Incorporating Usability Testing in the Implementation of the Hopkins Pediatric Early Warning Score (HPEWS)

AUTHORS: ALESSANDRA CATIZONE AND SADAF KAZI, PH.D.

AFFILIATIONS: ARMSTRONG INSTITUTE FOR PATIENT SAFETY AND QUALITY; JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE; JOHNS HOPKINS HOSPITAL; JOHNS HOPKINS UNIVERSITY SCHOOL OF NURSING, BALTIMORE, MD

1 Introduction

Problem and Background

- Johns Hopkins Children's Center (JHCC) has a higher rate of patients transferred to the PICU after a rapid response team is called (approx. 75% compared to 50% nationally)
- Pediatric Early Warning Scores (PEWS) can provide earlier identification of critically ill children

Aims of Hopkins PEWS (HPEWS) (figure 2):

- Enable early identification of patients likely to decompensate
- Standardize communication about patient status
- Effectively transition patients to different levels of care (McLellen et al., 2017 & Fenix e al., 2015)

Usability testing

- Usability testing not incorporated in previous studies
- Identify usability problems in HPEWS adoption
- Use user-centered design to suggest integration of HPEWS with workflow

Research question

- What are barriers to HPEWS use, and do they relate to short- and long-term HPEWS adoption?

2 Objectives

Use usability testing to investigate if nurses understand:

1. How to compute and document scores
2. How to interpret scores
3. Barriers to care escalation

3 STUDY 1: PRE-IMPLEMENTATION

Captured how nurses are using tool and if they understand how to document scores

Research Questions:

- Is the HPEWS a usable tool to understand and communicate about patient status?
- What are barriers to intended use?

Participants: 8 nurses from Bloomberg 9N

Materials

1. HPEWS
2. 2 scenarios yielding different HPEWS scores

Procedure

- Introduction of HPEWS
- Administration of cases (using counterbalancing)
- Nurses computed score for each system and final score
- Elicitation of intended action

