apparent diffusion coefficient threshold $<650 \times 10^{-6}$ mm^2/s in ≥10% of brain volume (indicating high ischemic burden), at a median of 4 days after return of circulation, were found to be moderately reliable tests. The task force suggested that these findings on a computed tomography scan within 24 hours or magnetic resonance imaging at 72 hours or more after return of circulation could be useful as one component of multimodal prognostication.

Airway, Breathing, Compressions Versus Compressions, Airway, Breathing: Order of Ventilation and Compression

Many adult algorithms now begin resuscitation with compression instead of airway and ventilations. The task force undertook this SysRev as a nodal review with the BLS Task Force because the merits of starting with ventilations in children were uncertain. This was last reviewed for the 2019 CoSTR summary.[59,60] Only 5 manikin studies were identified. Findings suggested that time to chest compressions was shorter with the compressions-airway-breathing approach, and chest compression fraction was higher. Time to ventilation was about 6 seconds faster with the airway-breathing-compressions approach in one study. Indirect evidence from before and after OHCA registry studies in adults suggests that switching from the airway-breathing-circulation to the circulation-airway-breathing approach may increase rates of bystander CPR[61] and improved patient outcomes.[61-63] Similar data on in-hospital cardiac arrest show conflicting evidence for patient outcomes.[64,65] One large registry study from Japan demonstrated increased bystander CPR rates in children with bystander-witnessed OHCA after compression-only CPR was introduced.[66] The task force concluded that there is insufficient evidence to make a recommendation about the optimal order of resuscitation. Both airway-breathing-compressions and compressions-airway-breathing approaches are reasonable, and both compressions and ventilations are important components of pediatric resuscitation.

Blood Pressure Monitoring and Targets During Pediatric In-Hospital Cardiac Arrest

When children have intra-arterial catheters in place, invasive hemodynamic data may provide information about the quality of chest compressions during cardiac arrest.[67] In this updated SysRev, 5 observational cohort studies were included.[68-72] Three were analyses of the same cohort (Pediatric Intensive Care Quality of CPR study) but examined different subpopulations or different outcomes.[69,71,72] Two studies of children with in-hospital cardiac arrest and arterial lines in place[68,69] found that exposure to a diastolic blood pressure of ≥25 mm Hg for infants <1 year and ≥30 mm Hg for children ≥1 year for the first 10 minutes of CPR was associated with obtaining ROSC, when compared with a lower diastolic blood pressure. Using the same cutoffs, a single study found that the higher diastolic blood pressure was associated with hospital survival in children with surgical cardiac disease (n=88) but not in those with medical cardiac disease (n=24).[72] Systolic blood pressure during CPR was not found to be associated with outcomes.

While evidence is limited and of very low certainty, and arterial lines are used only in high-resource settings, the task force concluded there was sufficient evidence to issue a weak recommendation suggesting targeting an intra-arrest diastolic blood pressure of ≥25 mm Hg for infants <1 year and ≥30 mm Hg for children 1 to 18 years with invasive blood pressure monitoring in place at the time of cardiac arrest.

Pulse Check Accuracy in Children During Resuscitation

Guidelines recommend a manual pulse check during rhythm analyses to detect ROSC, with different anatomical sites for different age groups.[73] With the increasing availability of ultrasound and arterial lines, the PLS Task Force prioritized this topic and conducted the first SysRev, expanding on a previous EvUp in 2023.[13] Three studies were identified, including 39 patients and 376 pulse checks.[74-76] Two of these studies assessed clinicians' ability to accurately palpate a pulse for children with left ventricular assist devices or on extracorporeal membrane oxygenation but without cardiac arrest. Sensitivity of pulse checks ranged from 76% to 100% in those studies, and specificity 64% to 79%.[74,75] In one of these studies,[75] only 39% (60/153) of participants decided on the presence of a pulse within 10 seconds, and determining whether a pulse was present took a median of 18 seconds. The third study was a series of cases in which an ultrasound was used during pulse checks, and duration of pulse checks was not reported.[76] The task force reinforced a prior recommendation stating that pulse checks are not reliable. Based on the lack of evidence supporting it, a prior recommendation to begin CPR unless a pulse is palpated within 10 seconds was withdrawn and then replaced with a new good practice statement that rescuers should start CPR for any unresponsive child who is not breathing and does not have signs of life.

