Improving Compliance and Efficiency Through Automation of Pediatric Early Warning Score

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BACKGROUND

- Pediatric early warning scores (PEWS) are used by many children's hospitals in the US and worldwide to identify children at risk for clinical deterioration.
- Validated PEWS combine a neurologic assessment, respiratory effort, perfusion, supplemental oxygen, and vitals (including heart rate, blood pressure, respiratory rate) to create a composite score with a higher score indicating high risk of decompensation.
- Historically, Monroe Carell Jr. Children's Hospital at Vanderbilt has used a modified PEWS consisting of 9 components manually entered in nursing flowsheets which takes a substantial amount of time.
- Given the rising census on acute care floors and increasing nursing tasks this burdensome scoring system has led to infrequent PEWS documentation.
- The electronic medical record (EMR) can automate some documentation and allow for easier scoring and notification of elevated PEWS.

Example of the previous manual PEWS documentation and the chart that was used to obtain each component score:

Pediatric Early Warning Scores (PEWS)	
PEWS Neurocognitive Score	1
PEWS Cardiac Score	0
PEWS Respiratory Rate Score	2
PEWS Respiratory O2 Sats Score	1
PEWS Respiratory Auscultation Score	0
PEWS Respiratory Effort Score	1
PEWS MAR Q2h Nebulization Score	1
PEWS Admission/Transfer Score	0
PEWS Rapid Response Score	1
PEWS Total Score	7
PEWS Action Level	Yellow (5-7)

Table 1: Example of the legacy manual PEWS calculation and documentation

	0	1	2	3
Neuro/ Behavior	•Awake/Alert •Appropriate •At Baseline	•Sleeping intermittently but arouses easily **OR** •Fussy/irritable but consolable	•Difficult to arouse/decrease response to verbal stimuli •Irritable/Inconsolable/ Aggressive	•Lethargic/Confused **OR** •Agitated/combative **OR** •Decreased response to painful stimuli •Acute neuro change
Cardio	•Capillary refill 1-2 seconds	•Capillary refill 3 seconds	•Capillary refill 4 seconds **OR** •HR increase or decrease >20 since last assessment	•Capillary refill 5 seconds or above **OR** •HR increase or decrease >30 since last assessment /baseline /admission vitals **OR** •Systolic blood pressure 20 mm < baseline/admission vitals despite fluid bolus administration

If score of 3 in either Neuro or Cardio category, automatically advance to orange algorithm				
Respiratory Rate 0 – 3 Months 3mo – 12 mo 1 – 3 Years 4 – 5 Years 6 – 12 years > 12 Years	30-40 20-30 18-26 16-24 14-20 12-18	41-50 31-40 27-34 25-30 21-26 19-23	51-60 41-50 35-39 31-35 27-30 24-27 **OR** • An increase in RR >10 bpm since last assessment	>60 or <20 >50 or <20 >40 or <18 >36 or <16 >31 or <14 >28 or <12 **OR** • An increase in RR >20 bpm since last assessment
Oxygen Saturation vs Baseline	• Within expected range on room air or baseline oxygen requirement	• Within expected range with 0.5 – 1 lpm oxygen requirement above baseline requirement	• Within expected range with 2 lpm oxygen requirement above baseline requirement	•Within expected range with 3-4 lpm oxygen requirement above baseline requirement **OR** •Inability to maintain desired saturations
Auscultation	• Good aeration throughout	• End expiratory wheezes **OR** • Mild crackles/rales	• Expiratory wheezes **OR** • course crackles/rales	• Inspiratory/expiratory wheezing, rhonchi, stridor at rest **OR** • Diminished breath sounds
Work of Breathing	• None	• Intercostal retractions	• Intercostal & substernal retractions **OR** •Nasal flaring	• Intercostal, substernal & supraclavicular retractions **OR** • Grunting
Add 1 point for each (☐ q2 hr nebs; ☐ previous Rapid Response within 24 hours- with/without transfer)				

Table 2: Knowledge base historically used to produce component scores cognitively

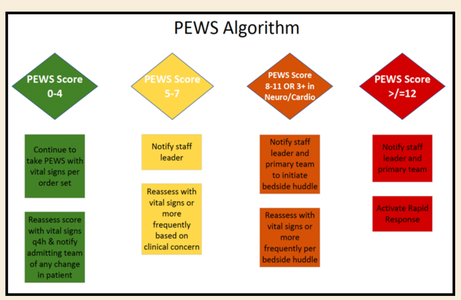
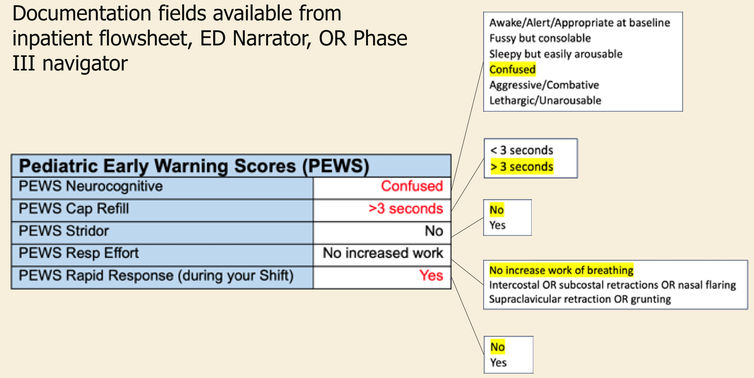


