Recidivism in the Cardiac Intensive Care Unit:
Insights from the Multinational Critical Care Cardiology Trials Network

#AHA24

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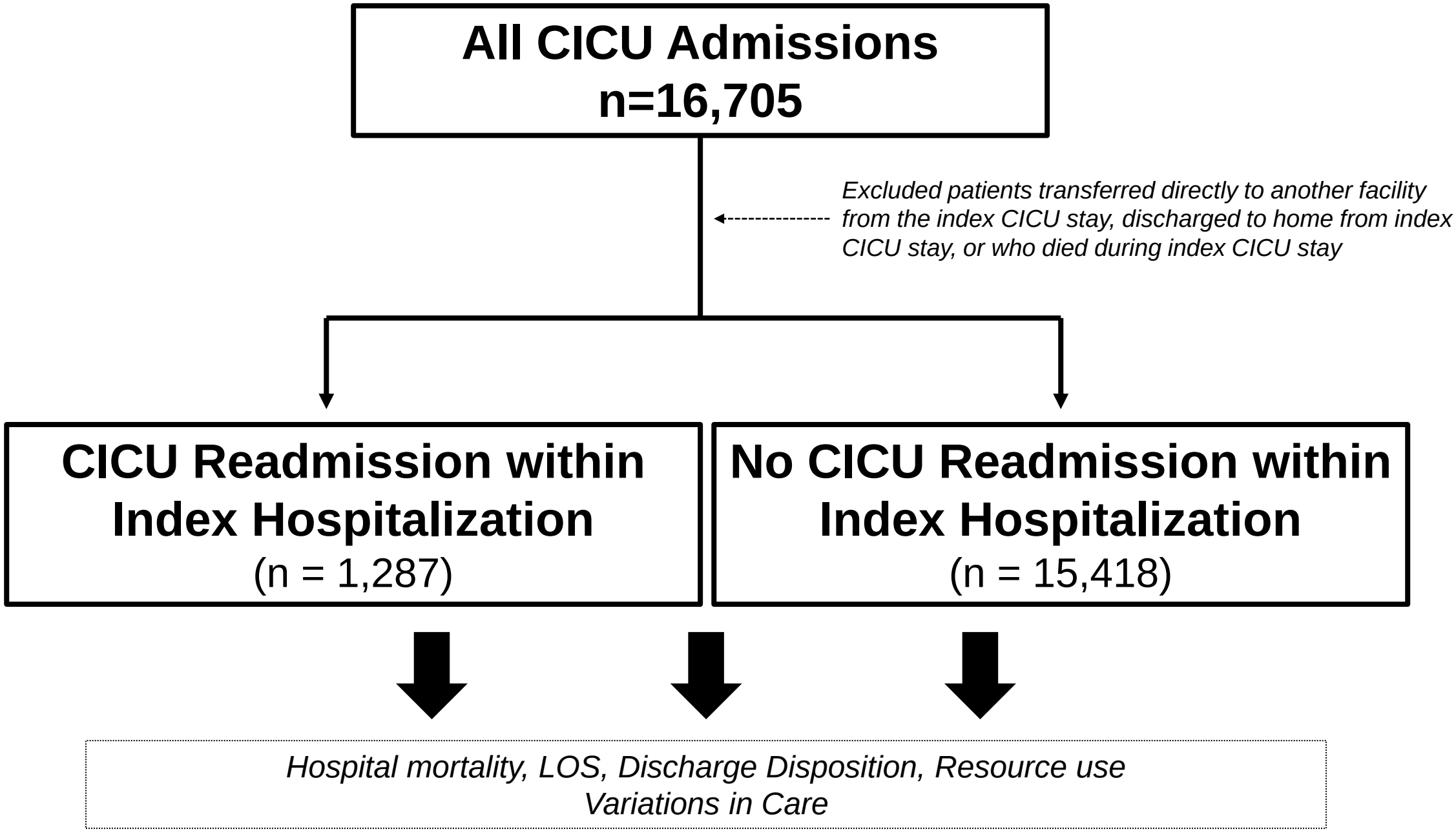
Background

- General Intensive Care Unit (ICU) readmission, or **recidivism**, is associated with increased resource consumption, greater hospital lengths-of-stay, higher costs-of-care, and worse patient survival
- Estimates suggest that rates of general ICU recidivism vary from **5-15%**
- To date, studies of ICU recidivism have largely excluded critically ill cardiac patients & none have examined care in adult, medical Cardiac ICUs (CICUs)
- **Goal:** to explore patterns of care, risk factors, resource use, and outcomes related to CICU recidivism in the Critical Care Cardiology Trials Network (CCCTN)

