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Simulation and education

Who is the real team leader? Comparing leadership performance of the team leader and CPR Coach during simulated cardiac arrest

Yiqun Lin [a,], Tyson Savage [b], Genevieve Gravel [c], Jennifer Davidson [a], Nancy Tofil [d], Jonathan Duff [e], Adam Cheng [f], for the International Network for Simulation-based Pediatric Innovation, Research, Education INSPIRE CPR Investigators [1]*

Abstract

Purpose: To describe the leadership performance of team leaders and CPR Coaches, and to determine if there is a correlation between leadership scores and CPR performance during management of simulated pediatric cardiac arrest events.

Methods: This is a secondary analysis of data from a prior randomized controlled trial. We observed the performance of both team leaders and CPR coaches during the management of an 18-minute simulated cardiac arrest scenario which was run for 20 resuscitation teams comprised of CPR-certified professionals from four pediatric tertiary care centers. CPR Coaches were responsible for providing real-time verbal feedback of CPR performance to compressors. Two raters were trained to use the Behavioral Assessment Tool (BAT) to assess leadership performance of the team leader and CPR Coach. BAT scores of team leaders and CPR coaches were compared and linked with objective CPR performance.

Results: There was no significant difference between the BAT scores of team leaders and CPR coaches (median score 27/40 vs 28.8/40, $p = 0.16$). Higher BAT scores of team leaders were significantly associated with higher percentage of excellent CPR ($r = 0.52$, $p = 0.02$), while higher BAT scores of CPR coaches were significantly associated with higher chest compression fraction ($r = 0.48$, $p = 0.03$).

Conclusions: Both team leaders and CPR coaches have similarly high leadership performance during the management of simulated cardiac arrest. Leadership behaviors were associated with quality of CPR performance.

Clinical Trial Registration: Registration ID: NCT02539238; https://www.clinicaltrials.gov.

Keywords: Cardiopulmonary Resuscitation, CPR Coach, Simulation, Pediatric, Leadership

Introduction

Although survival rates from in-hospital cardiac arrest (IHCA) have increased in recent years, most children suffering from IHCA will not survive.[1–3] This is in part driven by poor provider adherence with cardiopulmonary (CPR) resuscitation guidelines published by the American Heart Association (AHA).[4–6] In recent years, a new resuscitation team role – the CPR Coach – was introduced with the aim of improving individual and team performance during cardiac arrest.[7] The CPR Coach has multiple responsibilities: to provide feedback on the CPR quality, to coordinate provider switches, and to coordinate key tasks (i.e. defibrillation and intubation) while minimizing interruptions to CPR.[8] Integration of the CPR Coach role into resuscitation teams during simulated cardiac arrest events results in improvements in overall excellent CPR, peri-shock pause duration

Abbreviations: AHA, American Heart Association, BLS, Basic life support, CPA, cardiopulmonary arrest, CPR, Cardiopulmonary resuscitation, CC, chest compressions, CCF, chest compression fraction

* Corresponding author at: KidSIM-ASPIRE Simulation Research Program, Alberta Children's Hospital, University of Calgary, 28 Oki Dr NW, Calgary, Alberta T3B 6A8, Canada.

E-mail addresses: jeffylin@hotmail.com (Y. Lin), chenger@me.com (A. Cheng).

[1] The members of the International Network for Simulation-based Pediatric Innovation, Research, Education INSPIRE CPR Investigators are listed in Appendix 1 at the end of the article.

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and adherence to PALS protocols.[8,9] When included as part of cardiac arrest quality improvement bundle, CPR Coaching contributes to improved compliance with AHA CPR guidelines during in-hospital pediatric cardiac arrest.[7]

Although the CPR coach role seems to be effective in improving CPR performance, little is known about how this new role influences team dynamics. CPR Coaches and resuscitation team leaders both report high mental workload during simulated cardiac arrest, suggesting that both roles require considerable cognitive processing and decision making.[10] Both roles also require considerable interaction and communication with team members. Since little is known about this topic, we sought to understand the nature of leadership behaviors exhibited by CPR Coaches and team leaders during cardiac arrest. A better understanding of these behaviors will inform future revisions to resuscitation team roles and/or training programs.

