ORIGINAL RESEARCH

Sex-Based Differences in 30-Day Readmissions After Cardiac Arrest: Analysis of the Nationwide Readmissions Database

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BACKGROUND: There are limited data on the sex-based differences in the outcome of readmission after cardiac arrest.

METHODS AND RESULTS: Using the Nationwide Readmissions Database, we analyzed patients hospitalized with cardiac arrest between 2010 and 2015. Based on International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes, we identified comorbidities, therapeutic interventions, and outcomes. Multivariable logistic regression was performed to assess the independent association between sex and outcomes. Of 835,894 patients, 44.4% (n=371,455) were women, of whom 80.7% presented with pulseless electrical activity (PEA)/asystole. Women primarily presented with PEA/asystole (80.7% versus 72.4%) and had a greater comorbidity burden than men, as assessed using the Elixhauser Comorbidity Score. Thirty-day readmission rates were higher in women than men in both PEA/asystole (20.8% versus 19.6%) and ventricular tachycardia/ventricular fibrillation arrests (19.4% versus 17.1%). Among ventricular tachycardia/ventricular fibrillation arrest survivors, women were more likely than men to be readmitted because of noncardiac causes, predominantly infectious, respiratory, and gastrointestinal illnesses. Among PEA/asystole survivors, women were at higher risk for all-cause (adjusted odds ratio [aOR], 1.07; [95% CI, 1.03–1.11]), cardiac-cause (aOR, 1.15; [95% CI, 1.06–1.25]), and noncardiac-cause (aOR, 1.13; [95% CI, 1.04–1.22]) readmission. During the index hospitalization, women were less likely than men to receive therapeutic procedures, including coronary angiography and targeted therapeutic management. While the crude case fatality rate was higher in women, in both ventricular tachycardia/ventricular fibrillation (51.8% versus 47.4%) and PEA/asystole (69.3% versus 68.5%) arrests, sex was not independently associated with increased crude case fatality after adjusting for differences in baseline characteristics.

CONCLUSIONS: Women are at increased risk of readmission following cardiac arrest, independent of comorbidities and therapeutic interventions.

Key Words: cardiac arrest ■ sex-based disparity ■ thirty-day readmission
Consequently, the majority of studies have observed an increased CFR in women who experience CA.\textsuperscript{11–13} Despite this, it remains unclear how disparities in CA management\textsuperscript{14,15} impact men versus women at intermediate- and long-term follow-up. While studies have shown that nearly 1 in 5 survivors of CA are readmitted in 30 days,\textsuperscript{16,17} there is a paucity of data surrounding sex-based differences in readmission rates after CA. The purpose of this study was to characterize sex-based differences in 30-day readmissions in survivors of CA using a large, nationwide readmissions database.

**METHODS**

**Data Source and Study Population**

Data were obtained from the Agency for Healthcare Research and Quality, which administers the Healthcare Cost and Utilization Project (HCUP). We used the Nationwide Readmissions Database (NRD) from 2010 to 2015. The NRD is an annual database constructed using 1 calendar year of discharge data and is drawn from the HCUP state inpatient databases, with verified patient linkage numbers used to track the patients across hospitals within a state during a given year. The NRD is designed to support national readmission analyses and is a publicly available nationally representative healthcare database. Each patient record in the NRD contains information on the patient’s diagnoses and procedures performed during the hospitalization based on *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes as well as Clinical Classification Software (CCS) codes that groups multiple ICD-9-CM codes for facilitated statistical analyses. We identified study population, comorbidities, causes of readmissions, and in-hospital outcomes using a combination of ICD-9-CM and CCS codes (Table S1–S10). Institutional review board approval and informed consent were not required for the current study because all data collection was derived from a deidentified administrative database. All data and materials are available from the corresponding author on request.

**Study Population and Variables**

From 2010 to 2015, all hospitalizations for CA were selected by searching for ICD-9-CM codes for CA.\textsuperscript{4} One study demonstrated that women were less likely to receive these interventions, even with a witnessed arrest and initial shockable rhythm.\textsuperscript{17} Furthermore, women are less likely to undergo immediate angiography with PCI after CA and frequently experience higher rates of postprocedural complications after primary PCI for ST-segment–elevation myocardial infarction (STEMI) and coronary artery bypass graft (CABG).\textsuperscript{9–10}
been validated in prior studies.\textsuperscript{17,18} CAs that occurred as a complication of surgery or complicating abortion, ectopic pregnancy, or labor and delivery were excluded, as those arrests were coded with different ICD-9-CM codes (997.1 and 669.4x). Of note, given that the study period preceded the implementation of International Classification of Diseases, Tenth Revision (ICD-10), namely, October 1, 2015, International Classification of Diseases, Ninth Revision (ICD-9) codes were exclusively used in the current analysis.

Among patients who presented with CAs, VT was identified by ICD-9-CM code 427.1 and VF was identified by ICD-9-CM code 427.4. Pulseless electrical activity (PEA)/asystole arrests were defined as CAs without concomitant ventricular arrhythmia. Acute myocardial infarction and pulmonary embolism were identified by ICD-9-CM codes 410.x (excluding 410.7) and 415.1, respectively. TTM was identified using the ICD-9-CM procedure code 99.8. Coronary angiography was identified using ICD-9-CM codes 37.21, 37.22, 37.23, 88.53, 88.54, 88.55, 88.56, and 88.57. Last, PCI was identified using the ICD-9-CM codes 00.66, 34.06, 34.07, 34.09, 36.03, and 36.04.

Patient and hospital-specific variables were included in the assessment of baseline characteristics in men versus women. Hospital-specific variables were derived using the American Heart Association’s Annual Survey Database and included procedures that were performed during each patient’s index hospitalization (eg, coronary angiography, PCI, TTM, use of mechanical support).

Study End Points

The primary outcome of interest was 30-day all-cause readmission rates in men versus women, including temporal trends and categorization of readmission rates as all-cause, cardiac, or noncardiac. Time to readmission was computed as the number of days between date of discharge from the index admission to the readmission date. Only the first 30-day readmission was included; transfers to outside hospitals were not counted as readmissions. The primary cause of 30-day readmission was identified based on the CCS code in the first diagnosis field of each readmission record and dichotomized into noncardiac and cardiac causes.

Noncardiac causes included respiratory, infectious, gastrointestinal, neuropsychiatric/substance, stroke/transient ischemic attack, endocrine/metabolic, genitourinary, hematologic/oncologic, peripheral vascular disease, trauma, complication of medical procedure, and other noncardiac causes. Cardiac causes included angina and chronic ischemic heart disease, heart failure, acute myocardial infarction, nonspecific chest pain, arrhythmia, and other cardiac causes.

Secondary outcomes included in-hospital CFRs for men versus women and rates of therapeutic procedures in men versus women, which included TTM, urgent angiography, and use of mechanical support (eg, intra-aortic balloon pump support and extracorporeal membrane oxygenation). An additional analysis evaluating readmission outcomes and CFRs for in-hospital CA versus CA was also performed.

