

Evidence Summary: Deteriorating Patient (Children)

This summary focuses on best available evidence from 2011 to July 2014, for children aged 0-18 and is restricted to UK studies.

Early warning tools aid early identification of children at risk of clinical deterioration. There are no published randomised controlled trials performed in paediatric populations. A 2014 cross-sectional survey¹ looked at the use of paediatric early warning systems (PEWS) and rapid response teams (RRTs) in paediatric units in Great Britain. 85% of units were using PEWS and 18% had an RRT in place. A large number of PEWS were in use, the majority of which were unpublished and unvalidated systems. Despite the inconclusive evidence of effectiveness, the use of PEWS has increased since 2005. The implementation has been inconsistent with large variation in the PEWS used, the activation criteria used, availability of an RRT and the membership of the RRT.

The literature search identified two cohort studies when searching for care of the deteriorating child. The first cohort study looks specifically at neonates and compares a Neonatal trigger score to an established paediatric early warning score.

Neonatal Early Warning Tools

Neonatal trigger score out-performed PEWS (paediatric Early Warning System)

- based on cohort study
- 485 neonates - All neonates >35 weeks' gestation admitted to the NICU over an 18-month period, and an age-matched "well" cohort
- All neonates >35 weeks' gestation admitted to the NICU over an 18-month period, and an age-matched "well" cohort, were retrospectively scored by using the newly constructed NTS and all established paediatric early warning system (PEWS) scores.
- NTS score area under the receiver operating characteristic curve was 0.924 with a score of 2 or more predicting need for admission to the NICU with 77% sensitivity and 97% specificity
- Neonates scoring >2 had increased odds of needing intensive care (odds ratio [OR] 48.7, 95% confidence interval [CI] 27.5-86.3), intravenous fluids (OR 48.1, 95% CI 23.9-96.9), and continuous positive airway pressure (OR 29.5, 95% CI 6.9-125.8).
- The NTS was more sensitive than currently established PEWS scores
- NTS out-performed PEWS, with significantly better sensitivity, particularly in neonates who deteriorated within the first 12 hours after birth ($P < .001$) or in neonates with sepsis or respiratory symptoms ($P < .001$). Neonates with a score of 1 should be reviewed and those scoring >2 should be considered for NICU admission for further management.
- Reference - [Pediatrics 2013 Mar;131\(3\):e837²](#)

Pediatric Early Warning Tools

The second cohort study looks at the Melbourne Activation Criteria for identifying deteriorating children.

The Melbourne Activation Criteria had reasonable sensitivity, but at the cost of low specificity and positive predictive value.

- based on retrospective validation cohort study
- 1000 patients from admissions to all paediatric wards at the University Hospital of Wales
- A single abnormal observation determined by the Melbourne Activation Criteria (MAC) had a sensitivity of 68.3% (95% CI 57.7 to 77.3), specificity 83.2% (95% CI 83.1 to 83.2), positive predictive value (PPV) 3.6% (95% CI 3.0 to 4.0) and negative predictive value 99.7% (95% CI 99.5 to 99.8) for an adverse outcome.
- Seven of the 16 children (43.8%) would not have transgressed the MAC prior to the adverse outcomes.
- Four hundred and sixty-nine of the 984 children (47.7%) who did not have an adverse outcome would have transgressed the MAC at least once during the admission
- The MAC has a low PPV and its full implementation would result in a large number of false positive triggers.
- Reference – [Archives of Disease in Childhood, 2011 Feb;96\(2\):174](#)³

There were three case control studies identifying scores to predict clinical deterioration in hospitalised children.

Bedside PEWS score identified children at risk for cardiopulmonary arrest.

- based on multicentre, case-control study
- Case patients had experienced a clinical deterioration event involving either an immediate call to a resuscitation team or urgent admission to a paediatric intensive care unit. Control patients had no events..
- The scores ranged from 0 to 26 and were assessed in the 24 hours prior to the clinical deterioration event. Score performance was assessed using the area under the receiver operating characteristic (AUCROC) curve by comparison with the retrospective rating of nurses and the temporal progression of scores in case patients
- In the study of 2,074 patients at 4 university-affiliated centres, the Bedside PEWS score was able to identify patients at risk with at least one hour's notice.
- The median (interquartile range) maximum Bedside PEWS scores for the 12 hours ending 1 hour before the clinical deterioration event were 8 (5 to 12) in case patients and 2 (1 to 4) in control patients ($P < 0.0001$). The AUCROC curve (95% confidence interval) was 0.87 (0.85 to 0.89). In case patients, mean scores were 5.3 at 20 to 24 hours and 8.4 at 0 to 4 hours before the event ($P < 0.0001$). The AUCROC curve (95% CI) of the retrospective nurse ratings was 0.83 (0.81 to 0.86). This was significantly lower than that of the Bedside PEWS score ($P < 0.0001$).

