

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

# Resuscitation Plus

journal homepage: [www.elsevier.com/locate/resuscitation-plus](http://www.elsevier.com/locate/resuscitation-plus)

## Editorial

# Is your hospital doing everything it can to be ready for the next paediatric cardiac arrest?



Optimal response to paediatric in-hospital cardiac arrest (IHCA) requires a consistent, well-choreographed and cohesive response from first responders and the expert resuscitation team. Institutional behaviour, culture and organisation practices may be key ingredients to facilitate this paradigm, and understanding differences between institutions may help identify areas for quality improvement. Though survival following out-of-hospital cardiac arrest (OHCA) remains poor, outcomes for paediatric IHCA have improved over the past decade; survival to hospital discharge approaches 40% with favourable neurological outcomes in up to 77% of survivors.<sup>1,2</sup> These improvements are likely to be related to incremental improvements in systems, processes, training, and local, national and international guidelines and implementation initiatives to improve resuscitation. In this issue of Resuscitation Plus, Chan et al characterise the systems of care that are deployed across a broad spectrum of North American Hospitals, specifically comparing stand-alone children's hospitals to those in a combined hospital.<sup>3</sup>

In 2010 the American Heart Association announced a 10-year target to increase survival from IHCA to 50% for paediatric patients.<sup>4</sup> The approach to reaching this target included early recognition of clinical deterioration and cardiac arrest; spaced learning to improve the delivery of high-quality CPR; early transfer of patients to critical care environments; goal directed post-arrest care; and the consideration of extra-corporeal membrane oxygenation during CPR (E-CPR) in selected cases. These interventions are also outlined in the International Liaison Committee on Resuscitation (ILCOR) Formula for Survival.<sup>5</sup> Most paediatric IHCA events now occur in the ICU setting and resuscitation protocols are well defined and taught widely, but the institutional response to paediatric IHCA still varies in many ways, including resource allocation and resuscitation team training.

Chan et al provide a detailed narrative of the state of paediatric resuscitation practices following IHCA in North American hospitals.<sup>5</sup> Their comprehensive approach utilised the Get With The Guidelines®-Resuscitation (GWTG-R) registry - a prospective registry of hospital resuscitation events, launched in 1999. The authors surveyed 234 hospitals submitting data to the GWTG-R database in order to assess the variation in practices between 'stand-alone' paediatric hospitals (including specialist paediatric centres housed within a shared institution) as compared to paediatric departments in a combined hospital setting (adult and paediatric). The response rate of 88.9% (n = 208) is to be commended and speaks of the engagement of those submitting data to the registry. The appropriate exclusion of 155 adult-only hospitals and institutions reporting  $\leq 5$  cases per annum reduced the cohort to only 33 hospitals, 9 of which were

stand-alone centres. This represented 1412 children with IHCA during the 3-year study period.

The primary focus of this paper is self-reported institutional behaviours and organisation, the set-up to prevent and treat IHCA including simulation, intra-arrest monitoring of CPR quality, post-event debrief, designation of leadership and incorporation of nurse defibrillation prior to physician arrival. After risk-adjustment, there was no significant difference in patient survival between hospital types, in contrast to other reports;<sup>12</sup> although this study was underpowered to detect a difference.

The authors found that in 'stand-alone' paediatric institutions, you are more likely to find a device monitoring chest compression quality, a code team leader with a designated identifier (e.g., hat/lanyard), and an expectation for immediate code debrief. You are also more likely to find nursing staff supported to provide AED defibrillation prior to medical team arrival. Stand-alone centres also self-report to have more resuscitation champions (77.8% vs 54.1%) and debrief codes more frequently after an IHCA, but they do have nearly three times the number of IHCA per hospital (median IQR: 68 (40 to 119) vs 12.5 (7 to 31.5)). Perhaps patient volume simply leads to heightened awareness, resource allocation, focus on quality improvement and early adoption. How can we best prepare our system for the next paediatric IHCA? Education and training, team behaviours and research are key.

In the domain of resuscitation education, we know the quality and retention of basic life support skills for individuals is improved by spaced practice (regular task-oriented training exercises at shorter intervals).<sup>6</sup> How does this translate to training frequency for the complex team management of IHCA? Mock code training implementation in a paediatric hospital can improve time to first response and adherence to ALS algorithms; however, data is lacking to show consistent translation of this to improve patient outcomes.<sup>7</sup> Contextual relevance is important and there is a growing utilisation of innovative educational strategies to augment resuscitation team training.<sup>5</sup>

There may be some quick wins. We note the low rate of nurse-directed AED defibrillation in combined institutions (77.8% in stand-alone centres vs. 29.2%). A possible explanation is that the time to medical response is already so quick and it's not required; however, it may also be an easy area to target in order to improve time to first shock. We are, after all, encouraging first responder AED defibrillation in the community and we should be actively supporting the same behaviour in our hospitals, as reduced time to first shock is strongly associated with improved outcomes.

Does post-event debrief improve patient outcome? It might help the institution learn from each event and put systems in place to address any identified educational or equipment gaps. It could also improve team cohesion and familiarity when dealing with resuscitations. In a paediatric centre with well-established CPR quality improvement culture and initiatives (feedback-enabled defibrillators, regular CPR refresher training and a mock code simulation program), a structured, interdisciplinary quantitative debrief program was shown to improve CPR quality and was associated with improved survival with favourable neurological outcome after paediatric IHCA.<sup>8</sup> “Hot debrief” within minutes of the code, and “cold debrief” some days later, may help with clinical standard adherence, cooperation and communication.<sup>9</sup> These were reported more frequently in specialist paediatric centres (77% vs. 37%) by Chan et al. but further reinforcement (again, supported by evidence) of the positive impact they have is needed.

