



**The Bernard J. Tyson
National Award for
Excellence in Pursuit
of Healthcare Equity**

2024 Application Summary for Bernard J. Tyson National Award for Excellence in Pursuit of Healthcare Equity

Organization Name

Zuckerberg San Francisco General Hospital and Trauma Center

Initiative Title

Reducing Racial Disparities for African American Patients with Heart Failure

Executive Summary of Initiative

Zuckerberg San Francisco General Hospital's (ZSFG) heart failure (HF) equity improvement initiative successfully addressed and eliminated healthcare disparities among Black/African American (B/AA) patients with HF in the San Francisco Health Network (SFHN). Leveraging digital innovation within a resource-limited safety net hospital system, the project utilized machine learning and electronic health record (EHR) automation to lower readmission rates, improve mortality, and bridge gaps in healthcare equity. The HF initiative began with an evidence-based analysis that revealed HF as a leading cause of disproportionate hospitalizations among B/AA patients, compounded by socio-economic and structural inequities. Input from providers, patients, and community leader stakeholders informed an interdisciplinary task force's development and implementation of several interventions to meet our healthcare equity goals. Our team developed and implemented digital tools integrated into the clinical workflow, including an EHR-based decision support tool and a real-time dashboard for HF patient management across the SFHN. We mobilized a recurring multidisciplinary team – including primary care, Cardiology, Social Medicine, Addiction Medicine, and Palliative Care – to address the system's highest-risk HF patients, and we created the first reported Addiction Medicine/Cardiology co-management clinic for patients with stimulant use and HF. Through the cumulative effect of these interventions, we standardized the delivery of HF care and the approach addressing social determinants of health. As a result, our organization's HF initiative achieved measurable reductions in healthcare disparities. The 5.4% readmission rate gap between B/AA patients and the general population at the program's onset in 2018 was closed entirely by 2022. This achievement was accompanied by reduced 30-day readmission rates from 33% to 20% and significant improvements in mortality rates. Sustainability and scalability are fundamental tenets of the program, with regular data evaluations, ongoing provider training, and a commitment to sharing successful practices with other health systems. By reinforcing the project's lasting impact on health equity, it can be a replicable model for tackling disparities in additional disease states and healthcare settings.

Describe the healthcare disparity that was the target for the improvement initiative and the importance of this target population to your organization. Articulate the health equity problem/opportunity addressed and its importance.

HF drives over 1 million hospitalizations annually, each associated with a high risk of mortality and readmission. HF prevalence increases in populations with high rates of poverty and disability, and disparities in HF care and outcomes have been consistently reported in historically marginalized and underserved patient populations, particularly those identifying as Black/African American (B/AA). The SFHN provides primary and specialty medical care to approximately one in eight publicly insured and uninsured San Franciscans (~110,000 people), and ZSFG is the acute care hospital for this system. As is common in safety net systems, HF was our leading cause of hospitalization and readmission, and patients with HF experienced higher-than-expected mortality rates when compared to peer institutions and the national average. B/AA HF patients additionally experienced even worse HF outcomes. In 2018, there was a 5.4% gap in the 30-day hospitalization readmission rate between B/AAs (33.46%) and the overall population (28.06%). This equity gap appeared to be widening. At the same time ZSFG/SFHN was identifying HF disparities, the San Francisco Department of Public Health published the “Black/African American Health Initiative Report,” which described both the unevenly distributed barriers to health facing the City/County’s B/AA residents and subsequent health disparities. Across almost every social determinant of health (SDOH) measure, B/AA communities fared worse with consistently worse health outcomes. From 2014 to 2016, B/AA residents were almost seven times more likely to become hospitalized for hypertension and six times more likely to become hospitalized for diabetes than other residents. Consequently, the life expectancy of B/AA residents was 72 years, nearly ten years less than that of other residents. Therefore, in 2018, there was an urgent need to address specifically HF disparities in the ZSFG/SFHN population, likely a key driver in the healthcare disparities uncovered in the “Black/African American Health Initiative Report.” The SFHN and ZSFG undertook a population health equity initiative to improve HF care in San Francisco, close equity gaps in readmission rates, and reduce overall HF mortality rates. A secondary intent was to meet readmission reduction targets to retain at-risk funding needed for critical clinical programs serving ZSFGs most vulnerable patients.

Describe how the healthcare disparity was identified at your organization and your baseline measurement of the disparity (Be sure to provide baseline data demonstrating the disparity for the targeted population to establish that improvement was achieved.)

Multiple data sources identified the B/AA HF disparities and hospital readmission rates are a key performance indicator all health systems and hospitals track. ZSFG tracked this metric closely as a safety net hospital because \$1.2 million in annual government funding for clinical care is tied to meeting readmission reduction targets. Additionally, the City and County of San Francisco’s “Black/African American Health Initiative Report” revealed the aforementioned healthcare disparities and dire mortality trends. With these data and background, a task force was developed to evaluate the causes of elevated B/AA readmission and mortality rates. Utilizing A3 thinking and Lean principles, the team performed a data-driven analysis to understand the system-based challenges contributing to the problem. A pivotal finding was that HF accounted for over 40% of unplanned readmission events, causing an outsized effect on readmission performance and that B/AA HF patients fared even worse in terms of HF readmission and mortality risk. The baseline data the task force identified were that B/AA patients with HF had a 33.5% rate of 30-day readmission after hospitalization for HF, compared to 28.1% for the overall HF population (See Figure 1).