- the Bedside PEWS score could distinguish 'sick' from 'well' hospitalised patients and that this score increased during the time leading up to events and was consistently high in case patients independently of the number of risk factors for near and actual cardiopulmonary arrest.
- Reference – [Critical Care 2011;15\(4\):184](#)⁴

Use of the modified Pediatric Early Warning Score can help identify patients on wards who are at risk for deterioration

- based on retrospective case-control study
- study population included 100 cases and 250 controls.
- we used a modified version of the Brighton PEWS score, which is based on 3 clinical parameters—behavior, the cardiovascular system, and the respiratory system.
- the cases were patients transferred to the pediatric intensive care unit (PICU), and controls were those not transferred to the PICU. The maximum PEWS score in both groups were analyzed using Mann-Whitney U test and receiver operating characteristic curve (ROC).
- The length of hospital stay (18.09 + 32 vs 3.93 + 2.9 days; P <.001) and the maximum PEWS score (2.95 + 1.5 vs 1.4 + 0.8) were significantly higher for the cases (P <.0001).
- The PEWS score area under the ROC was 0.81 (95% confidence interval = 0.75-0.86). The sensitivity and specificity for a score 2.5 were 62% and 89%, respectively.
- use of a modified PEWS score can help identify patients on medical wards who are at risk for deterioration and need further evaluation, treatment, or transfer to a higher level of care. By using the modified PEWS score, clinicians could potentially prevent major adverse events on medical–surgical wards.
- Reference – [Clinical Pediatrics 2012 May;51\(5\):431](#)⁵

A set of non-vital sign patient characteristics associated with clinical deterioration in children were identified which may be useful in triaging the intensity of monitoring and surveillance for deterioration

- based on case-control study in A 460-bed children's hospital
- Cases (n = 141) were children who deteriorated while receiving care on non-intensive care unit (non-ICU) inpatient units. Controls (n = 423) were randomly selected.
- Aimed to develop a predictive score for deterioration using non-vital sign patient characteristics in order to risk-stratify hospitalized children before signs of deterioration are detectable.
- The exposures were complex chronic conditions, other patient characteristics, and laboratory studies. The outcome was clinical deterioration, defined as cardiopulmonary arrest, acute respiratory compromise, or urgent ICU transfer
- The 7-item score included age <1 year, epilepsy, congenital/genetic conditions, history of transplant, enteral tube, hemoglobin <10 g/dL, and blood culture drawn in the preceding 72 hours

- We grouped the patients into risk strata based on their scores. The very low-risk group's probability of deterioration was less than half of baseline risk. The high-risk group's probability of deterioration was more than 80-fold higher than the baseline risk.
- Reference – [Journal of Hospital Medicine \(online\) 2012 Apr;7\(4\):345](#)⁶

Additional studies were identified from a conference abstracts:

Burton Paediatric Early Warning System score charts are effective in identifying children at risk of sudden deterioration.

- Age appropriate Burton Paediatric Early Warning System (BPEWS) score charts were developed in 2011 using nine indicators which included physiological parameters, therapeutic intervention and doctor/nurse concern.
- A retrospective analysis of all children transferred to paediatric intensive care setting over the preceding 12 months was carried out to validate BPEWS charts.
- Detailed case notes review was undertaken to evaluate if BPEWS could have been useful to alert us of patients' deterioration in the 24 hour period prior to transfer.
- An average of 8.7 sets of observations per patient was recorded in the 24 hours period prior to intensive care transfer. Of the 200 sets of observations recorded in 23 patients, 93% sets would have triggered based on BPEWS. 44% sets of observation scores were in amber (4-7) while 35% were in red (>7) category. Average highest BPEWS score was 9.5 (range: 4-19).
- In 43% and 57% of patients, highest BPEWS score fell in amber and red category respectively.
- Reference – [Archives of Disease in Childhood 2012 Oct;97\(A421\)](#)⁷

ManChEWS: Royal Manchester Children's Hospital early warning score correctly identifies deteriorating patients.

- Royal Manchester Children's Hospital (RMCH) introduced a simple track and trigger Early Warning System (ManChEWS) in 2005 by which variation in six key physiological parameters is scored according to a trafficlight system in routine nursing observations.
- Three audits were carried out: an audit to evaluate ManChEWS in emergency admissions to the PICU or PHDU (2006 to 2007), a prospective audit of children who trigger EWS on the ward but do not require admission to the PHDU/PICU (2009), and an audit to evaluate the use of ManChEWS in children that died between 2005 and 2008 following an acute deterioration on the wards.
- ManChEWS correctly identifies the deteriorating child and offers staff a clear pathway for escalation of care and senior review.
- ManChEWS is not being used correctly on the wards by medical or nursing staff .
- For patients with underlying disease, ManChEWS overtriggers, leading to staff becoming immune to triggers.
- Reference – [Critical Care 2011 Apr; 15/S179](#)⁸

References

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