Developing and Optimising Observation and Monitoring Guidance for a Paediatric Early Warning System

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Method Article

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Abstract

Background: Hospitalised children experience predictable and potentially preventable life-threatening events in hospital that may be reduced by early warning systems. With the current interest in developing a national PEW system, and in the absence of relevant literature, we present guidance from a mature programme that may be useful to those institutions that are currently planning implementation or modification of an existing system.

Objectives: To develop an evidence and expert based observation and monitoring guidance as the standard and recommended practice underpinning a wider Paediatric Early Warning (PEW) system

Design: Case study using mixed methods of literature reviews, consultation, focus groups and co-production.

Setting: A specialist children's hospital.

Methods: This report outlines the development of the original guidance through consultation and co-production using a literature review and multi-professional focus groups and subsequent iterative changes.

Results: The original (2008) and the current (2019) guidance are presented to show the modifications over time including ergonomic chart design, documenting parental concern, continuous monitoring, alarm management, fluid balance and hydration risk assessment, Sepsis 6, conditions to omit and de-escalate observations, and documentation of significant clinical events contemporaneously on the observation chart. Our guidance is compared to the Royal College of Nursing Guidance (2017), which includes good general guidance for performing routine observations correctly, but still limited guidance on the triage/ admission interface, frequency of routine observations, escalation and de-escalation of frequency and type of observations, and specialist observations.

Conclusions: We have evolved evidence and expert based observation and monitoring guidance to support the implementation and maintenance of a PEW system over 12 years. The guidance sets standards of care to educate and guide clinicians and provides a template for assessment of that standard of care.

TWEETABLE ABSTRACT

Evidence and expert based observation and monitoring guidance to support the implementation and maintenance of a Paediatric Early Warning system.

Introduction

Approximately 50-75% of hospitalised children show physiological signs of deterioration prior to suffering a life-threatening event (including cardiac arrest, respiratory arrest or peri-arrest call for urgent help) and unplanned admission from the ward to the Paediatric Intensive Care (PIC)¹⁻³. These events result in increased hospital morbidity and mortality and are devastating for children, their families and clinicians^{4,5}. Paediatric Early Warning (PEW) systems may reduce predictable and preventable life-threatening events and mortality¹⁻⁵.

A PEW system was developed in 2007 and introduced in 2008 to reduce potentially avoidable cardiac arrests and mortality in our hospital. We used the Medical Research Council's framework for the design and evaluation of complex interventions, which included four interactive and dynamic phases: development, feasibility/piloting, evaluation and implementation⁶. The observation and monitoring guidance was developed alongside standardisation of monitoring and fluid charts, an aggregate PEW score and an education program. The education program included online teaching packages and face-to-face teaching from bedside support through simulation training to ensure that all staff could accurately perform routine clinical assessments and communicate concerns to ensure that appropriate response and assistance were obtained for a deteriorating child.

The guidance formed the important foundation of the PEW system. The purpose was to collate recommendations for good practice to use them as (1) a standard of care for the identification of clinical deterioration in routine practice, (2) guidance for education and (3) to provide a comparator during review of all life threatening events and unplanned PIC admissions of the standard of care, knowledge and improvement opportunities. In 2007, at the time of this development, there was no literature to guide the frequency or type of observation and/or monitoring for children other than a short report for children cared for in a surgical ward⁷. Alder Hey Hospital produced the first guidance in the UK and kindly shared this with us. Our work contributed to, and built on, the Royal College of Nursing (RCN) guidance 2007; subsequently updated in 2017⁸. This provides good guidance for performing routine observations correctly but still limited guidance on the triage/admission interface, frequency of routine observations, escalation and de-escalation of frequency and type, indications for continuous monitoring and specialist observations.

This case study report outlines the original development of observation and monitoring guidance (2008) and the subsequent update (2019) to show the modifications of the guidance over time. [Appendix 1] The comparison between our guidance and the RCN guidance highlights the areas that are required for specialised context-specific guidance that has evolved using a continuous review of avoidable factors [Table 1]. We hope this will prove useful to the national early warning system and those institutions that are currently planning implementation or improvement.