Explain what factors you identified as the causes of the disparity and possible targets for your intervention to reduce the disparity. Specifically, describe the analysis of the causes of the disparity within the healthcare organization or in the community that you identified through literature review or, optimally, through an analysis of your healthcare organization data or data about the community you serve (e.g., access to care, communication barriers, unequal diagnostic testing or treatment, social determinants of health, implicit/subconscious bias, and/or institutional/structural racism).

SFHN/ZSFG HF task force expanded upon their analysis by meeting with B/AA HF patients, providers, community members, and SFHN leadership to understand the causes of the healthcare disparities. Key findings included: 1. SDOH associated with structural racism had an outsized effect on outcomes: In a retrospective analysis of 290 patients between October 2018 and April 2019, the inpatient cardiology team determined that the factors with the strongest associations with readmission were living in a homeless shelter (relative risk of 3.20), experiencing homelessness (2.07) and engaging in intravenous drug use (2.00). In contrast, medical comorbidities such as hypertension (1.14) and diabetes (1.30) had lower relative risks of readmission. In addition, being B/AA had a high relative risk for readmission (2.28). This was consistent with the worse SDOH and health outcomes demonstrated in the 2018 B/AA Health Initiative Report (see Table 1). 2. There was no standardized approach to the care of HF patients, leading to significant variation and possible biases in care by individual providers and provider teams: The task force analyzed readmission rates by individual HF providers and uncovered significant variations in approaches to care where variations should not have been present. In interviews, several providers expressed reluctance to prescribe medications that were part of the optimal standard of care to individuals whom they considered unlikely to follow up in the clinic due to factors such as homelessness, substance use, or low health literacy. 3. Access to specialty care was limited, and there was difficulty in defining and triaging high-risk patients: Many HF readmission patients had co-occurring substance use disorders: 35% reported cocaine use, 33% reported alcohol use, 27% reported methamphetamine use, 64% reported tobacco use, and 16% reported opioid use. Identifying these high-risk patients systematically was difficult and connecting them to follow-up providers who met their complex health needs was even more challenging.

Describe team and stakeholder engagement throughout the initiative.

Initially, this initiative was led by two physicians and an executive sponsor. As digital innovation became more central to the improvement effort, hospital leadership established the Pioneering Research and Organizational Solutions to Promote Equitable Care through Technology (PROSPECT) Lab—a digital innovation task force with the mission of applying technology to improve health outcomes and equity in underserved populations. The lab includes experts in Lean, machine learning, artificial intelligence, informatics, EHRs, health equity, and SDOH. Stakeholder engagement was mandatory for the initiative's success. The PROSPECT lab surveyed the ZSFG/SFHN population to gain critical insights and established a patient group to inform the initiative. Diverse subject matter experts contributed to understanding the problem and developing countermeasures, including HF experts (cardiologists), primary care providers, specialists in Addiction Medicine, Palliative Care, and Social Medicine, and community leaders. Interviews and multidisciplinary workshops with these stakeholders generated input that was integrated into the development of the interventions.

Describe the interventions and how they were implemented. Specifically, describe the improvement methodology and tools used, strategy adjustments, evidence-based best practices employed, change management strategy).

Based on the PROSPECT Lab task force's A3 thinking and the Lean-based analysis, three pilot countermeasures were designed and implemented: 1. Utilizing an inpatient checklist to standardize care for all HF patients and address medical and social needs to limit the impact of individual provider biases (see Figure 2). 2. Creating a specialized team to care for the highest-risk HF patients: This "Heart Team" combined previously siloed healthcare providers into a multidisciplinary group of HF experts, primary care providers, and specialists in Addiction Medicine, Palliative Care, and Social Medicine*. 3. Creating a novel specialized clinic for patients with both HF and stimulant use: This "Heart Plus" clinic was led jointly by cardiologists and addiction medicine specialists. Though these pilot countermeasures yielded promising results, they were not scalable and lacked direct integration with clinical workflows. The team then deployed the pilot interventions as digital tools within the EHR to create a digital platform for HF readmission care coordination through the following: 1. Utilizing an EHR technology called "Care Paths," we adapted the discharge checklist into a logic-based, point-of-care decision support tool housed within a custom-built user interface (Figure 2). 2. Adapting a machine learning model predicting readmission risks to the ZSFG population to provide a framework for readmission risk stratification. Predictions from this model were surfaced in the decision support tool and guided providers to place prioritized referrals to the HF clinic (Figure 2). 3. Creating a HF dashboard within the EHR displaying machine learning-derived readmission risk predictions for all HF patients in real-time and key clinical metrics. Through this dashboard, the Heart Team transitioned to an anticipatory population health management approach where instead of identifying high-risk patients based on prior frequency of admissions, they focused on patients with a high risk of predicted unplanned readmission. The Heart Team also used this dashboard to identify patients to enroll in the Heart Plus clinic (Figure 3). * Jack Chase, Jenna Bilinski, and Hemal K. Kanzaria, "Caring for Emergency Department Patients With Complex Medical, Behavioral Health, and Social Needs," JAMA: The Journal of the American Medical Association 324, no. 24 (December 22, 2020): 2550–51.

Describe measurable improvement(s) achieved for the targeted disparity. Support this section with data here and in the supplemental upload document; illustrate improvements in processes of care, health outcomes, and/or experience of care (i.e., results tables, statistical tests, run charts, and other quantitative methods). Compare the data post-intervention(s) to the data used to establish the baseline and illustrate improvement.