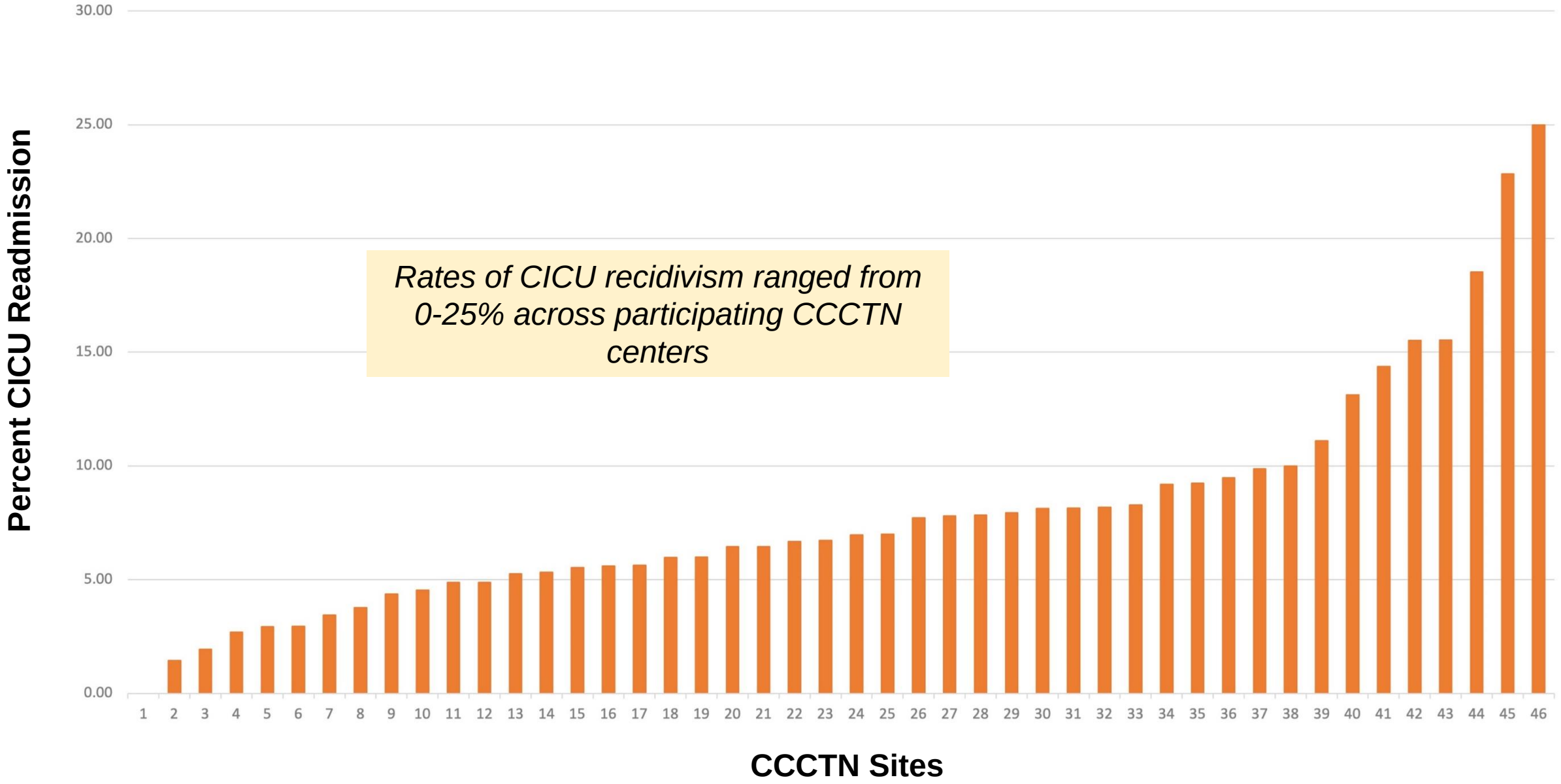
Cohn WE, et al. Chest 1999;116.
Vohra HA, et al. Eur J Cardiothorac Surg 2005;27.
Vollam S, et al. Intensive Care Med 2018;44.

Methods

- CCCTN is a multicenter registry of advanced CICUs coordinated by the TIMI Study Group (Boston, MA)
- Consecutive admissions were captured (n=16,705) and those with ≥1 CICU readmission during the same hospitalization were identified
- Multivariable logistic regression was used to determine baseline variables associated with recidivism, as well as to determine the association of recidivism with in-hospital mortality; mixed effect models used with random effect = study site


All CICU Admissions
n=16,705
Excluded patients transferred directly to another facility from the index CICU stay, discharged to home from index CICU stay, or who died during index CICU stay
CICU Readmission within Index Hospitalization
(n = 1,287)
No CICU Readmission within Index Hospitalization
(n = 15,418)
Hospital mortality, LOS, Discharge Disposition, Resource use
Variations in Care