In this study, we aimed to: (a) describe the leadership performance of team leaders and CPR Coaches; (b) determine if there is a difference in leadership scores between the Team Leader and the CPR Coach, and (c) to determine if there is a correlation between leadership scores and CPR performance during simulated cardiac arrest scenarios.

Methods

We conducted secondary analysis of data collected from a previously published multicenter, randomized controlled trial evaluating the impact of CPR coaching on provider performance of CPR during simulated cardiac arrest.[8] In this observational study, we examined the data collected from the intervention group (i.e. CPR Coached teams) only, as we wanted to compare team leader and CPR Coach performance within teams. Ethical approval was secured from the Research Ethics Board of all study sites, and informed consent was obtained from all participants.

Study participants

*H*ealth care providers from the emergency department and intensive care unit of four tertiary care pediatric hospitals were recruited to participate in the study. Participants were recruited in teams of five to fill the roles of team leader, CPR Coach, CPR provider (two) and airway provider. Inclusion criteria for team leaders and CPR Coaches were: (a) current PALS certification or PALS instructor; and (b) attending physician or senior resident (year 3 or 4) or fellow in pediatric emergency medicine, anesthesia, critical care or general pediatrics. CPR Coaches were also permitted to be nurses with >5 years clinical experience in an acute care setting. CPR providers and airway providers had to meet the following inclusion criteria: (a) recent BLS certification (past 2 years); and (b) pediatric nurse (CPR provider), respiratory therapist (airway provider), attending physician or resident/fellow (year 3 or 4) in pediatric emergency medicine, anesthesia, critical care or general pediatrics (both roles).

Intervention

CPR Coach role and training

The CPR Coach was responsible for: (i) coordinating initiation of CPR; (ii) providing corrective verbal feedback and positive reinforcement for chest compressions based upon objective data from the CPR feedback defibrillator; (iii) coordinating defibrillation (as needed); (iv) coordinating insertion of a definitive airway (when requested by team leader); and (v) coordinating CPR provider switches. All participants assigned to the CPR Coach role received standardized CPR Coach training before participation in the cardiac arrest simulation scenarios. CPR Coach training sessions were conducted individually; the team leader and the rest of the participants in the group did not receive CPR Coach training but received verbal orientation to the CPR Coach role immediately prior to the cardiac arrest simulation. CPR Coach training lasted one hour, and consisted of a short video introducing the concept of CPR coaching, followed by four consecutive one-minute hands-on simulated cardiac arrest scenarios highlighting the key tasks required of a CPR Coach (i.e. initiating CPR, provider switches, coordinating intubation, coordinating defibrillation; providing verbal feedback on CPR quality was part of all four scenarios). Scenarios were run with an actor playing the role(s) required of the scenario. After each scenario, feedback was provided to the participant with a review of key steps required for each task. Participants had a chance to repeat each scenario until they were comfortable with the task.

Study procedures and cardiac arrest scenario

In the initial multicenter study, participants were randomized into the intervention arm (i.e. CPR Coach) or control arm (i.e. no CPR Coach) by team (i.e. five participants per team).[8] In this study, we focus only teams that had both a CPR coach and team leader to better understand the team dynamics when both these members were presented. Resuscitation teams were comprised of five study participants (i.e. team leader, CPR provider $\times$ 2, airway provider, and CPR coach) and two trained research actors who played the roles of medication nurse and bedside clinician. Actors were not allowed to perform CPR, provide clinical suggestions, or function as a CPR coach. All participants received a short pre-briefing consisting of a video demonstrating use of the CPR feedback defibrillator, outlining features of the manikin, describing the layout of the resuscitation room, and introducing all team members to the new CPR Coach role.