From 2018 to 2023, ZSFG eliminated the readmission disparity between B/AA HF patients and the general HF population. In 2018, the gap between B/AA patients and the general HF population was 5.4% (33.46 vs. 28.06%) ($p = 0.01$). By 2022, there was no significant difference in readmission rates, and B/AA patients exhibited lower readmission rates than the general HF population. Compared to peer safety net hospitals, readmission risk declined at a significantly higher rate for B/AA patients at ZSFGH in the post-implementation period compared to other hospitals (HR 0.85 [CI 0.78,0.94], $p < 0.001$) (Figure 1). The elimination of the HF readmission rate disparity is striking because readmission rates declined substantially for the overall population. At its peak in 2018, all-cause 30-day readmission rates for HF patients were 33%, making ZSFG the safety net hospital with the highest readmission rates in the state. Currently, readmission rates are 20%, a statistically

significant absolute reduction of 13% ($p < 0.001$). In comparison to peer hospitals, the odds of 30-day readmission were significantly higher at ZSFG compared to other hospitals in the pre-implementation period (HR 1.58 [CI 1.21-2.06], $p < 0.001$), and readmission odds were trending upwards over time before implementation (HR 1.06 [CI 1-1.13]/year, $p = 0.065$). The decline in readmission odds following program implementation was significantly higher at ZSFG compared to other hospitals (HR 0.91 [CI 0.84-0.98]/year, $p = 0.015$) (Figure 4). Cox proportional hazards models adjusted for age, sex, Charlson Comorbidity Index, and social deprivation index revealed a significant reduction in risk of mortality in HF patients in the post-implementation period in comparison to the HF patients in the three years before implementation (HR 0.82 [CI 0.68-0.99], $p = 0.037$) (Figure 5). As a county safety net hospital, ZSFG was enrolled in federal and state pay-for-performance. Total at-risk pay per year was \$1.2 million, and ZSFG had yet to meet readmission metrics before implementing this program in 2018. Since implementation, the health system has met both metrics annually from 2018 to 2023, resulting in the retention of \$7.2 million of at-risk funding. This has been invested in clinical programs aimed at further improving health disparities at ZSFG/SFHN.

Describe whether the improvements achieved were sustained and any processes implemented to monitor and ensure that the improvement will be sustained in the future. Include the most recent available data.

The HF equity improvement program has demonstrated significant and sustained improvements in healthcare delivery, particularly in the management of HF patients within our safety net health system. The durability of these outcomes is evidenced by the continued decline in thirty-day all-cause readmission rates for HF patients, which, as of the latest data collection at the end of 2023, remains at a mere 20.1%. To ensure that these improvements endure, ZSFG has implemented a robust monitoring system centered around a real-time dashboard within the EHR. This offers continuous tracking of readmission risks for patients across the SFHN stratified by machine learning algorithms. This dashboard serves as an early warning system for potential upticks in readmission rates and functions as a quality control mechanism prompting immediate intervention when thresholds are breached. In addition to real-time monitoring, the hospital has established a quarterly review process, where the multidisciplinary team evaluates performance metrics, patient outcomes, and the efficacy of the digital decision support tools. This ensures that clinical practice evolves alongside new research findings and the ever-changing landscape of our patient population's needs. The PROSPECT Lab continues to refine the machine learning model predicting readmission risks. The initial model has been further localized and customized for our HF patient cohort. The enhanced version exhibits improved accuracy and has been deployed system-wide. This model is retrained regularly with the newest patient data to adapt to changing patterns inpatient admissions and health profiles. To specifically address SDOH, ZSFG has integrated a SDOH screening process into the routine care of HF patients. This screening is linked to the EHR so that providers have access to tailored community resources and referrals, ensuring a holistic approach to patient care. The effectiveness of this integration is monitored through patient follow-ups and an annual review of community resource linkage rates. Finally, the hospital recognizes the importance of provider engagement in sustaining improvements. Ongoing education programs and monthly orientations have been established to familiarize new staff with the digital tools and to refresh the knowledge of existing staff.

Describe how the interventions/solutions were (or could be) replicated (implemented/disseminated) by other parts of your organization or other facilities.

Digital innovation has significant potential to overcome many inherent resource limitations impeding successful health equity initiatives in safety net health systems. The digital tools created as part of this program are adaptable to other chronic diseases that exhibit healthcare disparities, and these tools are inherently shareable with other health systems. Since our EHR-based decision support tool is designed with adaptable logic pathways, it currently is being adapted to address healthcare disparities in sepsis as well as opiate overdose. Plans are in place for chronic disease management support for hypertension, diabetes, and asthma. In addition, the machine learning models have been developed with transferability in mind. These models can be used by other institutions to train the algorithms on their own patient data, ensuring local relevancy and precision. Finally, ZSFG is in the early stages of leading a technology Collaboratory among safety net health systems with the goal of sharing successful innovations and technology that have been proven to reduce health disparities and to defray the cost of development to resource limited health care systems.

