Resuscitation 95 (2015) e147–e168

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Part 6: Pediatric basic life support and pediatric advanced life support 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations☆,☆☆

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ARTICLE INFO

Keywords:
Arrhythmia
Cardiopulmonary resuscitation
Pediatrics
Resuscitation

Introduction

The Pediatric Task Force reviewed all questions submitted by the International Liaison Committee on Resuscitation (ILCOR) member councils in 2010, reviewed all council training materials and resuscitation guidelines and algorithms, and conferred on recent areas of interest and controversy. We identified a few areas where there were key differences in council-specific guidelines based on historical recommendations, such as the A–B–C (Airway, Breathing, Circulation) versus C–A–B (Circulation, Airway, Breathing) sequence of provision of cardiopulmonary resuscitation (CPR), initial back blows versus abdominal thrusts for foreign-body airway obstruction, an upper limit for recommended chest compression rate, and initial defibrillation dose for shockable rhythms (2 versus $4\,\mathrm{J\,kg^{-1}}$). We produced a working list of prioritized questions and topics, which was adjusted with the advent of new research evidence. This led to a prioritized palate of 21 PICO (population, intervention, comparator, outcome) questions for ILCOR task force focus.

The 2015 process was supported by information specialists who performed in-depth systematic searches, liaising with pediatric content experts so that the most appropriate terms and outcomes and the most relevant publications were identified. Relevant adult literature was considered (extrapolated) in those PICO questions that overlapped with other task forces, or when there were insufficient pediatric data. In rare circumstances (in the absence of sufficient human data), appropriate animal studies were incorporated into reviews of the literature. However, these data were considered only when higher levels of evidence were not available and the topic was deemed critical.

When formulating the PICO questions, the task force felt it important to evaluate patient outcomes that extend beyond return of spontaneous circulation (ROSC) or discharge from the pediatric intensive care unit (PICU). In recognition that the measures must have meaning, not only to clinicians but also to parents and caregivers, longer-term outcomes at 30 days, 60 days, 180 days, and 1 year with favorable neurologic status were included in the relevant PICO questions.

Each task force performed a detailed systematic review based on the recommendations of the Institute of Medicine of the National Academies[1] and using the methodological approach proposed by the Grading of Recommendations, Assessment, Development,

☆ 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations.
☆☆ This article has been copublished in Circulation. This article has also been reprinted in *Pediatrics*.
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http://dx.doi.org/10.1016/j.resuscitation.2015.07.044

and Evaluation (GRADE) working group.[2] After identifying and prioritizing the questions to be addressed (by using the PICO format)[3] with the assistance of information specialists, a detailed search for relevant articles was performed in each of three online databases (PubMed, Embase, and the Cochrane Library).

By using detailed inclusion and exclusion criteria, articles were screened for further evaluation. The reviewers for each question created a reconciled risk-of-bias assessment for each of the included studies, using state-of-the-art tools: Cochrane for randomized controlled trials (RCTs),[4] Quality Assessment of Diagnostic Accuracy Studies (QUADAS)-2 for studies of diagnostic accuracy,[5] and GRADE for observational studies that inform both therapy and prognosis questions.[6]

GRADE evidence profile Tables [7] were then created to facilitate an evaluation of the evidence in support of each of the critical and important outcomes. The quality of the evidence (or confidence in the estimate of the effect) was categorized as high, moderate, low, or very low,[8] based on the study methodologies and the five core GRADE domains of risk of bias, inconsistency, indirectness, imprecision, and other considerations (including publication bias).[9]

These evidence profile tables were then used to create a written summary of evidence for each outcome (the consensus on science statements). Whenever possible, consensus-based treatment recommendations were then created. These recommendations (designated as strong or weak) were accompanied by an overall assessment of the evidence and a statement from the task force about the values and preferences that underlie the recommendations.

Further details of the methodology that underpinned the evidence evaluation process are found in "Part 2: Evidence evaluation and management of conflicts of interest."