Variation in CICU Recidivism by Site



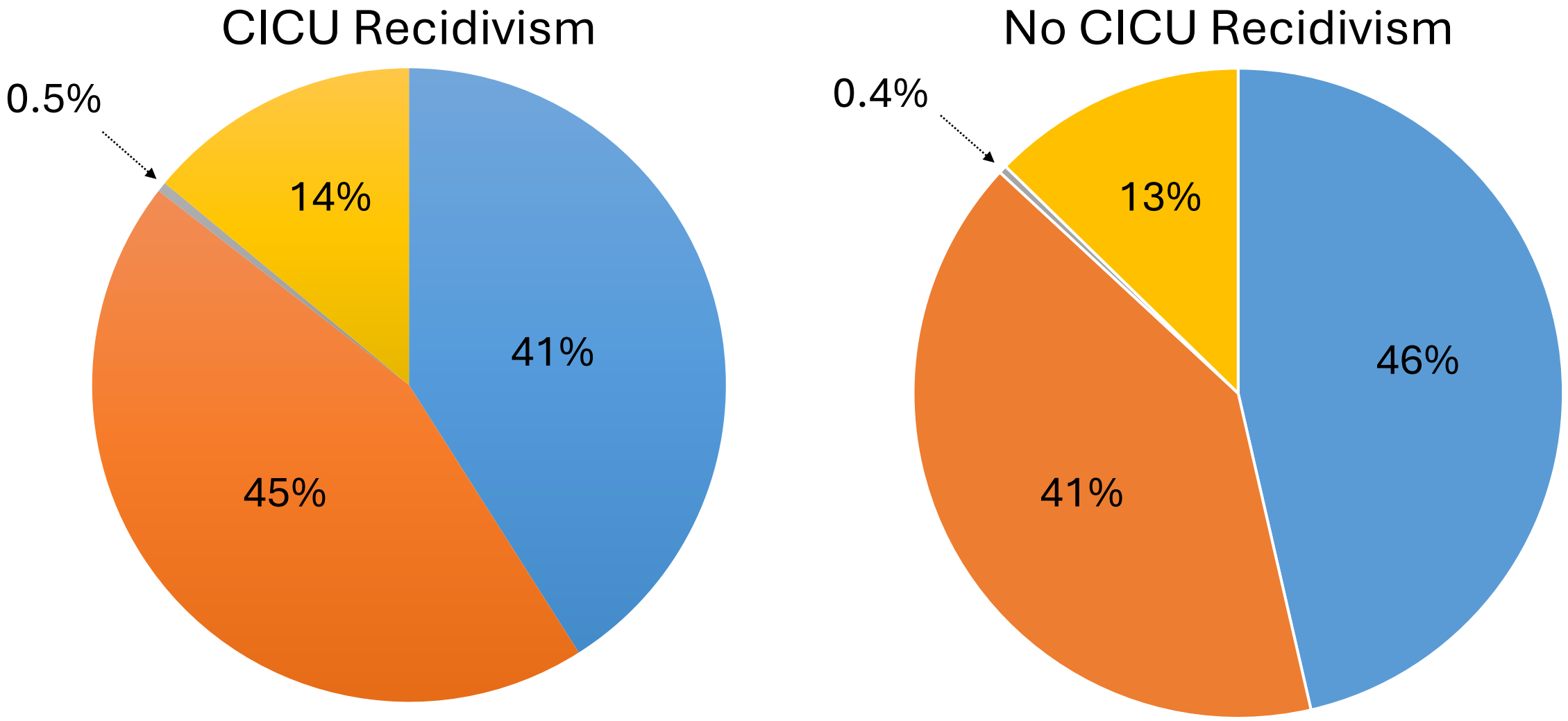
Rates of CICU recidivism ranged from 0-25% across participating CCCTN centers

Baseline Characteristics	CICU Recidivism (n=1,287)	No CICU Recidivism (n=15,418)	p-value
Age, Median (IQR), yrs	66 (56-74)	66 (56-76)	0.054
Sex			
Male **Female**	65% 35%	63.5% 36.5%	0.293
Race/Ethnicity			<0.001
Black **White** **Asian** **Other**	19.3% 49.7% 3.9% 27.2%	18.1% 56.2% 4.4% 21.3%	
BMI, Median (IQR), kg/m^2	27.3 (23.7-32.3)	27.6 (23.9-32.4)	0.241
SOFA Score, Median (IQR)	4 (2-7)	3 (1-6)	<0.001

