

Combining Electronic Health Record Based Automation and Machine Learning to Improve Heart Failure Outcomes, Increase Equity and Retain at Risk Funding in a Safety Net Health System

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BACKGROUND

- Safety net health systems (SNH), often treat populations experiencing suboptimal readmission and mortality rates for heart failure (HF), resulting in failure to retain pay for performance funding which is needed to fund clinical programs. Yet, few programs at SNHs have successfully improved outcomes.
- A comprehensive HF improvement program was launched in June, 2018, at Zuckerberg San Francisco General Hospital (ZSFGH), which incorporated machine learning risk prediction with electronic health record (EHR) based, automated clinical decision support pathways.
- Here we evaluate the program’s cumulative effect on the outcomes of readmission and mortality

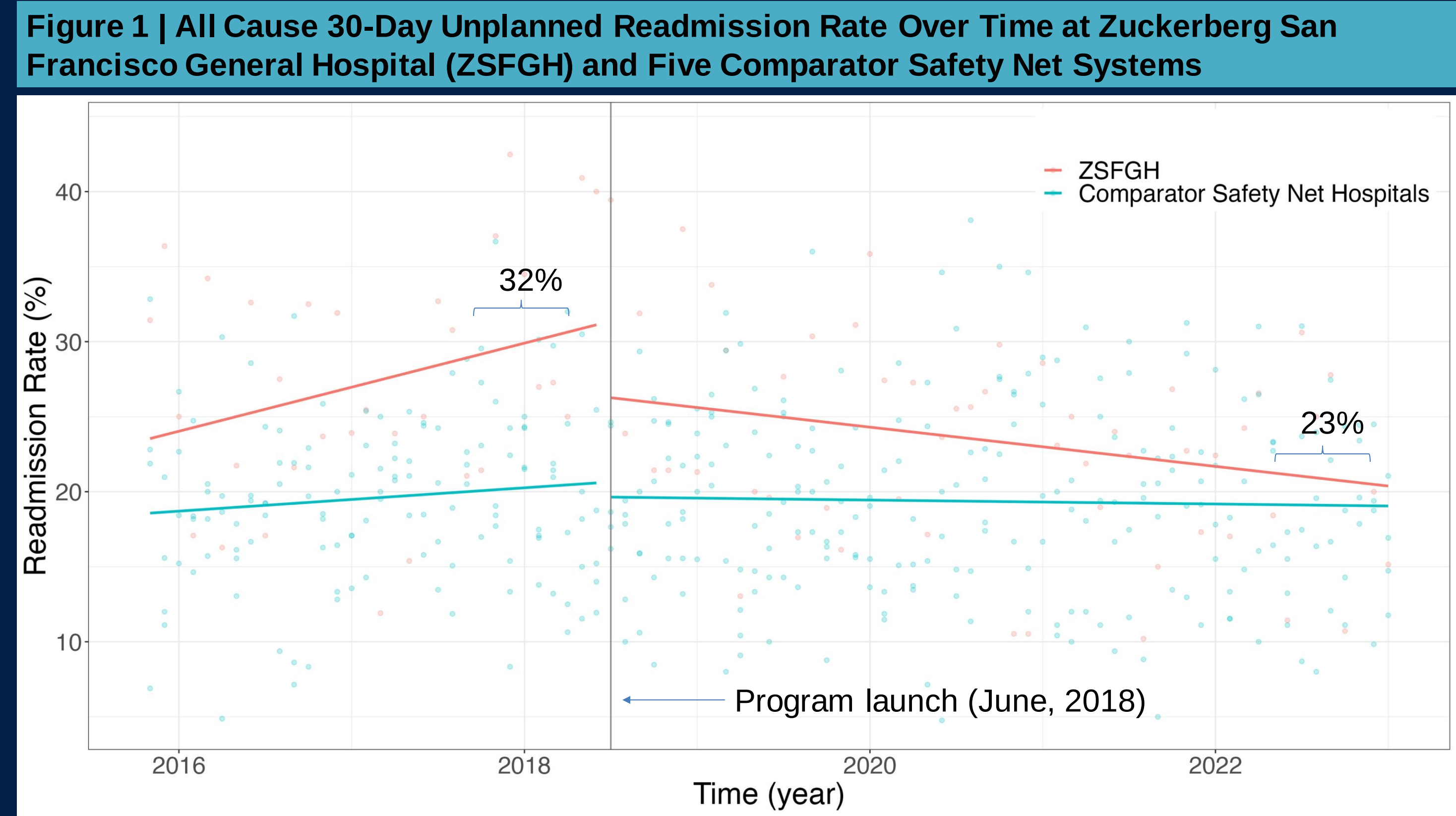
METHODS

- We performed a comparative, retrospective, interrupted time series analysis of 30-day unplanned readmission and all-cause mortality utilizing internal, historical controls and external, parallel controls from 5 SNHs in California
- All patients ≥18 years old, admitted for a primary diagnosis of HF between October, 2015 and January, 2023 were included.
- 2,130 patients met inclusion criteria at ZSFGH (861 pre-program launch (historical controls) and 1269 post). 12,638 patients met inclusion criteria at peer comparator hospitals.