The pediatric task force included several authors who had produced some of the most important primary work found in the literature. To ensure that there was transparency, and that there was not undue bias, the task force sought opinions as a whole with the interests of the involved author declared at the outset. At face-to-face meetings, this allowed for examination in detail of those papers, producing better understanding of the limitations and interpretation of the work of those authors. Consistent with the policies to manage potential conflicts of interest, participants in discussions with any potential conflicts abstained from any voting on the wording of the consensus on science or treatment recommendations.

External content experts attended the face-to-face meeting in February 2015 in Dallas (ILCOR 2015 International Consensus Conference on CPR and Emergency Cardiovascular Care Science With Treatment Recommendations), providing further independent review beyond that achieved by public consultation. This conference included representation from the World Health Organization (WHO) to add perspective on the global application of the guidelines. These collaborations enhanced participants' understanding of the variability of health care in resource-replete settings, with the realization that the "developed world" has certain parallels to resource-deplete settings. It was clearly understood that the economic classifications of "low-," "middle-," or "high-income country" are inadequate to explain the range of health care available within each country and that the information derived as part of any review of the scientific literature had to be viewed in context of the resources available to appropriately shape local guidelines. The WHO also uses the GRADE assessment process for its guidelines, and similarities were found between ILCOR work and that of the WHO. Thanks must go to the WHO representatives and associated clinicians for their informed and helpful input into discussions about subjects common to both groups.

The values, preferences, and task force insights section after each treatment recommendation section presents the prioritization of outcomes in the decision-making processes and the considerations that informed the direction and strength of the treatment recommendations.[10]

Evidence reviews addressing questions related to the prearrest State

Although survival from pediatric cardiac arrest is improving in many (but not all) parts of the world,[11–13] especially in the in-hospital setting, the recognition and early treatment of infants and children with deteriorating conditions remains a priority to prevent cardiac arrest.

This section contains the following reviews:

- Pediatric medical emergency team (MET) and rapid response team (RRT) (Peds 397).
- Pediatric Early Warning Scores (PEWS) (Peds 818).
- Prearrest care of pediatric dilated cardiomyopathy or myocarditis (Peds 819).
- Atropine for emergency intubation (Peds 821).
- Fluid resuscitation in septic shock (Peds 545).

MET, RRT, and PEWS systems have been widely implemented, and even mandated in many hospitals, but their effectiveness is difficult to measure. The implementation of the afferent (event recognition) and efferent (team response) arms of these systems is intimately related to providing education about the detection and prevention of deterioration with critical illness. There may be a whole system impact as a consequence of developing a MET that leads to change beyond that directly attributable to the MET itself. This may result in an increased awareness of earlier stages of patient deterioration, or increased communication about changes in a patient's condition, so earlier interventions may prevent the need for MET activation. The task force recognized that the PICO questions of MET/RRT and PEWS are related components of an in-hospital safety net and are difficult to evaluate separately.

Pediatric METs and RRTs (Peds 397)

For infants and children in the in-hospital setting (P), does the use of pediatric METs/RRTs (I), compared with not using METs/RRTs (C), change cardiac or pulmonary arrest frequency outside of the intensive care unit (ICU), overall hospital mortality (O)?

Consensus on science

For the critical outcome of cardiac arrest outside the ICU, we identified very-low-quality evidence from seven pediatric observational studies (downgraded for risk of bias, inconsistency, and imprecision). All seven studies showed that the rate of cardiac arrest outside the ICU declined after institution of a MET/RRT system (unadjusted relative risk (RR) less than 1), but none achieved statistical significance.[14–20] There was enough potential variability between the studies (of both patient and healthcare system factors, including the baseline incidence of cardiac arrest) that a decision was made to not pool the data.

For the critical outcome of all arrests (cardiac and respiratory) outside the ICU, we identified very-low-quality evidence from four pediatric observational studies (downgraded for risk of bias and imprecision). One study[21] demonstrated a statistically significant decline ($P = 0.0008$), whereas the other three studies[16,22,23] did not.

For the critical outcome of respiratory arrest, we identified very-low-quality evidence from 1 pediatric observational study[16] (downgraded for risk of bias and imprecision) that observed a decline in respiratory arrests (RR, 0.27; 95% confidence interval (CI), 0.05–1.01; $P = 0.035$).

For the important outcome of cardiac arrest frequency, we identified very-low-quality evidence from one pediatric observational