MEDICAL UNIVERSITY OF SOUTH CAROLINA
VALUE INSTITUTE
Evidence-Based Practice Brief
Effective use of PEWS by Bedside Nurses

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ASK THE QUESTION

**Question 1:** For bedside nurses using the Pediatric Early Warning Score (PEWS) to identify patients in need of a higher level of care, how can PEWS scores be used most effectively to determine appropriate nursing action?

SEARCH FOR EVIDENCE

**Databases:** CINAHL, PubMed, Scopus

**PubMed search strategy:** (“pediatric early warning score” OR "paediatric early warning score" OR PEWS) AND nurs*

**Keywords:** "pediatric early warning score", "paediatric early warning score", PEWS, nurs*

CRITICALLY ANALYZE THE EVIDENCE

There were 6 studies found addressing the use of PEWS scores to determine appropriate nursing action. In the majority of these studies, score-related nursing action was based on expert consensus and operationalized as part of the study protocol. However, these studies can inform decision-making, as their primary outcomes all supported the use of PEWS for effectively identifying patient deterioration.

Ennis et al. (2014) established a strategy for nursing response to PEWS that included the following:
- 0-1: continue monitoring
- 2: charge nurse review
- 3-4: charge nurse and resident, inform fellow/chief resident
- >5: charge nurse and fellow/chief resident review, inform attending/specialist

Ennis and colleagues found that in patients with PEWS ≥ 3 review by the charge nurse and resident lead to additional medical intervention in 97% of patients with 85% of patients improving within 24 hours. Additionally, review of patients with PEWS ≥ 5 occurred within 15 minutes 100% of the time.
Akre et al. (2010) retrospectively applied the PEWS to patients with rapid response team/code blue events and found that 97% received at least 1 consultation (MD, RN, RT) before the event and 43.5% had monitoring added during the 24 hours pre-event, indicating nurse staff awareness of deterioration.

Tucker et al. (2009) established a PEWS escalation algorithm for use during the study to determine appropriate nursing action. As a result of this protocol in conjunction with PEWS, Tucker and colleagues found that for each 1-point increase in PEWS children were more than twice as likely to transfer to the PICU (odds ratio = 2.8, 95% CI 2.36–3.35, p < .001).

Randhawa et al. (2011) was a quality improvement study with a focus on institutionalizing PEWS at a Children’s Hospital through the use of the Plan-Do-Check-Act methodology. It included the escalation algorithm developed by Tucker et al. (2009), as well as color-coding of patients within the EHR, and resulted in decreased utilization of rapid response teams (19.4% decrease) and improved code/patient day rates. The escalation algorithm is shown in Appendix D below.

Kaul et al. (2014) conducted a survey to compare the actions of nurses using and not using BedsidePEWS as a part of daily patient care. The survey found that identification of patient deterioration was significantly higher in nurses using BedsidePEWS (p<0.04). Additionally, using PEWS increased use of the following appropriate nursing actions: 1) considering rapid response team; 2) requesting physician order additional monitoring; and 3) calling charge nurse/senior resident to bedside.

Sefton et al. (2015) utilized a modified Bristol PEW (See Appendix C), which identified nursing action based on 1+ criteria being met. While this is a different tool, the nursing actions defined for the study protocol may be useful in decision-making.

PICO Question: For bedside nurses using the Pediatric Early Warning Score (PEWS) to identify patients in need of a higher level of care, how can PEWS scores be used most effectively to determine appropriate nursing action?