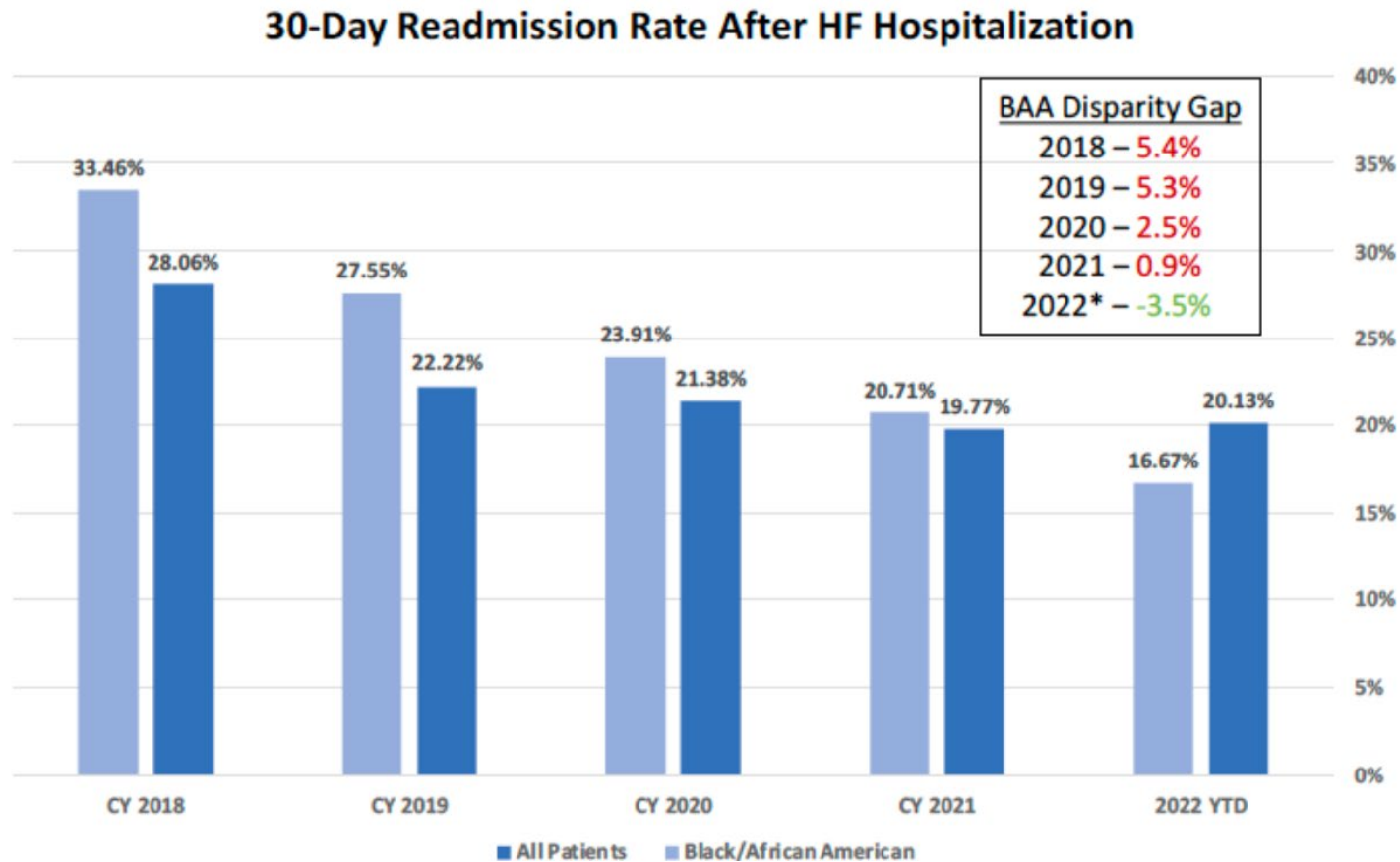
Describe innovative aspects of the work including principles that are applicable to other disparities and/or any lessons learned that may be beneficial to other organizations. Describe the lessons your team learned, and the tools, strategies, and methodologies that other organizations could adapt and adopt to achieve similar results.

This initiative has had wide-ranging impacts on care delivery at ZSFG and across the SFHN. To address disparities beyond HF, we employ the methodology of using data-driven analysis to identify problem areas, followed by piloting interventions and scaling successful ones through digital tools. Machine learning can effectively stratify patient risk and customize care plans, ensuring that interventions are targeted and resources are optimally allocated to appropriate patient populations. The success of multidisciplinary teams with expertise in performance improvement and available/emerging technologies has led our health system to consider technology for performance applications that it previously would not have. To systemically and systematically address health disparities, health care systems must share successful technology, methodology and strategies especially to those with limited resources. Our digital tools thus are available to all. Health systems should assemble teams with expertise in technology and performance improvement and support them with on high-priority, health system-aligned improvement projects. Through our collective efforts, we can meaningfully, measurably, and sustainably reduce healthcare disparities.

Applicants are encouraged to Upload a Supplemental Document, exclusively containing Figures and/or Tables that illustrate baseline, improvement, and sustained results. Limit seven (7) pages total; content in excess of 7 pages will not be considered in evaluation. Combine all supplemental documentation within one 7-page PDF document.

