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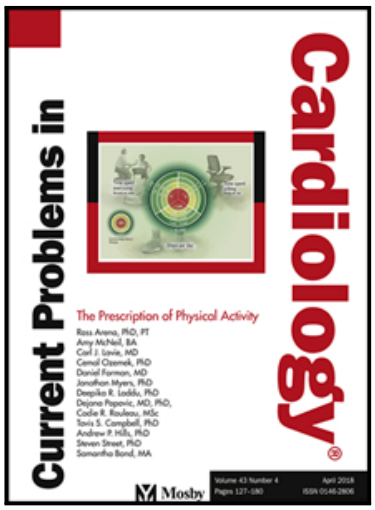

Association of Psychosocial risk factors and Outcomes in heart failure: Does COVID-19 affect outcomes?

Thrishala Reddy Kasireddy MD , Zeynep Yukselen MD , Anjani Muthyala MD , Kannu Bansal MD , Mahati Dasari MD , Pramukh Arun Kumar MD , Viswajit Reddy Anugu MD , Vidit Majmundar MD , Michael Nakhla MD , Garima Sharma MBBS, FACC , Nasir Khurram MD, MPH , Haider J Warraich MD , Sarju Ganatra MD , Sourbha S. Dani MD, MSc

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Title: Association of Psychosocial risk factors and Outcomes in heart failure: Does COVID-19 affect outcomes?

Authors:

Thrishala Reddy Kasireddy, MD[a], Zeynep Yukselen, MD[a,b], Anjani Muthyala, MD[a], Kannu Bansal, MD[a], Mahati Dasari, MD[a], Pramukh Arun Kumar, MD[a], Viswajit Reddy Anugu MD[c], Vidit Majmundar, MD[a], Michael Nakhla, MD[a], Garima Sharma, MBBS, FACC[d], Nasir Khurram, MD, MPH[e], Haider J Warraich, MD[f], Sarju Ganatra, MD[g], Sourbha S. Dani, MD, MSc[g]

Departments and Affiliations:

[a]Department of Internal Medicine, Saint Vincent Hospital, Worcester, MA

[b]School of Public Health and Health Sciences, University of Massachusetts, Amherst, MA

[c]John Ochsner Heart and Vascular Institute, Slidell, LA

[d]Department of Cardiovascular Medicine, Inova Heart And Vascular Institute, Falls Church, VA

[e]Division of Cardiovascular Prevention and Wellness, Department of Cardiology, Houston Methodist, Houston, TX

[f]Division of Cardiovascular Medicine, Brigham and Women's Hospital, Boston, Massachusetts, USA and Department of Medicine, VA Boston Healthcare System, Boston, MA

[g]Division of Cardiovascular Medicine, Department of Medicine, Lahey Hospital and Medical Center, Burlington, MA

- The study was done utilizing the Nationwide Readmissions Database.

Corresponding Author:

Sourbha S. Dani, MD, MSc

Division of Cardiovascular Medicine, Department of Medicine

Lahey Hospital and Medical Center,

Beth Israel Lahey Health,

Burlington, MA, USA 01805

Sourbha.s.dani@lahey.org

Phone:5083736085/Fax: 7817445261

Twitter: @SaurabhSDani

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Short Abstract:

Psychosocial risk factors (PSRFs) are crucial non-traditional risk factors affecting outcomes in heart failure (HF) patients. We sought to investigate the impact of the COVID-19 pandemic on PSRFs and HF outcomes. Utilizing 2019-2020 Nationwide Readmissions Database, 305,955 patients with a diagnosis of HF were selected of which 175,348 (57%) had PSRFs. We further compared these subgroups across non-COVID (2019) and COVID (2020) eras. Multivariable logistic regression models were constructed for analysis. In patients with PSRFs, we noted higher 30-day all-cause readmissions, 30-day heart failure readmissions, 30-day all-cause mortality and composite of MACE. Readmissions were higher in both eras, while mortality was significantly higher during the COVID-19 era. This highlights the importance of multidisciplinary care in this vulnerable population.

Full abstract:

Background:

Psychosocial risk factors (PSRFs) have emerged as crucial non-traditional risk factors affecting outcomes in patients with heart failure (HF). There is a paucity of data studying these risk factors in HF nationally. Additionally, whether the COVID-19 pandemic impacted outcomes remains unexplored, given the increased psychosocial risk during these times.

