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Rapid response systems

Organization and training for pediatric cardiac arrest in Danish hospitals: A nationwide cross-sectional study

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Abstract

Background: Improving survival from pediatric cardiac arrest requires a well-functioning system of care with appropriately trained healthcare providers and designated cardiac arrest teams. This study aimed to describe the current organization and training for pediatric cardiac arrest in Denmark.

Methods: We performed a nationwide cross-sectional study. A questionnaire was distributed to all hospitals in Denmark with a pediatric department. The survey included questions about receiving patients with out-of-hospital cardiac arrest, protocols for extracorporeal life support, cardiac arrest team compositions, and training.

Results: We obtained responses from 17 of 19 hospitals with a pediatric department. In total, 76% of hospitals received patients with pediatric out-of-hospital cardiac arrest and 35% of hospitals had a protocol for extracorporeal life support. None of the hospitals had identical cardiac arrest team member compositions. The total number of team members ranged from 4–10, with a median of 8 members (IQR 7;9). In 84% of hospitals a specialized course in pediatric resuscitation was implemented and in 5% of hospitals, the specialized course was for the entire cardiac arrest team. Only few hospitals had training in laryngeal mask (6%) and intubation (29%) for pediatric cardiac arrest and none of them were trained in extracorporeal life support.

Conclusion: We found high variability in the composition of the pediatric cardiac arrest teams and training across the surveyed Danish hospitals. Many hospitals lack training in important pediatric resuscitation skills. Although many hospitals receive pediatric patients after out-of-hospital cardiac arrest, only few have protocols for transfer for extracorporeal life support.

Keywords: Pediatric cardiac arrest teams, Training, Emergency medicine

Introduction

Every year, children suffer from cardiac arrest both inside and outside of hospital worldwide. In the United States alone, over 15.200 children receive in hospital cardiopulmonary resuscitation (CPR) each year.[1] While data from European countries are sparse, a comparable incidence may be likely in Europe. Return of spontaneous circulation (ROCS) and survival to discharge following pediatric in-hospital cardiac arrest (IHCA) has been reported to be between 70–74% and 35–41% in the United States and Spain respectively.[2–5] Pediatric IHCA is associated with high morbidity and mortality and therefore optimizing each step in the resuscitation process is of utmost importance.[6,7]

Several system initiatives have been proposed to improve survival from pediatric IHCA including hospital-wide cardiac arrest teams, team training, and systems for extracorporeal life support (E-CPR).[8–10] Pediatric cardiac arrest teams have been widely implemented[11]; however, data on how pediatric cardiac arrest teams are composed is limited. Moreover, quality of care depends not only on the team composition but also the training of the providers.[12–14] Only limited data exists on the training of pediatric cardiac arrest teams from a pediatric resuscitation quality improvement collaborative and knowledge on more overall organization of pediatric resuscitation and specific training content is lacking.[11] Research has been conducted on the organization and training of cardiac arrest teams for adults, but not for pediatric cardiac arrest.[15] Accordingly, this

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study aimed to describe the current organization and training of pediatric cardiac arrest in Danish hospitals.

Methods

Study design and setting of Danish hospitals

A nationwide cross-sectional study was performed including all hospitals in Denmark with a pediatric department. In Denmark, there are no children's hospitals except for one specialized unit in the capital city which is the only place routinely placing children on extracorporeal life support. Despite the absence of children's hospitals in Denmark, several hospitals throughout the country have specialized pediatric departments. There are no private hospitals in Denmark that provide emergency care for children. Denmark has four university hospitals with their own pediatric intensive care unit, while other hospitals transfer children to these university hospitals for pediatric intensive care. There are no fellowships in e.g. pediatric cardiology or pediatric intensive care in Denmark but those working in pediatric intensive care units receive some special training for this. Hospitals in Denmark have designated cardiac arrest teams to respond for all IHCAs. While the team composition for adult IHCA has been described previously, modifications to team composition for pediatric IHCA are unknown. In Denmark, cardiac arrest teams generally respond to cardiac arrest only, while the composition for e.g. medical emergency teams is different. The hospitals have a resuscitation committee, most often composed by key opinion-leading physicians and CPR educators, which is responsible for local policies on e.g. CPR training, cardiac arrest team composition, and equipment for resuscitation. Hospitals without a pediatric department were not included in the study.

