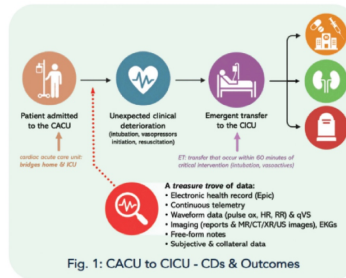


Objectives

- Identify early predictors of clinical deterioration (CD) requiring transfer from the Cardiac Acute Care Unit (CACU) to the Cardiac Intensive Care Unit (CICU).
- Establish a foundational logistic regression (LR) model to inform future real-time machine-learning (ML)-based risk stratification tools.
- Explore the potential for integrating clinical markers into early warning systems (EWS).

Background

- The CACU serves as a transitional unit in pediatric cardiac care, bridging home and intensive care. A subset of CACU patients experience unexpected CD and require emergent transfer (ET) to the CICU.
- ETs are associated with increased in-hospital mortality and prolonged length of stay. Thus, early and timely identification of CD and subsequent escalation of care is essential for improving patient outcomes.
- Existing EWS in pediatrics, like the Pediatric Early Warning Score (PEWS), are not tailored to populations with complex congenital heart disease (CHD).
- This study seeks to identify predictors of CD using Pediatric Acute Care Cardiology Collaborative (PAC³)/Pediatric Cardiac Critical Care Consortium (PC⁴) registry data and multivariable modeling.



Methods

- Single-center retrospective cohort study using PAC³/PC⁴ data, supplemented by Epic Clarity® EHR data between February 1, 2019 to September 30, 2024.
- Population criteria:
 - Included pediatric patients with CACU encounters.
 - Excluded patients with transfers involving the operating room or catheterization lab immediately prior to CICU admission, and bounce-backs <6 hours.
- Definition of CD: worsening clinical status with following criteria – a) ↑ VIS score or initiation/escalation of milrinone; or b) a major acute clinical event (cardiac arrest, intubation, NIPPV/RAM) – within a peri-transfer window.
- Definition of ET: receipt of vasoactives, intubation, or ≥60 mL/kg IV fluids within 60 minutes of CICU arrival. An ↑ milrinone dose was counted as new vasoactive initiation.
- Unit of analysis: CACU encounters resulting in CD were labeled “CD”; those without were “non-CD”.
- Predictor variables were selected based on clinical relevance to capture both static and dynamic risk.
- Analysis: univariate and bivariate comparisons; mixed-effects logistic regression (patient ID as random intercept). Nonlinear variables were further assessed using splines.

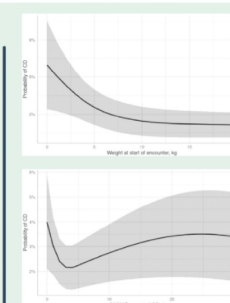
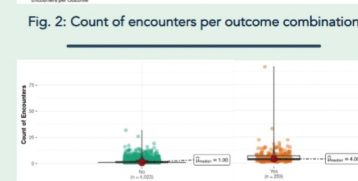
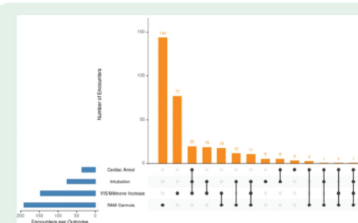
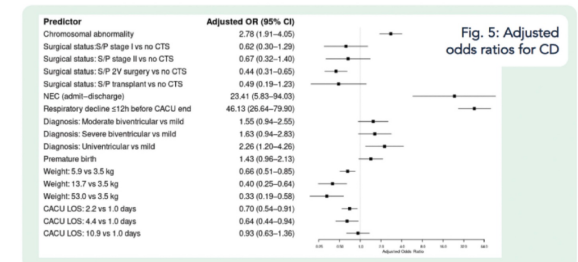


Fig. 4A (top): Weight at start of encounter (kg)
Fig. 4B: CACU encounter LOS (day)
Shaded areas indicate 95% CI

Results

- Identified 9,063 total CACU encounters, with 323 (3.6%) resulting in CD and transfer to the CICU.
- Median age was 1.11 years (IQR 0.27–7.56), with 53.3% male patients in a racially diverse cohort.
- Respiratory decline with 12 hours of CACU end was associated with a 46.13-fold increased odds of CD (95% CI 26.63–79.89, $p < 0.001$).
- NEC, though rare, was strongly associated with CD (aOR 23.40, 95% CI 5.83–94.03, $p < 0.001$).
- Presence of chromosomal abnormalities nearly tripled odds of CD (aOR 2.78, $p = 0.047$).
- Univentricular heart disease demonstrated higher odds of CD compared to mild biventricular disease (aOR 2.26, $p = 0.012$), while prior definitive BV repair proved to be protective (aOR 0.44, $p < 0.001$).



Conclusions & Future Directions

- Logistic regression identified key predictors of CD in pediatric cardiac patients, with respiratory decline, NEC, genetic abnormalities, surgical status, LOS, and weight showing and varied strong associations.
- While our mixed-effects model accounted for clustering by patient (ICC=0.56), residual confounding from unmeasured variables may persist, warranting further exploration to improve fit and interpretability.
- Findings will inform current development and deployment of an ML-enabled forward-facing CD model in the CACU, with plans to incorporate more granular data such as vital signs and waveforms.

3.6% of encounters resulted in a CD, associated with worse patient outcomes.

Respiratory decline in the prior 12 hours signaled a 46.13-fold increased odds of CD.