All teams participated in one simulated pediatric cardiac arrest scenario (with case progression from ventricular tachycardia [6 minutes] → ventricular fibrillation [6 minutes] → pulseless electrical activity [6 minutes]), that was tightly scripted to ensure standardization between groups. A Zoll R-Series™ Defibrillator with CPR feedback was used during the scenario, and all sites used the same pediatric manikin (SimJunior™, Laerdal Corporation) with an internal spring specifically designed for pediatric CPR training[11]. After each simulation an educational debriefing was performed to address any performance deficits. All scenarios were videotaped from a bird's eye view angle at the foot of the bed.

Outcome measures

Primary outcome measure: The Behavioral Assessment Tool (BAT)[12–16] was used to assess leadership performance of the team leader and CPR Coach. This tool contains a behaviorally anchored rating scale and is comprised of ten items describing crisis resource management behaviors for resuscitation event leaders, with each item rated on a scale of 0 [poor] to 4 [excellent] (maximum 40 points; scored as 0–100%). (See Appendix 2) Prior studies have provided supportive validity evidence, with a reported intraclass correlation coefficient of 0.84–0.95, and a Cronbach's alpha of 0.95–0.97.[12,13] Two raters (TS and GG) with a clinical background in emergency medicine were trained and calibrated to assess team leader and CPR coach performance using the BAT. Rater training consisted of a review of each item in the BAT, discussion of the rating scale for each item, and practice reviewing 3 training videos. Raters scores for each video was discussed, with consensus scores achieved on each item. Interrater reliability at the end of BAT rater training was 0.95. Videos from all twenty simulation scenarios were reviewed by both raters who provided BAT scores for the team leader and CPR Coach. The ratings for the team leader and CPR coaches were conducted separately in random order to avoid the comparison between the team leader and CPR coach within the same team. The leadership BAT scores for all items were calculated as the arithmetic mean of the 2 ratings.

Secondary outcome measure: CPR quality parameters including CC depth (mm), CC rate (cc/min) and chest compression fraction (CCF) for the whole simulation scenarios were collected from the Zoll R-Series™ Defibrillator. Compliance with 2020 AHA guidelines were defined as: depth 50–60 mm and rate 100–120/min.[4–6] The secondary outcome measure included (i) percentage of overall excellent CPR, defined as meeting AHA guidelines for CC depth and rate at the same time[17] and (ii) Chest compression fraction.

Statistical analysis

This study used a convenience sample of 20 teams from the intervention arm of the original CPR coach study.[8] We used descriptive statistics to summarize the demographic characteristics of CPR coaches and team leaders included in the analysis. Leadership BAT scores of individual items as well as composite scores were presented as median and interquartile range (IQR) for both team leaders and CPR coaches due to the nature of the data (ordinal, skewed). The inter-rater agreement was presented as intra-class correlation coefficient (ICC). Wilcoxon signed rank test was used to compare the difference of composite BAT scores between CPR coaches and team leaders. Spearman's correlations were used to assess the association between BAT and CPR performance (i.e. percentage of excellent CPR and chest compression fraction) for both team leaders and CPR coaches.

Results

In total, 40 teams of 5 were recruited from March 22, 2017, to February 26, 2018 (20 teams in the control group and 20 teams in the intervention group). The demographic characteristics of team leaders and CPR coaches included in the analysis are presented in Table 1.

Leadership performance

The two raters demonstrated an acceptable agreement in rating with an ICC of 0.65. The team leader achieved a median composite BAT score of 27 out of 40 with an interquartile range (IQR) from 20.1 to 32.0, while the CPR coaches scored a slightly higher (median composite score = 28.8, IQR 25.1–32.5). The difference in BAT scores between the team leader and CPR coaches were not statistically significant (Wilcoxon signed rank test effect size $r = 0.32$, $p = 0.16$) (Fig. 1).