Questionnaire

The questionnaire was developed by the authors and reviewed by three experienced hospital CPR educators to identify any obscurities before distribution of the questionnaire to the hospitals. The questionnaire was emailed to the head of the resuscitation committee at the invited hospitals. The following information was inquired in the questionnaire: 1) existing protocols for extracorporeal cardiopulmonary resuscitation (ECPR)/extracorporeal membrane oxygenation (ECMO). 2) cardiac arrest team member composition. 3) cardiac arrest team leader. 4) changes in team composition from adult to pediatric cardiac arrest. 5) referral and care of pediatric out-of-hospital cardiac arrest patients. 6) presence of a pediatric intensive care unit. 7) specific course on pediatric CPR. 8) training in pediatric resuscitation as part of the adult advanced life support training. If the respondents replied that they had a specific course, additional questions regarding the nature of the course were inquired: 1) if the course was mandatory. 2) who participated. 3) training content of and whether this was theoretically, practical or both. 4) training duration. 5) retraining 6) whether simulation training with the entire cardiac arrest team was conducted. If the respondents replied that only the pediatrics department or some of the team members participated in this course, additional questions regarding the training of the remaining team members were inquired. The full questionnaire is reported in Supplement 1.

Data collection

The questionnaire was distributed on 5th of November 2022 by e-mail. The study data was collected and managed using REDCap electronic data capture tools hosted at Aarhus University.[16] A reminder was sent after one week, two weeks, three weeks and on the day of response deadline. Furthermore, a reminder was sent one week after deadline.

Ethics

According to Danish law, no approval from the Danish National Committee on Biomedical Research Ethics was required (Danish Act on Research Ethics, Review of Health Research Projects, Act number 593 of 14 July 2011 section 14). All data on respondents were handled according to the European Union General Data Protection Regulation. All respondents gave informed consent to participate.

Data analysis

Data were analyzed using STATA version 14.0 (StataCorp LP, College Station, TX, USA). Categorical data are reported as percentages and medians. Continuous data are presented as median (quartile 1; quartile 3).

Results

We identified 19 Danish hospitals with a pediatric department. Of the 19 hospitals, 17 (89%) responded. Of the 17 hospitals, 13 hospitals (76%) received patients after pediatric out-of-hospital cardiac arrest (P-OHCA). Overall, 3 of the responding hospitals (17%) had a Pediatric intensive care unit (PICU) and one of these routinely placed children on ECMO. Among the two hospitals not responding, one of them had a pediatric intensive care unit. In total, 6 hospitals (35%) had a protocol for transferring patients to ECPR or ECMO.

Composition of the cardiac arrest teams

All hospitals have designated cardiac arrest teams. The composition of the cardiac arrest teams across different hospitals in Denmark is shown in Fig. 1. The total number of team members range from 4-10, with a median (quartile 1; quartile 3) of 8 members.[7,9]

The team leader changed for pediatric cardiac arrest compared to adult cardiac arrest in 59% of the cases corresponding to 10 hospitals. In 9 of 17 hospitals (52%) the team leader changed to a pediatrician. In five hospitals (29%) the team leader was an anesthesiology resident (post-graduate year 0–3) or fellow (>3 years

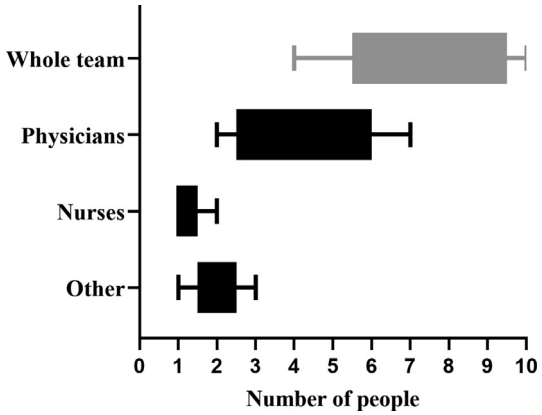

Fig. 1 – Composition of pediatric cardiac arrest teams. Boxes are reported as median with quartiles and maximum range.

post-graduate). In 1 hospital (6%) the team leader was a medical fellow.

In 15 of 17 hospitals (88%), the cardiac arrest team composition was different for pediatric cardiac arrest compared to adult cardiac arrest. In 14 of the 15 hospitals (93%) the cardiac arrest team included 1–3 additional members more for pediatric cardiac arrest compared to adult cardiac arrest. The additional team members included a pediatric fellow or attending physician in 15 hospitals (88%), a pediatric resident in 7 hospitals (41%), and an anesthesiology fellow or attending physician in 6 hospitals (35%). None of the hospitals had an identical cardiac arrest team composition. The different medical specialties represented on the cardiac arrest teams are shown in Fig. 2.