<table>
<thead>
<tr>
<th>Author/Date/Journal</th>
<th>Purpose of Study</th>
<th>Study Design</th>
<th>Sample &amp; Setting</th>
<th>Outcomes</th>
<th>Design Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akre et al., 2010, Pediatrics</td>
<td>To evaluate the Pediatric Early Warning Score (PEWS) sensitivity as an early indicator of patients deterioration leading to a Rapid Response Team (RRT)/code event</td>
<td>Retrospective chart review</td>
<td>170 RRT calls and 16 code blue events in 186 patients over 2 years at a children’s hospital in Minnesota</td>
<td>Sensitivity was 85.5%, with 1st PEWS &gt; 4 occurring 696 minutes (median) and the latest PEWS &gt; 4 occurring 30 minutes before the RRT/code event. 97% received at least 1 consultation (MD, RN, RT) before the event and 43.5% had monitoring added during the 24 hours pre-event, indicating nurse staff awareness of deterioration. Subgroup (72 patients with PEWS &gt; 4; clinician consult and addition of monitoring): -median time to first consultation significantly shorter (73 min vs 602 min, p&lt;0.001)</td>
<td>Study Limitations = None Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey) □ Insufficient sample size □ Sample not representative of patients in the population as a whole □ Variables (confounders, exposures, predictors) were not described □ Outcome criteria not objective or were not applied in blind fashion □ Insufficient follow-up, if applicable □ For diagnostic study, sample not defined at common point in course of disease/condition □ For prognostic study, sample not defined at common point in course of disease/condition □ Studies are indirect (Your PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome) □ Studies are imprecise</td>
</tr>
</tbody>
</table>

GRADE CRITERIA for rating a body of evidence (See Appendix A for more info)

Lower Quality Rating if: □ Studies inconsistent (When there are differences in the direction of the effect, populations, interventions or outcomes between studies) □ Studies are indirect (Your PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome) □ Studies are imprecise
| Ennis, L. 2014, Nursing children and young people | To incorporate a pediatric early warning score (PEWS) and track and trigger system in the routine care of children at a regional hospital | Prospective observational (Quality Improvement) | 1618 patients in the children’s ward over 4 months in a regional hospital in Ireland
Used NHS Institute’s PEWS chart
-7 criteria
-1 point per criteria outside normal parameters

**Score/Action:**
- 0/1 – continue monitoring
- 2 – charge nurse review
- 3/4 – charge nurse and resident, inform fellow/chief resident
- 5/6/7 – charge nurse and fellow/chief resident review, inform attending/specialist

PEWS > 3: 2.16%
-97% of these had a respiratory condition on admission
-97% concordance with standard that these patients should be rapidly reviewed by resident with a max response time of 30 min
-85% improved within 24 hours following 1st PEWS alert

PEWS > 5: 0.49%
-100% concordance with standard that these patients should be rapidly reviewed by resident within a max response time of 15 min

Audit at 1 year found 100% concordance with the PEWS escalation protocol.