Table 2 describes the individual item scores for team leaders and CPR coaches. Both team leaders and CPR coaches scored a median of 3 (i.e., above average) for 6 out of 10 items, including, anticipating potential problem, assumption of leadership role, communication, workload distribution, utilization of resources and recognition of limitations. CPR coaches scored higher than Team leaders in 4 of the items: knowledge of environment (CPR coaches vs team leaders 3.0 vs 2.0), attention allocation (3.0 vs 2.5), utilization of all information (3.0 vs 2.0), Interpersonal skills (4.0 vs 3.0).

Table 1 – Demographic characteristics of participants.

Role	Team leader (n = 20) Count (%)	Coach (n = 20) Count (%)
Gender		
Female	13 (65)	16(80)
Male	7 (35)	4(20)
Profession		
Attending physician	11 (55)	5(25)
Resident	9 (45)	3(15)
Nurse	0 (0)	12(60)
Last resuscitation course taken*		
More than 12 months	8 (40)	6(30)
7–12 months	4 (20)	4(20)
1–6 months	4 (20)	4(20)
Less than one month	1 (5)	0(0)
Instructor	3 (15)	6(30)
Chest compressions on real pediatric patients in the past 5 years		
Never	4 (20)	2(10)
1–5 times	10 (50)	8 (40)
More than 5 times	6 (30)	10(50)
Chest compressions on simulated pediatric patients in the past 5 years		
0–5 times	10 (50)	8 (40)
6–10 times	6 (30)	4 (20)
More than 10 times	4 (20)	8 (40)
Experience with CPR feedback device in the past 5 years		
Never	13 (65)	10 (50)
1–3 times	5 (25)	7 (35)
More than 3 times	2 (10)	3 (15)

* The resuscitation course includes Basic Life Support, Advanced Cardiovascular Life Support, Pediatric Advanced Life Support.

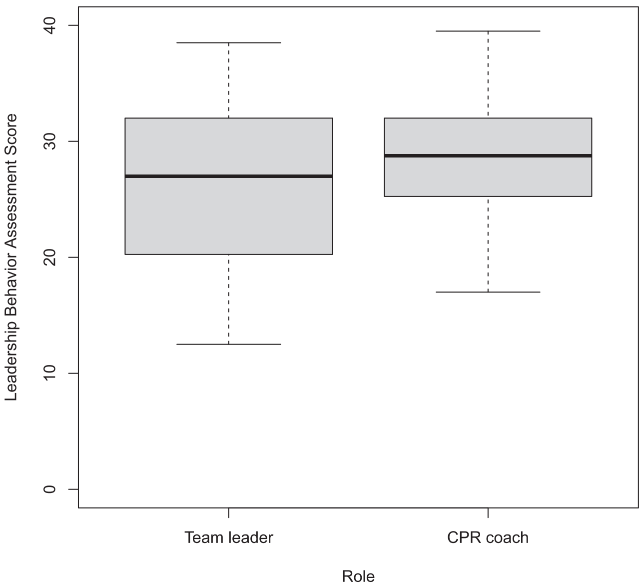

Fig. 1 – The leadership Behavior Assessment Score between CPR coaches and team leaders.

Correlation between BAT scores and CPR quality

The positive association between the percentage of excellent CPR and team leader BAT scores was statistically significant (Spearman's $r = 0.52$, $p = 0.02$). The association between the excellent CPR and CPR coach BAT scores was positive but did not yield statistical significance (Spearman's $r = 0.390$, $p = 0.09$) (Fig. 2). The BAT scores of CPR coaches were significantly associated with chest compression fraction in the management of cardiac arrest (Spearman's $r = 0.48$, $p = 0.03$), while an association between CCF and team leader BAT scores was not observed (Spearman's $r = 0.22$, $p = 0.35$) (Fig. 3).