Statistical Analysis

Statistical analyses were conducted using SAS (SAS Institute Inc). Discharge weights provided by the NRD were used to obtain national estimates with analyses accounting for complex survey design. A descriptive analysis was performed to assess significant differences in weighted baseline characteristics between men and women. Key baseline characteristics included causative rhythm for CA, sex, age, presentation with STEMI or pulmonary embolism, prespecified comorbidities, history of prior cardiovascular interventions (eg, PCI or CABG), and comorbidity burden. Comorbidity burden was assessed using Elixhauser methods.\textsuperscript{19,20} For comparison of characteristics between men and women, the Rao-Scott $\chi^2$ test was used for categorical variables, and a survey-specific linear regression was used for continuous variables.

Multivariable logistic regression analysis was used to assess the association between sex and clinical outcomes, namely rates of in-hospital CFR and 30-day readmission. The multivariable model included univariate predictors ($P<0.1$) of examined outcomes ($P<0.1$). The covariates included patient demographics and procedural and hospital-specific variables, such as patient’s history of prior PCI or CABG, hospital teaching status, hospital bed size, and urban versus rural setting. These analyses—specifically, unadjusted and adjusted rates of primary and secondary outcomes—were repeated for the subgroups of patients presenting with shockable (VT/VF) versus nonshockable (PEA/asystole) rhythms. In addition, we analyzed readmission outcomes and CFRs, stratified by the location of CA (in-hospital CA and OHCA) and by the position of CA diagnosis code in the NRD (primary and secondary). We used domain analysis methods to calculate accurate variance for subgroup analyses of the survey data. All statistical analyses were 2-sided, wherein a $P$ value <0.05 was considered statistically significant.

RESULTS

Study Population and Baseline Characteristics

From 2010 to 2015, an estimated 835 894 patients were admitted with CA. PEA/asystole comprised 76.1% of all CA cases, whereas VT/VF accounted
for the remaining 23.9%. Among this cohort, 44.4% (n=371,455) were women. Women were more likely to present with PEA/asystole than men (80.7% versus 72.4%). Table 1 presents baseline characteristics of the study cohort between sexes, weighted and stratified by type of CA. In both rhythm groups, women, compared with men, were older and had a greater burden of comorbidities such as hypertension, diabetes, anemia, pulmonary hypertension, and/or valvular disease. Conversely, men were more likely to have preexisting coronary artery disease with prior PCI or CABG, and present with STEMI.

**Utilization of Therapeutic Modalities and In-Hospital Outcomes by Sex**

Regardless of CA rhythm, women during index hospitalization were less likely than men to undergo therapeutic procedures (Table 1), including TTM, coronary angiography, PCI, intra-aortic balloon pump placement, and extracorporeal membrane oxygenation.

Over the 5-year study period, annual in-hospital CFRs remained unchanged across rhythm and sex differences (Figure 1). While the crude CFR was higher in women than men in both VT/VF and PEA/asystole arrests, sex was not independently associated with risk of CFR after adjusting for differences in baseline characteristics (Table 2).

**Trends in 30-Day All-Cause Readmission After CA**

Of 300,052 patients discharged alive after a hospitalization for CA, 58,150 patients (19.4%) were readmitted within 30 days of discharge. Women were more likely than men to be readmitted within 30 days of hospital discharge after both PEA/asystole (20.8% versus 19.6%) and VT/VF arrests (19.4% versus 17.1%). Importantly, 42.3% and 53.9% of readmissions occurred within 7 and 10 days of discharge, respectively, with a median time to readmission of 9 days (interquartile range, 3–18 days) (Figures S1–S10 through S3). The timing of 30-day readmission was similar in women and men with a median time to readmission of 9.3 days versus 8.8 days (P=0.38, 95% CI) in the VT/VF cohort and 9.0 days versus 8.8 days (P=0.87, 95% CI) in the PEA/asystole cohort, respectively.

Between 2010 and 2015, there was a significant decrease in 30-day readmission rates across sexes and causative rhythms. In the PEA/asystole cohort, 30-day readmission rates decreased by 13.4% (from 22.4% to 19.4%) in women and 5.0% (from 20.1% to 19.1%) in men (Figure 2A). In the VT/VF cohort, 30-day readmission rates declined by 15.2% (from 21% to 17.8%; 95% CI) and 22.3% (from 19.7% to 15.3%; 95% CI) in women and men, respectively (Figure 2B).

After adjusting for baseline risk factors and therapeutic modalities received during index hospitalization, women experienced increased risk of 30-day readmission (Table 2; Tables S2 through S6), including all-cause readmission (adjusted odds ratio [aOR], 1.07; [95% CI, 1.03–1.11]), cardiac-cause readmission (aOR, 1.15; [95% CI, 1.06–1.25]), and noncardiac cause readmission (aOR, 1.13; [95% CI, 1.04–1.22]) in the PEA/asystole cohort. By contrast, sex was not independently associated with a risk of readmission in survivors of VT/VF arrest.

The consistent trends of higher readmission rates in women compared with men with PEA/Asystole arrests were observed regardless of the location of CA, which was particularly significant for all-cause and cardiac readmissions among patients with OHCA (Tables S2 through S6). In this manner, female sex was observed as a predictor for readmission after CA, in both the VT/VF and PEA/asystole cohorts (Tables S7 through S10).

**Causes of 30-Day Readmission After CA**

The majority of 30-day readmissions were attributable to noncardiac causes (72.4%). Noncardiac causes of readmission were more common in women than men among VT/VF arrest survivors, while the distribution of readmission causes were comparable between sexes among PEA/asystole survivors (Figure 3).

The most common noncardiac causes for readmission included infectious, respiratory, and gastrointestinal illnesses. Infectious causes for readmission were more common in survivors of PEA/asystole compared with the VT/VF arrests (Figure 4A and 4B). Among survivors of VT/VF arrest, women were more likely than men to be readmitted for infectious and gastrointestinal illnesses, as well as procedural complications. Respiratory causes were more prevalent in women than men in readmission after PEA/asystole.

**DISCUSSION**

In this nationally representative sample of survivors of CA in the United States, we report several important findings. First, among survivors of PEA/asystole arrests, women had a 7% increased risk of 30-day re-admission, independent of their baseline comorbidities or therapeutic interventions during the index hospitalization. Second, while the rate of 30-day readmission after CA declined over the study period, it consistently remained higher in women. Infectious causes and procedural complications were more common in women among patients readmitted after VT/VF arrests, while respiratory causes were more common in women re-admitted after PEA/Asystole.