Objectives:

To assess the impact of PSRFs on the outcomes of HF and their comparison across non-COVID and COVID eras.

Methods:

Patients with a diagnosis of HF were selected using the 2019-2020 Nationwide Readmissions Database. Two cohorts were created based on the presence or absence of PSRFs and compared across non-COVID (2019) and COVID (2020) eras. We examined the association using hierarchical multivariable logistic regression models.

Results:

A total of 305,955 patients were included, of which 175,348 (57%) had PSRFs. Patients with PSRFs were younger (P<0.001), less likely to be female (P<0.001), and had a higher prevalence of cardiovascular risk factors. All-cause readmissions were higher in patients with PSRFs in both eras. All-cause mortality [HR 1.15 (1.04-1.27), P=0.005] and a composite of MACE [HR 1.11 (1.06-1.16), P<0.001] were higher in patients in the

non-COVID era. Compared to 2019, patients with PSRFs and HF in 2020 had significantly higher all-cause mortality [1.13 (1.03-1.24), P=0.009]; however, the composite of MACE was comparable [1.04 (1.00-1.09), P=0.03].

Conclusion:

The presence of PSRFs in patients with HF is associated with a significant increase in all-cause readmissions and all-cause mortality in COVID and non-COVID eras. The worse outcomes evident in the COVID era highlights the importance of multidisciplinary care in this vulnerable population.

Keywords: Psychosocial risk factors, Heart failure, COVID-19

Abbreviations:

PSRFs: Psychosocial risk factors

HF: Heart failure

COVID-19: Coronavirus disease 2019

MACE: Major adverse cardiovascular event

INTRODUCTION:

Heart failure (HF) is one of the common causes of hospital admissions and a significant contributor to morbidity and mortality. About 10% of the US population over 65 lives with HF(1). Despite multiple effective treatment modalities and advancements, patients with heart failure continue to have worsening symptoms and frequent readmissions to the hospital. In addition to addressing all the medical risk factors, psychosocial determinants of health must be addressed to improve outcomes. Studies have shown that one of the important yet often missed risk factors is the impact of psychosocial health (2-5). Psychiatric conditions, including anxiety and depression, are more prevalent and can be debilitating comorbidities in patients with HF (2,5). An estimated 20-30% of HF patients have co-existing depression (6,7). These conditions are associated with adverse outcomes in HF, such as decreased adherence to medications and diet, increased hospitalizations or emergency department visits, and death (6). In addition, complying with regular exercise, weight loss, and scheduled follow-up visits can be challenging. Other factors, including low socioeconomic status, marital status, and urban vs. rural location, are also associated with disparities in outcomes (8). Of the various affected outcomes, quality of life is increasingly recognized as necessary (3).

The SARS-CoV-2-associated Coronavirus-19 (COVID-19) global pandemic has exposed and exacerbated disparities in outcomes brought by PSRFs. Stringent lockdown, quarantine and isolation, and the fear of the pandemic worsened mental health among many patients. The first year of the COVID-19 pandemic (2020) increased the global prevalence of anxiety and depression by 25% per a WHO report (9). This significant increase in the prevalence of mental health problems has also disrupted the

availability of prompt care. Many hospitals cancelled elective procedures and a few outpatient services, including cardiac rehabilitation, as all the staff was redirected to the emergency and intensive care services, treating the severely ill. As a result, patients could not come for regular office visits/ follow-up appointments, affecting their baseline cardiovascular status (10).

During the COVID-19 pandemic, loneliness and social isolation worsened cardiovascular outcomes (11). However, there is a data paucity on its impact during the pandemic compared to pre-pandemic time on medical care.

Hence, we sought to study the impact of PSRFs in patients with known HF and compare outcomes in the pre-COVID-19 and COVID-19 eras.

METHODS

1. Data Source

For this study, we analyzed the Nationwide Readmissions Database (NRD) from 2019-2020. It is a publicly available, all-payer, de-identified administrative dataset developed by the Agency for Healthcare Research and Quality (AHRQ) for the Healthcare Cost and Utilization Project (HCUP). It is constructed by combining discharges from 30 state inpatient databases, representing ~60% of all United States hospitalizations. The patient can be traced across the hospitals within a state across one calendar year using linkage information provided in the NRD. Since the NRD contains a de-identified publicly available dataset for retrospective analysis, the study was deemed exempt by our Institutional Review Board and also precluded the need for informed consent.