NEONATAL LIFE SUPPORT

Umbilical Cord Management

Since 2020, the NLS Task Force has reviewed the evidence for umbilical cord management for vigorous term and late-preterm infants (SysRev 2021, EvUp 2025),[77-79] preterm infants (SysRev 2021 and SysRev Adolopment 2024, EvUp 2025),[4,5,77,78,80] and nonvigorous term and late preterm infants (SysRev 2025). In 2021 and 2024, SysRevs found that deferred cord clamping (for at least 60 seconds) reduced mortality and transfusion requirements for preterm infants and reduced later iron deficiency and anemia for late preterm and term infants. The 2024 SysRev for preterm infants incorporated adolopment to include the results of a large, comprehensive meta-analysis that used individual patient data,[81] enabling greater precision of estimates of outcomes than a study-level meta-analysis. Members of the task force worked with the individual patient data study team to ensure that the study addressed ILCOR population, intervention, comparator, and outcome questions. This review also concluded that for infants for whom deferred cord clamping was not feasible for either infant or maternal reasons, umbilical cord milking was a reasonable option for improving hematologic outcomes in infants ≥28 weeks' gestation, though for infants <28 weeks' gestation, it should not be used because of increased risk of intraventricular hemorrhage. Umbilical cord milking may reduce the occurrence of hypoxic ischemic encephalopathy in nonvigorous, late preterm and term infants.

Together, these reviews suggest a simplified approach to clinical practice, where deferred cord clamping ≥60 seconds is the preferred option for all infants who are vigorous at birth, to prevent mortality in very preterm infants and to improve hematologic outcomes in those who are more mature. There remain some cases in which deferred cord clamping is not feasible, for maternal or infant reasons, including circumstances in which the baby remains nonvigorous despite tactile stimulation. For those who are not vigorous but ≥28 weeks, milking the intact umbilical cord is now the suggested option to improve hematologic outcomes for all and to reduce hypoxic ischemic encephalopathy in late preterm and term infants. Other methods of umbilical cord management also deserve further research.

Supraglottic Airway Devices During Neonatal Resuscitation

For 2025, the NLS Task Force completed a ScopRev on the use of supraglottic airways during chest compressions. EvUps were done on the topics of supraglottic airways as an alternative to face-mask ventilation and as an alternative to tracheal intubation. Together, these reviews support that supraglottic airway devices should be considered as an alternative to face masks or tracheal tubes for providing positive-pressure ventilation, especially when an infant's condition is not improving despite face-mask ventilation and where there is nobody immediately available who can intubate, or where intubation is not successful (low- to very low–certainty evidence for each comparison). The ScopRev supports that this should include infants who are receiving chest compressions. Until recently, the devices available have only been suitable for infants ≥34 weeks' gestation and ,therefore, they are the only group represented in clinical trials. However, newer devices may be suitable for smaller infants.

Oxygen Concentration for Commencing Resuscitation

Oxygen concentration to be used when commencing resuscitation was reviewed with a SysRev for preterm infants for 2025, and an EvUp of studies on term infants was completed for 2025. In 2019, when both topics were reviewed previously, the task force concluded that an FIO_2 of 0.21 was preferrable for commencing resuscitation in term infants, or 0.21 to 0.3 for preterm infants <35 weeks' gestation. An individual patient network meta-analysis for preterm infants <32 weeks' gestation (NetMotion) cast doubt on the previous review's findings, suggesting that a concentration of 0.9 to 1.0 resulted in the best survival.[82] An updated NLS Task Force SysRev, which evaluated all available RCTs in a study-level analysis and considered the results of NetMotion by adolopment, concluded that all the evidence relating to mortality was of very low certainty, that benefit or harm could not be excluded for any other critical or important outcome, and that current and future large multicenter trials were needed to define the optimal oxygen concentration for commencing resuscitation. Meanwhile the use of an FIO_2 ≥0.30 is suggested for preterm infants, and 0.21 remains the recommendation for term infants, although the task force plans to update both reviews as further evidence becomes available. The task force has withdrawn the recommendation against FIO_2 1.0 for term infants, after concluding that contemporary Grading of Recommendations Assessment, Development, and Evaluation would result in an insufficient certainty of evidence for that recommendation.

Video Laryngoscopes

This 2025 SysRev found evidence that video laryngoscopes improve the intubation success rate for both first attempts and overall, although most studies included mostly inexperienced clinicians, and the benefits may be fewer in those who are already experienced in intubation. The NLS Task Force suggests video laryngoscopes be used for initial intubation attempts where resources allow, especially where less-experienced clinicians may be intubating, although traditional laryngoscopes are more widely available and must be available as a backup device.