ZSFGH – Tyson 2024 Award Application – Supplemental Data

Figure 1 | Thirty-Day All-Cause Readmission Rate in Black/African American HF Patients Compared with All Other HF Patients ZSFG



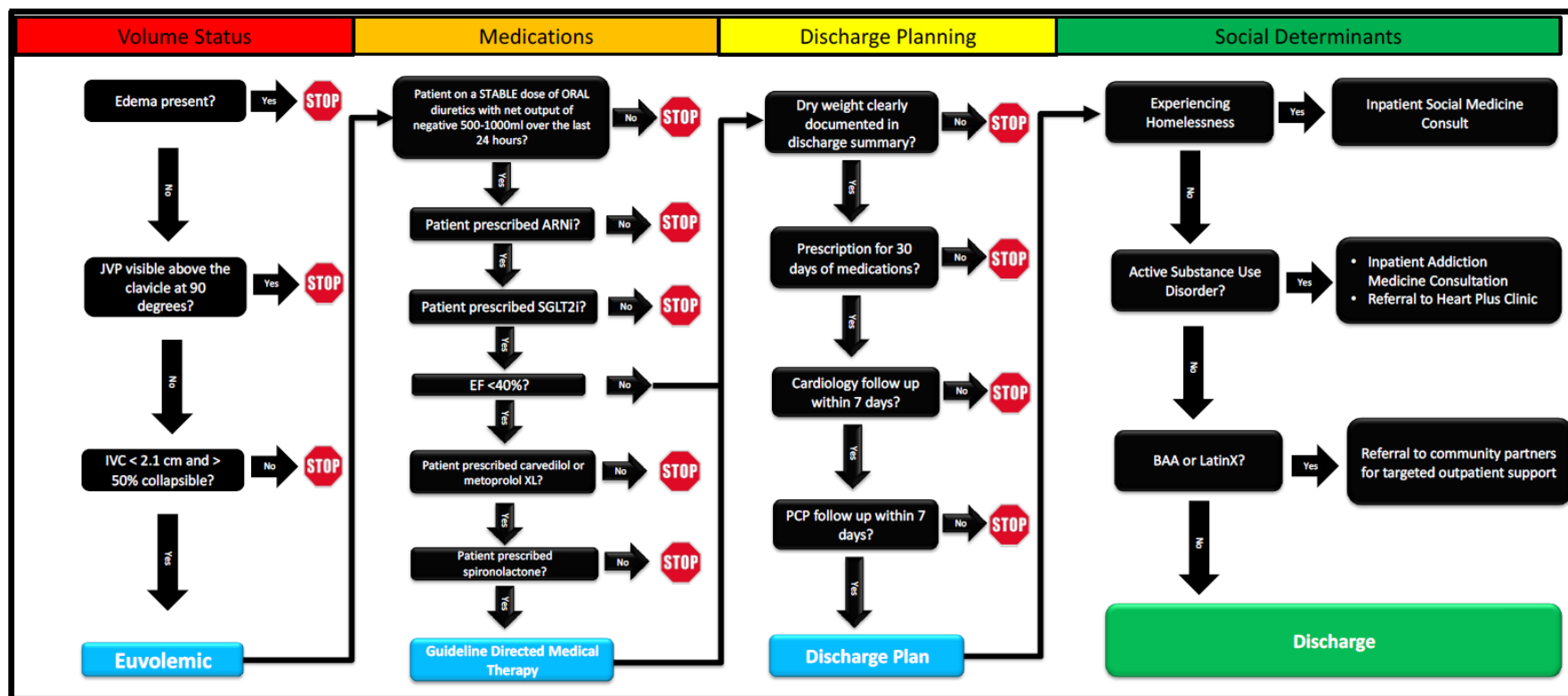
ZSFGH exhibited significant equity gaps in readmission rates between the B/AA HF and general HF populations in 2018 before implementing the readmission reduction program. By the end of 2022, there was no longer an equity gap in readmission rates.

Table 1 Retrospective Analysis Identifying Risk Factors for Readmission and Adverse Health Outcomes within the ZSFG/SHFN Heart Failure Population

Characteristic	Relative Risk (95% CI)
Age (years)	1.00 (0.98 – 1.02)
Sex Assigned at Birth	
Male	1.0
Female	1.20 (0.71 - 2.02)
Coronary artery disease	0.83 (0.54 - 1.30)
Hypertension	1.14 (0.67 - 1.93)
Diabetes	1.30 (0.82 - 2.04)
CKD	1.15 (0.73 - 1.80)
COPD	0.85 (0.53 - 1.37)
Self Reported Race	
White	1.0
Black	2.28 (1.00 - 5.20)
LatinX	2.53 (1.07 - 6.00)
Asian	0.65 (0.19 - 2.30)
Other	3.07 (1.02 - 9.27)
Mental illness	0.84 (0.41 – 1.72)
Housing status	
Marginally housed	1.02 (0.44 - 2.37)
Shelter	3.20 (1.27 - 8.02)
Homeless	2.07 (1.21 - 3.56)
Intravenous Drug Use	2.00 (1.08 – 3.70)