Training in pediatric resuscitation

Overall, 14 of 17 hospitals (84%) had a specialized course in pediatric resuscitation for either pediatricians only or for pediatricians and anesthesiologists only. Among hospitals with a pediatric resuscitation course, 11 hospitals (78%) had the course as mandatory training and 93% reported retraining which was performed every year (38%), every second year (30%), every third year (23%), and other intervals (7%).

In total, 11 hospitals (78%) reported the time duration of the theoretical and practical elements of the course. The theoretical element of the course had a median (quartile 1; quartile 3) duration of 60 minutes (45;60) whereas the duration of the hands-on simulation training was 90 minutes (65;135). The different topics covered in the course are shown in Fig. 3.

The participants on the specialized pediatric resuscitation course were physicians from the pediatric department in 3 hospitals (21%), the pediatric department and some members of the cardiac arrest team in 6 hospitals (42%), the pediatric department and the whole cardiac arrest team in 1 hospital (7%) and 4 hospitals answered "other" (28%).

Training in relation to the adult ALS course

In 5 of 17 hospitals (29%), cardiac arrest team members received training in pediatric resuscitation as part of the adult advanced life support (ALS) course. All 5 hospitals reported that retraining occurred. Retraining was performed every year in 1 hospital (20%). Every second year in 3 hospitals (60%) and every third year in 1 hospital (20%).

Simulation training

Simulation training in a learning facility (not in-situ) for the entire cardiac arrest team occurred in 3 out of 17 hospitals (17%). Announced in-situ simulation training for the entire cardiac arrest team occurred in 3 out of 17 hospitals (17%).

Discussion

In this nationwide study, we found that the majority of hospitals received patients after pediatric out-of-hospital cardiac arrest but despite this only few hospitals had protocols in place for transfer of patients in need of extracorporeal life support. We found a high variability in the composition of pediatric cardiac arrest teams across Danish hospitals. Furthermore, there was a lack of training in pediatric resuscitation in Danish hospitals and none of them providing unannounced in-situ simulation training for the entire cardiac arrest team.

Notably, our finding of most hospitals receiving patients after pediatric out-of-hospital cardiac arrest is in contrast to the organization of adult out-of-hospital cardiac arrest that in most regions of Denmark will be transferred to university hospitals only. Only the national hospital in capital city will regularly use ECPR/ECMO for pediatric patients. Therefore, it is of utmost importance to have protocols in place to ensure swift transfer for pediatric patients in cardiac arrest. Having a system with only one hospital doing ECPR/ECMO combined with lacking protocols for transfers may result in underutilization of ECPR or delayed ECPR for pediatric cardiac arrest patients which may result in worse survival outcomes for this selected population.[17]

The optimal size and composition of pediatric cardiac arrest teams is currently unknown.[15] In our study, we found that pediatric cardiac arrest teams both changed the team composition compared to the adult cardiac arrest team and had larger team sizes. However, over-crowding has been reported to be the most frequently occurring problem during resuscitation as perceived by adult cardiac arrest team members.[18,19] Consequently, one might speculate whether the problem is even bigger in pediatric cardiac arrest compared to adult cardiac arrest. While the optimal team size for pediatric CPR is unknown, a study found that approximately 7 team members resulted in more tasks being completed during pediatric trauma resuscitation.[20]

Our study found that in all cases where the cardiac arrest team composition changed, a pediatrician joined the team and, for the most part, the team leader role changed to the pediatrician. Overall, there were large variations in specialty and seniority of the team leader and in some cases, the team leader was a resident, even though previous studies reported that most residents do not feel comfortable and competent to lead a cardiac arrest team.[21,22]

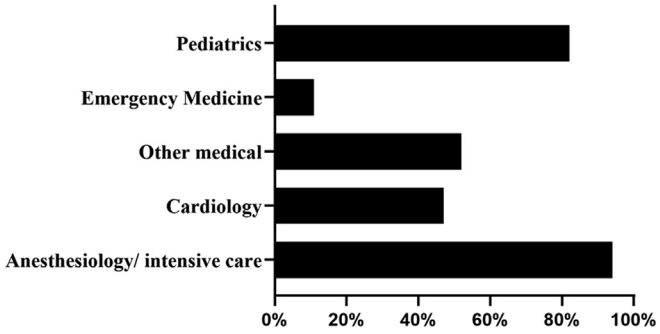

Fig. 2 – Proportion of hospitals with at least one physician within the specialty.

