Paediatric early warning systems (PEWS and Trigger systems) for the hospitalised child: time to focus on the evidence

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Paediatric early warning systems (PES) detect trends of abnormality and indicate the need for care escalation, the extent of which depending on the value of score, for example, from nursing review to consultant input being required. Two broad systems exist: Trigger systems and early warning scores (PEWS). Trigger systems operate in an ‘all or nothing’ fashion as they activate an urgent clinical review when one of the trigger criteria is reported. PEWS systems assign an aggregated score according to the degree of physiological derangement and the presence or absence of other factors such as staff or carer concern and comorbidities of patients. Over a decade ago, a number of hospital serious case reviews into child deaths identified contributory factors being deficiencies in clinical assessment and the failure to act on deteriorating vital signs. In response, the UK National Patient Safety Agency, National Institute for Health and Clinical Excellence, together with the UK Confidential Enquiry into Maternal and Child Health report ‘Why Children Die’ made recommendations for the use of early warning systems. The recommendations have been broadly implemented with the proportion of UK paediatric hospital units using PES rising from <25% in 2005 to 85% in 2012.1 During the same period, a proliferation in the types of PES have occurred since the introduction and validation of the Brighton score in 2005 with over 30 scores now in use,1 all having varying degrees of validation. Differences in expert opinion on which parameters (including physiological, comorbidities and staff intuition) are most important in determining illness severity have largely driven the creation of the different scores and at this time no consensus on the overall best performing score exists. The NHS Institute for Innovation and Improvement has adopted a modification of the Brighton score, the NHS PEWS III, which has moderate sensitivity and specificity in detecting clinical deterioration.2

Chapman et al3 aim to address this issue of score validation in hospitalised children and report on the performance of 18 different PES, (12 PEWS and 6 ‘Trigger systems’), to detect critical deterioration in hospitalised children prior to respiratory/cardiac arrest, unplanned intensive care admission or unexpected death. This retrospective case control study examining 224 case patients (with 297 events) with 244 age matched controls show wide variation in the performance across the 18 PES, with the Trigger systems often overestimating the level of care required, with an area under the receiver operative curve (AUROC) <0.73. PEWS however performed better than Trigger systems, the best three performing PEWS systems being Cardif and Vale, Bedside PEWS and Modified PEWS III, sacrificing poorer sensitivity for better specificity. Their AUROCs were ≥0.87 (which would be considered as a good) and are consistent with the results of other studies.2 4 5 These PEWS could identify cases from a median time of 17–39.5 hours before critical deterioration. No clear defining features of the components of the individual scoring systems helped to characterise why one system worked better than another and indeed the more complex systems encompassing more scoring parameters did not have an overall advantage over the simpler systems. Their paper is subject to the limitations of being retrospective with significant missing data. Sixty-four per cent of observational data sets had incomplete data and missing data parameters were presumed to be normal, therefore increasing the risk of underestimating illness scores and their performance. It was conducted in a tertiary children’s hospital with a patient population not necessarily representative of the wider paediatric inpatient population. Cases tended to be patients admitted as an emergency (64.6% cases vs 39.2% controls) and, although the authors attempted to match cases by ‘ward specialty’, there is still likely to be variation in the nature of medical conditions and illness severity within the ward groups. However, the work highlights a crucial issue of varying performances of different illness scores. There are likely other scores in use, developed locally in institutions based on expert opinion, that have yet to undergo formal validation so that the 18 systems studied here may be the tip of the iceberg. Indeed, in the context of this study, the PEWS developed locally at the investigator’s institution was ranked 10th and has now been replaced with the Bedside PEWS.

The vogue for implementing paediatric scoring systems is seen beyond the population of inpatient children—they are common place in health telephone triage systems and prehospital emergency services. Their utility in the children’s emergency department is variable. But do they work well for what they were designed to do, that is, reduce mortality and morbidity? In 2015, the Paediatric Task Force under the umbrella of the International Liaison Committee of Resuscitation, in their Consensus on Science and Treatment Recommendations, did not find sufficient evidence to say confidently that using PES as opposed to not using PES affected overall hospital mortality or unplanned paediatric intensive care unit admission, and that further prospective evaluation was needed.6 Without vigorous validation, scores that were intended to prevent harm may paradoxically do the opposite. This may be through either under-reporting illness severity leading to late detection of critical deterioration or over-reporting leading to escalation fatigue for staff, overinvestigation of patients and misuse of overstretched resources.

The positive aspects of illness scores are that they increase awareness of staff to monitor vital signs regularly, for the staff to recognise physiological abnormality earlier and to escalate concerns in a timely way leading to agreed management pathways. The use of a score also creates a common form of communication that all staff with differing levels of training can understand. If this way of working could be combined with using validated scores there will be benefit to patients and lives may be saved.

In conclusion, Chapman et al3 have shown that some PES perform better than others, and that overall, PEWS...
perform better than Trigger systems. Based on the current evidence, Cardiff and Vale, Bedside PEWS and Modified PEWS III perform best and should be used over poorer performing or yet to be validated systems. Their work also highlights the need to robustly evaluate these systems before their implementation.

The question of 'do early warning scores help detect critical deterioration early and improve outcomes' will require multicentre prospective evaluation with collaborative agreement on methodology and outcomes. Investigating the impact individual parameters (including physiological, comorbidities and staff concerns as measures) have on predicting deterioration will allow better weighting of scores and subsequently the creation of more refined scoring systems. Ideally a single unifying PES could be developed.

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