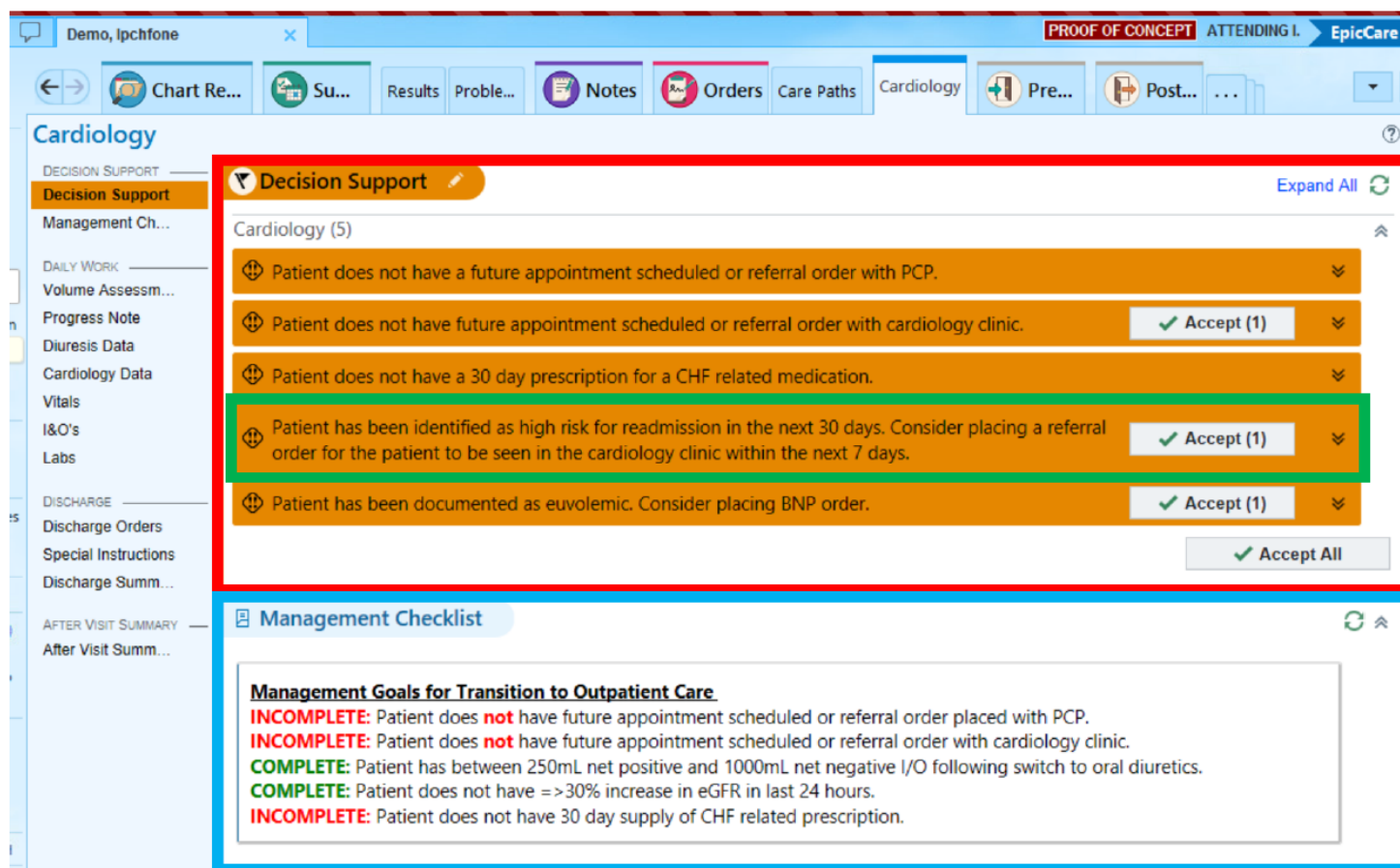
This analysis revealed that specific social determinants of Health and self-identification as black slash African American were significantly associated with increased readmission risk and adverse health outcomes. This analysis hoped to inform the approach of the heart failure equity task force.

Figure 2 Pilot Discharge Checklist for admitted Patients with Heart Failure at ZSFG



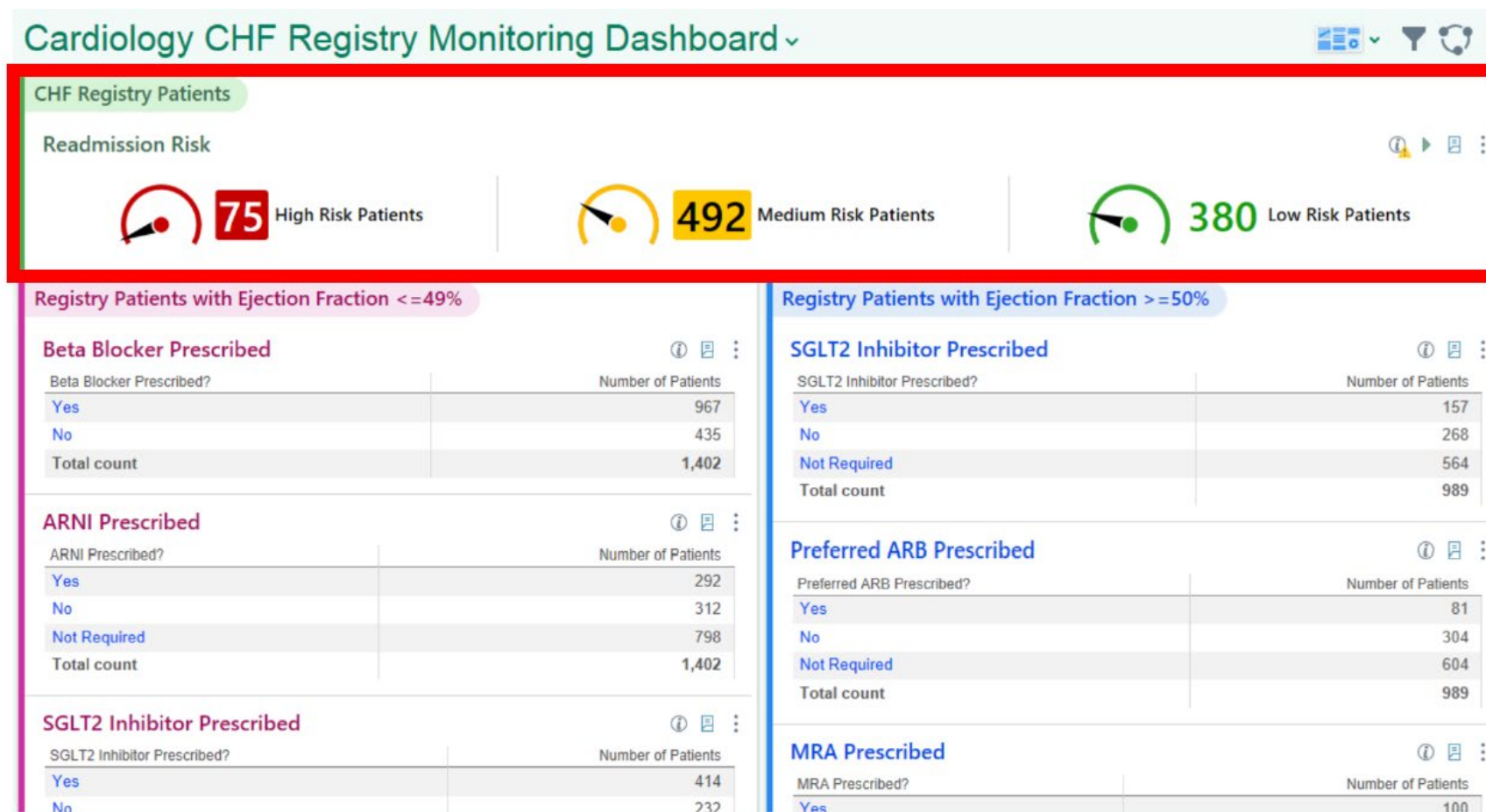
Responding to the lack of standardization of inpatient HF care and episodes of treatment bias, the task force created a standardized approach to inpatient heart failure care. The standardized approach manifests at the discharge checklist, which ensures that all patients, regardless of demographics or adverse social determinants, receive the highest level of heart failure, including addressing social determinants that have been shown to increase the risk of readmission.