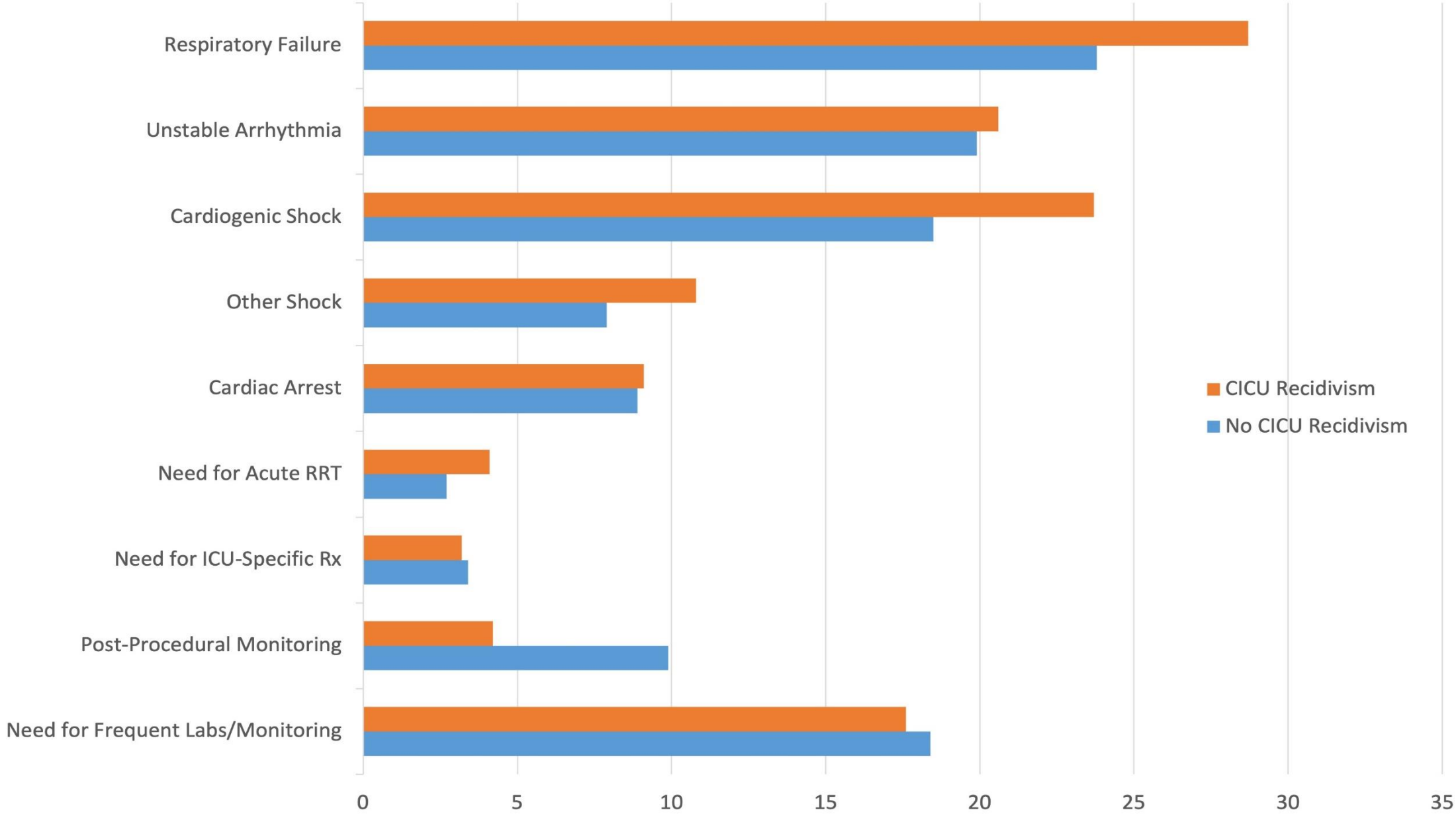
Comorbidities	CICU Recidivism (n=1,287)	No CICU Recidivism (n=15,418)	p-value
Diabetes Mellitus	40.5%	35.3%	<0.001
Chronic Kidney Disease	31.2%	23.5%	<0.001
Coronary Artery Disease	37.1%	34.1%	0.029
Ventricular Arrhythmia	9.5%	6.5%	<0.001
Heart Failure	47%	37.1%	<0.001
Atrial Fibrillation	31.2%	24.9%	<0.001

Primary Admission Diagnosis	CICU Recidivism (n=1,287)	No CICU Recidivism (n=15,418)	p-value
Heart Failure	26.2%	17.2%	<0.001
Cardiogenic Shock	5.2%	3.6%	0.005
Valvular Disease	8.5%	5.7%	<0.001
VT/VF	8.7%	7.9%	0.332
Acute Coronary Syndrome	24.3%	28.4%	0.002
Acute Aortic Syndrome	1.2%	2.1%	0.041
Procedural Complication	0.7%	1.9%	0.002
Cardiac Arrest	1.7%	2.1%	0.321