Discussion

To our knowledge, this is the first study examining the leadership performance in both CPR coaches and team leaders during cardiac arrest scenarios. We have shown that the leadership performance scores of CPR coaches and resuscitation team leaders were similar during the management of simulated pediatric cardiac arrest. Positive associations between the leadership and high-quality CPR metrics were demonstrated.

Leadership is a critical component of effective team dynamics for successful resuscitation. CPR coaches should be considered a leadership role within the "mini-CPR team", where the CPR coach primarily directs communication to CPR providers, the defibrillator operator, and the airway provider during resuscitation. The CPR coach also intermittently communicates with the resuscitation team leaders to coordinate critical tasks (e.g. intubation, defibrillation) and provide updates. Therefore, it is important for CPR coaches to demonstrate leadership skills during resuscitation. In our study, CPR coaches demonstrated a wide array of leadership skills, thus highlighting the importance of these behaviors in effective CPR coaches.

Due to the nature of CPR coach role (i.e., a link between the team leader and mini-CPR team), the introduction of CPR coach could potentially influence team dynamics. On one hand, a coach who is too vocal could potentially "hijack" the resuscitation team leader role, which may influence perceived hierarchy amongst resuscitation team members. On the other hand, a resuscitation team leader who does not truly handover the responsibility of monitoring and guiding CPR to the CPR Coach may end up delaying the detection and management of reversible causes. In this study, no significant differences in BAT scores were detected between the team leader and CPR coaches, which may have been a downstream effect of CPR coach training. In an ideal situation, team leaders should also be included in the CPR coaching training, as both roles need to understand and practice how to co-manage the leadership and communication during resuscitation events. Future studies should explore how CPR coaches and resuscitation team leaders should be trained to interact with each other and other team members more effectively to optimize efficiency.

Our study describes positive associations between leadership performance and quality of CPR. This was consistent with the previous studies. Krage et al demonstrated the significant correlation between non-technical skills and technical performance scores ($r = 0.67$) during the management of simulated cardiac arrest.[18] Similar association was also observed in real advanced life support events by Peltonen et al.[19] These studies were limited by using subjective technical skill measurement lack of validity evidence (e.g. self-developed technical skill assessment tool). In our study, we used objective measures such as chest compression fraction and percentage of excellent CPR measured by defibrillators. In our study, we demonstrated that CPR coach leadership performance was positively associated with both percentage of excellent CPR and chest

Table 2 – Description of Behavior Assessment Tool Score for each item.

Item	Team Leader Median (IQR)	Coach Median (IQR)	*p*-value
Knowledge of Environment	2.0 (2.0–3.0)	3.0 (2.0–4.0)	0.089
Anticipation and planning for potential problems	3.0 (2.0–3.0)	3.0 (2.0–3.0)	0.825
Assumption of Leadership role	3.0 (2.0–4.0)	3.0 (2.0–4.0)	0.227
Communication with other team members	3.0 (2.0–3.0)	3.0 (2.0–4.0)	0.288
Distribution of workload/Delegation of Responsibility	3.0 (2.0–4.0)	3.0 (2.0–3.0)	0.808
Attention Allocation	2.5 (1.0–3.0)	3.0 (1.0–3.0)	0.437
Utilization of all Information	2.0 (2.0–3.0)	3.0 (2.0–3.5)	0.107
Utilization of Resources	3.0 (2.0–3.0)	3.0 (2.0–4.0)	0.075
Recognizes Limitations/Calls for help early enough	3.0 (2.0–3.0)	3.0 (2.0–4.0)	0.053
Professional Behavior/Interpersonal skills	3.0 (2.0–4.0)	4.0 (2.0–4.0)	0.200

IQR: interquartile range; *p*-value for Wilcoxon signed-rank tests.