Figure EHR integrated, adaptive, point-of-care, decision support tool with machine learning based risk prediction



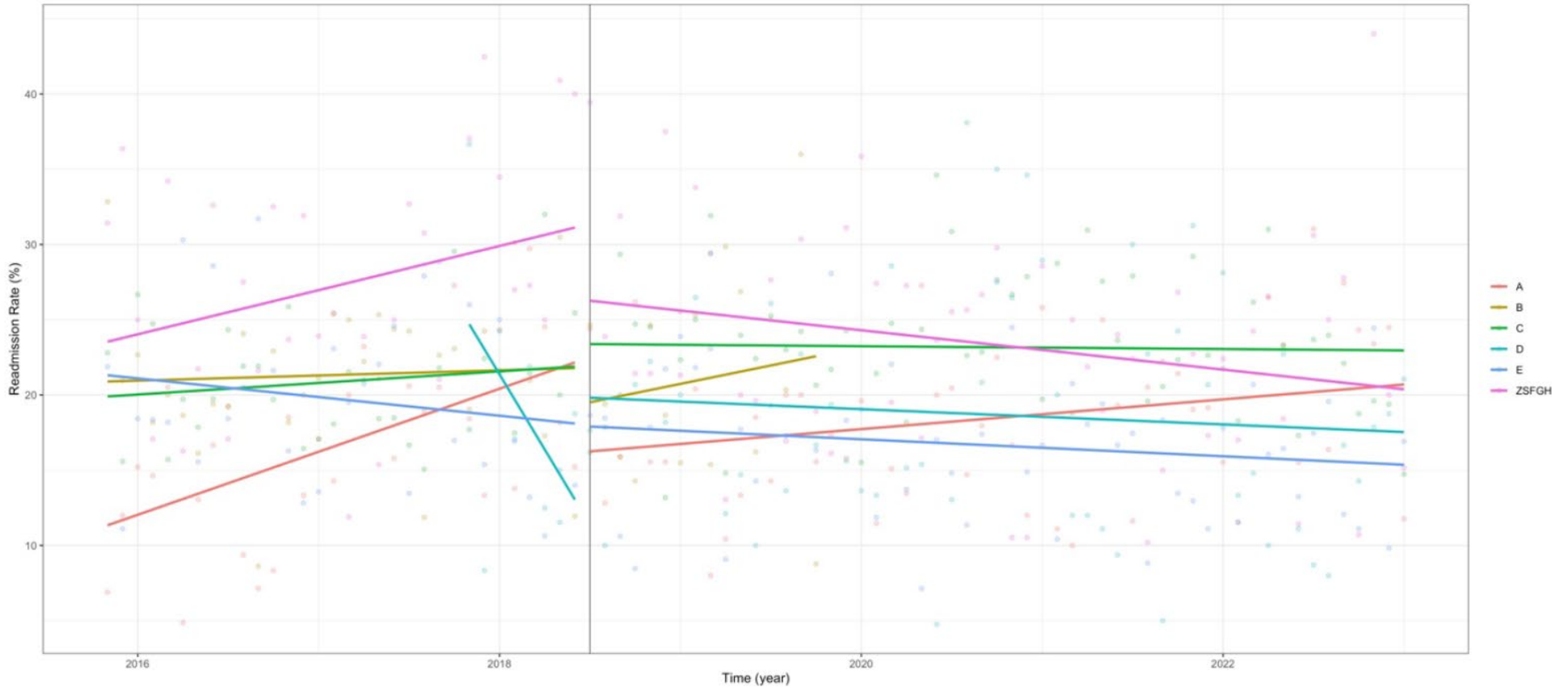
ZSFG adapted a paper-based discharge checklist into an adaptive, point-of-care, automated decision support tool integrated directly into the EHR. The decision support interface includes inline prompts (red box) and a management checklist (blue box) outlining the tasks and status of each task the provider needs to accomplish before advancing to the next step of the heart failure treatment pathway. A specific inline prompt (green box) surfaces and individual patient's risk of unplanned 30 day readmission and, if high risk, prompts the provider to place a priority referral. The decision support tool is housed within a custom user interface in the EHR.