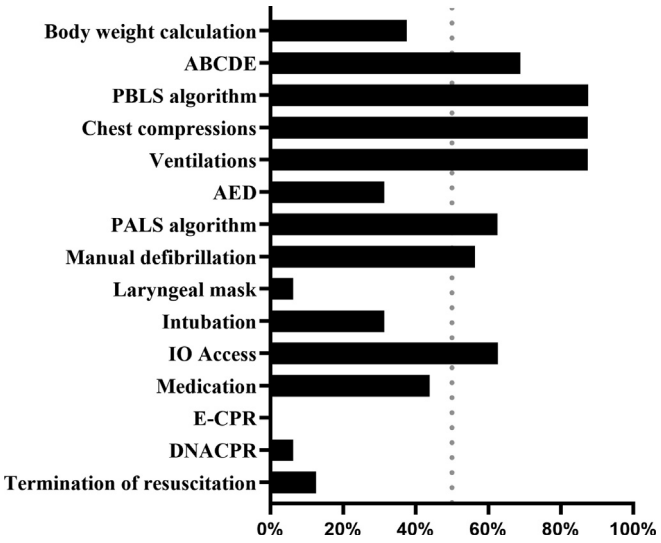

Fig. 3 – Hands on simulation training topics. DNACPR (Do not attempt cardiopulmonary resuscitation), E-CPR (Extracorporeal cardiopulmonary resuscitation), IO access (Intraosseous access), PALS (Pediatric advanced life support), AED (Automated external defibrillator), PBLS (Pediatric basic life support). In addition to the practical hands-on simulation some hospitals had theoretical training in; termination of resuscitation (50%), DNACPR (50%), E-CPR (23%), medication (28%), IO access (14%), intubation (28%), Laryngeal mask (21%), Manual defibrillation (7%), PALS algorithm (7%), AED (21%), ABCDE (14%) and weight calculation (28%).

Overall, members of the different pediatric cardiac arrest teams in Danish hospitals, receive highly variable training and in many cases, all team members do not train together. Less than 30% of hospitals reported to have training in pediatric resuscitation as part of the adult ALS course. This means that in the majority of hospitals, only one or a few members of the cardiac arrest team were trained in pediatric resuscitation. Despite this, the teams are expected to work efficiently and perform under high pressure in time-critical events. Importantly, a clinical study suggested that contextualized training for the whole cardiac arrest team is important to facilitate good communication and teamwork in the clinical setting.[18] As only one hospital undertakes pediatric CPR training for all members of the pediatric cardiac arrest team, this may lead to barriers for the teamwork on pediatric cardiac arrest teams in Denmark.

Additionally, our study, identified a major difference in which skills that were trained across hospitals. None of the hospitals had any practical training in Do Not Attempt CPR (DNACPR) and Extracorporeal CPR (E-CPR) and very few had training in laryngeal mask and intubation. Studies show that errors in airway management during resuscitation frequently occur and a significant number of rapid response teams have been reported not to provide advanced airway skills.[23–25] The lack of training in airway management during resuscitation might be contributing to errors in airway management during resuscitation.

We found that only few hospitals used in-situ simulation training. Although simulation-based training is an important tool that has been associated with improved communication, performance, and survival outcomes,[26] transfer of skills from the simulation center to the clinical environment may be lacking sometimes. In-situ simulation training will enable teams to train using beds, equipment, and rooms that are already a part of the clinical setting. This results in highly contextualized training and will also enable hospitals to identify latent safety threats, e.g. problems with clinical equipment and suboptimal room ergonomics.[27] Moreover, in-situ simulation training may provide a good opportunity to train teamwork, leadership and communication in a realistic manner which is essential for cardiac arrest team performance.[28–32] Thus, use of in-situ simulations have been suggested as an important step towards improving outcomes following adult- and pediatric IHCA.[10] Furthermore, studies have shown that hospitals in the US having the highest risk-adjusted survival rates following adult IHCA conducted more unannounced in-situ simulations[30] and use of monthly in-situ simulation training was associated with improved survival outcomes in adults.[33]

Importantly, guidelines suggest retraining to be conducted as low-dose, high-frequency training.[34,35] Overall, the majority of hospitals with pediatric resuscitation training reported the occurrence of retraining. Retraining occurred from one year to 3 years, which contrasts the literature suggesting that retraining intervals of 1–6 months are superior to less frequent training.[12,36–38]