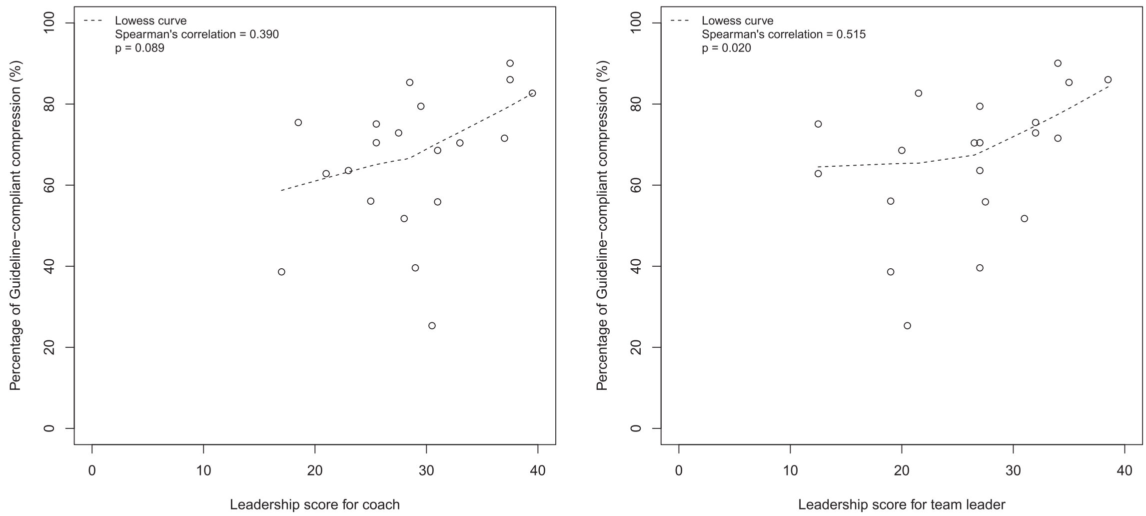

Fig. 2 – Association between BAT scores and percentage of excellent CPR.

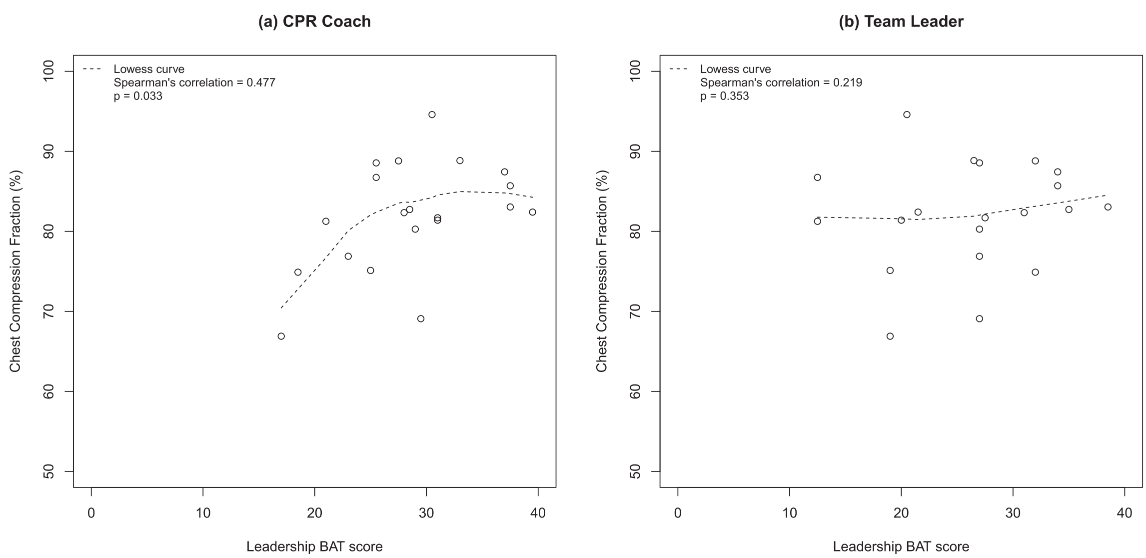

Fig. 3 – Association between BAT score and chest compression fraction.

