

# Qualitative study exploring factors influencing escalation of care of deteriorating children in a children's hospital

Orsola Gawronski,<sup>1,2</sup> Christopher Parshuram,<sup>3</sup> Corrado Cecchetti,<sup>4</sup> Emanuela Tiozzo,<sup>1</sup> Marta Luisa Ciofi degli Atti,<sup>5</sup> Immacolata Dall'Oglio,<sup>1,2</sup> Gianna Scarselletta,<sup>6</sup> Caterina Offidani,<sup>7</sup> Massimiliano Raponi,<sup>7</sup> Jos M Latour<sup>8</sup>

**To cite:** Gawronski O, Parshuram C, Cecchetti C, *et al*. Qualitative study exploring factors influencing escalation of care of deteriorating children in a children's hospital. *BMJ Paediatrics Open* 2018;**2**:e000241. doi:10.1136/bmjpo-2017-000241

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/bmjpo-2017-000241>).

Received 1 December 2017  
Revised 20 April 2018  
Accepted 29 April 2018

## ABSTRACT

**Background** System-level interventions including rapid response teams and paediatric early warning scores have been designed to support escalation of care and prevent severe adverse events in hospital wards. Barriers and facilitators to escalation of care have been rarely explored in paediatric settings.

**Aim** This study explores the experiences of parents and healthcare professionals of in-hospital paediatric clinical deterioration events to identify factors associated with escalation of care.

**Methods** Across 2 hospital sites, 6 focus groups with 32 participants were conducted with parents (n=9) and healthcare professionals (n=23) who had cared for or witnessed a clinical deterioration event of a child. Transcripts of audio recording were analysed for emergent themes using a constant comparative approach.

**Findings** Four themes and 19 subthemes were identified: (1) impact of staff competencies and skills, including personal judgement of clinical efficacy (self-efficacy), differences in staff training and their impact on perceived nursing credibility; (2) impact of relationships in care focusing on communication and teamwork; (3) processes identifying and responding to clinical deterioration, such as patient assessment practices, tools to support the identification of patients at risk and the role of the rapid response team; and (4) influences of organisational factors on escalation of care, such as staffing, patient pathways and continuity of care.

**Conclusions** Findings emphasise the considerable influence of social processes such as teamwork, communication, models of staff organisation and staff education. Further studies are needed to better understand how modification of these factors can be used to improve patient safety.

## INTRODUCTION

Hospitalised patients with acute and complex diseases might experience a clinical deterioration that can lead to unplanned admissions to paediatric intensive care unit (PICU), cardiac arrest or death on the ward.<sup>1,2</sup> Undetected severe illnesses and delayed response

## What is already known on this topic?

- Escalation of care in hospitalised children at risk of clinical deterioration is still suboptimal.
- The use of paediatric early warning systems in association with rapid response systems has an impact on clinical outcomes of deteriorating children.
- Successful implementation of rapid response systems in hospital wards is related to human, social and organisational factors.

## What this study hopes to add?

- Understanding factors influencing escalation of care might improve clinical outcomes of deteriorating children.
- Teamwork, communication, models of staffing and staff education have been identified for timely and effective escalation of care on children's wards.
- Parents are able to identify factors of escalation of care, making them trustworthy partners in the care of their sick child.

to deteriorating patients in hospital wards are a public health issue, both for paediatric and adult patients.<sup>3-6</sup> Escalation of care is a changed clinical behaviour in response to changing clinical condition. Changes can be multiple and include monitoring, documentation frequency, and secondary review by an expert nurse, medical consultant or a paediatric intensivist.<sup>7</sup> Rapid response systems (RRS) are generally composed of two essential parts: an afferent limb, defined by alert criteria to identify children at risk of clinical worsening; and an efferent limb, to provide resources when advanced assistance is needed.<sup>8-10</sup> Successful implementation of RRS is related to human, social and organisational factors such as healthcare professionals' skills, organisational frameworks,



For numbered affiliations see end of article.

### Correspondence to

Orsola Gawronski; [orsola.gawronski@opbg.net](mailto:orsola.gawronski@opbg.net)

social patterns and local healthcare cultures.<sup>11–14</sup> However, barriers and facilitators to escalation of care received limited attention in paediatric settings despite the peculiar characteristics of this patient group, such as an increased parental role in mediating the communication with healthcare providers.<sup>11</sup> Therefore, the aim of this study was to identify factors influencing escalation of care in deteriorating children through the experiences of parents and healthcare professionals.

