Paediatric Early Warning Systems: myths and muses

Damian Roland

Abstract

The concept of using early warning systems to detect deterioration in patients in hospitals is well established in healthcare systems. However their implementation has not always been in parallel with the available evidence. The face validity of tools that alert staff to early changes in physiological and observational parameters is a significant driver to their spread. However there are a number of factors which should give healthcare providers pause for thought. This review examines some common questions raised about PEWS (Paediatric Early Warning Systems) and discusses how we might use them to their maximum potential.

Keywords Paediatric Early Warning Scores; Paediatric Early Warning Systems; patient safety; PEWS

Background

There are some illnesses, injuries and disease processes that can't be altered and therefore, regardless of the best medical care, the outcome for these children and young people will always be tragic. However it is an uncomfortable paradigm that death may be an avoidable event in the very institution which should be expert at preventing it. Internationally, improvement bodies and regulators have raised concerns over preventable mortality in inpatients but while the chain of events needed to respond to the deteriorating child is clear; the best methodologies of doing this have yet to be clearly defined (Figure 1).

Scores vs systems

A number of systematic reviews have explored the range of tools developed to recognise in hospital deterioration but there is no one tool that appears to deliver the required specificity and sensitivity. This is a complex area of research as definitions are not universal and outcomes extremely variable. For example, the term PEWS has been used to mean Paediatric Early Warning *Score* and Paediatric Early Warning *System*. A *score* being the amalgamation of various physiological and observational parameters into a singular descriptor of their extent of deviation from normal. Track and trigger is a term used to describe this process with various models having been published (Table 1).

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A *system* includes how the escalation and response to a change in score occurs. Self-evidently this needs to be robust if you are going to affect patient outcomes. Unfortunately the outcome you are looking to alter is often a challenge to define. Mortality is a rare event in children's hospitals, so much so that studies have struggled to run over long enough time periods to demonstrate significant change. Admission to intensive care is often used as a proxy but generates bias when comparing tertiary institutions (which contain their own units) with secondary care hospitals (which need to transfer patients to tertiary centres). Furthermore smaller hospitals are rarely able to provide a rapid response teams (a dedicated group of healthcare professionals who can be called if there are concerns about a child) in addition to the child's normal medical and nursing care.

Defining outcomes

As a result of these, and other challenges, PEWS (scores and systems) have developed in a somewhat ad hoc fashion. In the United Kingdom there has been a clear growth in the use of PEWS but a huge amount of variation in their design and use. A number of potential challenges have surfaced which need to be addressed if we are to improve patient outcomes, one of which is having standard outcomes and definitions for illness.

Being able to recognise an ill child is a fundamental component of medical training. Everyone thinks they know what ill looks like. However although for individual diseases we have stratification of severity (e.g. asthma and croup scores) we rarely record a standard definition of illness which is linked to outcome. The Paediatric Index of mortality score (PIM2) is one such system and provides a way of evaluating performance between different units. There is no similar ward based tool and the fact that PICU admission occurs on a relatively infrequent basis means PIM2, or equivalents, are probably not useful to apply on the wards. Location of care describes the differences in dependency between ward, high dependency and intensive care units as a measure of severity of illness regardless of underlying condition. However staffing, capacity and skill mix often mean that a child may be placed in a location which is not optimal or required for their needs. Standardisation of illness is relevant as it would help us understand in which situations a PEWS (system) approach would be beneficial and when the outcome of illness is unlikely to be altered. This is particularly important for non-ward based areas where children are seen. Of relevance are Emergency Departments where children are often untreated prior to arrival and may demonstrate extremely prompt deterioration. Numerous studies have failed to show an impact of PEWS in these environments. The unique physiology of children with cardiac lesions has prompted the development of cardiac specific PEWS. Similar arguments can be made for oncology and long term ventilation units. The heterogeneity of illness is one of the reasons why senior medical and nursing staff reject PEWS, "*it will work on their ward, but not ours*". This is compounded by the fact they have witnessed first-hand the realities that dispel two common myths.