Results

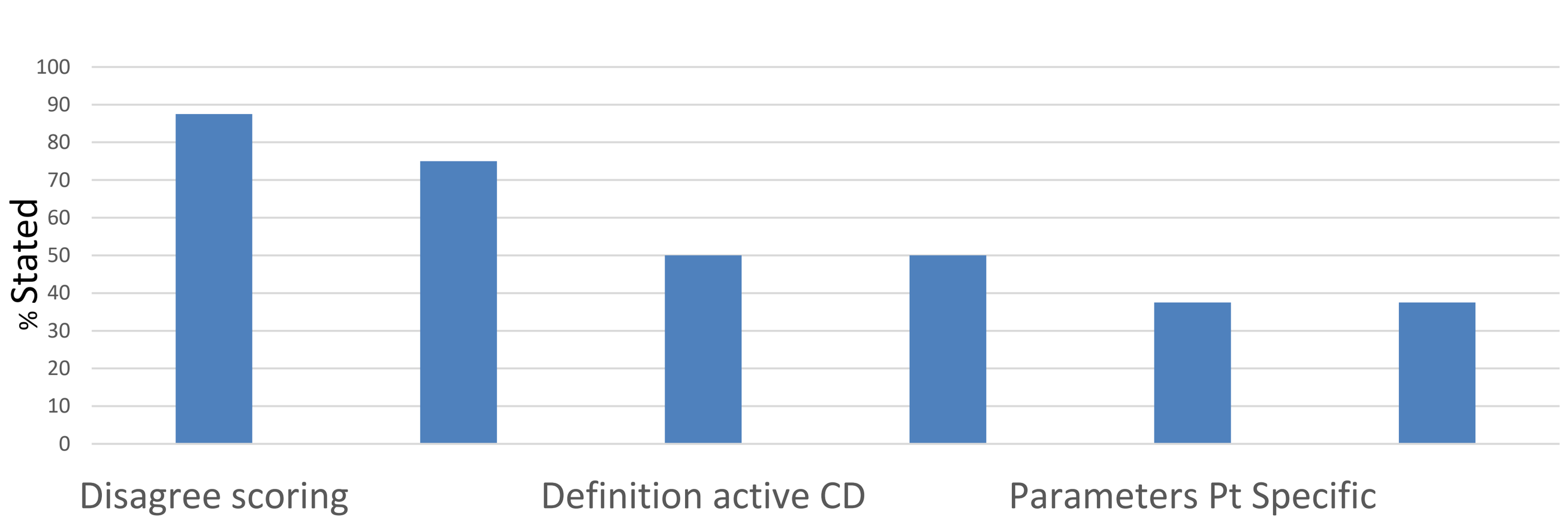

Figure 1: Pre-implementation results

- Final score
  - 88% disagreement
  - 75% computation confusion

HPEWS: Hopkins Pediatric Early Warning Score

Patient Name: ______________________ Patient MRN: ______________________

Your Name & Unit: ______________________

System			
Neuro Goal GCS (if applicable): _____	Current GCS < 1 from goal GCS	Current GCS =1- 2 from goal GCS	Current GCS ≥3 from goal GCS
	Crying, fussy, but consolable	Irritable, but consolable	Inconsolable, Lethargic, Confused
Cardio-vascular Goal HR (range): _____ Goal BP (range): _____ Other: _____	HR and/or BP ≤10 above or below goal	HR and/or BP = 11-29 above or below goal	HR and/or BP ≥30 above or below goal; New arrhythmia
	Cap Refill < 2 sec	Cap Refill = 2-3 seconds	Cap Refill <1 sec or > 4 sec
			Color: mottled, grey, or ruddy
			Pulse pressure (SBP-DBP) ≤ 25
			Body temp < 36° or > 41°
Respiratory Goal RR (range): _____ Goal O2 sats (range) & FiO2 (for vent): _____	RR ≤ 10 above goal	RR = 11-19 above goal	RR ≥ 20 above or below goal
	O2 sats ≤ 5 above or below goal	O2 sats between 5-9 above or below goal	O2 sats ≥ 10 above or below goal
	WOB: Mild increased (e.g. 1 site accessory muscle use)	WOB: Moderate increased (e.g. 2 sites accessory muscle use)	WOB: Severe increased (e.g. grunting, head bobbing, unable to speak)
	Standard NC O_2 flow < 2 L/min	Standard NC O_2 flow = 2-4 L/min	Standard NC O_2 flow ≥ 4 L/min > 60% FiO2 on face mask
		Stable or weaning on HFNC	Initiation of HFNC
	Nebs ≥ q3 hours	Nebs = q2 hours	Nebs q1 hours or continuous
		Suctioning ≥ q2 hours	Suctioning < q2 hours
	Home BIPAP/CPAP settings	Increasing BIPAP/CPAP settings ≤ 2 times per shift	Requiring 3 or more BIPAP changes/shift
		Difficult airway	
		Trach/vent dependent at baseline	
GI	Exam: Distended but soft, non-tender	Exam: Distended and tender	Exam: Rigid abdomen or peritoneal signs
		Recurrent emesis despite anti emetics	Bilious emesis
Other		Parental concern (inpatients)	

Circle the system(s) in the highest color category. Final Score is the Highest Color in Any System.
If Active Cardiac Disease, Add ONE Color Category to the Final Score.

Date Time				FINAL
	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	
	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	
	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	
	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	
	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	
	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	
	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	Neuro | CV | Resp | GI	

Figure 2: HPEWS usability tool

4 STUDY 2: POST- IMPLEMENTATION

Research Questions:

- Is the HPEWS an effective tool in communicating about patient status?
- What are barriers to continued adoption of HPEWS?

STUDY 2a – Immediate Post-Implementation

Education plan rolled out and HPEWS superusers identified in each unit

Participants- 23 nurses from Bloomberg 9N, 9S, 10N, 10S, and 11S

Materials and Procedure

- Survey 1: Assessing persistence of barriers from pre-implementation
- Survey 2: Assessing general usability of HPEWS with the Systems Usability Scale (SUS, Brook, 1996).
- Administered 3 days post-implementation

Results

- 79% had difficulty with documenting final score
- 87% expressed no difficulty with documenting system score

STUDY 2b: Delayed Post-Implementation

Residents tasked with documenting goal vital signs (lower input workload for nurses)

Participants- 95 nurses from Bloomberg 9N, 9S, 10N, 10S, and 11S

Materials and Procedure

- Survey 1 and 2
- Administered 2 months post-implementation survey

Results

- 79% above the midpoint for difficulty with documenting final score
- 41% above the midpoint for wanting continued use of HPEWS

