Impact of Near Real-Time Warning Index in Simulated Clinical Assessment of Single Ventricle Infants

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INTRODUCTION

The Intensive Care Warning Index (I-WIN) is a near real-time clinical decision support (CDS) algorithm which assesses risk of deterioration in infants with single ventricle heart disease¹

- *I-WIN* identifies patients at risk of cardiac arrest, ECMO, or reintubation with AUC of 0.92 up to 4 hours prior to event
- Many CDS tools exist or are in development, there is a paucity of data suggesting clinical impact
- We sought to better understand how *I-WIN* CDS tool impacts a simulated clinician assessment

FIGURE 1. I-WIN Risk Model Development

- Machine Learning derived risk model
- Developed from:
 - 488 single ventricle interstage patients
- 203 clinical deterioration events
 - 130 unplanned intubations
 - 34 CPR and 29 E-CPR Events
 - 10 ECMO Cannulations



Ruiz VM, Goldsmith MP, et al. Early prediction of clinical deterioration using data-driven machine-learning modeling of electronic health records. *J Thorac Cardiovasc Surg.* 2022





- Half of patients reviewed had a predefined deterioration event, matched with controls with no event
- Each patient time epoch contained 12 hours of standard vital sign and laboratory data displayed in standard EMR views (Epic Inc, Verona, WI)
- Half of time epochs randomized to include I-WIN risk assessment (Intervention)
- Remaining half of time epochs had EMR Only Clinicians assessed patient stability and risk of
- deterioration
- Time to decis

METHODS

- In this simulation study, CICU clinicians reviewed 12 timeepochs of patients with single ventricle congenital heart disease during interstage period

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		Figure 3. I-WIN Risk A
		I-WIN Risk Level I
		Risk Level*
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-0.4238	-0.2238	-0.02376 0.1762 0.3762
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Risk Factor In (Vertical	npact	ArtBP_diastolic [FLOWS Arterial Line MAP [FLOWS ArtBP_systolic [FLOWS Hypoplastic left heart syndrome Unspecified Pharmaceutical Subclass(Pharmaceutical Subclass) Other congenital anomalies of hear SpO2 [FLOWS Unspecified Therapeutic Class(Therapeutic Class) Unspecified Pharmaceutical Class(Pharmaceutical Class) Unspecified Pharmaceutical Class(Pharmaceutical Class) Urine (mL) [FLOWS Cardiovascular Agents(Therapeutic Class) Neuromuscular Blockers(Pharmaceutical Class) BP_systolic [FLOWS RR [FLOWS Sum of 195 other fe

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Algorithm







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12:00

14:00

RESULTS

N=13 clinical test users completed the study (n=5 fellows, n=6 nurse practitioners, n=1 physician assistant, n=1 hospitalist). 69% (N=9) had prior experience with clinical early warning systems.

Cases with I-WIN clinical decision support (intervention) had a non-significant trend toward more accurate identification of patients with a future deterioration event (0.81 (SD 0.18), vs 0.68 (SD 0.17), p = 0.1. Non-significant trend toward improved sensitivity (0.74 vs 0.56, p = 0.15) in the intervention vs EMR only cases

	Intervention	EMR Only	P value
Prediction Accuracy	0.81 (0.18)	0.68 (0.17)	0.10
Sensitivity	0.74	0.56	0.15
Specificity	0.87	0.80	0.54
Time to Decision	87 Sec (56 sec)	119 sec (185 sec)	0.44

Table 1. Subject Performance

Figure 3. Diagnostic Accuracy of Intervention vs EMR only





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CONCLUSIONS

- In a small cohort of test users not previously familiar or experienced with the I-WIN platform, there were nonsignificant trends toward improved accuracy of diagnosis and sensitivity when presented with a clinical decision support algorithm.
- Surprisingly, there was no difference in time to diagnosis between two groups.
- This simulation study does not re-create the time or work-pressure of the real ICU environment, future studies may pursue these pressures.

FUTURE STEPS

- Assess impact of Risk Algorithm on clinical assessment in clinicians while distracted, under time pressure, fatigued.
- Assess how Risk Factor Impact variables effect clinician perception of stability, instability, and therapeutic targets
- Develop prospective studies which capture impact of risk algorithm on clinical decision making

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