Overall, hospital readmissions are frequent after CA with nearly 1 in 5 readmitted within 30 days of
Table 1. Baseline Patient and Hospital Characteristics for CA Stratified by Sex, 2010–2015

| Characteristics (%) | All | PEA/Asystole | VT/VF | P value | All | PEA/Asystole | VT/VF | P value |
|---------------------|-----|--------------|-------|---------|-----|--------------|-------|---------|
| No. of admissions (%) | 464,439 (55.6) | 371,455 (44.4) | 33,629 (2.9) | 299,586 (47.1) | <0.001 | 128,191 (64.1) | 71,869 (35.9) | <0.001 |
| VT/VF | 128,191 (27.6) | 71,869 (19.3) | ... | ... | ... | ... | ... | ... |
| STEMI | 55,602 (12.0) | 31,062 (8.4) | 23,723 (7.1) | 18,195 (6.1) | <0.001 | 31,878 (24.9) | 12,867 (17.9) | <0.001 |
| Pulmonary embolism | 17,341 (3.7) | 16,742 (4.5) | 14,147 (4.2) | 14,254 (4.8) | <0.001 | 3193 (2.5) | 2488 (3.5) | <0.001 |
| Age, mean (SE), y | 66.5 (55.4–77.4) | 70 (57.5–81.1) | 67.2 (55.6–78.3) | 70.9 (58.2–81.8) | <0.001 | 64.9 (55.0–74.9) | 66.6 (55.0–77.8) | <0.001 |
| Hypertension | 271,455 (58.4) | 227,674 (61.3) | 194,523 (57.9) | 183,645 (61.3) | <0.001 | 76,797 (59.9) | 44,030 (61.3) | <0.001 |
| Diabetes | 15,425 (3.2) | 12,055 (3.4) | 11,085 (3.3) | 10,291 (3.4) | <0.001 | 41,166 (32.1) | 24,144 (33.6) | <0.001 |
| Known CAD | 184,988 (39.8) | 106,605 (28.7) | 111,994 (33.3) | 77,410 (25.8) | <0.001 | 72,994 (56.9) | 29,195 (40.6) | <0.001 |
| Previous myocardial infarction | 39,118 (8.4) | 21,648 (5.8) | 16,215 (5.4) | <0.001 | 15,038 (11.7) | 5,433 (7.6) | <0.001 |
| Previous PCI | 33,642 (7.2) | 17,339 (4.7) | 20,756 (6.2) | 12,578 (4.3) | <0.001 | 12,886 (10.1) | 4,581 (6.4) | <0.001 |
| CKD | 77,441 (20.8) | 78,457 (23.3) | 64,221 (21.4) | 24,644 (19.2) | <0.001 | 31,075 (43.2) | 21,944 (27.6) | <0.001 |
| CKD on hemodialysis | 45,586 (9.8) | 37,160 (10.2) | 29,671 (9.9) | 21,269 (7.1) | <0.001 | 11,184 (8.7) | 7,504 (10.4) | <0.001 |
| Anemia | 116,139 (25.0) | 106,846 (28.8) | 88,216 (26.2) | 87,003 (29.0) | <0.001 | 27,923 (21.8) | 19,644 (27.6) | <0.001 |
| Atrial fibrillation | 14,583 (28.8) | 9,497 (25.6) | 8,708 (25.0) | 7,482 (25.0) | <0.001 | 37,501 (29.2) | 20,188 (28.1) | 0.003 |
| Pulmonary circulation disorders | 27,507 (5.9) | 30,117 (8.1) | 22,218 (6.6) | 25,258 (8.6) | <0.001 | 53,821 (42.0) | 6,459 (1.6) | <0.001 |
| Valvular heart disease | 25,776 (5.5) | 25,997 (7.0) | 19,670 (5.9) | 21,238 (7.1) | <0.001 | 6105 (4.8) | 4758 (6.6) | <0.001 |
| Elixhauser comorbidity scores >4 | 257,352 (55.5) | 220,232 (59.3) | 190,514 (56.7) | 178,260 (59.5) | <0.001 | 67,017 (52.3) | 41,937 (58.4) | <0.001 |

Procedures performed

| Procedure | All | PEA/Asystole | VT/VF | P value | All | PEA/Asystole | VT/VF | P value |
|-----------|-----|--------------|-------|---------|-----|--------------|-------|---------|
| Coronary angiography | 87,406 (18.8) | 46,616 (12.5) | 33,585 (10.0) | 23,376 (7.8) | <0.001 | 53,821 (42.0) | 23,240 (32.3) | <0.001 |
| PCI | 44,595 (9.6) | 20,074 (5.4) | 14,556 (4.3) | 9,095 (3.0) | <0.001 | 30,039 (23.4) | 10,797 (15.3) | <0.001 |
| IABP | 21,408 (4.6) | 9,637 (2.6) | 8,480 (2.5) | 4,814 (1.6) | <0.001 | 12,927 (10.1) | 4,823 (6.7) | <0.001 |
| LVAD | 25,311 (0.5) | 999 (0.3) | 953 (0.3) | 458 (0.2) | <0.001 | 1,578 (1.2) | 541 (0.8) | <0.001 |
| ECMO | 20,253 (0.4) | 1003 (0.3) | 1061 (0.3) | 634 (0.2) | <0.001 | 964 (0.8) | 370 (0.5) | <0.001 |
| TTM | 15,564 (3.4) | 914 (2.5) | 7636 (2.3) | 5594 (1.9) | <0.001 | 7927 (6.2) | 3553 (4.9) | <0.001 |
| Mechanical ventilation | 31,657 (68.2) | 24,942 (67.2) | 22,475 (67.9) | 19,847 (66.2) | <0.001 | 88,099 (68.7) | 50,975 (70.9) | <0.001 |
| Hemodialysis | 51,206 (11.0) | 37,964 (10.2) | 36,487 (11.4) | 30,547 (10.3) | <0.001 | 12,719 (9.9) | 7,507 (10.4) | 0.037 |

CA indicates cardiac arrest; CABG, coronary artery bypass graft; CAD, coronary artery disease; CHF, congestive heart failure; CKD, chronic kidney disease; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; PCI, percutaneous coronary intervention; PEA, pulseless electrical activity; pLVAD, percutaneous left ventricular assist device; STEMI, ST-segment-elevation myocardial infarction; TTM, targeted temperature management; and VT/VF, ventricular tachycardia/ventricular fibrillation.
Sex Differences: Readmission After Cardiac Arrest

In the current study, even after adjusting for sex-based differences in baseline characteristics and therapeutic interventions, there was a strong association between sex and 30-day readmission. This signal was especially notable in the PEA/asystole cohort with a 7% increase in the odds of readmission for women compared with men. The majority of readmissions in women were attributable to noncardiac causes, with the most common being infectious, gastrointestinal, or respiratory. This is likely owing to the fact that women had a greater burden of comorbidities than men. This, in turn, likely put women at higher risk for decompensated noncardiac illness and related complications, such as COPD exacerbation, acute kidney injury, pneumonia, and other infectious issues.