compression fraction (although the association was not statistically significant due to small sample size for excellent CPR). We trained the CPR coaches the key tasks designed to address the gaps in the management of cardiac arrests, which include not only continuously monitoring the chest compression depth, rate, and recoil, but also implementing strategies to minimize the interruptions of chest compression. For example, the CPR coaches were trained to share their mental models (i.e. the thought or idea in the mind) before a complicated procedures that could potentially prolong the interruption of chest compression (e.g. intubation, defibrillation) and prompted the CPR providers back on the chest if it took more than 10 seconds to complete the procedures. We also found the leadership performance of the resuscitation team leader was also associated with percentage of excellent CPR, which was not anticipated since the team leader did not provide feedback to the compressors. However, we believe leadership qualities in general help to keep CPR providers on task, and it contributes to improved CPR performance.

Limitations

Our study has several limitations. First, this is a secondary analysis of CPR COACH study therefore, the sample size estimation was not for the research question in this study. Hence, there is a risk of this analysis being underpowered. Second, this study was conducted at tertiary pediatric centers with extensive exposures to resuscitation and CPR related research, which could potentially influence the generalizability of the study. Third, the structure of the resuscitation team was uniform for the purpose of standardization. In the real resuscitation events, the interaction between the CPR coaches, team leaders and other team members might be even more complex, which is not captured in this study.

Conclusion

Both team leaders and CPR coaches have similarly high leadership performance during the management of simulated cardiac arrest. The leadership behavior performance of the team leader was associated with higher percentage of excellent CPR. The leadership behavior of the CPR coach was associated with chest compression fraction during the management of simulated cardiac arrest.

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Role of the Funder/Sponsor

The research grant from the Heart and Stroke Foundation of Alberta was used for the design and conduct of the study, including recruitment, data collection, analysis, and interpretation of data. Funds from research infrastructure (Alberta Children's Research Institute, the Alberta Children's Hospital Foundation and the Department of Pediatrics) were used to support equipment and simulation space at Alberta Children's Hospital.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: 'Dr. Yiqun Lin is a volunteer for the American Heart Association (Resuscitation Education Summit and Education Writing Group) and the International Liaison Committee for Resuscitation. Dr. Adam Cheng is a volunteer for the American Heart Association (Resuscitation Education Summit and Education Writing Group) and the International Liaison Committee for Resuscitation (Domain Lead, Education). The other authors have no other relevant disclosures.'.

Appendix 1

The International Network for Simulation-based Pediatric Innovation, Research and Education (INSPIRE) CPR investigators are Megan Nye RN, Columbia University; Stacy Gaither RN, University of Alabama at Birmingham; Jenny Chatfield RN, Alberta Health Services; David Kessler MD, MSc, Columbia University; Elizabeth A. Hunt, MD, MPH, PhD, Johns Hopkins University.

Appendix 2. Supplementary material

Supplementary material to this article can be found online at https://doi.org/10.1016/j.resplu.2023.100400.

Author details

for the International Network for Simulation-based Pediatric Innovation, Research, Education INSPIRE CPR Investigators[1] [a]*Jennifer Davidson RN, KidSIM-ASPIRE Simulation Research Program, Alberta Children's Hospital, University of Calgary, Canada* [b]*Department of Emergency Medicine, University of Calgary, Canada* [c]*Department of Emergency Medicine, Laval University, Quebec City, Canada* [d]*Department of Pediatrics, University of Alabama at Birmingham, Birmingham, AL, USA* [e]*Department of Pediatrics, Faculty of Medicine and Dentristry, University of Alberta, Edmonton, Canada* [f]*Department of Pediatrics and Emergency Medicine, Cumming School of Medicine, University of Calgary, KidSIM-ASPIRE Simulation Research Program, Alberta Children's Hospital, Canada*

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