Methods

Context: A specialist children's hospital providing primary, secondary, tertiary and quaternary care for specialist conditions to the UK populations. The hospital has 220 beds, including 15 higher dependency beds in specialist wards and 31 PIC beds. Admission rates have increased from 33000/year in 2007 to 45000/year in 2018. Patients may be admitted directly from outpatients to the wards, as emergency referrals to specialist teams or via the emergency department. Ethical permission was not required for this study.

Process: The initial development of the guidance was through consultation and co-production using a literature review and focus groups. A working party with representative nurses and doctors worked together to develop and refine the content and detail of the guidance and participated in a consensus process.

A literature review was conducted to identify relevant published literature (1966-2007). Searches were performed on PUBMED, CINAHL and Web of Science for existing evidence on observation and monitoring practices. Extensive grey literature searches were conducted for standards and guidance from the Royal College of

Paediatrics, Royal College of Nursing, American Association of Paediatrics, National Institute of Health and Care Excellence (NICE) and the National Patient Safety Association (NPSA). The literature was summarised for presentation to the focus groups.

All clinical staff were invited to participate in focus groups held at BCH in March 2007. Additional purposeful sampling ensured adequate clinical breadth and expertise. Attendees were asked what elements of observation and monitoring should be included in the policy. The responses were grouped into themes and incorporated with the relevant literature into the draft guidance. This provided overall content, identified published recommendations on the topics and highlighted gaps where expert opinion would be required.

The guidance included two levels of recommendation:

- 1) *Standards*: an acceptable baseline standard of care from national published guidance that should always be achieved.
- 2) *Guidance*: experts recommended best practices that should be achieved where possible.

The target for adoption of >90% consensus on content, format and level of recommendation was achieved after three modified Delphi rounds with the working party members. A pilot of the guidance on four wards was conducted to identify areas of discrepancy, poor clarity and omission and to refine the final 2008 version.

Revisions in 2011 and 2015 used similar expert working parties, updated the literature review and collected learning from clinical incident reporting. In 2011, the two levels of recommendation (standard versus guidance) were removed because they did not contribute to functionality. Initially, the guidance was only applied to inpatient ward areas. Over time, due to problems around deterioration during patient transfers, the guidance has been extended to include all clinical areas (PIC, Theatre Recovery, day care units, Haemodialysis and the Emergency Department) except operating theatres.

A small group of experts reviewed all life-threatening events and unplanned PIC admissions to assess the clinical treatment provided, assess the standards of care in comparison to the observation and monitoring guidance and to identify areas for improvement and fed back to the individual clinical teams. These cases identified omissions in the guidance and deviations due to implicit knowledge and beliefs. Learning from these cases was tracked over time and included in updated guidance. Acute life-threatening events were categorised as predictable or not and potentially preventable or not. Unplanned PIC admissions were assessed as either timely or untimely. We started with published definitions⁹ and over time evolved our own definitions.

Results

The full initial Observation and Monitoring Policy 2008 (Appendix 1) and current Observation, Monitoring and Escalation Policy 2019 (Appendix 2) are attached to provide detail. The guidance included hyperlinks to current clinical guidelines and references the source literature when available.

a) Change of guidance content

The changes in content of the guidance reflected new published standards and guidance, feedback from the reviewed cases, the need to incorporate parental concern and escalation, changes to governance structures and

the addition of Nursing Care Quality Indicators.

A full comparison is presented in Appendix 3. The main changes included:

- i) Parental concern has been integrated into each set of routine observations. A leaflet called 'Listening to you' is given to parents to help them communicate their concerns.
- ii) Quick tips to answer frequent questions.
- iii) Continuous and intermittent cardiorespiratory monitoring is detailed for certain conditions and medications.
- iv) The documentation on the chart is clarified with pictures.
- v) Alarm management
- vi) The use of extension charts for respiratory support, neurological and cardiac catheter observations.
- vii) Indications for continuous pulse oximetry and sensor positioning.
- viii) Oxygen is a medication and therefore must be prescribed or administered via a patient group directive, and each set of observations requires a signature.
- ix) Fluid balance observations, target fluid volumes and hydration risk assessment.
- x) Sepsis 6 identification and treatment is included¹⁰
- xi) Conditions to omit and de-escalate observations.
- xii) Documentation of significant clinical events contemporaneously on the observation chart.
- xiii) Department- and condition-specific observations.
- xiv) Guidance and chart design incorporate ergonomic design.