2. Study Population

Hospitalizations for HF in adults aged ≥ 18 years in 2019 and 2020 were identified using the International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-CM) [Table S1]. ICD-10-CM (clinical modification) were used to identify comorbidities and outcomes [Table S1], and, HCUP Clinical Classification Software Refined (CCSR) was used to identify causes of readmissions [CIR001-CIR039 for cardiac causes; rest were designated non-cardiac, and CIR019 for heart failure]. Weighted samples were used for all analyses. The index admission was defined as the first hospitalization in the calendar year for HF. Patients were excluded if index HF hospitalization was in December of respective years owing to lack of 30-day follow-up data. We excluded patients with index HF admission in January-March of 2019 and 2020 (n=167,363) as we aimed to study the impact of the COVID-19 pandemic, which started in March 2020. Additional exclusion criteria included concomitant COVID-19 positive status in index HF admission (n= 1,109) and patients that left against medical advice (n=7,134) or were lost to follow up (n=43,299), or died (n=7,040) during index hospitalization due to lack of 30-day follow-up data. The final cohort included 305,955 index HF admissions across both years (Figure 1).

Psychosocial risk factors were classified into five domains based on previous work (12): psychiatric disease, limited cognitive understanding, substance use disorder, uninsured status, and low socioeconomic status. The presence of ≥1 factor was used to define the cohort of patients with PSRFs.

3. Patient and Hospital Characteristics

We extracted baseline patient demographics (age, sex, median household income, primary expected payer), psychosocial risk factors, type of HF, comorbidities, hospital

characteristics (bed size, hospital location, teaching status), and discharge disposition data [Table 1]. ICD-10-CM and HCUP CCSR codes were used to define these variables.

4. Outcomes

Primary outcomes of interest were 30-day all-cause readmissions, 30-day mortality, and 30-day major adverse cardiovascular event (defined as a composite of myocardial infarction, heart failure readmission, stroke and all-cause death). Only the first readmission was counted for patients with multiple readmissions within 30 days. Transfer to another hospital or inpatient rehabilitation center was not counted as readmission. Secondary outcomes included causes of 30-day readmissions (cardiac, non-cardiac, heart failure) using HCUP CCSR codes and individual outcomes of the 30-day MACE composite.

5. Statistical Analysis

Patient demographics, comorbidities, hospital characteristics, and discharge disposition were compared between patients with vs. without PSRF using the Pearson χ^2 test for categorical variables and the Kruskal-Wallis test for continuous variables and were further compared separately for 2019 and 2020. Weighted data were used for national-level estimates.

Multivariable hierarchical logistic regression models were constructed to evaluate differences in primary and secondary outcomes. Variables listed in table 1 were used as covariates. Categorical variables were presented as frequency (percentage) and continuous variables as mean (SD) or median (IQR) as appropriate. Odds ratios and 95% confidence intervals (CIs) were used to report the results of regression analyses. Statistical analyses were performed using Stata, version 17 (Statistical Software:

Release 17. College Station, TX: StataCorp LLC). Two-tailed p-values of <0.05 were considered significant for the analyses.

RESULTS:

1. Selection of cases

Using NRD, 531,900 index HF admissions were screened between 2019 and 2020. Of these, 305,955 patients met the inclusion criteria (Figure 1). 136,383 patients (45%) were admitted in 2019 (non-COVID era), while 169,572 (55%) were admitted in 2020 (COVID era). Psychosocial risk factors (PSRFs) were present in 56% of patients with HF in non-COVID era and in 58% of patients with HF in COVID era.

2. Baseline characteristics

There were significant differences in baseline characteristics in patients with PSRFs compared to those without, both in COVID and non-COVID eras [Table 1]. Patients with PSRFs were younger (P<0.001), less likely to be female (P<0.001), had a higher prevalence of cardiovascular risk factors, including pre-existing coronary artery disease (CAD), diabetes mellitus, dyslipidemia and smoking (P<0.001) [Table S2]. Additionally, baseline characteristics of patients with PSRFs in 2019 and 2020 are compared in Table S3.