EDUCATION, IMPLEMENTATION, AND TEAMS

Debriefing of Clinical Resuscitation Performance

Debriefing strategies are used widely to improve CPR team performance and optimize delivery of care. However, there are few data showing the effect on patient outcomes or whether there are negative aspects to debriefing (eg, cost, emotional impact on professionals). The topic was last reviewed in 2020, but this included a mixture of resuscitation and trauma studies.[83,84] The EIT Task Force undertook a new SysRev on debriefing that included only resuscitation studies in adults, children, and neonates and that sought clinical and patient outcomes. Ten observational studies (6 in adults,[85-90] 3 in neonates,[91-93] and 1 in children[94]) were identified, and these included a wide range of interventions: postresuscitation debriefing[85]; audiovisual feedback plus weekly postevent debriefings[86]; short individual oral debriefing[87]; hot or cold debriefings[88]; weekly debriefing sessions with audiovisual feedback during cardiac arrests[89]; an after-training workshop with debriefing[91]; video-assisted, performance-focused debriefings[93]; positive-pressure ventilation refresher and performance debriefing[92]; and postresuscitation interdisciplinary team debriefings.[94] Some studies showed no effect following postresuscitation debriefing while others showed an association with improvements in several outcomes, such as favorable neurological outcome, survival to discharge, ROSC, chest compression depth, chest compression rate, chest compression fraction, and adherence to guidelines. Given the lack of RCTs comparing debriefing with no debriefing after CPR, the task force noted a serious risk of bias in these studies. There are also no data on the cost-effectiveness of postevent debriefing or on the effect of postevent debriefings in low-resource settings. Despite these limitations, the findings underpinned a new treatment recommendation: We suggest performing postevent debriefing after adult, pediatric, and neonatal cardiac arrest in all settings (weak recommendation, very low–certainty evidence).

Prehospital Critical Care for OHCA

In many countries, prehospital critical care teams are being implemented as part of a tiered EMS response.[95-97] The teams comprise specialists in the care of critically ill patients requiring resuscitation,[98] and they have competencies in ALS beyond that of standard EMS teams.[99] The EIT Task Force undertook a SysRev to determine the impact of prehospital critical care teams on clinical outcomes among adults and children after OHCA. Fifteen observational studies were identified.[95-109] Pooled results from these studies showed an association between prehospital critical care teams and higher rates of ROSC, survival to discharge, survival to 30 days, and favorable neurological outcome at 30 days. The EIT Task Force recommended that prehospital critical care teams attend adults with nontraumatic

OHCA within EMS systems with sufficient resource infrastructure (weak recommendation, low-certainty evidence) and suggested that prehospital critical care teams attend children with OHCA within EMS systems with sufficient resource infrastructure (weak recommendation, very low–certainty evidence). Implementing prehospital critical care services will incur additional resources, training, and EMS infrastructure costs, which may not be feasible in some health care systems. The optimal composition of prehospital critical care teams has yet to be determined.

CPR Coaching During Adult and Pediatric Cardiac Arrest

It is well recognized that adherence to guidelines is poor during CPR. A resuscitation team member whose primary responsibility is to provide real-time coaching on resuscitation quality, known as a *CPR Coach*, may improve compliance with CPR guidelines. To investigate this, the EIT Task Force undertook a SysRev focusing on coaching in which the coach is an active resuscitation team member. Of the 7 studies identified, one investigated use of CPR Coaches in a clinical setting,[110] and 6 were simulation studies—although 5 of these were based on the same RCT.[111-116] In general, the use of a CPR Coach was associated with improved CPR performance, and the EIT Task Force recommended considering the inclusion of a CPR Coach as a member of the resuscitation team during cardiac arrest resuscitation in settings with adequate staffing (weak recommendation, very low–certainty evidence). The effect of CPR Coaches in the setting of real cardiac arrests and their effect on patient survival remains unknown.

CPR Feedback Device Use in Resuscitation Training

Use of CPR feedback devices during resuscitation skills training may improve CPR skill acquisition and retention, but the results of studies are inconsistent. The use of CPR feedback devices during resuscitation courses is increasing and, although this topic was reviewed in the 2020 CoSTR,[83,84] the EIT Task Force considered it important to undertake an updated SysRev and included only RCTs. Twenty relevant studies were identified, 3 involving lay providers[117-119] and 17 in health care professionals.[120-136] Use of CPR feedback devices improved compliance with current guidelines among health care professionals and laypersons with respect to compression depth and compression rate. Use of CPR feedback devices also improved chest recoil among health care professionals but not in laypersons. No undesirable effects were detected in the review, feedback devices are well accepted, and their cost is relatively low. Based on these data, the EIT Task Force recommended the use of CPR feedback devices during resuscitation training for health care professionals and lay providers (strong recommendation, moderate-certainty evidence). The impact on patient outcomes of improved CPR skills from training with feedback devices remains a major knowledge gap.