CONCLUSIONS

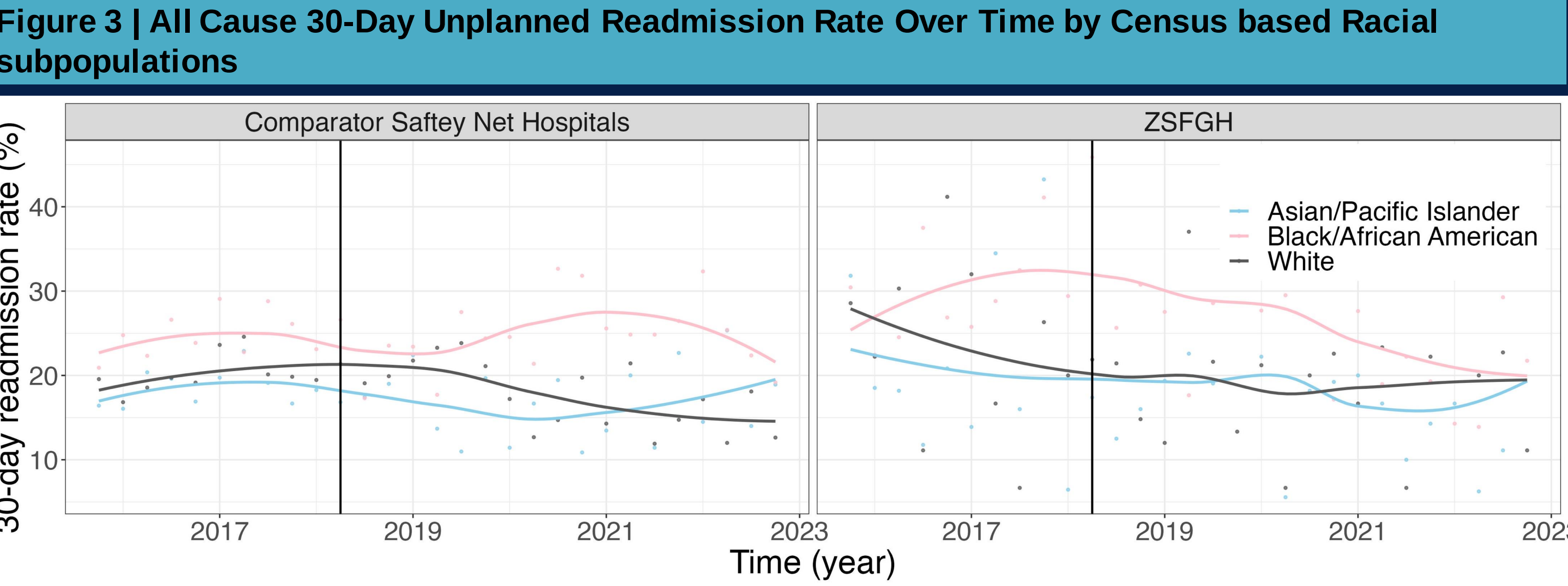
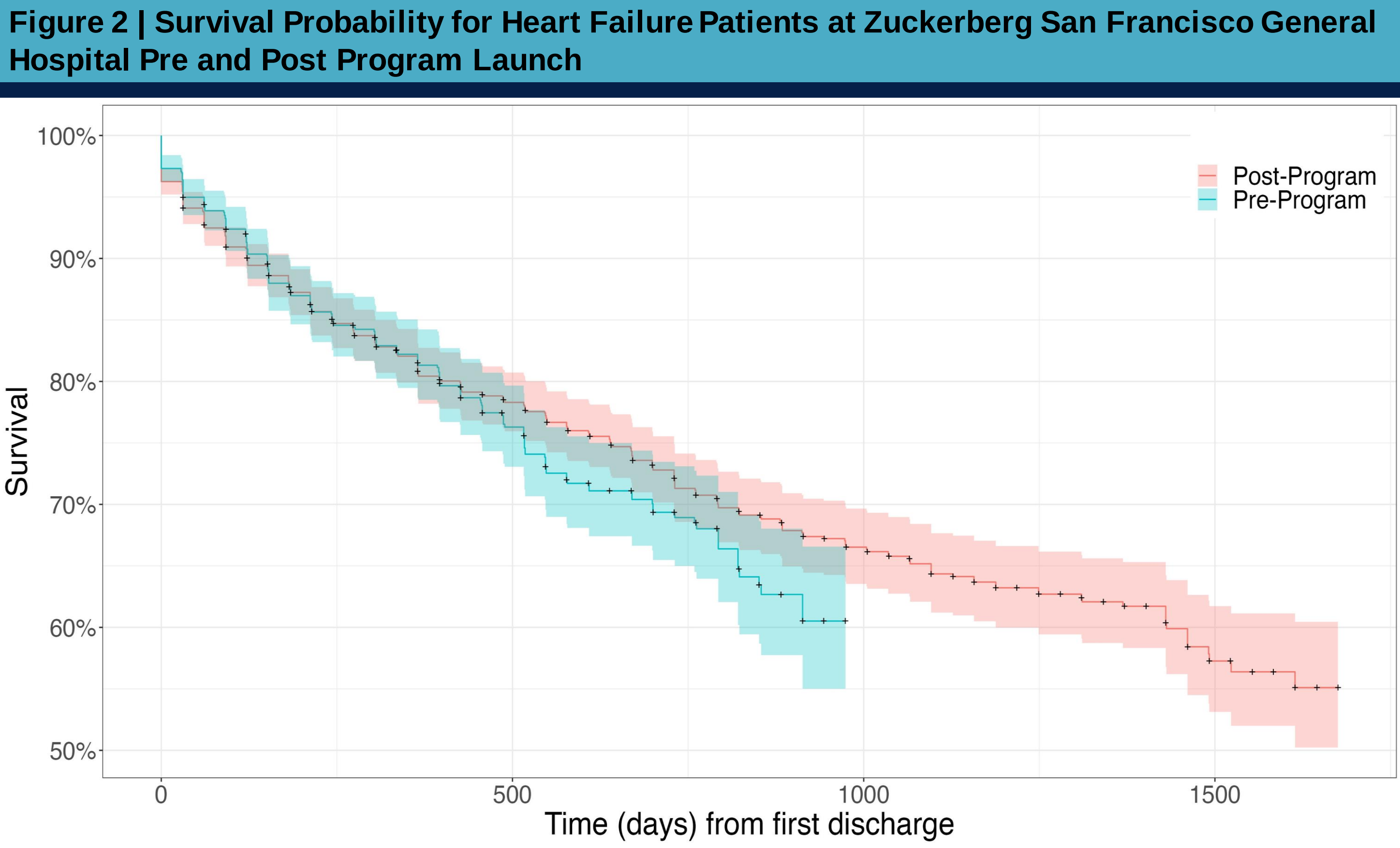
- An EHR integrated, machine learning based performance improvement program was associated with reduced readmission and mortality rates, and closure of racial equity gaps at our urban, safety net healthcare system
- Improvement in readmission rate resulted in retention of over \$6 million of at risk funding that was directly used for clinical care
- Machine learning and EHR based digital clinical decision support can be effectively combined to improve clinical outcomes in a SNH. This could serve as a model for other SNH.