3. Outcomes

As a group, all-cause readmissions were higher in patients with PSRFs when compared to those without [1.09 (1.06 - 1.11), P<0.001] (Table 2). This included both non-cardiac and cardiac (predominantly HF) readmissions. The adjusted outcomes for all-cause mortality [1.12 (1.04 - 1.20), P=0.003] and a composite of MACE [1.08 (1.04 - 1.12), P<0.001] were also higher in patients with PSRFs versus those without.

Comparing patients with and without PSRFs in both COVID and non-COVID eras, all-cause readmissions were significantly higher in HF patients with PSRFs compared to those without (P<0.001) across both eras (Table 3). This was primarily driven by non-cardiac and HF readmissions (P<0.001). In addition, all-cause mortality was higher in patients with PSRFs when compared to those without, only in the non-COVID era [1.15 (1.04 - 1.27), P=0.005]. Similar results were seen with the composite of MACE and MI (P<0.01). These effects were, however, comparable in the COVID era (Table 3).

In contrast, among patients with PSRFs, there was no difference in all-cause readmissions [1.00 (0.97 - 1.03), P=0.78] and composite of MACE [1.04 (1.00-1.09), P=0.03] between COVID and non-COVID eras. However, there was a significant increase in all-cause mortality [1.13 (1.03-1.24), P=0.009] of HF patients hospitalized in the COVID era compared to the non-COVID era. Similarly, MI [1.19 (1.08-1.30), P<0.001] was higher in the COVID era versus the non-COVID era (Table 4).

DISCUSSION:

The most important finding in our study is that among patients with PSRFs, the risk of MI and all-cause mortality increased during the COVID era. To our knowledge, ours is the first study showing the 30-day outcomes of HF admissions in patients with

psychosocial risk factors in the COVID era. One possible causal mechanism is that the COVID-19 pandemic has highlighted pre-existing inequalities, particularly in terms of healthcare access and economic opportunities. The pandemic has disrupted the continuity of care for many services, disproportionately affecting vulnerable communities such as low-income individuals who may already experience numerous PSRFs (13).

PSRFs are now increasingly recognized as crucial indicators for predicting outcomes in cardiovascular diseases. Studies have shown that the increasing prevalence of PSRFs is linked to a higher mortality risk and worse prognosis (14-17). In addition, patients with heart failure often experience a range of psychological risk factors, including depression and anxiety, leading to poor quality of life. Our study further supports this by demonstrating that PSRFs are prevalent in HF patients and predispose them to an increased risk of adverse outcomes. In our study, about 57% of HF patients had at least one PSRF, regardless of the impact of the COVID-19 pandemic. These risks may be related to the physical symptoms and limitations imposed by heart failure, as well as the emotional and social implications of the condition. Additionally, patients with heart failure may experience social isolation, financial stress, and caregiver burden, all of which can contribute to poor mental health. The added uncertainty, the fear of recurrent hospitalizations, and limited treatment options for the advanced disease may also lead to psychological distress (18-23).

Prior studies have reported that a significant proportion (15%) of hospitalized heart failure patients are diagnosed with substance use or tobacco use disorder (24). We found an even higher rate of substance abuse and tobacco use in our study. Substance abuse disorder accounted for 37% in the non-COVID era and 41% in the COVID era among these patients, while smoking rates were 29.8% and 32.5% in the non-COVID

and COVID eras, respectively. This is an important finding as it has been shown that substance abuse is a significant cause of morbidity in HF patients and is associated with increased emergency department visits and heart failure hospitalization (25).

We report a 13% increase in mortality risk and a 19% increase in MI risk in patients with PSRFs during the COVID-19 pandemic compared to the previous year (Table 4). Although we cannot clearly explain why the mortality risk of patients with PSRFs increased during the COVID era, one of the possible reasons could be that the standard of care for HF treatment for hospitalized patients was not maintained enough in the beginning phase of the pandemic. Additionally, the conversion of cardiology wards and heart failure units to COVID-19 wards and the reallocation of healthcare professionals to care for COVID-19 patients affected the care of HF patients (12, 28). However, Shoaib et al. showed a significant rise in mortality from HF within 30 days of discharge during the COVID-19 pandemic despite the same practice of guideline-recommended medical therapy and interventions. They suggested that the mortality increase was likely due to post-discharge care, which caused suboptimal care after discharge (25). Furthermore, the closure of outpatient clinics during the pandemic may have also contributed to inadequate post-discharge care and increased mortality (26, 27).