Myth 1: abnormal observations mean abnormal outcomes

Because fever and distress can elevate heart and respiratory rate in the absence of serious bacterial illness it is challenging to

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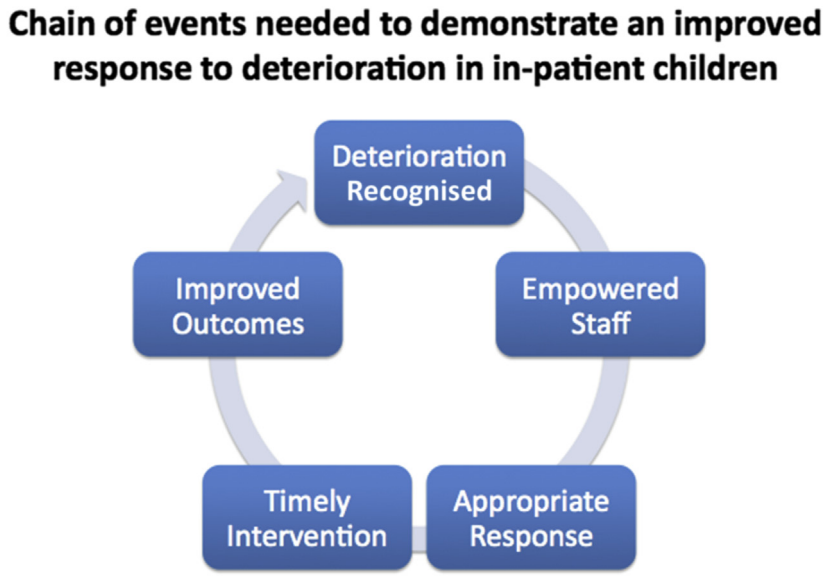

Ioffe AR, Anton NR, Burkholder SC. Reduction in Hospital Mortality Over Time in a Hospital Without a Pediatric Medical Emergency Team: Limitations of Before-and-After Study Designs. Arch Pediatr Adolesc Med 2011;165(5):419-423.

Figure 1

Definitions of track and trigger systems

Four categories of track and trigger system (as defined by the National Institute for Clinical Excellence, NICE)

Single parameter system	Periodic observation of selected vital signs that are compared with a simple set of criteria with predefined thresholds, with a response algorithm being activated when any criterion is met.
Multiple parameter system	Response algorithm requires more than one criterion to be met, or differs according to the number of criteria met.
Aggregate scoring system	Weighted scores are assigned to physiological values and compared with predefined trigger thresholds.
Combination system	Single or multiple parameter systems used in combination with aggregate weighted scoring systems.

Table 1

create vital sign tables which do not trigger a large number of false positives. While an increasingly elevated heart rate is often noticed in retrospect following serious adverse events, tachycardia in children is common. In a study of children on a small hospitals observation ward 43% (148/334) of those who were ultimately diagnosed as having minor illness (conditions in which the child would recover without treatment and without sequelae) had an elevated heart rate. An extremely large American study determined that 6122 of 40,356 included patients met Systemic Inflammatory Response Syndrome criteria but 81.6% (4993 patients) of these were discharged without treatment or return within 72 hours. The belief that observations generate additional work often reduces engagement (Figure 2). The impact of this has been quantified in an Emergency Department where it was shown review activations may have generated an additional 7060 minutes of work for no net benefit.

Myth 2: normal sets of observations mean normal outcomes

Conversely it is not always the case the absence of deranged physiology is reassuring. In a study conducted in a large tertiary hospital in the UK there were 11 adverse outcomes in children with only 0—1 sets of abnormal observations. To avoid missing the child who is unwell despite normal observations integration of clinician gut feeling, sometimes described as tacit knowledge, into PEWS occurs in a number of systems. However the individual impact of this is not clear. The concept of identifying 'watchers' is increasing in use. This approach allows staff to identify children on their wards who they feel are most at risk of deterioration. This is not just based on their clinical background but the instincts of staff who are caring for them. Parent involvement is also recognised as being invaluable in detecting the child who may not trigger on established scoring mechanisms but appear 'not quite right' to their carers. A study in America demonstrated that parent 'red' calls were more accurate than clinician ones.

The now

Creating a PEWS (system) which is can reliably recognise the deteriorating child taking into account parental and clinician concerns, escalate appropriately and allow for an appropriate response is clearly a challenge. However ignoring this challenge is not an option. Currently there are a number of studies that might clarify the best approaches to some of these difficult questions. Parshurum et al's multi-centre validation of BPEWS

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