## METHODS

### Setting

The study setting is a 607-bed paediatric hospital. During the study period, the hospital had 27 336 paediatric discharges per year. The Bedside Paediatric Early Warning System (BedsidePEWS), composed of seven critical indicators embedded in age-specific clinical charts, is used for screening patients at risk of clinical deterioration. The scores range between 0 and 26.<sup>15 16</sup> The score is matched to care recommendations, which include the type and frequency of monitoring, frequency of clinicians' reviews and the number of patients per nurse according to patient risk. Ward staff were trained, continuing education is offered and new staff receive BedsidePEWS education during the induction period.

The ward team manages early signs of deterioration until the patient is severely ill. To respond to clinical deterioration, a PICU physician on patient duty can be called for advanced support or consultation to the hospital wards. A PICU consult is recommended when the score is  $\geq 7$ . The call is made by the ward physician according to clinical criteria set by a response system policy, which includes the BedsidePEWS. Nurses may directly call the PICU in case of emergency. Parents are excluded from the PICU calling process.

### Study design

A qualitative research design using focus groups with parents of children admitted on a hospital ward and healthcare professionals was deployed to elicit retrospective experiences of escalation of care during clinical deterioration events. Data were collected by focus groups

because of the possibility of interaction and exchange of experiences between participants provided by this method.<sup>17</sup>

### Participants

A purposive sample of hospital staff and parents was selected from nine clinical areas. Separate focus groups (n=6) for each of staff nurses, nurse managers, ward physicians, PICU physicians and parents of admitted children were performed.

Ward staff and parents of children who had personally witnessed a clinical deterioration event (PICU urgent admission or PICU consult) of their child during hospital admission within the previous 12 months were asked to participate. We excluded parents whose children were admitted to the PICU at time of enrolment to avoid additional burden. Enrolment occurred in two phases: first, the nurse manager explored the interest of the most experienced available staff (>2 years of experience in their current specialty) and identified the parents on the ward who had a deterioration event of their child; second, the researcher informed the potential participants of the study objectives and focus group methodology and collected written informed consent on agreement to participate. Staff were invited by the researcher according to experience in paediatric care, assuming this would be a criterion for a more informative discussion. A consent form was signed prior to the focus group.

### Data collection

A female researcher trained in qualitative research methods (OG) conducted semistructured focus groups to explore the experiences and views of parents and healthcare professionals on escalation of care in the deteriorating child. At total of 6 focus groups with 32 participants were conducted: one focus group with ward nurses, one with nurse managers, one with ward physicians, one with PICU physicians and two with parents (table 1). In the two focus groups with the parents, nine parents of eight children participated. The focus groups were performed in a private room in the hospital. A semistructured interview schedule guided the discussion (online supplementary material 1). A female research nurse participated as

**Table 1** Population and focus group composition

Focus groups	Participants (n)	Age (years), mean (range)	Female, n (%)	Work experience in paediatrics (years), mean (range)	Surgical ward, n (%)
Nurses	7	40 (26–49)	7 (100)	15 (3–26)	3 (43)
Ward physicians	6	47 (30–61)	4 (66)	19 (4–33)	3 (50)
Nurse managers	6	42 (30–51)	6 (100)	21 (8–36)	2 (33)
Paediatric intensive care unit physicians	4	48 (42–58)	–	17 (11–29)	–
Parents	5	43 (35–50)	2 (40)		5 (100)
Parents	4	43 (33–49)	2 (50)		3 (75)
Total	32				

an observer (GS) and provided field notes of the focus group discussion. All focus groups were audio-recorded and the research team transcribed verbatim the interview data. Personal names and locations were anonymised, transcripts were translated into English by a researcher (OG) and reviewed by a native English speaker, and differences were resolved by discussion with the research team.