PSRFs increased the risk of 30-day all-cause readmissions by 9% in the non-COVID era and 8% in the COVID era (Table 3). Our study findings are more comprehensive regarding psychosocial risk factors as we analyzed the effect of limited cognition, substance abuse, and psychiatric disorders. Several randomized trials have reported follow-up interventions after discharge, such as medication counselling, medication reconciliation, formal education, detailed discharge planning, and phone follow-up to reduce readmissions (28-31); however, interventions focusing on PSRFs have been understudied. By demonstrating the effect of substance abuse, psychiatric disorders, and

limited cognition on heart failure readmissions, we highlight the importance of different determinants of psychosocial risk factors on HF readmissions, which should be considered as prognostic factors, offering significant implications as a future strategy to reduce hospital readmissions and costs.

LIMITATIONS:

Our study does have a few limitations. The NRD database relies solely on ICD coding and does not include parameters of hospital admission, including clinical, laboratory and echocardiography data. Similarly, it does not capture the involvement of multidisciplinary teams, if any, especially palliative care which can be of pivotal importance in advanced heart failure and affect the outcomes. We also could not divide the patients on the subtype of HF based on ICD coding, and, as such, could not associate outcomes based on subtypes of HF. Also, we do not have data on the severity of PSRF illness. Out-of-hospital mortality or emergency care visits are not captured. Finally, information on race/ethnicity is not available in NRD, which would have been beneficial, considering the disparities in PSRF across various ethnic groups.

CONCLUSION:

The findings of our retrospective study using the pre-COVID and COVID Nationwide readmissions data in 2019 and 2020 underscores the effect of the COVID-19 pandemic on the association between PSRFs and HF outcomes. Although not considered a traditional risk factor for heart failure, PSRFs were associated with increased all-cause readmissions in both COVID and non-COVID eras, highlighting its magnitude. The 30-

day all-cause mortality and MI in HF with PSRFs patients were higher in the COVID era. It is prudent to address the increased incidence and prevalence of PSRFs, such as substance use, psychiatric disease, and low socioeconomic status, along with the worsened quality of life during this pandemic which, when paired with substandard HF care in-hospital as well as post-discharge likely led to worse outcomes in the COVID era. Further studies are necessary, focusing on specific PSRF and their effect on reducing hospital readmissions in HF patients.

CLINICAL PERSPECTIVES:

Competency in medical knowledge: In patients with heart failure, psychosocial risk factors lead to frequent readmissions and increased mortality. The additive effect of mental stress through the COVID-19 pandemic further worsened this association.

Competency in Patient Care: Patients with psychosocial risk factors should be provided a holistic approach with medication optimization, counselling, and measures to address cardiovascular risk factors and psychological and social health. A multidisciplinary team involving cardiology, psychiatry, and social services will be helpful.

Translational Outlook: Although psychosocial risk factors are a known risk factor for worse cardiovascular outcomes, future research is needed to see if regular behavioral interventions can help decrease the magnitude of these worse outcomes.

Declarations:

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TABLES

Table 1: Baseline characteristics of patients with HF in non-COVID (2019) and COVID (2020) eras

Characteristics	Patients with HF in 2019 (non-COVID era)			Patients with HF in 2020 (COVID era)		
	With PSRFs N=79,376 (58.2%)	Without PSRFs N=57,007 (41.8%)	P value	With PSRFs N=95,972 (56.6%)	Without PSRFs N=73,600 (43.4%)	P value
Age (mean, SD)	67.1 (14.9)	73.5 (3.3)	<0.001	68.5 (15.0)	74.6 (13.2)	<0.001
Female	38,685 (48.7)	28,607 (50.2)	<0.001	48,240 (50.3)	38,024 (51.7)	<0.001
Median household income, percentile						
0-25th	41,733 (52.6)	-	<0.001	51,970 (54.2)	-	<0.001
26th-50th	15,891 (20.0)	22,534 (39.5)		17,395 (18.1)	27,138 (36.9)	
51st-75th	12,308 (15.5)	18,424 (32.3)		15,064 (15.7)	25,142 (34.2)	
76th-100th	8,756 (11.0)	15,024 (26.4)		10,691 (11.1)	19,975 (27.1)	
Primary Payer						
Medicare	48,766 (61.4)	43,225 (75.8)	<0.001	62,291 (64.9)	57,401 (78.0)	<0.001
Medicaid	13,480 (17.0)	4,228 (7.4)		14,230 (14.8)	4,893 (6.6)	