In Situ (at the Workplace) Simulation-Based CPR Training

Training using simulation is traditionally undertaken in the classroom setting, but moving such training to clinical areas may improve fidelity and provide a better test of organizational processes. The EIT Task Force completed a SysRev comparing in situ simulation CPR training with traditional training. Nine studies were identified: 4 studies in adults,[137-140] 3 in children,[141-143] and 2 in neonates.[144,145] One prospective observational study with historical controls documented an association between the in-situ simulation period and higher odds of survival to hospital discharge among children with cardiac arrest (odds ratio, 2.06; 95% CI, 1.02–4.25).[142] One observational study reported a lower incidence of neonatal asphyxia after a period of in-situ simulation training compared with a preintervention period of traditional training.[145] Three before-and-after observational studies[138,141,142] documented improvements in elements of clinical resuscitation performance following a period of in-situ CPR training, eg, reduced time to starting chest compressions, and reduced delay to defibrillation. Four RCTs[143,139,144,140] and 1 observational study[137] documented improvements in resuscitation performance with in-situ simulation training compared with traditional training. Based on these improvements across several outcomes, the EIT Task Force recommended that in-situ simulation may be considered as an option for CPR training where resources are readily available (weak recommendation, very low–certainty evidence). The resources required for implementation of in-situ simulation training and its feasibility in low- and middle-income countries are knowledge gaps.

FIRST AID

Foreign-Body Airway Obstruction

This topic was last reviewed for the 2020 CoSTR.[146,147] An EvUp identified 17 new studies since the last review. In a retrospective study of 709 patients, abdominal thrusts as a first intervention was associated with lower odds of relief of the obstruction (odds ratio, 0.57; 95% CI, 0.39–0.62) and lower odds of survival to hospital discharge (odds ratio, 0.2; 95% CI, 0.07–0.59) compared with back blows as a first intervention.[148] Multiple publications were identified that reported on the safety and possible efficacy of several different airway clearance devices.[149-153] A registry study of 407 patients reported that bystanders attempted to clear the airway obstruction in 54% of cases and were successful in 48% of these attempts. Survival was significantly higher in patients for whom a bystander had attempted to clear the obstruction.[154] The task force continues to suggest back slaps as the first strategy for foreign-body airway obstruction removal, followed by abdominal thrusts if back slaps are unsuccessful.

Unintentional Injury From Laypersons Providing Chest Compressions to Patients Who Are Not in Cardiac Arrest

Lay rescuers may be hesitant to begin CPR because of concern for injuring a person, especially if they are uncertain about whether the person is truly in cardiac arrest. This topic was last reviewed for the 2020 CoSTR.[146,147,155] One new study was added to the 4 identified previously,[156-160] and these 5 studies included a total of 1031 patients who received CPR but were not in cardiac arrest. Of these people, 7 (0.7%) sustained a physical injury attributed to CPR, and an additional 24 (2%) had symptoms such as chest pain or discomfort. Based on this low injury rate and the lifesaving potential of CPR, the task force made a strong recommendation that lay rescuers start CPR in cases of presumed cardiac arrest without concerns for causing injury.

External Uterine Massage for Prevention of Postpartum Hemorrhage

Postpartum hemorrhage is a major cause of global morbidity and mortality, particularly in lower-resource settings where most birth attendants have limited professional health education and may be considered lay or first aid providers.[161] Many international guidelines and other knowledge syntheses recommend external uterine massage for the prevention and management of postpartum hemorrhage.[162-169] This simple and safe intervention may reduce morbidity and mortality, and the First Aid Task Force reviewed evidence for its provision by lay or first aid providers specifically, without advanced training. A single RCT[170] was identified, including 127 women who had recently given birth in Kenya and were advised to perform self-massage cued by an alarm every 15 minutes for the first 120 minutes after birth. The study reported better compliance with the intervention but a nonsignificant difference in blood loss and blood transfusion. Given the safety of this maneuver, the task force suggests manual uterine massage, including self-massage, to prevent postpartum hemorrhage in the immediate postpartum period.

Preservation of Amputated Body Parts

The First Aid Task Force recognizes that the top priority when approaching a patient with an amputated or avulsed body part is stopping the bleeding and resuscitating the patient. Retrieval and preservation of the amputated body part should not be overlooked, however, so that replantation can be attempted. This ScopRev identified evidence on methods of preserving avulsed or amputated body parts to maximize the chance of successful replantation. Most of the evidence came from case reports and case series, with some observational and experimental studies also identified.[171] More distal amputated parts (eg, digits) without skeletal muscle tolerate periods of ischemia without cold preservation up to 12 hours; cold preservation extends the tolerable ischemic time before successful replantation to

24 hours or more. Observational studies of major upper extremity amputations also support cold preservation, which may extend tolerable ischemia time from approximately 6 to 12 hours. The task force good practice statements suggest retrieving the body part and transporting it to the hospital as soon as possible and cooling it if feasible. This can be accomplished by wrapping the part in a moist clean cloth or gauze and sealing it in a watertight bag or container before cooling, avoiding freezing. A SysRev is planned.

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