During the focus groups two examples of clinical deterioration were used to prompt the recall of similar situations experienced by participants. The aim of the scenarios was to trigger the reflection on personal experiences and the expression of opinions on factors associated with different levels of escalation of care. The scenarios were written through the consensus of a group of experts from the research team, based on the BedsidePEWS score matched care recommendations for escalation of care and PICU consult (CC, CP, CO and OG). One scenario described an event with timely escalation of care, and the second described a scenario where the child deteriorated and was urgently admitted to PICU. First, staff were asked to imagine they had a 3-month-old patient admitted from the emergency room for diarrhoea and vomiting. After 4 hours, the child keeps having episodes of diarrhoea and is not feeding well. His vital signs are moderately altered and the BedsidePEWS is 4. In the evening the nursing assessment results in an increased heart rate and capillary refill, with a BedsidePEWS of 7. The physician called for a review, consults a PICU physician and prescribes an intravenous rehydration. After a few fluid boluses, the vital signs improve. Staff was asked to consider factors that might have contributed to escalation of care in this patient. Then, the case of a 5-year-old child with chronic kidney disease just transferred from the PICU to the ward was presented. Her BedsidePEWS score at ward admission is 5 and within 24 hours increases to 9. Her blood pressure is constantly below normal ranges, the heart rate is high, she is on oxygen and work of breathing increases as the hours go by. She is readmitted to PICU after 24 hours. Staff was asked to consider what factors might have prevented escalation of care resulting in an urgent PICU readmission of this child. The two scenarios were used as examples to prompt the recall of clinical deterioration events experienced by participants, and to explore factors facilitating or preventing timely escalation of care. Parents were asked to recall their experience of the clinical deterioration of their child on the ward and to describe the response of the ward staff. To trigger the discussion the interviewer described scenarios of clinical deterioration involving PICU consults, more easily understood by parents, such as of increased work of breathing or deteriorated consciousness. The interviewer asked participants to describe their opinion on what facilitates and what hinders a timely response to a child that deteriorates during hospital ward admission. Finally, they were asked their suggestions for improvement.

## Data analysis

The focus group recordings were transcribed ad verbatim by the researcher (OG). For the purpose of the analysis with a second English-speaking researcher, the transcripts were translated by the researcher (OG) into English and the translated quotations were also used for presentations and publications. Two researchers (OG and JML) conducted an independent thematic analysis of the focus group. At first, they read the interviews to familiarise themselves with the data. Then, they independently formulated the dimensions based on the identified quotations. Subthemes across the data and dimensions were formulated. They examined the quotations, dimensions and subthemes to reach a consensus on the themes, by merging or renaming the dimensions and subthemes to provide a greater understanding of the phenomenon. A third researcher (CP) reviewed the (sub)themes and any discussion was resolved through consensus.<sup>18</sup> The qualitative data analysis software NVivo V.8 was used. Descriptive statistics were used to calculate frequencies, median, mean and quartile scores of the characteristics of the focus group participants using STATA V.11.

## FINDINGS

The six focus groups were conducted between April and October 2015 with 32 participants. The focus groups had an average of five participants per group (range 4–7). Participating parents came from different wards. The demographic data of the study participants are described in [table 1](#). The mean duration of the focus group was 63 min (range 42–80 min).

Four main themes emerged from the data analysis: (1) impact of staff competencies and skills; (2) impact of relationships and leadership in care; (3) processes identifying and responding to clinical deterioration; and (4) influences of organisational factors on escalation of care. The 4 themes have been derived from 19 subthemes. Subthemes are further described by dimensions, as specific descriptions of the subthemes ([table 2](#)). Online supplementary material 2 presents the themes, subthemes and relevant quotations of the focus groups.

### Impact of staff competencies and skills

Staff competencies and skills was a theme raised by healthcare providers and parents. Subthemes include issues of standard baseline, specialty and advanced competences on the wards, the role of self-perceived ability in decision making and communication in escalation of care, and supporting less expert staff through peer-to-peer mentoring when a child deteriorates. Nurses and physicians identified differences in staff training and lack of paediatric specialty education as potential risk factors. Feelings of uncertainty and distrust were reported by physicians and nurses due to different baseline paediatric clinical competency levels of healthcare professionals. Moreover, professional credibility based on competency and experience affects communication among physicians