In addition, women were more likely to be readmitted for postprocedural complications after VT/VF arrests in the current study. Numerous studies have similarly revealed higher rates of postprocedural complications (eg, bleeding) in women, especially after

![Figure 1. Annual in-hospital case fatality rate by sex and cardiac arrest rhythm, 2010–2015. Pulseless electrical activity (PEA)/asystole: P trend=0.576 for women; P trend=0.269 for men. Ventricular tachycardia/ventricular fibrillation (VT/VF): P trend=0.144 for women; P trend=0.416 for men.]

| Table 2. Unadjusted and Adjusted Association Between Sex and Likelihood of 30-Day Readmission/CFR by Causative Rhythm |
|---|---|---|---|---|---|---|
| Outcomes | Rhythm | Event rates, % | Unadjusted OR | Adjusted OR | P for interaction |
| In-hospital CFR* | VT/VF | 47.4 | 51.8 | 1.19 (1.15–1.23) | 1.02 (0.98–1.06) | <0.001 |
| | PEA/asystole | 68.5 | 69.3 | 1.04 (1.02–1.06) | 0.99 (0.97–1.01) | |
| All-cause readmission† | VT/VF | 17.1 | 19.4 | 1.16 (1.09–1.23) | 1.06 (1.00–1.14) | 0.395 |
| | PEA/asystole | 19.6 | 20.8 | 1.08 (1.04–1.12) | 1.07 (1.03–1.11) | |
| Cardiac readmission† | VT/VF | 7.0 | 6.6 | 0.93 (0.85–1.02) | 0.96 (0.87–1.06) | 0.067 |
| | PEA/asystole | 4.4 | 4.7 | 1.08 (1.00–1.17) | 1.15 (1.06–1.25) | |
| Noncardiac readmission† | VT/VF | 10.1 | 12.8 | 1.30 (1.21–1.40) | 1.04 (0.99–1.09) | 0.010 |
| | PEA/asystole | 15.1 | 16.1 | 1.07 (1.03–1.12) | 1.13 (1.04–1.22) | |

CFR indicates case fatality rate; OR, odds ratio; PEA, pulseless electrical activity; and VT/VF, ventricular tachycardia/ventricular fibrillation.

*Adjusted for age, ST-segment–elevation myocardial infarction (STEMI), pulmonary embolism, hypertension, diabetes, known coronary artery disease (CAD), previous myocardial infarction (MI), previous percutaneous coronary intervention (PCI), previous coronary artery bypass graft (CABG), history of congestive heart failure (CHF), history of cardiac arrest (CA), peripheral vascular disease, pulmonary hypertension, chronic pulmonary disease, chronic kidney disease (CKD), CKD on hemodialysis, liver disease, anemia, atrial fibrillation, coagulopathy, collagen vascular disease, electrolyte disorders, obesity, pulmonary circulation disorders, valvular heart disease, Elixhauser comorbidity scores ≥4, weekend admission, coronary angiography, PCI, intra-aortic balloon pump, extracorporeal membrane oxygenation, mechanical ventilation, hemodialysis, median household income, primary payer, hospital teaching status, and hospital bed size.

†Adjusted for age, STEMI, hypertension, diabetes, known CAD, previous MI, previous CABG, history of CHF, history of CA, pulmonary hypertension, chronic pulmonary disease, CKD, CKD on hemodialysis, liver disease, anemia, atrial fibrillation, coagulopathy, collagen vascular disease, electrolyte disorders, obesity, pulmonary circulation disorders, valvular heart disease, Elixhauser comorbidity scores ≥4, weekend admission, coronary angiography, PCI, targeted temperature management, mechanical ventilation, hemodialysis, median household income, primary payer, hospital bed size, length of stay, and discharge disposition.
STEMI. Elevated postprocedural complication rates in women—particularly, access site bleeding—are likely the result of the older age, comorbidity burden, and historically higher rates of femoral access use in women undergoing PCI. Previous studies have also shown that women who undergo PCI for acute myocardial infarction are more likely to have postdischarge bleeding that is not brought to their physician’s attention.

In the current study, women were not only older and had a higher burden of comorbidities but they were significantly less likely to present with a shockable rhythm, STEMI, and/or have a preexisting history of coronary artery disease. These findings support prior literature that women presenting with CA have important phenotypic differences compared with men. The current study also demonstrated that women are much less likely to receive therapeutic interventions such as immediate coronary angiography, PCI, or TTM. Given the class I recommendation for TTM use in VT/VF arrests, this discrepancy in sex-based TTM may explain why women have worse post-CA cognitive, functional, and psychiatric outcomes than men. Specifically, it is possible that women experience greater neurologic injury post-CA because of lower rates of TTM utilization. Other factors contributing to poorer neurologic outcomes in women include advanced age, delayed time to return

**Figure 2.** Annual all-cause readmission rates in survivors of cardiac arrest.
A. Annual all-cause readmission rates by sex in survivors of pulseless electrical activity/asystole, 2010–2015: P trend <0.001 for men; P trend = 0.005 for women. B. Annual all-cause readmission rates by sex in survivors of ventricular tachycardia/ventricular fibrillation (VT/VF), 2010–2015: P trend = 0.031 for women; P trend <0.001 for men.

**Figure 3.** Causes of readmission after cardiac arrest by sex and causative rhythm.
P EA indicates pulseless electrical activity; and VT/VF, ventricular tachycardia/ventricular fibrillation.
of spontaneous circulation, and higher likelihood of presenting with nonshockable rhythms.

This, coupled with women’s historically higher rates of postprocedural complications, highlights the need for close outpatient follow-up care in women post-CA. Follow-up care is essential to help manage women’s historically greater number of chronic illnesses, monitor for post-PCI complications, and assess their need for home care services. Efforts to curtail readmission after CA should thus concentrate on transitions of care, including care coordination during each patient’s index hospitalization and at the time of discharge, which have been correlated with lower readmission rates.

Cardiac rehabilitation (CR), in particular, is regarded as a critical component of post-acute coronary syndrome care, and has been a consistent class I recommendation by the American Heart Association and American College of Cardiology. Therefore, in patients presenting with CA attributable to underlying cardiac disease, CR can serve as a pivotal and time-sensitive intervention. A recent study demonstrated that women are less likely to receive CR after acute coronary syndrome. Prior studies have identified some of the unique barriers for rehabilitative care in women, such as unconscious provider bias, education level, and socioeconomic status. Several

Figure 4. Causes of readmission in survivors of cardiac arrest. A, Noncardiac causes of readmission in survivors of ventricular tachycardia/ventricular fibrillation arrest. *Infectious, gastrointestinal P<0.001. **Complication of procedure, neuropsychiatric/substance: P<0.05. B, Noncardiac causes of readmission in survivors of pulseless electrical activity arrest/asystole. *Infectious, gastrointestinal: P<0.001. **Complication of procedure, neuropsychiatric/substance: P<0.05. TIA indicates transient ischemic attack.
of these barriers are amenable to corrective action, such as low patient awareness of CR and its associated benefits, as well as unconscious provider bias leading to reduced CR referral rates in women. One meta-analysis reviewing 623 studies on CR indicated that women are 36% less likely to enroll in CR after a cardiac event and less likely to stay in a rehabilitative program once enrolled.48

Ultimately, the current study supports prior data that women survivors of CA constitute an especially vulnerable population, as a result of sex-related delays in recognition of symptoms, higher rates of nonshockable rhythms, greater burden of comorbidities, lower rates of therapeutic intervention, poorer neurologic outcomes, and higher risk of postprocedural complications in women. Further research encompassing sex-based differences in post-hospital follow-up—including discrepancies in referrals for home care services, neuropsychiatric care, and CR after CA—is warranted.