| Study Limitations = ☑ None
Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)
- Insufficient sample size
- Sample not representative of patients in the population as a whole
- Variables (confounders, exposures, predictors) were not described
- Outcome criteria not objective or were not applied in blind fashion
- Insufficient follow-up, if applicable
- For diagnostic study, gold standard not applied to all patients
- For diagnostic study, no independent, blind comparison between index test and gold standard
| Quality Improvement (pre-post, controlled pre-post, historical comparison, time series)
- Intervention not evidence-based
- Improvement method was not clearly identified or the need for improvement was not described
- Stakeholders, organizational culture, patients, or interventions were not clearly described or appropriate
- Interventions were not described in enough detail to be replicated by others
- Baseline and outcome data were not collected and reported appropriately or in the same manner
- Data collection tools were not validated to measure intended outcomes
- Any modifications made to the...
<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcome</th>
<th>Study Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaul et al., 2014, Journal for Specialists in Pediatric Nursing</td>
<td>Descriptive, cross-sectional study</td>
<td>Electronic survey of 35 nurses &amp; 17 physicians with and without experience using the Bedside PEWS</td>
<td>Nurses using BedsidePEWS reported significantly greater ability to identify early signs of deterioration (mean: 4.43 vs 3.9, p&lt;0.04)</td>
<td>Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)</td>
<td></td>
</tr>
<tr>
<td>Randhawa et al., 2011, Western Journal of Nursing Research</td>
<td>Prospective observational w/ retrospective audit (Quality Improvement)</td>
<td>1 hospital implementation of PEWS using the Plan-Do-Check-Act methodology (3 cycles)</td>
<td>&quot;the scoring system provided them with an objective measure or universal language to sum up a patient’s vital signs and assessment findings for effective communication with other healthcare providers&quot;</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>
| Sefton et al., 2015, Intensive & critical care nursing | To explore how the introduction of PEWs at a tertiary children’s hospital affects emergency admissions to the Pediatric Intensive Care Unit (PICU) and the impact on service delivery | Pre-post observational study | 958 unplanned PICU admissions (admissions and emergency transfers) 1 year before/after PEWS integration
- modified Bristol PEW (See Appendix C) incorporated into the patient chart & PEWS was “activated” if 1+ abnormal observations occurred
Clinical response to patients activating PEWs was:
- existing med/surg teams respond to own patients if triggered
- on-call med/surg team responds to | PEWS did not reduce incidence of emergency admissions, but the pediatric index of mortality did decrease from 0.44 to 0.60 (p<0.001) indicating earlier identification of deterioration.
PEWS did not statistically affect emergency transfers from other facilities. | **Quality Improvement (pre-post, controlled pre-post, historical comparison, time series)**
- Intervention not evidence-based
- Improvement method was not clearly identified or the need for improvement was not described
- Stakeholders, organizational culture, patients, or interventions were not clearly described or appropriate
- Interventions were not described in enough detail to be replicated by others
- Baseline and outcome data were not collected and reported appropriately or in the same manner
- Data collection tools were not validated to measure intended outcomes
- Any modifications made to the intervention were not based on pilot studies

**Study Limitations =**
- None

**Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)**
- Insufficient sample size
- Sample not representative of patients in the population as a whole
- Variables (confounders, exposures, predictors) were not described
- Outcome criteria not objective or were not applied in blind fashion
- Insufficient follow-up, if applicable
- For prognostic study, sample not defined at common point in course of disease/condition
- For diagnostic study, gold standard not applied to all patients
- For diagnostic study, no independent, blind comparison between index test and gold standard
### PEWS triggers outside regular work hours
- Target of 10 min for airway trigger, 30 min for all other triggers

### PEWS
- Tucker et al., 2009, Journal for Specialists in Pediatric Nursing

To evaluate the use of the Pediatric Early Warning Score (PEWS) for detecting clinical deterioration among hospitalized children

- Prospective observational study
- 2,979 patients admitted to one medical unit of a pediatric hospital over 1 year
- Used the Monaghan & Quist-Therson PEWS tool - score of 0-3 in 3 categories: behavior, cardiovascular, respiratory (range: 0-13)
- Calculated for 24 hours before event at 4 hour intervals
- PEWS > 4 required consultative action

PEWS is able to discriminate between children who required transfer to the PICU and those who did not require transfer (AUC 0.89, 95% CI 0.84–0.94, p < 0.001).

Association between PEWS and transfer to the PICU indicated that for each 1-point increase in PEWS children were more than twice as likely to transfer to the PICU (odds ratio = 2.8, 95% CI 2.36–3.35, p < .001).

**Study Limitations**
- None

### REFERENCES

## Appendix A: GRADE criteria for rating a body of evidence on an intervention

Developed by the GRADE Working Group

### Grades and interpretations:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Further research is very unlikely to change our confidence in the estimate of effect.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.</td>
</tr>
<tr>
<td>Low</td>
<td>Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.</td>
</tr>
<tr>
<td>Very low</td>
<td>Any estimate of effect is very uncertain.</td>
</tr>
</tbody>
</table>

### Type of evidence and starting level

<table>
<thead>
<tr>
<th>Type of Evidence</th>
<th>Starting Level</th>
</tr>
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<tbody>
<tr>
<td>Randomized trial</td>
<td>High</td>
</tr>
<tr>
<td>Observational study</td>
<td>Low</td>
</tr>
<tr>
<td>Any other evidence</td>
<td>Very low</td>
</tr>
</tbody>
</table>