**Table 2** Themes, subthemes and dimensions

Themes/subthemes	Dimensions
<b>Impact of staff competencies and skills</b>	
Differences in staff training and knowledge.	Paediatric training. Specialty clinical skills.
Individual self-perceived ability in identifying clinical deterioration.	Past experiences increasing the belief about self-perceived capability of escalating care. Interdisciplinary credibility based on competence and personal assurance of own abilities.
Peer-to-peer mentoring.	Coaching less expert nurses.
Belief on ward responsibility for severely deteriorated patients: keeping high-risk patients on the ward.	Advanced skills to treat the deteriorating child.
<b>Relationships and leadership in care</b>	
Teamwork.	Integrated handover and care planning processes. Interdisciplinary rounding and huddles. Trust among staff members.
Communication.	Interprofessional and intraprofessional communication.
Knowing the patient and colleagues.	Knowing the team. Knowing the patient.
Family empowerment.	Recognising and accepting parent's competences of child's illness. Listening to parent's concerns. Family-centred needs and support.
Leadership: defining priorities.	Prioritising tasks. Unclear accountability in escalation processes.
Interprofessional hierarchies.	Empowerment in initiating escalation of care.
<b>Processes identifying and responding to clinical deterioration</b>	
Clinical observation and patient assessment practices.	Intuition—the gut feeling. Observing the patient and monitoring.
Tools supporting the identification of patient risk and decision making.	Influence of early warning scores/standardised processes. Adherence to BedsidePEWS score matched recommendations and clinical judgement.
Ward rounding.	Bedside rounding practices. Nursing and family involvement in rounds.
Situational awareness.	Interpreting clinical deterioration through the BedsidePEWS. Tunnel vision of reasons for clinical deterioration.
RRT role.	Calling RRT only in extreme clinical deterioration. Proactive patient rounding of RRT members in support of escalation processes.
<b>Hospital management: organisational factors</b>	
Staffing and workload.	Discrepancy between staffing levels and workload. Balancing nursing seniority on shift. Reduced senior staffing present on site during nights, weekends and public holidays. Clinical record documentation workload.
Production pressure.	Organisational demands on clinicians competing with patient care needs.
Management and relational continuity of care.	Service physician availability 24 hours a day.

Continued

Table 2 Continued

Themes/subthemes	Dimensions
	Nursing primary care.
	Shift structure.
Patient pathway.	Mismatch between severity of illness and level of care.
	Discrepancy between the children's illness and the specialty of the ward where they are located (specialty patients outlying on non-specialty wards).
	Availability of PICU beds.

BedsidePEWS, Bedside Paediatric Early Warning System; PICU, paediatric intensive care unit; RRT, rapid response team.

and nurses: “Because the doctor maybe won’t listen to the less experienced nurse” (FGnurse). Recalling past experiences to support clinical judgement of a deteriorating child and nursing critical care background are reported as factors facilitating escalation of care. Despite the lack of advanced resources and skills, according to PICU physicians, ward physicians believe it is their responsibility to treat deteriorating patients, as “sometimes, the attending physicians, it’s their choice to try to manage those patients on the ward” (FGphysician). According to parents, balancing nursing seniority on shift is critical for patient safety: “There are ‘older’ nurses, with a lot of experience and with them I feel very sure unfortunately now the new ones... don’t have the same experience” (FGparent). Parents also advocate for the availability of a subspecialty physician 24 hours a day on step-down units to guarantee timely escalation of care.

### Impact of relationships in care

Relationships between healthcare professionals and with family members emerged as having an important role in escalation of care. Contributing factors identified in this theme are communication, teamwork, a physician-led care team involved in ongoing patient care management, parent and nursing empowerment to call for advanced help, and the role of hierarchies and leadership. Nurses and physicians report the key role of integrated care in the process of reviewing the patient’s clinical condition, care plan and triggering escalation of care. Multi-disciplinary rounding involving parents was described as a possible quality improvement strategy. Across all focus groups issues of interprofessional communication emerged. Impaired communication affects teamwork according to healthcare professionals, affected also by time pressures, “because we do not speak, or at least I’ve got no time to talk” (FGphysician). Ward nurses reported the experience of junior staff feeling ignored by physicians when the worsening of a child’s condition is reported. Healthcare providers described the value of involving parents in the observation and decisions regarding their child’s care plan. On the other hand, parents reported insufficient communication and partnership with healthcare providers, which may result in delayed action: “she got worse, her breathing and everything, when the doctor made the rounds I showed him there was something wrong, something not going well but I don’t know, he wasn’t listening to me. He

didn’t listen to me” (FGparent). Parents also described the impact of hierarchies and cultural boundaries among healthcare professionals on decision making when a child deteriorates.