Future studies should also evaluate sex-based differences in neuropsychiatric status after CA, as measured by standard screening tools such as the Cerebral Performance Category score, Center for Epidemiological Studies Depression Scale, and the PTSD Checklist.11 Such research may inspire novel strategies to assess for neurologic injury after CA, provide an appropriate level of post-CA care, and, in turn, reduce preventable readmissions in women.49

**Strengths**
The current study’s notable strengths include its large sample size, use of a nationally representative database (ie, NRD), stratification for notable sex differences in baseline comorbidities including coronary artery disease history, and balanced inclusion of patients presenting with VT/VF versus PEA/asystole, as well as men and women.

**Limitations**
There are several limitations to the current study, mostly owing to the data and retrospective nature of the study design. Our estimates were derived from a representative 50% sample of US hospitals, making it possible that the readmission cohort was either underrepresented or overrepresented by the sample. Nonetheless, the NRD has been used extensively to examine national healthcare trends, and its sampling design has been validated in numerous studies.

In addition, this was a retrospective study based on data from the NRD, and, as such, miscoding can occur in large administrative data; however, HCUP quality control procedures are routinely performed to confirm that NRD data values are valid, consistent, and reliable. Given that the current study was conducted between 2010 and 2015, before the implementation of ICD-10 codes, our analysis used exclusively ICD-9 codes. A future analysis, incorporating both ICD-9 and ICD-10 codes, may potentially capture a larger, more comprehensive population of patients with CA.

In addition, while the NRD can track postdischarge mortality rates in patients with CA who are readmitted, it is unable to capture postdischarge deaths that occur at home. As such, it is possible that the true number of readmissions may be somewhat underestimated. This is noteworthy, given that in the United States, 30-day survival rates for survivors of in-hospital CA have been estimated to be between 15% and 20%.50,51 Rates of postacute care use after CA, such as referrals to inpatient rehabilitation versus skilled nursing facilities, continue to be investigated.52 In contrast, 30-day survival rates in OHCA survivors have historically been lower: ≈10.5% in patients who received immediate bystander CPR versus 4.0% in patients who received CPR upon emergency medical services arrival.53 Other studies have shown 30-day survival rates as high as 14.5%, in patients with OHCA who receive CPR within 5 minutes of CA.54 Despite the historically lower rates of 30-day survival in patients with OHCA, OHCA survival rates have improved over time.55 There are limited data surrounding the rates of at-home death (ie, 30-day mortality) in patients with CA. Nonetheless, given variable 30-day survival rates in patients with OHCA versus in-hospital CA, this would be an important topic for future study.

Finally, the NRD does not include detailed information about patient clinical characteristics, such as coronary anatomy, heart failure class, left ventricular function, discharge medications, postdischarge death, or details surrounding outpatient follow-up care, which would offer a more comprehensive evaluation of post-CA outcomes. This may have also impacted unmeasured confounders that could not be accounted for in our adjustment models. Nevertheless, a more detailed exploration of the impact of such confounders is beyond the scope of our analysis and would be a valuable avenue for future study.

**CONCLUSIONS**
In survivors of CA, women are at an independently higher risk for readmission, particularly after PEA/asystole. While women comprise a particularly vulnerable population, the complex mechanisms for sex-based differences in readmission are not yet fully understood and warrant further investigation.

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Supplemental Material
Tables S1–S10
Figures S1–S3

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SUPPLEMENTAL MATERIAL
| Variables                                      | ICD-9-CM or CCS Codes                                      |
|------------------------------------------------|-----------------------------------------------------------|
| Comorbidities                                  |                                                           |
| Hypertension with and without complications,   | Elixhauser comorbidity measures within database            |
| Diabetes with and without complications,       |                                                           |
| Chronic pulmonary disease,                     |                                                           |
| Obesity, Coagulopathy,                          |                                                           |
| Deficiency anemia,                              |                                                           |
| Chronic blood loss anemia,                      |                                                           |
| Collagen vascular disease or Rheumatoid         |                                                           |
| arthritis, Fluid/electrolyte disorders,         |                                                           |
| Liver disease, Pulmonary circulation disorders, |                                                           |
| Valvular heart disease                         |                                                           |
| VF                                             | 427.4                                                     |
| VT                                             | 427.1                                                     |
| Acute myocardial infarction                     | 410.x (excluding 410.7)                                   |
| Pulmonary embolism                              | 415.1                                                     |
| Known coronary artery disease                   | 414.00-414.07                                             |
| Previous myocardial infarction                  | 412                                                       |
| Previous PCI                                    | V45.82                                                    |
| Previous CABG                                   | V45.81                                                    |
| History of CHF                                  | 398.91, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23,    |
|                                                | 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42,  |
|                                                | 428.43, 402.01, 402.11, 402.91, 428.9                    |
| History of cardiac arrest                       | V12.53                                                    |
| Pulmonary hypertension                          | 416.0, 416.8                                             |
| Chronic pulmonary disease                       | 500, 501, 502, 503, 504, 505, 506.4 + CCS code 127      |
| Peripheral vascular disease                     | CCS code 114                                             |
| Chronic kidney disease (Non-dialysis-dependent) | 404.00, 404.01, 404.02, 404.03, 404.10, 404.11, 404.12, |
|                                                | 404.13, 404.90, 404.91, 404.92, 404.93, 582.0, 582.1,  |
|                                                | 582.2, 582.4, 582.8, 582.81, 582.89, 582.9, 583.0, 583.1,|
|                                                | 583.2, 583.4, 583.6, 583.7, 583.8, 583.81, 583.89, 583.9,|
|                                                | 585.1, 585.2, 585.3, 585.4, 585.5, 585.6, 586, 587, 588.0,|
|                                                | 588.9, V420                                              |
| Chronic kidney disease (Dialysis-dependent)     | 585.6, V56.0, V56.1, V56.2, V56.3, V56.31, V56.32, V56.8,|
|                                                | V45.11, V45.12                                          |
| Atrial fibrillation                             | 427.31                                                   |
| Procedures                                     |                                                           |
### Table S2. Outcomes Rates and Multivariable Regression Analyses on Outcomes by Causative Rhythm in Patients with In-Hospital Cardiac Arrest

| Outcomes                  | Rhythm     | Event Rates | P value | Adjusted OR<sup>1</sup> | P value |
|---------------------------|------------|-------------|---------|--------------------------|---------|
|                           |            | Men         | Women   |                          |         |
| In-hospital CFR           | VT/VF      | 56.5%       | 58.0%   | 0.012                    | 0.94 (0.89-0.99) | 0.029   |
|                           | PEA/Asystole| 72.7%       | 71.9%   | 0.016                    | 0.96 (0.93-0.99) | 0.024   |
| All-cause readmission     | VT/VF      | 19.8%       | 20.7%   | 0.238                    | 1.00 (0.91-1.09) | 0.963   |
|                           | PEA/Asystole| 21.4%       | 22.4%   | 0.080                    | 1.07 (1.00-1.15) | 0.050   |
| Cardiac readmission       | VT/VF      | 8.3%        | 7.1%    | 0.013                    | 0.87 (0.76-1.01) | 0.059   |
|                           | PEA/Asystole| 5.1%        | 5.0%    | 0.674                    | 1.04 (0.90-1.19) | 0.603   |
| Non-cardiac readmission   | VT/VF      | 11.5%       | 13.6%   | <0.001                   | 1.09 (0.97-1.23) | 0.151   |
|                           | PEA/Asystole| 16.3%       | 17.4%   | 0.032                    | 1.08 (1.00-1.16) | 0.062   |