b) The use of the PEW score chart influences guidance

The guidance is closely linked to the observation chart and how it is used. Our current revision of the chart has incorporated ergonomic recommendations, including altering the layout to improve the process flow, completeness of documentation and specific questions for parental concern. The guidance has therefore been updated with these recommendations to support practice change and clinical decision-making. Similarly, when we introduced the Paediatric Sepsis 6 initiative¹⁰ and included ideas from other hospitals (e.g., Parental/Nurse concern, planned observation frequency, patient-specific risk factors and a signature for each set of observations), the guidance was updated accordingly.

c) Enhanced scoring

The guidance provides clear instructions for these situations to ensure consistency in practice. In our aggregate PEW score deviations from "normal physiology for age" accrue scores of one, two or four. There are some "at risk" patient groups that we score higher to reflect their additional risk. For example, all patients on enhanced

respiratory support, such as humidified high flow oxygen or continuous positive airway pressure, will be scored four for oxygen delivery (in the category >4 l/min/ $>50\%$), for the gas flow even though they may be in air (usually zero), because this reflects the higher risk we see in patients on respiratory support. Similarly, cyanotic patients are still scored four for pulse oximetry $\geq 91\%$, even though it is normal for them. Their own normal pulse oximetry range will be documented in the patient-specific parameters.

d) Ownership and Governance

The PEW system, including observation and monitoring guidance, is managed by the Director of Nursing for Quality & Safety. Revisions are multi-professional and systematic and include information from risk reporting through the governance department.

The guidance is used as part of the Morbidity and Mortality review process to determine whether there were avoidable factors associated with patient harm. The results of these reviews are reported quarterly at the Executive Board level in the Trust Quality Report and to our Commissioners. The guidance is a very important template and keeps potential avoidable harm visible to senior decision-makers. Because our guidance is used in serious incident reviews, it has also been used in coronial and civil courts to determine acceptable standards of care.

Charts and guidance need careful version control when they are revised. Printers have simply switched out the age group on a chart resulting in incorrect thresholds, with a resultant increase in clinical risk. Each change requires clear responsibility for updating the intranet and introducing it into the education and training of existing and new starters to the organisation.

e) Differences between Birmingham Children's Hospital (BCH) and RCN guidance.

The purpose of the RCN guidance is to standardise the performance of vital sign measurement. The purpose of BCH guidance is the performance of observations, monitoring, documenting and communicating that information to detect, evaluate and manage clinical deterioration. The BCH guidance includes similar information to the RCN guidance but is broader, context-specific and provides standards for monitoring a wide range of situations and conditions appropriate to our resources. There is guidance on triage and the transition to admission observations, planning the normal frequency of observations, continuous monitoring, escalation and de-escalation of observations for stable children. It also extends to fluid balance monitoring as well monitoring for sedation and procedures. At BCH, a PEW score is required with each set of observations rather than being optional. Learning from events can be seen in the advice about what to do if your concerns are not adequately addressed, a warning about looking for (and so not missing) deterioration when starting a new chart and listening to parental concern. The RCN guidance provides an interesting section on teaching children and families about observations not included in the BCH guidance. They are complimentary, both useful in their different areas of focus and should be adapted to the local context of patients and resources.

Discussion

We present our original and current observation and monitoring guidance from our specialist children's hospital from development to current iteration, as it has evolved over 12 years since the implementation of a PEW

system in 2008. The content and detail of the guidance has been vital in training our clinicians and ensuring that our children receive a high standard of care.