### Processes identifying and responding to clinical deterioration

Healthcare providers described a series of actions and human factors related to the recognition of the deteriorating child and escalation of care. For nurses, patient observation supported by experience and intuition was the primary activity to detect a deteriorating child. Continuous monitoring helps detect vital signs, but monitoring can be a risk if “there isn’t the clinical observation of the child” (FGphysician). Standardised observation and consistent patient rounding processes are described by nurses as factors having a positive influence on care planning and recognising changing trends of patients’ clinical conditions, “so you’re able to evaluate... a colour that changes, pain that worsens, even visually” (FGnurse). Critical thinking and situational awareness emerged as factors related to the decision-making process of escalating care. Participants reported that screening tools, such as the BedsidePEWS, were useful to help them measure and visually display vital signs with a frequency based on the child’s condition. Nurses and physicians recall cases when the BedsidePEWS was useful in identifying subtle changes in the child’s condition, even in children with chronic diseases, which may already have baseline alterations of vital signs. On the other hand, experiences of PICU referrals made late in the child’s deterioration were reported when clinicians happened to focus on single aspects of a case, resulting in a restrictive tunnel vision of the child’s condition despite elevated BedsidePEWS scores. Poor nursing empowerment to call the PICU was described as a relevant factor weakening the safety net, leading to delayed escalation. Some parents recalled alerting personally the ward or PICU physician when their child deteriorated but did not feel this should be their role. According to parents and PICU physicians, “a PICU physician should round” (FGparents) to evaluate patients at higher risk of clinical deterioration.

### Influences of organisational factors on escalation of care

Focus group participants referred organisational factors such as staffing, workload, organisational demands on

clinicians competing with patient care needs, continuity of care and patient pathways as having an impact on escalation of care. Healthcare professionals and parents reported discrepancies between staffing and workload, hindering timely escalation of care. Healthcare professionals reported clinical activities such as nursing medication preparation or blood specimen collections competing with the clinical needs of deteriorating patients. Participants in all focus groups related concerns about day and night staffing differences, potentially leading to suboptimal care. *“You have to take into account that during the day there are also all the specialists, then during the day you also feel safer because you can talk through any issues. While being alone with the PICU intensivists at night is different”* (FGphysician). Reduced staffing at night goes along with medical cross coverage of different patient specialties they do not usually assist, raising issues of continuity of care. Also, nursing shift duration, staffing and patient care assignments were reported as contributing factors, such as one stated by a nurse: *“because...changing shifts or patients too often does not help us get a sense of the history of the patient. If instead I care for a patient for 1, 2, 3 days, I know more or less the trend and if it deviates”* (FGnurse).

## DISCUSSION

Four main themes emerged from our focus group data describing factors influencing escalation of care: the impact of staff competencies and skills, the role of relationships in care, the role of processes identifying and responding to clinical deterioration, and the impact of organisational factors.

Our data illustrate the relevance of clinicians' knowledge, situational awareness and ability to manage the deteriorating patient according to parents and clinicians. Limited understanding of the signs of physiological deterioration, unreliable or selective vital signs taking, and reduced critical thinking are common in healthcare.<sup>19–21</sup> Participants in this study considered that standardised paediatric orientation and continuing education programmes supported by interactive simulation strategies are warranted to improve staff's ability to recognise, communicate and respond to deteriorating children.<sup>22–24</sup>

Health professionals and parents described relationship-based influences including interprofessional and intraprofessional communication, teamwork, previous engagement with patients and staff, stakeholder empowerment, credibility, and trust. Brady and Goldenhar<sup>11</sup> illustrated the importance of team situational awareness and the role of organisational processes to support it. Our data illustrate the importance of processes to facilitate communication and integration among different professionals at handovers and rounds. Professionals in our study described the effect of communication gaps among nurses and physicians as well as with family members on delaying risk assessment and treatment. Interprofessional miscommunications, lack of leadership and challenges prioritising among competing demands have been linked to clinical

deterioration events and poor outcomes.<sup>13 25</sup> Local healthcare and ward cultures associated with organisational factors may have a role.<sup>13</sup> Factors such as communication, respect, trust, task prioritising and unequal power have been described to affect nurse–physician collaboration.<sup>26 27</sup> Also, dismissive attitudes, described in our study, affect communications on deteriorating patients.<sup>28</sup> Improving collaborative practice and information sharing through appropriate organisational strategies, as our study participants pointed out, may have an impact on the identification of children at risk and escalation of care.