<sup>1</sup> Adjusted for the same covariates listed in Table 2.

**VT = Ventricular Tachycardia, VF = Ventricular Fibrillation, PEA = Pulseless Electrical Activity**

### Table S3. Outcomes Rates and Multivariable Regression Analyses on Outcomes by Causative Rhythm in Patients with Out-of-Hospital Cardiac Arrest

| Outcomes                  | Rhythm     | Event Rates | P value | Adjusted OR<sup>1</sup> | P value |
|---------------------------|------------|-------------|---------|--------------------------|---------|
|                           |            | Men         | Women   |                          |         |
| In-hospital CFR           | VT/VF      | 39.6%       | 45.6%   | <0.001                   | 1.09 (1.04-1.15) | 0.001   |
|                           | PEA/Asystole| 65.8%       | 67.8%   | <0.001                   | 1.01 (0.99-1.04) | 0.360   |
| All-cause readmission     | VT/VF      | 15.5%       | 18.4%   | <0.001                   | 1.12 (1.02-1.22) | 0.014   |
|                           | PEA/Asystole| 18.7%       | 20.0%   | <0.001                   | 1.07 (1.02-1.12) | 0.011   |
| Cardiac readmission       | VT/VF      | 6.2%        | 6.2%    | 0.918                    | 1.04 (0.91-1.18) | 0.581   |
|                           | PEA/Asystole| 4.1%        | 4.6%    | 0.005                    | 1.22 (1.11-1.35) | <0.001  |
| Non-cardiac readmission   | VT/VF      | 9.3%        | 12.2%   | <0.001                   | 1.15 (1.04-1.27) | 0.009   |
|                           | PEA/Asystole| 14.6%       | 15.4%   | 0.017                    | 1.02 (0.97-1.08) | 0.483   |

<sup>1</sup> Adjusted for the same covariates listed in Table 2.

**VT = Ventricular Tachycardia, VF = Ventricular Fibrillation, PEA = Pulseless Electrical Activity**
Table S4: Outcomes Rates and Multivariable Regression Analyses on Outcomes by Causative Rhythm in Patients with Cardiac Arrest Coded as Primary Diagnosis

| Outcomes                  | Rhythm     | Event Rates | P value | Adjusted OR\(^1\) | P value |
|---------------------------|------------|-------------|---------|-------------------|---------|
|                           |            | Men         | Women   |                   |         |
| In-hospital CFR           | VT/VF      | 40.5%       | 42.4%   | 0.039             | 0.93 (0.85-1.02) | 0.146   |
|                           | PEA/Asystole| 86.7%       | 86.1%   | 0.340             | 0.93 (0.84-1.04) | 0.212   |
| All-cause readmission     | VT/VF      | 14.1%       | 17.0%   | 0.001             | 1.22 (1.06-1.40) | 0.006   |
|                           | PEA/Asystole| 11.9%       | 16.4%   | 0.004             | 1.36 (1.03-1.80) | 0.029   |
| Cardiac readmission       | VT/VF      | 6.8%        | 6.5%    | 0.616             | 1.03 (0.83-1.28) | 0.773   |
|                           | PEA/Asystole| 3.4%        | 3.9%    | 0.551             | 1.26 (0.77-2.07) | 0.363   |
| Non-cardiac readmission   | VT/VF      | 7.3%        | 10.5%   | <0.001            | 1.34 (1.13-1.58) | <0.001  |
|                           | PEA/Asystole| 8.5%        | 12.6%   | 0.004             | 1.36 (0.99-1.87) | 0.059   |

VT = Ventricular Tachycardia, VF = Ventricular Fibrillation, PEA = Pulseless Electrical Activity

\(^1\)Adjusted for the same covariates listed in Table 2.

Table S5: Outcomes Rates and Multivariable Regression Analyses on Outcomes by Causative Rhythm in Patients with Cardiac Arrest Coded as Secondary Diagnosis

| Outcomes                  | Rhythm     | Event Rates | P value | Adjusted OR\(^1\) | P value |
|---------------------------|------------|-------------|---------|-------------------|---------|
|                           |            | Men         | Women   |                   |         |
| In-hospital CFR           | VT/VF      | 49.4%       | 54.2%   | <0.001            | 1.04 (1.00-1.09) | 0.061   |
|                           | PEA/Asystole| 67.4%       | 68.2%   | <0.001            | 0.99 (0.97-1.01) | 0.313   |
| All-cause readmission     | VT/VF      | 18.1%       | 20.2%   | <0.001            | 1.03 (0.96-1.10) | 0.459   |
|                           | PEA/Asystole| 19.8%       | 20.9%   | <0.001            | 1.07 (1.02-1.11) | 0.002   |
| Cardiac readmission       | VT/VF      | 7.1%        | 6.6%    | 0.145             | 0.94 (0.85-1.04) | 0.248   |
|                           | PEA/Asystole| 4.4%        | 4.8%    | 0.055             | 1.15 (1.06-1.25) | <0.001  |
| Non-cardiac readmission   | VT/VF      | 11.1%       | 13.6%   | <0.001            | 1.08 (0.99-1.18) | 0.086   |
|                           | PEA/Asystole| 15.3%       | 16.2%   | 0.004             | 1.03 (0.99-1.08) | 0.139   |

VT = Ventricular Tachycardia, VF = Ventricular Fibrillation, PEA = Pulseless Electrical Activity

\(^1\)Adjusted for the same covariates listed in Table 2.