Our results highlight gaps in pediatric life support training and cardiac arrest team organizations which has been recognized as important steps to improve survival from IHCA by the International Liaison Committee on Resucitation.[10] However, it should be acknowledged that there are several unknown variables relating to how training and team organization can be implemented in the best possible way to improve survival outcomes. This point was highlighted in a recent trial failing to improve survival outcomes following pediatric IHCA using a bundled care intervention of physiologic point-of-care training and debriefings.[39] Our findings may although be a stepping stone to initiate research and quality improvement work among key stakeholders, resuscitation experts and organizations. Nationally standardized teams may be difficult to implement due to differences in resources at different hospitals. But a minimum standard should be recommended such as ensuring that staff in the departments of pediatrics and cardiac arrest team members responding to a pediatric cardiac arrest should have mandatory training in pediatric resuscitation. As pediatric cardiac arrests are low-volume, high-stakes events, it may require large, international collaborations and

initiatives to be able to study the impact of team compositions and training on patient outcomes following pediatric cardiac arrest. Such initiatives are essential in order to make future evidence-based standards for team composition and training for pediatric IHCA.

Strength and limitations

We had a response rate of 89% and cannot infer on the remaining hospitals. The surveys were emailed to the head of the resuscitation committee at the invited hospitals as it was presumed that they would have the necessary knowledge to complete the survey. Some respondents were a pediatric attending physicians who may not know exactly how the cardiac arrest team was trained. Regarding retraining, some may train less often than what is reported.[40] Furthermore, we do not know the scope or frequency of the in-situ simulation training and we do not know whether the training they received was adequate. Finally, some anesthesiologists and pediatricians may have received training in other contexts such as e.g. the European Resuscitation Council Pediatric Advanced Life Support course.

Conclusions

We found high variability in the composition of the pediatric cardiac arrest teams and training across the surveyed Danish hospitals. Many hospitals lack training in important pediatric resuscitation skills. Although many hospitals receive pediatric patients after out-of-hospital cardiac arrest, only few have protocols for transfer for ECPR/ ECMO.

CRediT authorship contribution statement

Bea Brix B. Pedersen: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Visualization, Writing – original draft. **Kasper G. Lauridsen:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing. **Sandra Thun Langsted:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Visualization, Writing – review & editing. **Bo Løfgren:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Kasper Lauridsen is an associate editor for Resuscitation Plus but was not involved in any decision making of the manuscript. None of the other authors have conflicts of interest of relevance to this work.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resplu.2024.100555.

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REFERENCES

1. Holmberg MJ et al. Annual incidence of adult and pediatric in-hospital cardiac arrest in the United States. Circ Cardiovasc Qual Outcomes 2019;12 e005580.
2. Slomine BS et al. Neurobehavioural outcomes in children after In-Hospital cardiac arrest. Resuscitation 2018;124:80–9.
3. Knudson JD et al. Prevalence and outcomes of pediatric in-hospital cardiopulmonary resuscitation in the United States: an analysis of the Kids' Inpatient Database*. Crit Care Med 2012;40:2940–4.
4. Holmberg MJ et al. Trends in survival after pediatric in-hospital cardiac arrest in the United States. Circulation 2019;140:1398–408.
5. López-Herce J et al. In-hospital pediatric cardiac arrest in Spain. Rev Esp Cardiol (Engl Ed) 2014;67:189–95.
6. Bimerew M et al. Survival of pediatric patients after cardiopulmonary resuscitation for in-hospital cardiac arrest: a systematic review and meta-analysis. Ital J Pediatr 2021;47:118.
7. Morgan RW et al. Pediatric in-hospital cardiac arrest and cardiopulmonary resuscitation in the United States: a review. JAMA Pediatr 2021;175:293–302.
8. Brilli RJ et al. Implementation of a medical emergency team in a large pediatric teaching hospital prevents respiratory and cardiopulmonary arrests outside the intensive care unit. Pediatr Crit Care Med 2007;8:236–46.
9. Bonafide CP et al. Development of a pragmatic measure for evaluating and optimizing rapid response systems. Pediatrics 2012;129:e874–81.
10. Chan PS et al. Ten steps toward improving in-hospital cardiac arrest quality of care and outcomes. Resuscitation 2023;193 109996.
11. Pfeiffer S et al. Code team structure and training in the pediatric resuscitation quality international collaborative. Pediatr Emerg Care 2021;37:e431–5.
12. Lauridsen KG et al. Cardiopulmonary resuscitation training for healthcare professionals: a scoping review. Simul Healthc 2021.
13. Cashen K et al. Association of CPR simulation program characteristics with simulated and actual performance during paediatric in-hospital cardiac arrest. Resuscitation 2023;191 109939.
14. Thim S et al. Simulation-based emergency team training in pediatrics: a systematic review. Pediatrics 2022;149.
15. Lauridsen KG et al. Organisation of in-hospital cardiac arrest teams – a nationwide study. Resuscitation 2015;89:123–8.
16. Harris PA et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inform 2019;95 103208.
17. Esangbedo ID et al. Pediatric extracorporeal cardiopulmonary resuscitation: a systematic review. Pediatr Crit Care Med 2020;21: e934–43.
18. Lauridsen KG et al. Barriers and facilitators for in-hospital resuscitation: a prospective clinical study. Resuscitation 2021;164:70–8.