In our study we identified processes responding to clinical deterioration on the ward that are relevant to escalation of care. Patient observation, critical thinking supported by the BedsidePEWS, reducing hierarchical barriers to call for advanced help and PICU staff available for deteriorating patients emerged as fundamental elements for patient screening and escalation of care.<sup>29</sup> Despite nursing staff reporting the usefulness of the BedsidePEWS as a screening tool to spot subtle clinical changes, this study also describes experiences of reliance on personal clinical judgement as reported in other studies on this topic.<sup>29 30</sup> Our findings also described the belief in ward responsibility for severely deteriorating patients and the role of intraprofessional and interprofessional hierarchies as factors having an impact on PICU activation delay.<sup>13 14 31–33</sup> A wider proactive role of the PICU response team and nursing empowerment to call the PICU were envisioned both by staff and parents to facilitate escalation of care. The impact of breaking hierarchical boundaries and empowering staff and parents to call the PICU for advanced help is an issue that needs further evaluation and research.

Focus group participants identified organisational factors having an impact on escalation of care, such as staffing ratios, workload, continuity of care, and mismatch of patient acuity and level of care. Aiken and colleagues<sup>34 35</sup> described a correlation between nursing staffing and adult in-hospital mortality. Both PICU and ward physician staffing have also been found to be associated with reduced hospital and intensive care unit (ICU) mortality and length of stay, also on weekends.<sup>36 37</sup> There is also evidence of the impact of nurse staffing on clinical outcomes in children.<sup>38</sup> Moreover, PICU bed unavailability determines the unintended presence of high-risk patients, possibly dependent on advanced therapies, on the wards. This may increase the severity of illness of delayed urgent ICU admissions.<sup>39</sup> Limited PICU resources need to match with the capacity to provide an adequate balance of clinical expertise on wards to care for high-risk patients and prevent ICU admissions.

This study has some limitations. First, our results may not be generalisable to other hospitals. The study was conducted in a tertiary care paediatric hospital. Staffing, processes of care and patient pathways might be different in other paediatric hospitals. Second, participants' selection was performed through the ward nurse managers, who knew better available staff and parents. Inclusion

and exclusion criteria were provided to reduce the risk of selection bias. However, the results may be affected by the increased mean age of participating staff, probably due to the ageing healthcare providers' population in this context. Also, parents were mainly selected from specialty surgical wards, possibly reflecting the point of view of parents of children with chronic complex diseases, with multiple admissions and longer length of stay. Third, findings may be subject to researchers' interpretation. However, data triangulation using independent analysis of two researchers was confirmed by a third researcher, suggesting reproducibility of results. Last, the topic may be perceived as threatening to discuss in a group setting, where privacy is limited, other participants may be unknown, discussion may be dominated by specific characters and emotions may be difficult to deal with. This risk of information bias was reduced by providing a safe setting, avoiding hierarchies among healthcare providers within single groups and facilitating participants' expression of opinions and emotions through appropriate interviewing techniques.

## CONCLUSION

We identified four themes describing factors that may be associated with escalation of care in deteriorating children. These factors are useful in understanding reasons for clinical deterioration events on paediatric wards and might guide improvement in clinical practice. Experienced staffing, continuing multidisciplinary education, clear accountability and empowerment of healthcare providers through escalation protocols are recommended. These recommendations have also been reported in a realist review stating that escalation of care and RRS need to be re-examined to deliver effective and timely care delivery of deteriorating children in hospitals.<sup>40</sup> Our findings might serve as a base to create a quantitative instrument to measure the impact of individual, social and organisational factors on escalation of care. The impact of teamwork, communication and staffing models needs to be studied further related to clinical outcomes of deteriorating children in order to define new strategies to improve patient safety.

### Author affiliations

<sup>1</sup>Continuing Education and Nursing Research Unit, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

<sup>2</sup>Department of Biomedicine and Prevention, University of Rome Tor Vergata, Rome, Italy

<sup>3</sup>Department of Critical Care Medicine, The Hospital for Sick Children, Toronto, Ontario, Canada

<sup>4</sup>Department of Critical Care Medicine, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

<sup>5</sup>Clinical Epidemiology Unit, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

<sup>6</sup>Department of Cardiology and Cardiac Surgery, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

<sup>7</sup>Medical Directorate, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

<sup>8</sup>School of Nursing and Midwifery, Faculty of Health and Human Sciences, University of Plymouth, Plymouth, UK

**Acknowledgements** The research team would like to thank the hospital leadership for supporting the study, and all the staff and family members that

participated in the project. We would like to thank Elena Mita and Martina D'Amico, MS students from Sacred Heart Catholic University of Rome, for their contribution during data collection.