IHCA in children is not rare. Last year, approximately 15,200 infants and children in the USA received CPR from a resuscitation team who were striving to provide the best care possible.<sup>10</sup> There are clear challenges in preparing a system to respond effectively and provide this standard. The strength of the evidence on which we base our resuscitation practices is often limited by small, single centre studies and observational research. This is exemplified in this current survey where only 18% of hospitals managing paediatric IHCA monitored diastolic blood pressure during an arrest – an intervention identified in a single study to be associated with improved survival and neurological function.<sup>11</sup> So the expansion and translation of clinical research must be supported by the development and implementation of system-wide approaches to improve resuscitation systems and to improve clinical research. Research, such as this important study by Chan et al. shines a spotlight on key areas that are highly variable between hospital types.

Whilst the paediatric resuscitation community has a collective responsibility to improve the evidence base to support practice, individual healthcare practitioners and those in positions of leadership within institutions have a responsibility to ask: is your hospital doing everything it can to be ready for your next paediatric cardiac arrest? Chan et al. have given us all some idea of the landscape of system approaches to resuscitation across a broad spectrum of hospitals who care for children.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## REFERENCES

- Holmberg MJ, Wiberg S, Ross CE, et al. Trends in Survival After Pediatric In-Hospital Cardiac Arrest in the United States. *Circulation* 2019;140:1398–408.
- Jayaram N, McNally B, Tang F, Chan PS. Survival after out-of-hospital cardiac arrest in children. *J Am Heart Assoc* 2015;4:e002122.
- Chan et al., Resuscitation Practices in Hospitals Caring for Children: Insights from Get With The Guidelines-Resuscitation, *Resuscitation Plus*. 2022; 9: . <https://doi.org/10.1016/j.resplu.2021.100199>.
- Neumar RW. Doubling Cardiac Arrest Survival by 2020: Achieving the American Heart Association Impact Goal. *Circulation* 2016;134:2037–9.
- Sørdeide E, Morrison L, Hillman K, et al. The formula for survival in resuscitation. *Resuscitation* 2013;84:1487–93.
- Cheng A, Nadkarni VM, Mancini MB, et al. Resuscitation Education Science: Educational Strategies to Improve Outcomes From Cardiac Arrest: A Scientific Statement From the American Heart Association. *Circulation* 2018;138:e82–e122.
- Knight LJ, Gabhart JM, Earnest KS, Leong KM, Anglemeyer A, Franzon D. Improving code team performance and survival outcomes: implementation of pediatric resuscitation team training. *Crit Care Med* 2014;42:243–51.
- Wolfe H, Zebuhr C, Topjian AA, et al. Interdisciplinary ICU cardiac arrest debriefing improves survival outcomes. *Crit Care Med* 2014;42:1688–95.
- Wolfe HA, Wenger J, Sutton R, et al. Cold Debriefings after In-hospital Cardiac Arrest in an International Pediatric Resuscitation Quality Improvement Collaborative. *Pediatr Qual Saf* 2020;5:e319.
- Holmberg MJ, Ross CE, Fitzmaurice GM, et al. Annual Incidence of Adult and Pediatric In-Hospital Cardiac Arrest in the United States. *Circ Cardiovasc Qual Outcomes* 2019;12:e005580.
- Berg RA, Sutton RM, Reeder RW, et al. Association Between Diastolic Blood Pressure During Pediatric In-Hospital Cardiopulmonary Resuscitation and Survival. *Circulation* 2018;137:1784–95.
- Skellett S, Orzechowska I, Thomas K, Fortune PM. The landscape of paediatric in-hospital cardiac arrest in the United Kingdom National Cardiac Arrest Audit. *Resuscitation* 2020;155:165–71. <https://doi.org/10.1016/j.resuscitation.2020.07.026>.

M. Harvey

R. Neal

*Paediatric Intensive Care, Birmingham Women's & Children's NHS Foundation Trust, Birmingham, UK*

*E-mail addresses: [Matthew.harvey11@nhs.net](mailto:Matthew.harvey11@nhs.net) (M. Harvey)*

*[RichardNeal@nhs.net](mailto:RichardNeal@nhs.net) (R. Neal)*

V. Nadkarni

*University of Pennsylvania Perelman School of Medicine, Children's Hospital of Philadelphia, Department of Anesthesiology and Critical Care Medicine, Philadelphia, United States*

*E-mail addresses: [Nadkarni@email.chop.edu](mailto:Nadkarni@email.chop.edu)*

B.R. Scholefield

*Paediatric Intensive Care, Birmingham Women's & Children's NHS Foundation Trust, Birmingham, UK*

*Birmingham Acute Care Research Group, Institute of Inflammation and Ageing, University of Birmingham, Birmingham, UK*

*E-mail addresses: [b.scholefield@bham.ac.uk](mailto:b.scholefield@bham.ac.uk)*

Received 28 January 2022

Accepted 29 January 2022

<https://doi.org/10.1016/j.resplu.2022.100212>

© 2022 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).