Table S6: Multivariable Regression Analyses on CFR & Readmission Adjusting for Demographics, Comorbidities, Procedure Rates & Hospital Characteristics

|                    | Rhythm     | Adjusted OR (95% CI) (Model 1) | Adjusted OR (95% CI) (Model 2) | Adjusted OR (95% CI) (Model 3) |
|--------------------|------------|--------------------------------|--------------------------------|--------------------------------|
| In-hospital CFR    | VT/VF      | 1.14 (1.11-1.18)                | 1.05 (1.01-1.09)                | 1.02 (0.98-1.06)                |
|                    | PEA/Asystole| 1.00 (0.98-1.02)                | 1.00 (0.98-1.02)                | 0.99 (0.97-1.01)                |
| All-cause readmission | VT/VF      | 1.10 (1.04-1.19)                | 1.06 (0.99-1.13)                | 1.06 (1.00-1.14)                |
|                    | PEA/Asystole| 1.05 (1.01-1.09)                | 1.06 (1.02-1.10)                | 1.07 (1.03-1.11)                |
|                    | VT/VF      | 0.90 (0.82-0.99)                | 0.96 (0.87-1.06)                | 0.96 (0.87-1.06)                |
|                  | Cardiac readmission | Non-cardiac readmission |
|------------------|----------------------|-------------------------|
| PEA/Asystole     | 1.03 (0.95-1.11)     | 1.23 (1.14-1.33)        |
| VT/VF            | 1.14 (1.06-1.24)     | 1.11 (1.03-1.20)        |
| PEA/Asystole     | 1.15 (1.06-1.25)     | 1.04 (0.99-1.09)        |

Model 1: Adjusted for demographics (age, income quartile, primary payer).
Model 2: Adjusted for covariates in model 1 and comorbidities.
Model 3 (full model): Adjusted for covariates in model 1, model 2, procedures during hospitalization, and hospital characteristics.

Table S7: Predictors of CFR among patients with cardiac arrest associated with VT/VF

| Predictor                                      | Adjusted odds ratio (95% CI)      | P value |
|------------------------------------------------|-----------------------------------|---------|
| Female                                         | 1.02 (0.98-1.06)                  | 0.324   |
| Age                                            |                                   |         |
| STEMI                                          | 1.55 (1.46-1.64)                  | <0.001  |
| Pulmonary embolism                             | 1.42 (1.23-1.64)                  | <0.001  |
| Hypertension                                   | 0.95 (0.91-0.99)                  | 0.015   |
| Diabetes mellitus                              | 1.30 (1.24-1.35)                  | <0.001  |
| Known coronary artery disease                  | 0.92 (0.88-0.96)                  | <0.001  |
| Previous myocardial infarction                 | 0.95 (0.89-1.01)                  | 0.104   |
| Previous PCI                                   | 1.12 (1.04-1.21)                  | 0.002   |
| Previous CABG                                  | 1.14 (1.06-1.22)                  | <0.001  |
| History of CHF                                 | 0.63 (0.60-0.65)                  | <0.001  |
| History of cardiac arrest                      | 0.39 (0.34-0.45)                  | <0.001  |
| Peripheral vascular disease                    | 1.38 (1.29-1.47)                  | <0.001  |
| Pulmonary hypertension                         | 1.18 (1.08-1.29)                  | <0.001  |
| Chronic pulmonary disease                      | 1.08 (1.03-1.13)                  | <0.001  |
| Chronic kidney disease                         | 1.21 (1.15-1.27)                  | <0.001  |
| Chronic kidney disease on HD                   | 1.36 (1.25-1.47)                  | <0.001  |
| Liver disease                                  | 1.22 (1.12-1.34)                  | <0.001  |
| Anemia                                         | 0.80 (0.76-0.83)                  | <0.001  |
| Atrial fibrillation                            | 0.86 (0.83-0.90)                  | <0.001  |
| Coagulopathy                                   | 1.12 (1.07-1.19)                  | <0.001  |
| Collagen vascular disease                      | 1.20 (1.06-1.36)                  | 0.004   |
| Electrolyte disorders                          | 1.11 (1.06-1.16)                  | <0.001  |
| Obesity                                        | 1.00 (0.95-1.05)                  | 0.945   |
| Pulmonary circulation disorders                | 0.92 (0.82-1.04)                  | 0.171   |
| Valvular heart disease                         | 1.02 (0.93-1.11)                  | 0.697   |
| Elixhauser comorbidity scores > 4              | 0.88 (0.84-0.93)                  | <0.001  |
| Predictor                      | Adjusted odds ratio (95% CI) | P value |
|-------------------------------|-----------------------------|---------|
| Weekend admission             | 1.06 (1.02-1.10)            | 0.006   |
| Coronary angiography          | 0.20 (0.19-0.21)            | <0.001  |
| PCI                           | 0.59 (0.55-0.63)            | <0.001  |
| IABP                          | 2.20 (2.03-2.37)            | <0.001  |
| ECMO                          | 1.86 (1.43-2.42)            | <0.001  |
| Mechanical ventilation        | 1.66 (1.59-1.73)            | <0.001  |
| Hemodialysis                  | 0.87 (0.80-0.94)            | <0.001  |
| Median household income       |                             | <0.001  |
| First quartile                | 1 (reference)               | -       |
| Second quartile               | 0.94 (0.89-0.99)            | 0.010   |
| Third quartile                | 0.92 (0.88-0.97)            | 0.002   |
| Fourth quartile               | 0.86 (0.81-0.90)            | <0.001  |
| Primary payer                 |                             | <0.001  |
| Medicare                      | 1 (reference)               | -       |
| Medicaid                      | 0.98 (0.92-1.04)            | 0.458   |
| Private including HMO         | 0.81 (0.77-0.85)            | <0.001  |
| Self-pay/no charge/other      | 1.18 (1.10-1.26)            | <0.001  |
| Hospital teaching status      |                             | 0.192   |
| Teaching                      | 0.97 (0.93-1.02)            |         |
| Hospital bed size             |                             | 0.051   |
| Small                         | 1 (reference)               | -       |
| Medium                        | 1.08 (1.00-1.17)            | 0.042   |
| Large                         | 1.09 (1.02-1.17)            | 0.016   |

Table S8: Predictors of CFR among patients with cardiac arrest associated with PEA/asystole
### Table S9: Predictors of readmission among patients with cardiac arrest associated with VT/VF

| Predictor                                      | Adjusted odds ratio (95% CI) | P value |
|------------------------------------------------|------------------------------|---------|
| **Female**                                     | 1.06 (1.00-1.14)             | 0.055   |
| **Age**                                        | 1.00 (1.00-1.00)             | 0.673   |
| **STEMI**                                       | 0.94 (0.86-1.02)             | 0.125   |
| **Hypertension**                               | 0.94 (0.8-1.00)              | 0.050   |
| **Diabetes mellitus**                          | 1.07 (1.01-1.15)             | 0.036   |