**Contributors** OG was involved in the conception and the design of the study, collected all data, contributed to the analysis and interpretation of the data, and led the writing of this paper. JML and CP were involved in the conception and the design of the study, supervised data collection, and contributed to the analysis of the data and the drafting of the paper. GS was involved in data collection and analysis. CC, MLCdA, IDO and CO were involved in the study conception, design and drafting of the paper. ET and MR are the guarantors.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** CP is the named inventor of the BedsidePEWS and has shares in a decision support company of which the BedsidePEWS is a product.

**Patient consent** Not required.

**Ethics approval** The hospital's ethics committee (Bambino Gesù Children's Hospital Ethics Review Board, 915\_OPBG\_2015) approved the study.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data sharing statement** Qualitative data are held on the hospital's computers, in password-protected folders. Unpublished data are available upon request to the corresponding author.

**Open Access** This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

© Article author(s) (or their employer(s) unless otherwise stated in the text of the article) 2018. All rights reserved. No commercial use is permitted unless otherwise expressly granted.

## REFERENCES

1. Wolfe I, Macfarlane A, Donkin A, *et al.* *Why children die: death in infants, children, and young people in the UK—Part A*. London: Royal College of Paediatrics and Child Health, 2014.
2. Hillman K. Health systems research & intensive care. *Intensive Care Med* 1999;25:1353–4.
3. Tume L. The deterioration of children in ward areas in a specialist children's hospital. *Nurs Crit Care* 2007;12:12–19.
4. Buist M, Bernard S, Nguyen TV, *et al.* Association between clinically abnormal observations and subsequent in-hospital mortality: a prospective study. *Resuscitation* 2004;62:137–41.
5. Pearson GA, Ward-Platt M, Harnden A, *et al.* Why children die: avoidable factors associated with child deaths. *Arch Dis Child* 2011;96:927–31.
6. McGloin H, Adam SK, Singer M. Unexpected deaths and referrals to intensive care of patients on general wards. Are some cases potentially avoidable? *J R Coll Physicians Lond* 1999;33:255–9.
7. Parshuram CS, Dryden-Palmer K, Farrell C, *et al.* Evaluating processes of care and outcomes of children in hospital (EPOCH): study protocol for a randomized controlled trial. *Trials* 2015;16:245–015–712.
8. Chapman SM, Wray J, Oulton K, *et al.* Systematic review of paediatric track and trigger systems for hospitalised children. *Resuscitation* 2016;109:87–109.
9. Bonafide CP, Roberts KE, Weirich CM, *et al.* Beyond statistical prediction: qualitative evaluation of the mechanisms by which pediatric early warning scores impact patient safety. *J Hosp Med* 2013;8:248–53.
10. Bonafide CP, Localio AR, Roberts KE, *et al.* Impact of rapid response system implementation on critical deterioration events in children. *JAMA Pediatr* 2014;168:25–33.
11. Brady PW, Goldenhar LM. A qualitative study examining the influences on situation awareness and the identification, mitigation and escalation of recognised patient risk. *BMJ Qual Saf* 2014;23:153–61.
12. Massey D, Aitken LM, Wendy C. What factors influence suboptimal ward care in the acutely ill ward patient? *Aust Crit Care* 2008;21:127–40.
13. Shearer B, Marshall S, Buist MD, *et al.* What stops hospital clinical staff from following protocols? An analysis of the incidence and factors behind the failure of bedside clinical staff to activate the