Figure 1: Algorithm for PEWS- based clinical actions

INTERVENTION

Flowsheet

- Decreased nursing documentation fields from **11** to **5**
- Decreased cognitive burden: Assessment selections vs numbers
- Documentation fields available from inpatient flowsheet, ED Narrator, OR Phase III navigator



Pediatric Early Warning Scores (PEWS)	
PEWS Neurocognitive	Confused
PEWS Cap Refill	>3 seconds
PEWS Stridor	No
PEWS Resp Effort	No increased work
PEWS Rapid Response (during your Shift)	Yes

Scoring System

- **10** Scoring Systems that contribute to PEWS Total Score
  - Scoring systems evaluate last filed nursing PEWS assessments and additional parameters (HR/Pulse, Blood Pressure, Respiratory Rate, Oxygen Delivery, Rapid Response, Respiratory Treatment)
- Color coded based on score value
- Null Values: Asterisk next to total score if one or more null values; Hyphen for each rule that returns null
- Filter rule to decrease system performance burden (Monroe Carell or VUH 11S Burn AND PEWS Neuro Assessment in the last 12 hours)
- Batch job files each scoring system hourly (Pertinent for trended scores and auditing prior scores)

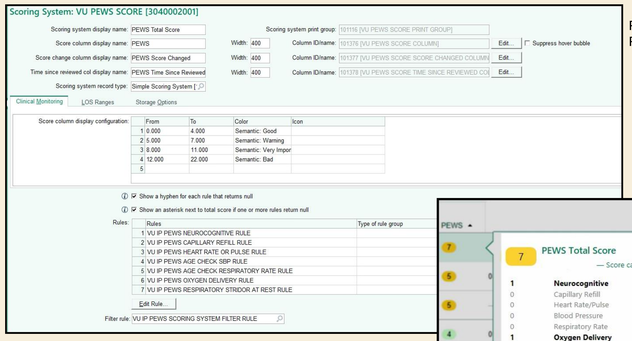


Figure 1: Main HDA Record

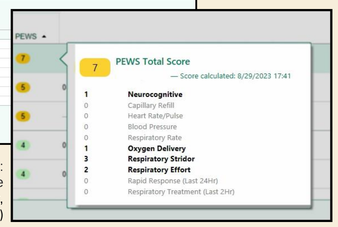
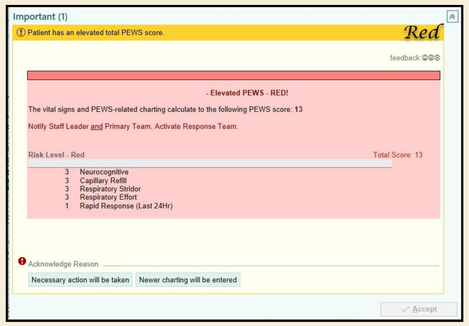


Figure 2: Column to display total score (Available from Patient List, OR Status Board, ED Trackboard)

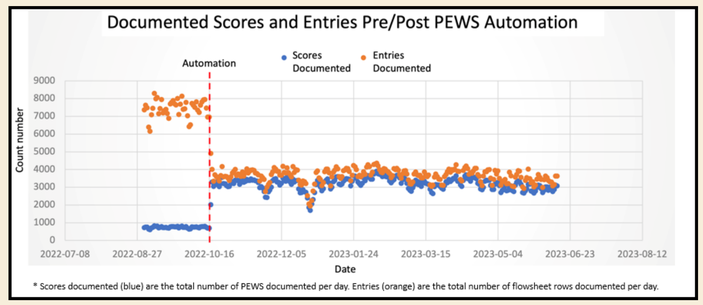
Best Practice Advisories

- 1 Best Practice Advisory (dynamic display based on score) – Yellow, Orange, Orange (Neuro/Cardiac), Red
- Display: Last score, rules contributing to score, recommended action steps
- Trigger Action: Filing PEWS Assessment
- Limited to RN and LPN provider types



RESULTS

- Novel automation of the most broadly used model for clinical deterioration in pediatrics acute care nationally.
- Total score calculated by the EMR using nursing assessments via drop-down selections and automated scores based on vitals, supplemental O2, and nebulizers from the medication administration record.
- Intervention design, analysis, build, and testing within four months
- Cut-over without reported significant workflow or technical incidents
- Saved the nurses 1.38 million flowsheet entries per year
- Eliminated 2.73 million occasions of nursing cognitive processes to manually produce sub-scores.
- Generated 4.3x more PEWS scores for faster detection of clinical deterioration.



CONCLUSIONS

- PEWS calculation can be successfully automated using the EMR.
- PEWS automation increased the frequency of documentation and the interrater-reliability of documentation.
  - More frequently documented scores carry the potential to detect patient deterioration sooner.
- Automation and providing selection drop-downs in the EMR simplifies and streamlines score entry.
- Automation of PEWS increased documentation efficiency and decreased nursing documentation burden.
- BPAs provide notification of elevated PEWS and offer in the moment information for care escalation.

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