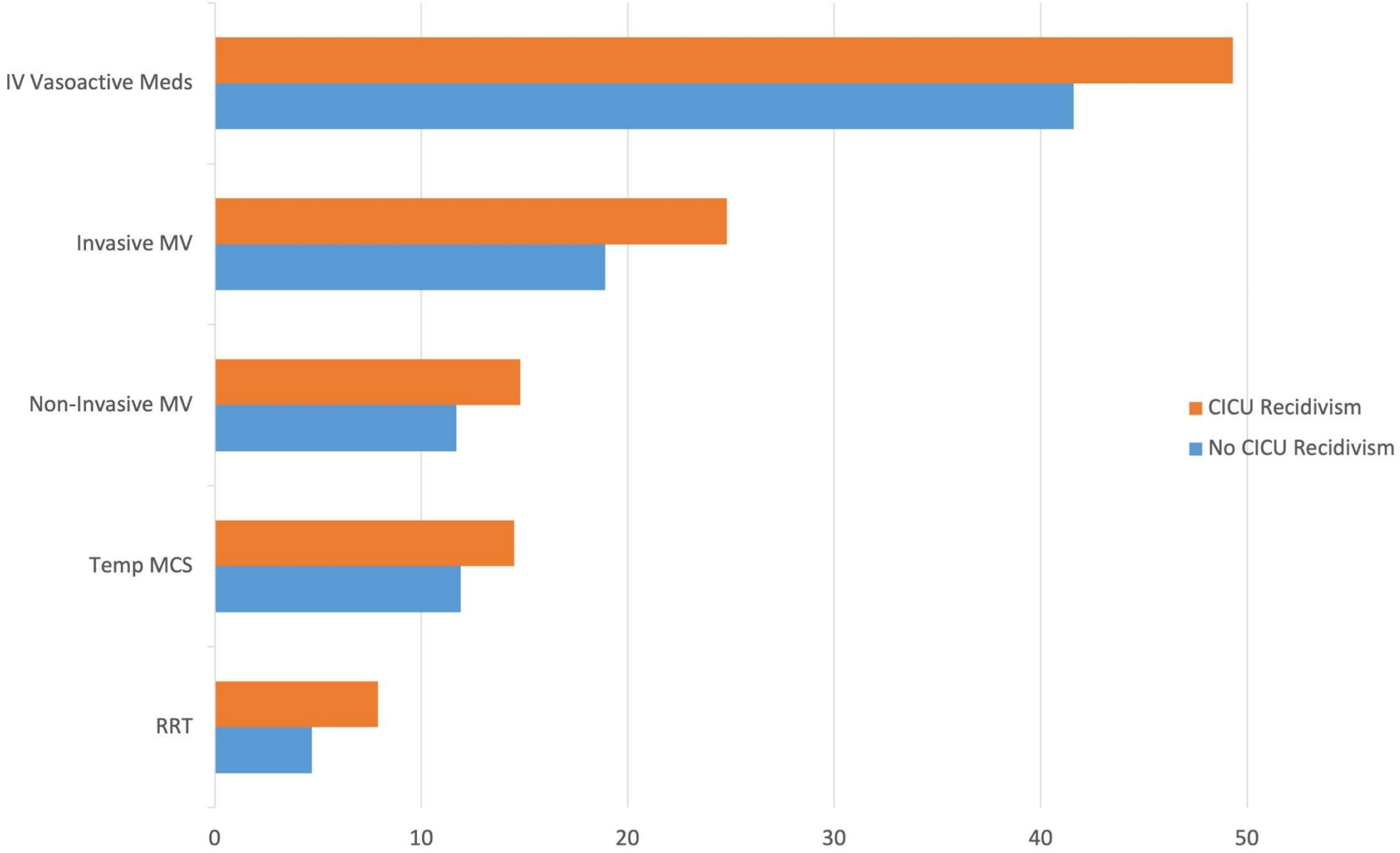
Mode of Arrival



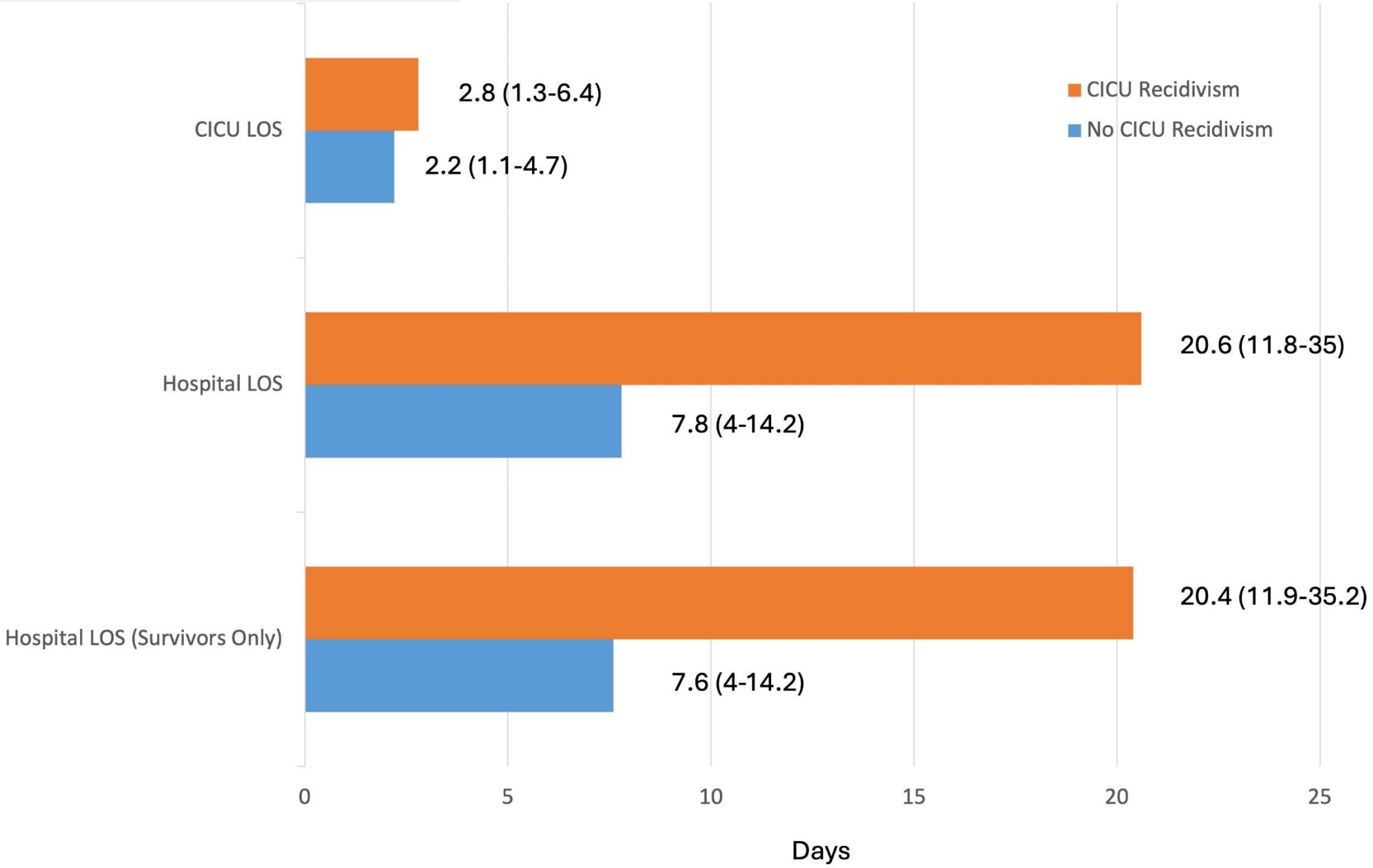
Intensive Care Unit Indication *(Initial admission)*