A comprehensive heart failure improvement program combining machine learning with electronic health record based clinical decision support tools was associated with reduced 30-day unplanned readmission, improved mortality, and retention of \$6M of at-risk funding



Odds of unplanned 30-day readmission declined at a significantly greater rate at ZSFGH after program launch compared to other state SNHs (Odds Ratio[95%CI] 0.91/year[0.84-0.98,p=0.015], reflected by a decline in monthly readmission rate

There was a significant reduction in all-cause mortality when comparing post-program to pre-program time periods (Hazard Ratio[95%CI]: 0.82[0.68-0.99],p=0.037)



Odds of 30-day readmission were significantly higher for Black/African American patients than for other census based racial or ethnic subpopulations at ZSFGH, but declined at a significantly greater rate after program launch compared to other SNHs (OR 0.85/year[0.8-0.9], p<0.001)



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KEY PROGRAM INTERVENTION

- EHR integrated Clinical Decision Support Tool:** An electronic health record (EHR)-integrated inpatient support tool utilized a machine learning risk prediction model which risk-stratified patients for treating inpatient teams; optimized medical management, discharge medications, and discharge referral placement; and prompted referrals to specialty services to address specific social determinants of health associated with high risk of readmission

Referral support triaged patients with specific social needs to two programs also built and deployed by the HF improvement program:

- Heart Team:** A multidisciplinary team composed of Cardiologists, Addiction Medicine specialists, Palliative Care, and Social Medicine specialists was created to develop and deploy patient specific treatment plans for the highest risk patients and subpopulations, which were identified by EHR data driven predicted risk of readmission.
- Heart+ Clinic:** A dual diagnosis clinic for patients with comorbid HF and stimulant use disorder was developed. Highest risk patients as identified by EHR data driven risk prediction were triaged to this clinic