Private insurance	9,987 (12.6)	8,113 (14.2)		11,405 (11.9)	9,794 (13.3)	
Self-pay	4,612 (5.8)	-		5,421 (5.6)	-	
No charge	257 (0.3)	94 (0.1)		403 (0.4)	133 (0.2)	
Other	2,130 (2.7)	1,271 (2.2)		2,119 (2.2)	1,301 (1.8)	
Psychosocial risk factors						
Limited cognition	10,053 (12.7)	-	<0.001	13,683 (14.3)	-	<0.001
Substance abuse	32,653 (41.1)	-	<0.001	35,541 (37.0)	-	<0.001
Psychiatric disorders	20,923 (26.4)	-	<0.001	23,939 (24.9)	-	<0.001
Comorbidities						
Smoking	25,822 (32.5)	341 (0.6)	<0.001	28,594 (29.8)	566 (0.8)	<0.001
Dyslipidemia	39,249 (49.4)	31,715 (55.6)	<0.001	46,830 (48.8)	40,000 (54.3)	<0.001
Hypertension	68,197 (85.9)	48,968 (85.9)	0.92	82,805 (86.3)	63,068 (85.7)	0.001
Diabetes	30,468 (38.4)	22,745 (39.9)	<0.001	36,658 (38.2)	28,642 (38.9)	0.003
Obesity	24,746 (31.2)	16,827 (29.5)	<0.001	26,634 (27.8)	19,195 (26.1)	<0.001
Known CAD	31,928 (40.2)	24,696 (43.3)	<0.001	38,949 (40.6)	32,191 (43.7)	<0.001
Prior MI	9,844 (12.4)	7,074 (12.4)	0.97	12,260 (12.8)	9,254 (12.6)	0.22
Prior PCI	8,659 (10.9)	6,920 (12.1)	<0.001	10,867 (11.3)	9,279 (12.6)	<0.001

Prior CABG	6,941 (8.7)	6,486 (11.4)	<0.001	9,475 (9.9)	9,284 (12.6)	<0.001
Prior TIA/ stroke	7,270 (9.2)	5,322 (9.3)	0.27	9,103 (9.5)	7,430 (10.1)	<0.001
Atrial fibrillation	20,703 (26.1)	18,651 (32.7)	<0.001	34,681 (36.1)	35,036 (47.6)	<0.001
Prior PPM	4,816 (6.1)	5,269 (9.2)	<0.001	6,809 (7.1)	7,521 (10.2)	<0.001
Prior ICD	4,983 (6.3)	3,897 (6.8)	<0.001	6,614 (6.9)	5,549 (7.5)	<0.001
Peripheral vascular disease	11,300 (14.2)	9,180 (16.1)	<0.001	14,239 (14.8)	12,002 (16.3)	<0.001
Anemia	6,810 (8.6)	4,911 (8.6)	0.82	7,315 (7.6)	5,654 (7.7)	0.65
Chronic kidney disease	4,654 (5.9)	4,663 (8.2)	<0.001	5,218 (5.4)	5,429 (7.4)	<0.001
Chronic lung disease	34,704 (43.7)	19,289 (33.8)	<0.001	42,463 (44.2)	25,857 (35.1)	<0.001
Chronic liver disease	5,502 (6.9)	2,739 (4.8)	<0.001	5,580 (5.8)	2,835 (3.9)	<0.001
Coagulopathy	4,774 (6.0)	3,922 (6.9)	<0.001	5,282 (5.5)	4,569 (6.2)	<0.001
Hypothyroidism	12,076 (15.2)	10,909 (19.1)	<0.001	15,201 (15.8)	14,346 (19.5)	<0.001
Pulmonary circulation disorders	17,471 (22.0)	14,005 (24.6)	<0.001	20,235 (21.1)	17,418 (23.7)	<0.001
Cancer	3,057 (3.9)	3,343 (5.9)	<0.001	3,680 (3.8)	4,171 (5.7)	<0.001
No. of Elixhauser comorbidities, median (IQR)	5 (3)	5 (3)	<0.001	5 (3)	5 (2)	<0.001
Hospital characteristics						
Bed size						