19. Leary M et al. Improving providers' role definitions to decrease overcrowding and improve in-hospital cardiac arrest response. Am J Crit Care 2016;25:335–9.
20. Kelleher DC et al. Factors affecting team size and task performance in pediatric trauma resuscitation. Pediatr Emerg Care 2014;30:248–53.
21. Hayes CW et al. Residents feel unprepared and unsupervised as leaders of cardiac arrest teams in teaching hospitals: a survey of internal medicine residents. Crit Care Med 2007;35:1668–72.
22. Lauridsen KG et al. Clinical experience and skills of physicians in hospital cardiac arrest teams in Denmark: a nationwide study. Open Access Emerg Med 2017;9:37–41.
23. Ornato JP et al. Impact of resuscitation system errors on survival from in-hospital cardiac arrest. Resuscitation 2012;83:63–9.
24. Jones D et al. Rapid response team composition, resourcing and calling criteria in Australia. Resuscitation 2012;83:563–7.
25. Fiadjoe JE et al. Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry: a prospective cohort analysis. Lancet Respir Med 2016;4:37–48.
26. Gilfoyle E et al. Improved clinical performance and teamwork of pediatric interprofessional resuscitation teams with a simulation-based educational intervention. Pediatr Crit Care Med 2017;18:e62–9.
27. Stærk M et al. In-situ simulations to detect patient safety threats during in-hospital cardiac arrest. Resusc Plus 2023;14 100410.
28. Cooper S, Wakelam A. Leadership of resuscitation teams: "Lighthouse Leadership'. Resuscitation 1999;42:27–45.
29. Hunziker S et al. Hands-on time during cardiopulmonary resuscitation is affected by the process of teambuilding: a prospective randomised simulator-based trial. BMC Emerg Med 2009;9:3.
30. Nallamothu BK et al. How do resuscitation teams at top-performing hospitals for in-hospital cardiac arrest succeed? A qualitative study. Circulation 2018;138:154–63.
31. Andersen PO et al. Identifying non-technical skills and barriers for improvement of teamwork in cardiac arrest teams. Resuscitation 2010;81:695–702.
32. Lauridsen KG et al. Standardising communication to improve in-hospital cardiopulmonary resuscitation. Resuscitation 2020;147:73–80.
33. Josey K et al. Hospitals with more-active participation in conducting standardized in-situ mock codes have improved survival after in-hospital cardiopulmonary arrest. Resuscitation 2018;133:47–52.
34. Finn JC et al. Part 8: Education, implementation, and teams: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation 2015;95:e203–24.
35. Cheng A et al. Part 6: resuscitation education science: 2020 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation 2020;142:S551–79.
36. Kim JW et al. Improvement in trainees' attitude and resuscitation quality with repeated cardiopulmonary resuscitation training: cross-sectional simulation study. Simul Healthc 2016;11:250–6.
37. Anderson R et al. Optimal training frequency for acquisition and retention of high-quality CPR skills: A randomized trial. Resuscitation 2019;135:153–61.
38. Sutton RM et al. Low-dose, high-frequency CPR training improves skill retention of in-hospital pediatric providers. Pediatrics 2011;128: e145–51.
39. Sutton RM et al. Effect of physiologic point-of-care cardiopulmonary resuscitation training on survival with favorable neurologic outcome in cardiac arrest in pediatric ICUs: a randomized clinical trial. JAMA 2022;327:934–45.
40. Lauridsen KG et al. Why do not physicians attend hospital cardiopulmonary resuscitation training? Open Access Emerg Med 2021;13:543–51.