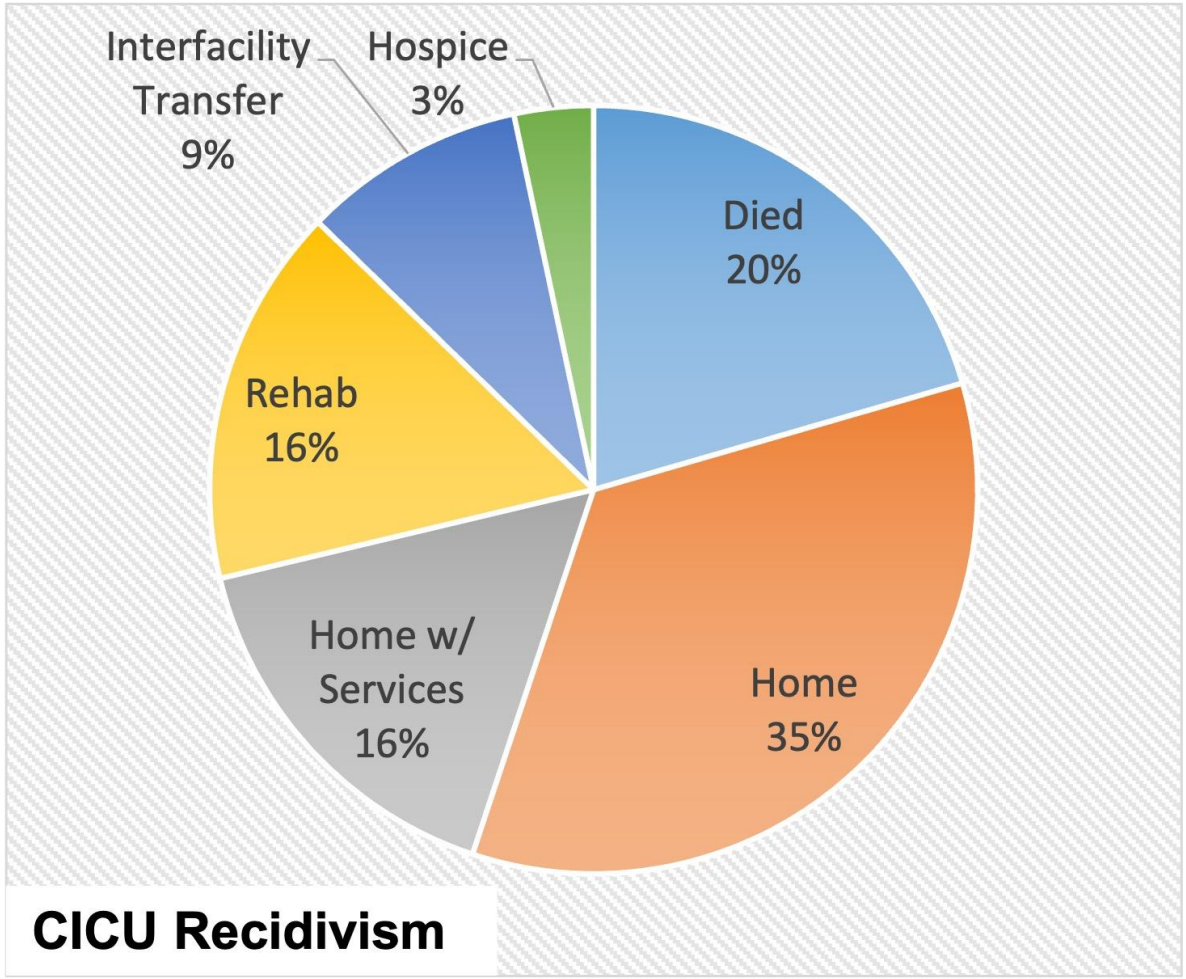
Critical Care Resource Use *(Initial admission)*