Small	15,942 (20.1)	13,163 (23.1)	<0.001	18,547 (19.3)	16,962 (23.0)	<0.001
Medium	22,205 (28.0)	15,826 (27.8)		26,938 (28.1)	20,943 (28.5)	
Large	41,229 (51.9)	28,018 (49.1)		50,487 (52.6)	35,695 (48.5)	
Location						
Rural	2,780 (3.5)	1,296 (2.3)	<0.001	3,618 (3.8)	1,445 (2.0)	<0.001
Urban	76,596 (96.5)	55,711 (97.7)		92,354 (96.2)	72,155 (98.0)	
Teaching Status						
Non-teaching	26,388 (33.2)	16,776 (29.4)	<0.001	32,620 (34.0)	21,847 (29.7)	<0.001
Teaching	52,988 (66.8)	40,231 (70.6)		63,352 (66.0)	51,753 (70.3)	
Heart failure type						
HFrEF	6,404 (8.1)	4,073 (7.1)	<0.001	7,309 (7.6)	5,294 (7.2)	0.001
HFpEF	3,971 (5.0)	3,725 (6.5)	<0.001	4,895 (5.1)	4,812 (6.5)	<0.001
Combined	2,219 (2.8)	1,566 (2.7)	0.59	2,546 (2.7)	2,032 (2.8)	0.17
Unspecified	66,782 (84.1)	47,643 (83.6)	0.006	81,222 (84.6)	61,462 (83.5)	<0.001
Disposition						
Routine	47,507 (59.9)	30,918 (54.2)	<0.001	56,876 (59.3)	40,335 (54.8)	<0.001
Short-term hospital	849 (1.1)	665 (1.2)		1,088 (1.1)	928 (1.3)	

SNF	9,788 (12.3)	6,994 (12.3)		15,885 (16.6)	12,130 (16.5)	
Home health care	21,204 (26.7)	18,409 (32.3)		22,081 (23.0)	20,183 (27.4)	

Data is represented as N (%)
AKI: acute kidney injury, AMI: acute myocardial infarction, CABG: coronary artery bypass graft, CAD: coronary artery disease, HFrEF: heart failure with reduced ejection fraction, HFpEF: heart failure with preserved ejection fraction, ICD: implantable cardioverter- defibrillator, IQR: inter-quartile range, MI: myocardial infarction, MV: mitral valve, PCI: percutaneous coronary intervention, PPM: permanent pacemaker, SD: standard deviation; SNF: skilled nursing facility, TIA: transient ischemic attack.

Table 2: Comparison of outcomes in HF patients with and without PSRFs

30-day outcomes	Unadjusted outcomes			Adjusted outcomes	
	With PSRFs N=175,348	Without PSRFs N=130,607	P value	With PSRFs N=175,348	P value
All-cause readmissions	29,789 (16.9%)	20,886 (15.9%)	<0.001	1.09 (1.06-1.11)	<0.001
All-cause mortality	2,160 (1.2%)	1,695 (1.3%)	0.106	1.12 (1.04-1.20)	0.003
MACE	14,514 (8.2%)	9,883 (7.5%)	<0.001	1.08 (1.04-1.12)	<0.001
Myocardial infarction	2,647 (1.5%)	1,718 (1.3%)	<0.001	1.08 (1.00-1.16)	0.036
Stroke	920 (0.5%)	650 (0.5%)	0.30	1.09 (0.97-1.23)	0.155
Cardiac readmissions	15,862 (9.0%)	11,195 (8.5%)	<0.001	1.03 (0.99-1.06)	0.054
Non-cardiac readmissions	13,927 (7.9%)	9,691 (7.4%)	<0.001	1.13 (1.10-1.17)	<0.001
Heart failure readmissions	10,589 (6.0%)	7,023 (5.3%)	<0.001	1.08 (1.04-1.12)	<0.001

Data is represented as N (%), excepted adjusted outcomes. Adjusted outcomes are represented as odds ratio with confidence intervals.
Abbreviations: MACE, major adverse cardiovascular event; PSRF, psychosocial risk factor.
MACE includes composite of all-cause mortality, heart failure-readmissions, stroke and myocardial infarction.