### Criteria for increasing or decreasing level

#### Reductions

- Study quality has serious (−1) or very serious (−2) problems
- Important inconsistency in evidence (−1)
- Directness is somewhat (−1) or seriously (−2) uncertain
- Sparse or imprecise data (−1)
- Reporting bias highly probable (−1)

#### Increases

- Evidence of association† strong (+1) or very strong (+2)
- Dose-response gradient evident (+1)
- All plausible confounders would reduce the effect (+1)

†Strong association defined as significant relative risk (factor of 2) based on consistent evidence from two or more studies with no plausible confounders. Very strong association defined as significant relative risk (factor of 5) based on direct evidence with no threats to validity.
Appendix B: Nursing Survey Items (Kaul et al., 2014)

Q3) How confident are you in your ability to recognize individual aspects of a patient’s assessment that serve as an early red flag for a patient’s deteriorating health? (Select all that apply)

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>1 Not confident at all</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 Extremely confident</th>
</tr>
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</table>

Q4) When you recognize that a patient is clinically deteriorating, how confident are you in knowing what next steps to take to escalate the needed care? (Next steps include what nursing actions to take, what monitoring to add, how frequently to reassess the patient, and who to contact)

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>1 Not confident at all</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 Extremely confident</th>
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</tbody>
</table>

Q5) How confident are you in your ability to communicate your concerns about a patient’s deteriorating status with the medical provider?

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>1 Not confident at all</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 Extremely confident</th>
</tr>
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</table>

Q6) What are the most influential parameters in your nursing assessment that you use to determine a patient’s level of stability? (Select all that apply)

- Heart rate
- Respiratory rate
- Oxygen requirement
- Oxygen saturation
- Blood pressure
- Sedation score
- Urine output
- Capillary refill time
- Parental concern
- Temperature
- Respiratory effort
- Other

Please read the following scenario and use it to answer the next set of questions. You assess a 2-year-old patient with pneumonia coming from the ED/ICU to your unit whose admission assessment is as follows: Sedation score 4 while held by parent with HR 166 RR 66 BP 118/64 Temp 39.1 PaO2 100 mL 99% NaCl bolus in EDTC Diaper dry and parents report latest diaper was approximately 12 hours ago Oxygen saturation 92% PaO2 on 1L oxygen via nasal cannula PaO2 hands and feet are slightly cool with cap refill time of less than 3 seconds Parent verbalized that pt is typically more alert and playful PaO2 having moderate subcostal and substernal retractions with occasional grunting.

Q7) Which pieces of your assessment findings concern you the most, if any? (Select all that apply)

- Sedation score 4 while held by parent
- HR 166
- RR 66
- BP 118/64
- Temp 39.1
- PaO2 given 150 mL 99% NaCl bolus in EDTC Diaper dry and parents report latest diaper was approximately 12 hours ago Oxygen saturation 92% PaO2 on 1L oxygen via nasal cannula PaO2 hands and feet are slightly cool with cap refill time of less than 3 seconds Parent verbalized that pt is typically more alert and playful PaO2 having moderate subcostal and substernal retractions with occasional grunting
- Other

Q8) What actions do you feel are appropriate for you to take based on your patient’s assessment findings? (Select all that apply)

- Reassess pt in 4 hours to determine if clinical status has improved
- Consider RRT
- Obtain order to place pt on NIV and nebulize
- Stop the use of oxygen at 32% by the first hour
- Complete reassessment of pt including vital signs in 2 hours
- Alert charge nurse and medical provider regarding your assessment findings
- Request charge nurse and senior resident presence at bedside for pt assessment
- Encourage oral clear liquid intake or pedialyte
- Consider communication with charge nurse requesting decreased patient care assignment
- Complete reassessment of pt including vital signs in 15 minutes
- Suggest that resident call attending to update them regarding the patient’s status
- Write a progress note regarding notification of charge nurse and medical provider by name
- Complete reassessment of pt including vital signs in 1 hour
- Consider communication with resident regarding ICU consult
- Other

Q9) What do you do to effectively communicate your concerns about your patient in an objective manner?