Much of the literature surrounding early warning has focused on the content and performance of the varied scores and response teams¹¹⁻¹³. There is little guidance about how frequently the observations and monitoring that contribute to the early warning scores should be and are performed¹²⁻¹⁴. The systematic literature review of Lambert et al. identified 16 studies relating to the cultural and socio/technical PEW system implementation strategies, none of which dealt with which vital signs should be monitored or the frequency, escalation and de-escalation of monitoring practice¹². The RCN guidance provides a good foundation for accurate measurement of vital signs⁸. Because it is broad guidance for all health care environments, it therefore lacks detail of how often and which observations and monitoring should be performed in different circumstances and settings. Like the overall PEW system, the guidance needs to be adapted to the context and the resources available for each organisation^{12,13}.

There are limitations to this single centre, specialised hospital development of observation and monitoring guidance. The content reflects a complex and specialised patient group that may have limited relevance to other primary, secondary or even tertiary environments. However, this guidance has been shared and adopted by many such institutions (in primary and secondary care) that have selected the relevant information and omitted monitoring for more complex interventions. In our current guidance, there is no reference to electronic patient records and the behaviours required to support active vital sign input because we do not yet have an electronic patient record.

Prior to implementation of a PEW system, there is significant variation (25 to 88%) in the frequency of observations^{1,2,15}. Two randomised control trials^{2,16} and a systematic literature review¹⁷ have shown that following implementation of a PEW system, there is demonstrable improvement in observation performance and patient mortality. It has also been shown that effective identification, rather than response team attendance, is associated with these improved outcomes^{18,19}. Since we started developing our PEW system, international interest has resulted in online publications of guidelines adapted to various clinical contexts²⁰⁻²⁵. Despite this, there is little information on the development and no real-life testing reported. We therefore hope that this description of the 12-year real-life evolution of observation and monitoring guidance will be useful to those institutions that are planning to implement a PEW system, or like us, seeking continuous improvement, to deliver optimal care and avoid avoidable harm.

Observation and monitoring guidance needs to be context specific for the patient spectrum, the treatments offered and the resources available to respond to escalation. To have an impact on patient outcomes, guidance needs to be used across the spectrum of education, clinical practice and review of specific patient and population outcomes. This translation of guidance to practical application requires understanding the local social and cultural environment. When we started in 2007, the Medical Research Council's framework literature on implementing complex interventions in health care was the most appropriate among the limited literature⁶. Now, there is a wealth of literature on implementation science research and publication in healthcare^{26,27} as well as updated guidance on designing an early warning system with appropriate outcomes²⁸. The Sociocultural Framework of Compliance²⁹ and Framework for Theorizing and Evaluating Nonadoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies (NASSS)³⁰ include

useful multi-level strategies to identify local facilitators and barriers to change the behaviours required to support improved outcomes. We have started using the NASSS framework to guide future maintenance and development that will be targeted towards wireless and active vital sign input and the interaction with an electronic patient record.

Conclusion

We have evolved evidence and expert-based observation and monitoring guidance to support the implementation and maintenance of a PEW system and a clear standard of care for our specialised hospital. There is limited published guidance on the observation and monitoring of hospitalised children and no reports of real-world testing. Our guidance complements the latest RCN standards⁸, which addresses how to correctly perform routine observations. The addition of performing observations at the triage/admission interface, frequency of routine observations, escalation and de-escalation of frequency and type of observations, and specialist observations provides a practical standard of care. Current practice and intermittent review of our guidance performance has led to the introduction of ergonomic chart design, documenting parental concern, continuous monitoring, alarm management, fluid balance and hydration risk assessment, Sepsis 6¹⁰, conditions to omit or de-escalate observations, and documentation of significant clinical events contemporaneously on the observation chart. Our guidance has set a standard of care that serves to educate and guide our clinicians and to provide a template for the assessment of that standard of care during case review to identify when we fall short of our aspired standard of care. We believe our context-specific guidance supports safe care within an early warning system.

Declarations

CONFLICT OF INTEREST

The authors have no conflicts of interest.

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Table

Table 1 is available in the Supplemental Files section

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table1.ComparisonofRCNandBCHobservationandmonitoringguidance.pages](#)
- [ObservationMonitoringPolicy2019pdf.pdf](#)