Table 3: Comparison of outcomes in HF patients with and without PSRFs in non-COVID (2019) and COVID (2020) eras

	Patients with HF in non-COVID era

30-day outcomes	Unadjusted outcomes			Adjusted outcomes	
	With PSRFs N=95,972	Without PSRFs N=73,600	P value	With PSRFs N=95,972	P value
All-cause readmissions	16,398 (17.1%)	11,768 (15.9%)	<0.001	1.09 (1.06-1.13)	<0.001
All-cause mortality	1,126 (1.1%)	908 (1.2%)	0.257	1.15 (1.04-1.27)	0.005
MACE	7,848 (8.1%)	5,450 (7.4%)	<0.001	1.11 (1.06-1.16)	<0.001
Myocardial infarction	1,329 (1.3%)	871 (1.1%)	<0.001	1.14 (1.03-1.27)	0.012
Stroke	500 (0.5%)	353 (0.4%)	0.233	1.10 (0.93-1.29)	0.26
Cardiac readmissions	8,739 (9.1%)	6,262 (8.5%)	<0.001	1.05 (1.01-1.09)	0.017
Non-cardiac readmissions	7,659 (7.9%)	5,506 (7.4%)	<0.001	1.12 (1.08-1.17)	<0.001
Heart failure readmissions	5,793 (6.0%)	3,926 (5.3%)	<0.001	1.10 (1.05-1.16)	<0.001
	Patients with HF in COVID era				
	With PSRFs N=79,376	Without PSRFs N=57,007	P value	With PSRFs N=79,376	P value
All-cause readmissions	13,391 (16.8%)	9,118 (15.9%)	<0.001	1.08 (1.04-1.12)	<0.001
All-cause mortality	1,034 (1.3%)	787 (1.3%)	0.22	1.08 (0.97-1.20)	0.16
MACE	6,666 (8.3%)	4,433 (7.7%)	<0.001	1.04 (0.99-1.10)	0.063
MI	1,318 (1.6%)	847 (1.4%)	0.011	1.02 (0.92-1.14)	0.69
Stroke	420 (0.5%)	297 (0.5%)	0.84	1.08 (0.91-1.29)	0.38
Cardiac readmissions	7,123 (8.9%)	4,933 (8.6%)	0.04	1.01 (0.96-1.05)	0.80

Non-cardiac readmissions	6,268 (7.8%)	4,185 (7.3%)	<0.001	1.15 (1.10-1.20)	<0.001
Heart failure readmissions	4,796 (6.0%)	3,097 (5.4%)	<0.001	1.05 (0.99-1.11)	0.10

Data is represented as N (%), excepted adjusted outcomes. Adjusted outcomes are represented as odds ratio with confidence intervals.
Abbreviations: COVID, coronavirus disease 2019; HF, heart failure; MACE, major adverse cardiovascular event; PSRF, psychosocial risk factor.
MACE includes composite of all-cause mortality, heart failure-readmissions, stroke and myocardial infarction.

Table 4: Comparison of outcomes in HF patients with ≥1 psychosocial risk factor in non-COVID (2019) versus COVID (2020) eras

	Non-COVID era (2019) N=95,972 (54.7%)	COVID era (2020) N=79,376 (45.3%)	P value	Adjusted outcomes	P value
All-cause readmissions	16,398 (17.1%)	13,391 (16.8%)	0.231	1.00 (0.97-1.03)	0.78
All-cause mortality	1,126 (1.1%)	1,034 (1.3%)	0.014	1.13 (1.03-1.24)	0.009
MACE	7,848 (8.1%)	6,666 (8.3%)	0.095	1.04 (1.00-1.09)	0.03
Myocardial infarction	1,329 (1.3%)	1,318 (1.6%)	<0.001	1.19 (1.08-1.30)	<0.001

Stroke	500 (0.5%)	420 (0.5%)	0.81	1.04 (0.90-1.19)	0.59
Cardiac readmissions	8,739 (9.1%)	7,123 (8.9%)	0.34	1.00 (0.97-1.04)	0.79
Non-cardiac readmissions	7,659 (7.9%)	6,268 (7.8%)	0.52	1.00 (0.96-1.04)	0.91
Heart failure readmissions	5,793 (6.0%)	4,796 (6.0%)	0.96	1.02 (0.97-1.07)	0.42

Data is represented as N (%), excepted adjusted outcomes. Adjusted outcomes are represented as odds ratio with confidence intervals.
Abbreviations: COVID, coronavirus disease 2019; HF, heart failure; MACE, major adverse cardiovascular event; PSRF, psychosocial risk factor.
MACE includes composite of all-cause mortality, heart failure-readmissions, stroke and myocardial infarction.