

Identifying 30-Day Readmission Risk in Neonatal Congenital Heart Disease: Insights from a Multi-Center United States Interstage Home Monitoring Cohort

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Background

- Children with complex congenital heart disease (CHD) are frequently admitted during their first year of life due to complex care needs and high clinical risk.
- Remote home monitoring has helped reduce mortality, unplanned readmissions, and intensive care utilization.
- By better understanding these readmissions, monitoring practices and care may be improved.
- Using data from the CHAMP® Cardiac Research Repository, a software platform enabling asynchronous data submission, we aimed to understand the first interstage readmission after neonatal discharge among infants monitored at home and identify patterns that may identify patients at highest risk of re-admission.

Methods

- Retrospective cohort (n=1259) included infants with complex CHD discharged with home monitoring needs from 12 hospitals contributing complete neonatal discharge and treatment endpoint data.
- Interstage treatment endpoints included bi-directional Glenn surgery, biventricular cardiac surgical repair, death, listed for transplant, or transition off home monitoring.
- Unplanned first readmission (< 31 days, "early", n=445) and readmission > 31 days or no readmission prior to treatment endpoint ("late", n=814).
- Univariate analyses included chi-square, independent t-tests, and non-parametric tests.
- Significant variables were entered via backward likelihood ratio multivariate logistic regression model in a 75/25 learning-validation split in SPSS and Python.
- Model fit and area under the receiver-operator curve (AUC) was calculated.



	"Early" Readmission (n=445)	"Late" Readmission" (n=814)	p-value
Fetal Cardiac Diagnosis	86.7% (386)	81.7% (665)	.021
Age of Primary caregiver (years)	29.08 ± 5.89	28.41 ± 6.29	.045
Low English Proficiency at home	4.8% (19)	8.1% (59)	.033
Any Major anomaly	20% (89)	15.6% (127)	.048
Major GI system anomaly	6.7% (30)	3.9% (32)	.028
Major Airway/Trachea anomaly	2.5% (11)	1.0% (8)	.038
Norwood (All Types)	47.0% (209)	41.2% (335)	.049
Secondary Cardiac Diagnosis- MAPCAs	0.7% (3)	2.2% (18)	.042
Post-operative Cath done after neonatal surgery or as first procedure (n=984)	25.8% (90)	20.0% (127)	.036
Bypass Time	159.0 ± 63.5	149.8 ± 64.0	.034
Aortic Cross Clamp time (min)	77.8 ± 43.1	67.3 ± 39.6	.002

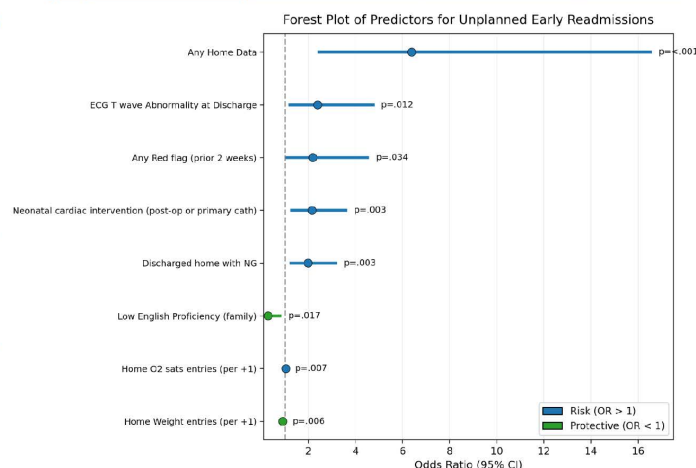


Figure 1: Forest plot of impact factors on unplanned readmission with 30 days of neonatal cardiac hospitalization.

Results

- 85.5% interstage infants had a readmission (n=1077) with only 2.3% a major event readmission
- 96.7% interstage survival overall, with infants with early readmissions having a higher mortality than those who did not (5.8% vs. 1.8%, p=.004).
- Family entered home monitoring data increased significantly in the 2 weeks prior to early readmit: oxygen saturation, weight, intake, and video data (all p<.05) and were more likely to have had a red flag in the 2 weeks prior (9.9% vs. 4.8%, p<.001).
- The multivariable model (Figure 1) retained eight independent predictors with a statistically significant model (χ^2 (df=9), p<.001), variance explained of 18.1% and moderate model discrimination (learning AUC .678; validation AUC .625).

Risk Score Calculator- Example Recalibrated Model for Risk Prediction

Binary Predictors (0 = No, 1 = Yes)				
Variable	Description	Weight	Input	Points
ECG T-wave Abnormality	T-wave abnormality on ECG	13	1	13
Low English Proficiency	Any/No English proficiency	-18	1	-18
Red Flag Form (2 wk)	Red flag within 2 weeks	11	1	11
Any Home Data	Weight/Height/HR captured	27	1	27
Post Op Cath Done	Cardiac catheterization	11	0	0
NG Tube Present	NG tube at discharge	10	1	10

Continuous Predictors (per unit)				
Variable	Range	Weight/Unit	Input	Points
Number O2 Measurements	0 - 35	0.64	10	6.4
Number Weight Measurements	0 - 20	-1.26	14	-17.64

RESULTS	
Total Score	31.76
Predicted Probability	0.185433861
Risk Category	High

Risk Classification Thresholds
Low: Score <= 9 Moderate: 10 - 31 High: Score >= 32
probability = 1 / (1 + exp(-alpha + gamma * score)) where alpha = 3.6652, gamma = 0.0689

Conclusion

- Within a large multi-site cardiac cohort of infants with complex CHD, clinical and family-reported home monitoring indicators were associated with unplanned early readmission after neonatal discharge.
- The eight predictors included in our multivariable model had modest ability to predict early hospital re-admission and can aid clinicians in identifying high risk infants possibly warranting closer outpatient monitoring or clinical evaluation.
- Future research will test the low-medium-high risk predictions for early, unplanned readmissions after neonatal discharge from this tool.