Q10) Have you ever used PEWS in your practice?

- Yes
- No

Answer if you have ever used PEWS

Q11) How has PEWS helped you in your practice?

Figure 1: Nursing Survey Items Excluding Consent and Demographics.

BP, blood pressure; CRN, cardiolungemetry monitor; EDTC, emergency department triage center; HR, heart rate; ICU, intensive care unit; PEWS, Pediatric Early Warning Score; RR, respiratory rate; RRT, rapid response team; Temp, temperature.
Appendix C: Modified Bristol PEW tool (Sefton et al., 2015)

### PAEDIATRIC EARLY WARNING TOOL

**Each time the red flags are taken, they must be cross-referenced against the PEW criteria. The tool is considered to be triggered if any one or more of the parameters are breached. Follow action below.**

<table>
<thead>
<tr>
<th>A</th>
<th>ACUTE AIRWAY OBSTRUCTION (seek prompt assistance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Child requires nebulised Adrenaline G1, no improvement after nebulised Adrenaline</td>
</tr>
<tr>
<td>2</td>
<td>Clinically tiring or impending complete airway obstruction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B</th>
<th>BREATHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SaO2 ≤ 92% in any amount of oxygen</td>
</tr>
<tr>
<td>2</td>
<td>SaO2 ≤ 75% in any amount of oxygen (cyanotic heart disease)</td>
</tr>
<tr>
<td>3</td>
<td>Persistent tachypnoea</td>
</tr>
<tr>
<td>4</td>
<td>Apnoes +/- head-ache in children under 5 years</td>
</tr>
<tr>
<td>5</td>
<td>Marked increased effort of breathing (3+ on table front sheet)</td>
</tr>
<tr>
<td>6</td>
<td>Respiratory depression RR ≤ 20 ± 3 months, % half lower value for age and height front sheet</td>
</tr>
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<thead>
<tr>
<th>C</th>
<th>CIRCULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Persistent tachycardia following one bolus of 10mls / kg fluid</td>
</tr>
<tr>
<td>2</td>
<td>Poor perfusion: prolonged capillary refill (≥ 3 secs); +/- low BP, large central/peripheral temp gradient</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>D</th>
<th>DISABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GCS = 11 or falling. Children scored by AVPU: responding only to pain or unresponsive</td>
</tr>
<tr>
<td>2</td>
<td>Fitting; unexpected DB; not responding to prescribed analgesics</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>E</th>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hyperkalaemia - K+ ≥ 6.0 mmol/litre</td>
</tr>
<tr>
<td>2</td>
<td>Any child with pH &lt; 7.2 whatever the cause</td>
</tr>
<tr>
<td>3</td>
<td>Any child with unresolved pain on current analgesic therapy</td>
</tr>
<tr>
<td>4</td>
<td>Any child whose condition is worrying – but not triggering on above parameters</td>
</tr>
</tbody>
</table>

**Action to be taken if the PEW tool is triggered**

This tool does not replace clinical judgement. If the child is deteriorating rapidly, or peri-arrest put out an arrest call immediately – Dial 2222

Medical review expected within 30 minutes, within 10 minutes if it is an airway trigger

- Alert the nurse in charge on the ward.
- Increase the frequency of observations.
- Notify patient’s own medical team. If the team cannot be contacted or cannot attend, contact the on call team to review & stabilise the child.
- Out of hours contact the on call team and inform the Night Nurse.
- Complete PEW tool assessment on medi-tech under nursing assessment.
- Children triggering PEW must be discussed with the registrar.

If the patient already transgresses the above criteria, the medical team responsible for the child’s care can set alternative acceptable Paediatric Early Warning parameters. The PEW tool is triggered when the alternative parameters are breached.

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**Figure 1** Modified Bristol Paediatric Early Warning tool,
Adapted from Haines (2005).

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Appendix D: Escalation Algorithm (Tucker et al., 2009)