Evaluation of a Digital Phenotype for the Early Recognition of Pediatric Sepsis

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Background

- Sepsis results in significant morbidity and mortality among children worldwide.[1]
- International guidelines emphasize systematic screening methods and early initiation of antibiotic therapy, ideally within one hour of recognition.[2]
- Sepsis is difficult to recognize in children due to nonspecific symptoms and operational barriers within the clinical setting.
- Implementing changes to reduce time to recognition and treatment of sepsis in children is critically important to reduce mortality and improve health outcomes.

Solution

Duke Pediatric Sepsis Phenotype (DPSP) to identify sepsis in real-time:

Identify sepsis early & coordinate care → **Standardize & expedite treatment** → **Decrease morbidity & mortality**

Key Findings

- **The Duke Pediatric Sepsis Phenotype (DPSP) can accurately identify patients who meet retrospective definitions of sepsis.**
- **Patients meeting DPSP have significantly higher mortality, longer hospital length-of-stay, and are more likely to be Black/African American.**

Cohort and Outcome

Cohort: All pediatric hospitalizations at Duke Children's Hospital between 11/1/2016 – 04/30/2023 (28,399)

Outcome: **Duke Pediatric Sepsis Phenotype (DPSP)**

1) Duke Children's Trigger Tool (TT)
A consensus-based phenotype developed by Duke multi-specialty team to direct indications for empiric antibiotics using a shared-risk model.

AND

2) Real-Time Weiss Definition (RT)
A previously described retrospective informatics-based definition of sepsis modified to be usable in real-time.[3]

Phenotype Performance

ICD Codes for Sepsis

	Sensitivity	PPV
Trigger Tool (TT)	0.92	0.09
Real-Time Weiss (RT)[3]	0.84	0.15
Duke Pediatric Sepsis Phenotype (DPSP)	**0.79**	**0.18**

Weiss[3] Definition for Sepsis

	Sensitivity	PPV
Trigger Tool (TT)	0.95	0.13
Real-Time Weiss (RT)[3]	1.00	0.25
Duke Pediatric Sepsis Phenotype (DPSP)	**0.95**	**0.30**

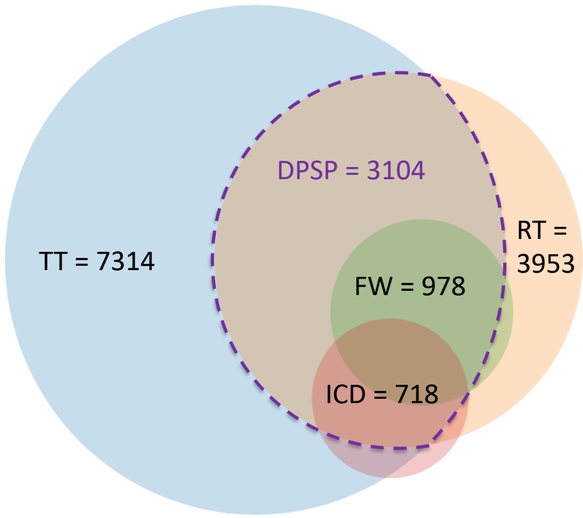
Phenotype Demographics

		Cohort	DPSP
Average age (years)		7.79***	6.99***
Average hospital length-of-stay (days)		6.72***	23.48***
Mortality (%)		0.74***	5.67***
Sex	Male	14,668 (52%)*	1,671 (54%)*
	Female	13,731 (48%)*	1,433 (46%)*
Race	White	13,357 (47%)***	1,282 (41%)***
	Black/African American	8,809 (31%)***	1,117 (36%)***
	Other/Not Reported	6,231 (22%)***	705 (23%)***
Ethnicity	Hispanic	3,763 (13%)	414 (13%)
	Other/Not Reported	24,599 (87%)	2,688 (87%)
Total encounters		**28,399**	**3,104 (10.9%)**

*p < 0.05, **p < 0.01, ***p < 0.001

- Patients meeting DPSP had significantly longer mean hospital length-of-stay (23.48 vs 6.72 days) and mortality rate (5.67% vs 0.74%) than the retrospective cohort
- Patients meeting DPSP were more likely to be Black/African American than the retrospective cohort (36% vs. 31%)

Cohort Characterization



Cohort Sub-Group	Encounters
Trigger Tool (TT)	7,314 (25.8%)
Real-Time Weiss (RT)	3,953 (13.9%)
Duke Pediatric Sepsis Phenotype (DPSP)	3,104 (10.9%)
"Full" Weiss definition of sepsis (FW)	978 (3.4%)
ICD codes for sepsis (ICD)	718 (2.5%)
Full Cohort	**28,399**

Next Steps

- Temporal validation and assessment of real-time utility of the DPSP
- Clinical adjudications performed by physicians to confirm clinical relevance
- Compare DPSP performance to Phoenix Sepsis Criteria using Duke's retrospective cohort
- Silent validation
- Deploy for bedside use

1. Balamuth F, Weiss SL, Neuman MI, et al. Pediatric severe sepsis in U.S. children's hospitals. Pediatr Crit Care Med. 2014;15(9):798–805.

2. Weiss SL, Peters MJ, Alhazzani W, et al. Surviving sepsis campaign international guidelines for the management of septic shock and sepsis-associated organ dysfunction in children. Pediatr Crit Care Med. 2020; 21(2):e52–e106.

3. Weiss SL, Balamuth F, Chilutti M, Ramos MJ, McBride P, Kelly NA, Payton KJ, Fitzgerald JC, Pennington JW. Identification of Pediatric Sepsis for Epidemiologic Surveillance Using Electronic Clinical Data. Pediatr Crit Care Med. 2020 Feb;21(2):113-121.