- rapid response system in a multi-campus Australian metropolitan healthcare service. *BMJ Qual Saf* 2012;21:569–75.
14. Benin AL, Borgstrom CP, Jenq GY, *et al.* Defining impact of a rapid response team: qualitative study with nurses, physicians and hospital administrators. *BMJ Qual Saf* 2012;21:391–8.
  15. Parshuram CS, Duncan HP, Joffe AR, *et al.* Multicentre validation of the bedside paediatric early warning system score: a severity of illness score to detect evolving critical illness in hospitalised children. *Crit Care* 2011;15:R184.
  16. Parshuram CS, Hutchison J, Middaugh K. Development and initial validation of the Bedside Paediatric Early Warning System score. *Crit Care* 2009;13:R135.
  17. Morrison RS, Peoples L. Using focus group methodology in nursing. *J Contin Educ Nurs* 1999;30:62–5.
  18. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3:77–101.
  19. Ludikhuijze J, Smorenburg SM, de Rooij SE, *et al.* Identification of deteriorating patients on general wards; measurement of vital parameters and potential effectiveness of the Modified Early Warning Score. *J Crit Care* 2012;27–424.e7–e13.
  20. De Meester K, Das T, Hellemans K, *et al.* Impact of a standardized nurse observation protocol including MEWS after Intensive Care Unit discharge. *Resuscitation* 2013;84:184–8.
  21. Cooper S, Kinsman L, Buykx P, *et al.* Managing the deteriorating patient in a simulated environment: nursing students' knowledge, skill and situation awareness. *J Clin Nurs* 2010;19:2309–18.
  22. Liaw SY, Wong LF, Lim EY, *et al.* Effectiveness of a Web-Based Simulation in Improving Nurses' Workplace Practice With Deteriorating Ward Patients: A Pre- and Postintervention Study. *J Med Internet Res* 2016;18:e37.
  23. Callaghan A, Kinsman L, Cooper S, *et al.* The factors that influence junior doctors' capacity to recognise, respond and manage patient deterioration in an acute ward setting: An integrative review. *Aust Crit Care* 2017;30.
  24. Liaw SY, Scherpbier A, Klainin-Yobas P, *et al.* A review of educational strategies to improve nurses' roles in recognizing and responding to deteriorating patients. *Int Nurs Rev* 2011;58:296–303.
  25. Australian Commission on Safety and Quality in Healthcare. Safety and Quality Improvement Guide Standard 9: Recognising and Responding to Clinical Deterioration in Acute Health Care. 2012 <https://www.safetyandquality.gov.au/publications/safety-and-quality-improvement-guide-standard-9-recognising-and-responding-to-clinical-deterioration-in-acute-health-care-october-2012/> (accessed 11 May 2017).
  26. Tang CJ, Chan SW, Zhou WT, *et al.* Collaboration between hospital physicians and nurses: an integrated literature review. *Int Nurs Rev* 2013;60:291–302.
  27. Sterchi LS. Perceptions that affect physician-nurse collaboration in the perioperative setting. *Aorn J* 2007;86:45–57.
  28. Weller JM, Barrow M, Gasquoine S. Interprofessional collaboration among junior doctors and nurses in the hospital setting. *Med Educ* 2011;45:478–87.
  29. DeVita MA, Smith GB, Adam SK, *et al.* "Identifying the hospitalised patient in crisis"—a consensus conference on the afferent limb of rapid response systems. *Resuscitation* 2010;81:375–82.
  30. Odell M. Detection and management of the deteriorating ward patient: an evaluation of nursing practice. *J Clin Nurs* 2015;24:173–82.
  31. Davies O, DeVita MA, Ayinla R, *et al.* Barriers to activation of the rapid response system. *Resuscitation* 2014;85:1557–61.
  32. Massey D, Chaboyer W, Aitken L. Nurses' perceptions of accessing a Medical Emergency Team: a qualitative study. *Aust Crit Care* 2014;27:133–8.
  33. Roberts KE, Bonafide CP, Paine CW, *et al.* Barriers to calling for urgent assistance despite a comprehensive pediatric rapid response system. *Am J Crit Care* 2014;23:223–9.
  34. Aiken LH, Sloane DM, Bruyneel L, *et al.* Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet* 2014;383:1824–30.
  35. Aiken LH, Clarke SP, Sloane DM, *et al.* Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA* 2002;288:1987–93.
  36. Pronovost PJ, Angus DC, Dorman T, *et al.* Physician staffing patterns and clinical outcomes in critically ill patients: a systematic review. *JAMA* 2002;288:2151–62.
  37. Glance LG, Osler T, Li Y, *et al.* Outcomes are Worse in US Patients Undergoing Surgery on Weekends Compared With Weekdays. *Med Care* 2016;54:608–15.
  38. Wilson S, Bremner A, Hauck Y, *et al.* The effect of nurse staffing on clinical outcomes of children in hospital: a systematic review. *Int J Evid Based Healthc* 2011;9:97–121.
  39. Wunsch H, Angus DC, Harrison DA, *et al.* Variation in critical care services across North America and Western Europe. *Crit Care Med* 2008;36:2787–8.
  40. McGaughey J, O'Halloran P, Porter S, *et al.* Early warning systems and rapid response to the deteriorating patient in hospital: A systematic realist review. *J Adv Nurs* 2017;73:2877–91.