Figure - Population Health Heart Failure Management Dashboard



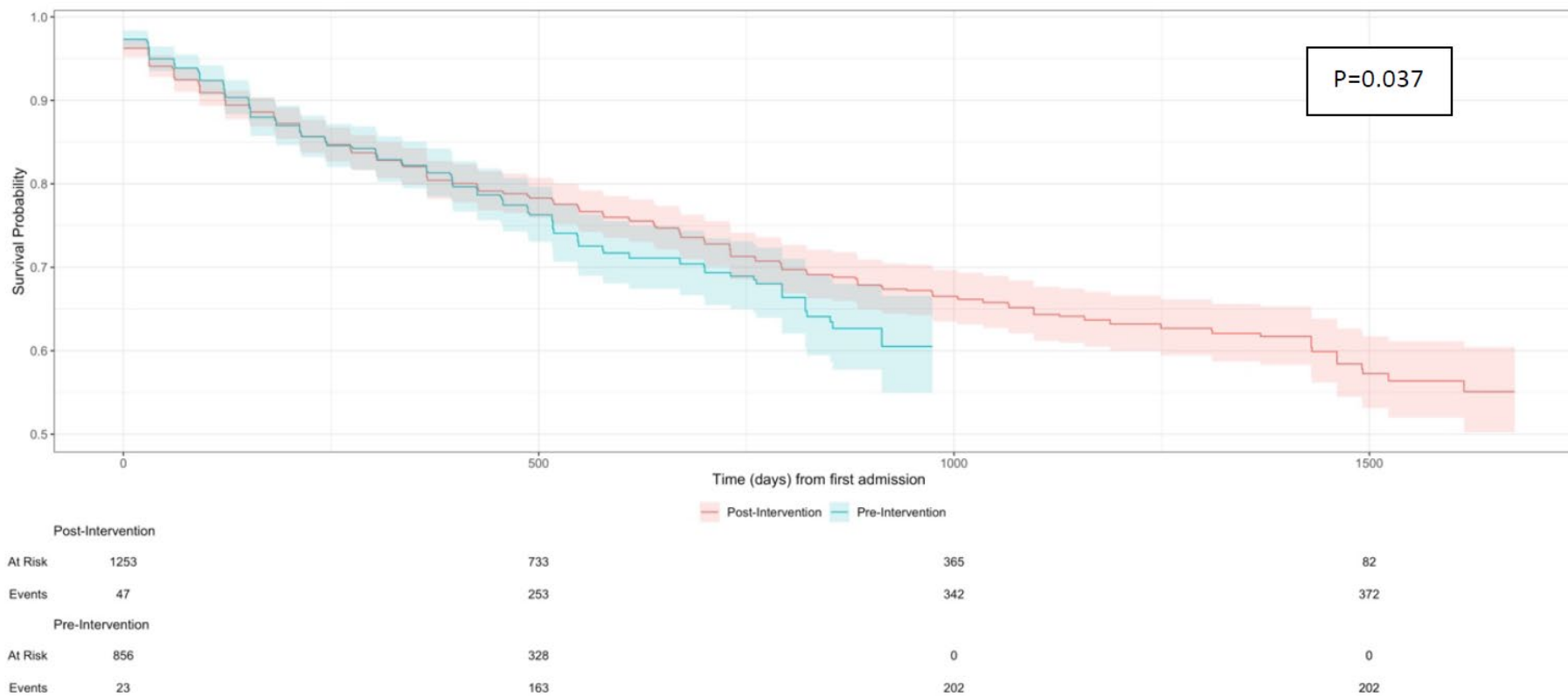
ZSFG created a population health management dashboard for the heart team tasked with identifying and caring for the highest-risk patients. The figure above shows the dashboard and its components. A Red box highlights where the machine learning risk prediction model has stratified HF patients into categories by readmission risk. Each category can be drilled to view individual patients, important information, and specific risk predictions.

Figure 4 – All cause 30-Day Unplanned Readmission Rates at ZSFG Compared to Peer Safety Net Hospitals during the Pre and Post-Implementation Periods



All-cause 30-day unplanned readmission rate (%), all-cause unplanned 30-day readmissions, and total monthly discharges for each safety net hospital over the study period. Readmission rate trend lines are divided at the implementation time (June 2018), denoted by a vertical gray line. Adjusted odds of 30-day readmission declined at a significantly greater rate (HR 0.91/year [95% CI: 0.84 - 0.98], p-value = 0.015) at Zuckerberg San Francisco General Hospital (ZSFGH) in the post implementation period compared to other hospitals.

Figure 5 – Survival probability for heart failure patient at Zuckerberg San Francisco General Hospital comparing pre and post implementation periods



Survival time to all-cause mortality in days following first admission for heart failure in the pre- (Blue; October 2015 to June, 2018) and post (red; June 2018 to January 2023) implementation periods. COX proportional hazard models adjusted for age, sex, Charlson comorbidity index, and social deprivation index revealed a significant reduction in mortality risk in the post-intervention cohort (HR 0.82, [95% CI: 0.68 - 0.99], p= 0.037).