Length of Stay

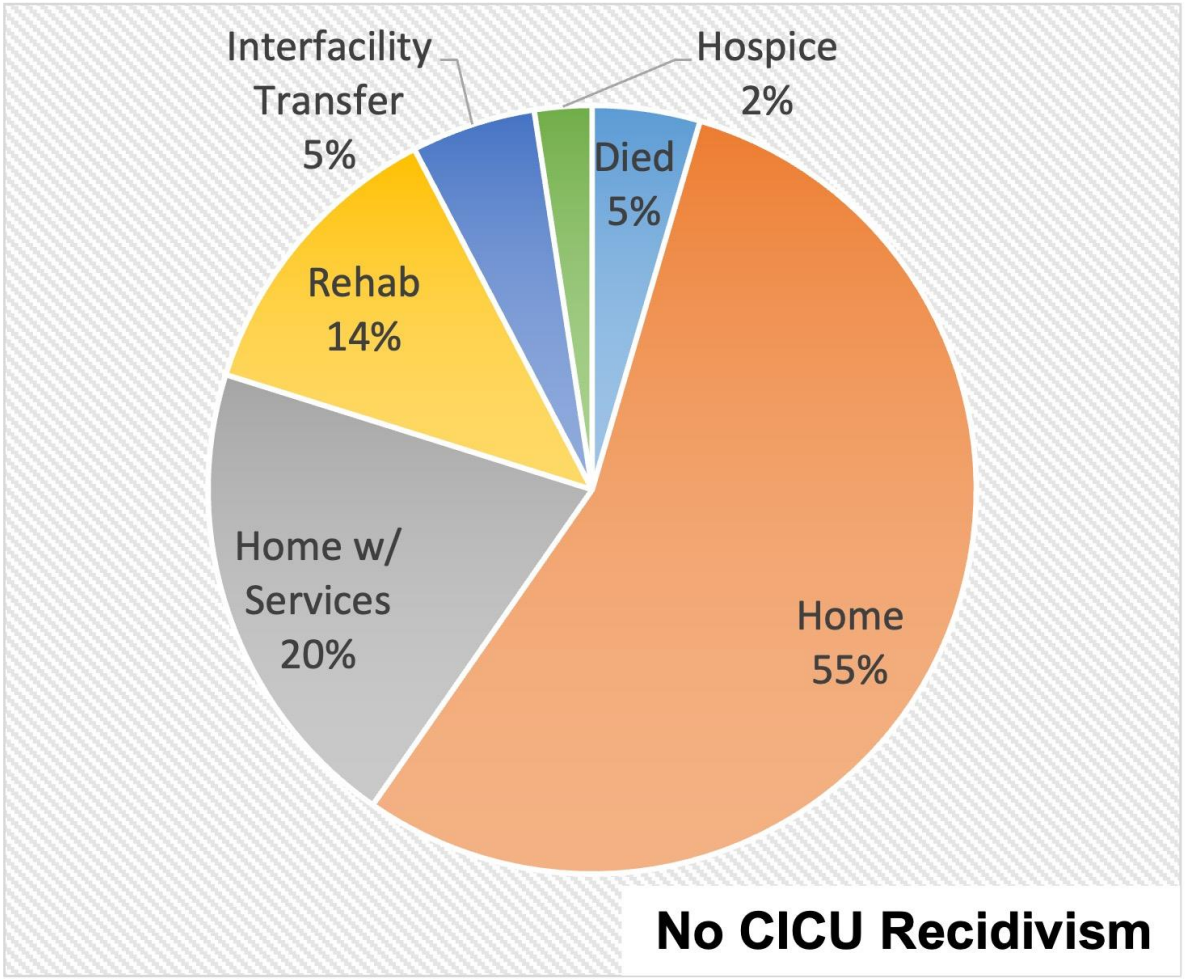


Patient Outcome/Disposition



CICU Recidivism

Hospital Mortality = *20.3%*

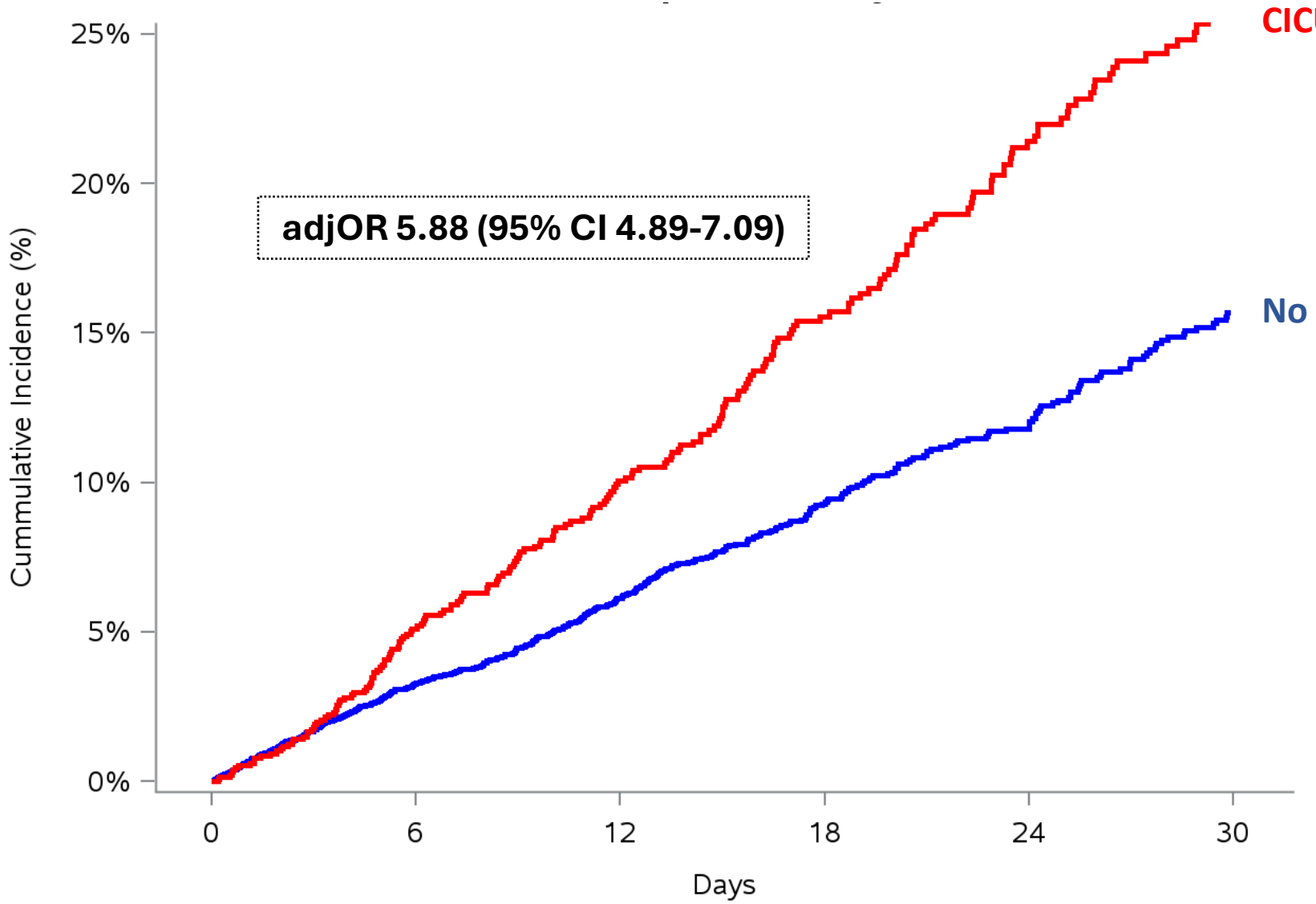


No CICU Recidivism

Hospital Mortality = *4.5%*

p<0.001

Cumulative In-Hospital Mortality



Number at risk:

No CICU Recidivism	15417	6079	2908	1642	1026	699
CICU Recidivism	1287	1079	791	565	407	283

Model adjusted for: age, sex, race, BMI, CVD, PAD, CKD, severe valvular disease, severe lung disease, active malignancy, DM, SOFA, preceding cardiac arrest, shock, advanced resp therapies, DNR/DNI; random effect = study site

Odds of CICU Recidivism

Variable	OR (95% CI)	p-value
Age	0.995 (0.991-0.999)	0.015
Diabetes	1.14 (1.01-1.28)	0.040
PMHx: Heart Failure	1.28 (1.12-1.47)	<0.001
PMHx: Chronic kidney disease	1.26 (1.10-1.45)	<0.001
Mode of Arrival: Direct transfer from OSH vs Other (ref)	1.28 (1.13-1.45)	<0.001
Cardiogenic Shock or HF	1.34 (1.17-1.52)	<0.001
SOFA Score	1.06 (1.04-1.08)	<0.001

Explanatory variables included: *age, sex, race, PMHx (DM, CAD, HF, CKD), mode of arrival, primary diagnosis/reason for CICU (ACS, CS/HF, unstable conduction disorder, respiratory failure), need for RRT, SOFA score*

Conclusions

1. CICU recidivism is common (~8%) but highly variable across high-volume centers

2. Patients readmitted to the CICU have different baseline characteristics, are more frequently transferred from referral hospitals, and have longer initial CICU and overall hospital LOS

3. Patients with higher initial illness severity are at greater risk for CICU recidivism

4. **Approximately 1 in 5 patients readmitted to the CICU will die, and recidivism was independently associated with increased hospital mortality (>5-fold increased odds of death)**

Future Directions

- While most studies focus on “outcome metrics” in the CICU, this analysis suggests that there may be utility to more closely exploring “process metrics” – *you can’t manage what you don’t measure (P. Drucker)*
- Pressing questions:
  - Are staffing and/or structural models associated with recidivism?
  - Does timing of CICU recidivism influence patient outcomes?
  - What about bed capacity? note: a crude, exploratory capacity variable (# of admissions during 2-month campaign / avg # of admissions) was not associated with recidivism
- CICU recidivism **should be measured** in future CICU-based studies, and (if predictable & modifiable) may be helpful in both assessing & comparing the quality of CICU care