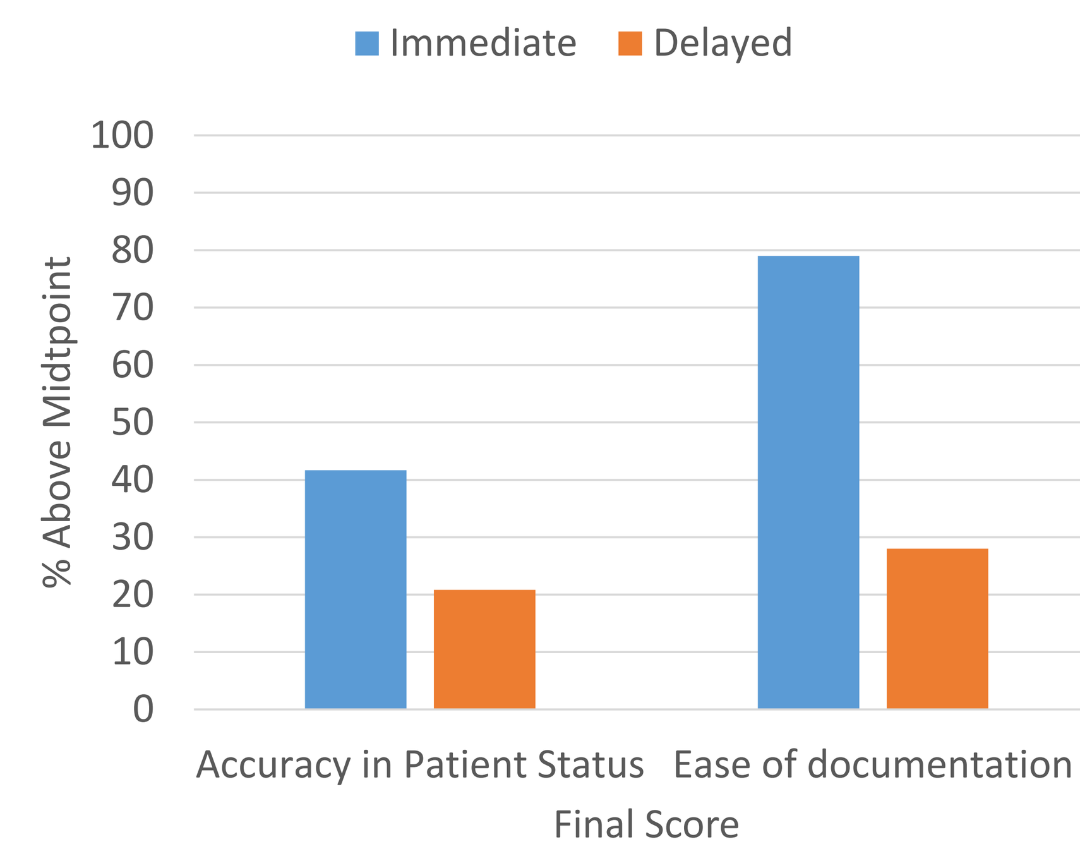

Figure 3: Pre- vs. Post-implementation results

- Adoption declined over time
- SUS score indicated sub-optimal usability, attributable to frequency of completing HPEWS and paper nature of tool
- HPEWS usage is not resilient if education not adequate or tool not integrated into the workflow

5 Future Directions

- Incorporate usability testing at the onset of development cycle
- Incorporate HPEWS into workflow by designing it into EPIC
- Changes to HPEWS have been made since usability testing. Need to see if changes have given nurses less time-consuming factors in completing the tool
- Reduce the amount of criteria nurses have to sort through
- Resident surveys to address similar issues of usage

6 References

Brooke, J. (1996). SUS-A quick and dirty usability scale. *Usability evaluation in industry*, *189*(194), 4-7.

McLellan MC, Gauvreau K, Connor JA. Validation of the Children's Hospital Early Warning System for Critical Deterioration Recognition. J Pediatr Nurs. 2017;32:52-58.

Fenix, J.B., Gillespie, C.W., Levin, A, Dean, N. (2015). Comparison of Pediatric Early Warning Score to Physician Opinion for Deteriorating Patients. Hosp Pediatr. 2015;5(9):474-479.

Funding Source:

The Helene Fuld Leadership Program for the Advancement of Patient Care Quality and Safety

JOHNS HOPKINS
SCHOOL of NURSING