| Chronic kidney disease on HD | 1.15 (1.10-1.20) | <0.001 |
| Liver disease                | 1.61 (1.54-1.70)  | <0.001 |
| Anemia                        | 0.83 (0.81-0.85)  | <0.001 |
| Atrial fibrillation           | 0.93 (0.90-0.95)  | <0.001 |
| Coagulopathy                  | 1.19 (1.15-1.22)  | <0.001 |
| Collagen vascular disease     | 1.25 (1.17-1.33)  | <0.001 |
| Electrolyte disorders         | 1.11 (1.08-1.13)  | <0.001 |
| Obesity                       | 0.84 (0.82-0.87)  | <0.001 |
| Pulmonary circulation disorders| 0.92 (0.87-0.98) | 0.006  |
| Valvular heart disease        | 0.93 (0.89-0.97)  | <0.001 |
| Elixhauser comorbidity scores > 4 | 0.93 (0.90-0.95) | <0.001 |
| Weekend admission             | 1.09 (1.07-1.12)  | <0.001 |
| Coronary angiography          | 0.30 (0.28-0.31)  | <0.001 |
| PCI                            | 0.57 (0.53-0.62)  | <0.001 |
| IABP                           | 1.56 (1.44-1.69)  | <0.001 |
| ECMO                           | 1.45 (1.17-1.81)  | <0.001 |
| Mechanical ventilation        | 1.06 (1.03-1.09)  | <0.001 |
| Hemodialysis                  | 0.68 (0.66-0.71)  | <0.001 |
| Median household income       | 0.93 (0.90-0.96)  | <0.001 |
| First quartile                | 1 (reference)      | -       |
| Second quartile               | 0.92 (0.89-0.94)  | <0.001 |
| Third quartile                | 0.91 (0.88-0.94)  | <0.001 |
| Fourth quartile               | 0.91 (0.88-0.94)  | <0.001 |
| Primary payer                 | 1.12 (1.08-1.17)  | <0.001 |
| Medicare                      | 1 (reference)      | -       |
| Medicaid                      | 0.97 (0.94-1.00)  | 0.028   |
| Private including HMO         | 1.34 (1.28-1.40)  | <0.001 |
| Self-pay/no charge/other      | 1.34 (1.28-1.40)  | <0.001 |
| Hospital teaching status      | 0.85 (0.83-0.88)  | <0.001 |
| Teaching                      | 1 (reference)      | -       |
| Hospital bed size             | 0.89 (0.84-0.94)  | <0.001 |
| Small                         | 0.89 (0.84-0.94)  | <0.001 |
| Medium                        | 0.91 (0.86-0.97)  | 0.002   |
| Large                         | 0.91 (0.86-0.97)  | 0.002   |

Adjusted odds ratio (95% CI): This column presents the adjusted odds ratio along with the 95% confidence interval (CI) for each predictor. The P value column indicates the statistical significance of the association between the predictor and the readmission event.
| Condition                                                                 | Odds Ratio (95% CI) | p-Value |
|---------------------------------------------------------------------------|---------------------|---------|
| Known coronary artery disease                                            | 1.06 (0.99-1.15)    | 0.114   |
| Previous myocardial infarction                                           | 0.94 (0.85-1.03)    | 0.164   |
| Previous CABG                                                             | 0.92 (0.82-1.04)    | 0.187   |
| History of CHF                                                            | 1.30 (1.22-1.38)    | <0.001  |
| History of cardiac arrest                                                | 0.82 (0.70-0.96)    | 0.015   |
| Pulmonary hypertension                                                   | 1.00 (0.87-1.14)    | 0.983   |
| Chronic pulmonary disease                                                | 1.18 (1.09-1.27)    | <0.001  |
| Chronic kidney disease                                                   | 1.23 (1.14-1.33)    | <0.001  |
| Chronic kidney disease on HD                                              | 1.71 (1.50-1.95)    | <0.001  |
| Liver disease                                                             | 1.14 (0.99-1.33)    | 0.078   |
| Anemia                                                                    | 1.06 (0.99-1.14)    | 0.089   |
| Atrial fibrillation                                                       | 1.01 (0.95-1.08)    | 0.715   |
| Coagulopathy                                                              | 1.02 (0.94-1.12)    | 0.642   |
| Collagen vascular disease                                                | 1.11 (0.92-1.34)    | 0.272   |
| Electrolyte disorders                                                     | 1.03 (0.96-1.10)    | 0.431   |
| Obesity                                                                   | 0.99 (0.91-1.08)    | 0.890   |
| Pulmonary circulation disorders                                           | 1.16 (0.97-1.39)    | 0.096   |
| Valvular heart disease                                                   | 1.04 (0.92-1.19)    | 0.543   |
| Elixhauser comorbidity scores > 4                                        | 1.08 (0.98-1.18)    | 0.117   |
| Weekend admission                                                         | 0.96 (0.89-1.02)    | 0.189   |
| Coronary angiography                                                      | 0.84 (0.78-0.91)    | <0.001  |
| PCI                                                                       | 1.15 (1.04-1.26)    | 0.005   |
| TTM                                                                       | 0.77 (0.67-0.90)    | <0.001  |
| Mechanical ventilation                                                    | 0.99 (0.92-1.06)    | 0.736   |
| Hemodialysis                                                              | 1.07 (0.94-1.22)    | 0.290   |
| Median household income                                                   | 1 (reference)       |         |
| First quartile                                                           | 1.0 (reference)     |         |
| Second quartile                                                          | 1.01 (0.92-1.10)    | 0.844   |
| Third quartile                                                           | 0.98 (0.90-1.06)    | 0.585   |
| Fourth quartile                                                          | 0.97 (0.88-1.06)    | 0.467   |
| Primary payer                                                             | 1 (reference)       |         |
| Medicare                                                                  | 1 (reference)       |         |
| Medicaid                                                                  | 1.08 (0.98-1.21)    | 0.136   |
| Private including HMO                                                     | 0.72 (0.66-0.79)    | <0.001  |
| Self-pay/no charge/other                                                  | 0.65 (0.58-0.74)    | <0.001  |
| Hospital bed size                                                         | 1 (reference)       |         |
| Small                                                                     | 1 (reference)       |         |
| Medium                                                                    | 0.96 (0.86-1.09)    | 0.558   |
| Large                                                                     | 1.00 (0.89-1.12)    | 0.980   |
| Length of stay (≥12 days)*                                                | 1.36 (1.27-1.46)    | <0.001  |
**Table S10: Predictors of readmission among patients with cardiac arrest associated with PEA/asystole**

| Predictor                                      | Adjusted odds ratio (95% CI) | P value |
|------------------------------------------------|-----------------------------|---------|
| Female                                         | 1.07 (1.03-1.11)            | 0.055   |
| Age                                            | 1.00 (1.00-1.00)            | <0.001  |
| STEMI                                          | 0.95 (0.86-1.05)            | 0.287   |
| Hypertension                                   | 0.98 (0.94-1.03)            | 0.498   |
| Diabetes mellitus                              | 1.14 (1.09-1.19)            | <0.001  |
| Known coronary artery disease                  | 1.07 (1.01-1.12)            | 0.015   |
| Previous myocardial infarction                 | 1.05 (0.97-1.14)            | 0.223   |
| Previous CABG                                  | 0.96 (0.87-1.05)            | 0.317   |
| History of CHF                                 | 1.23 (1.17-1.29)            | <0.001  |
| History of cardiac arrest                      | 0.76 (0.65-0.88)            | <0.001  |
| Pulmonary hypertension                         | 0.96 (0.88-1.06)            | 0.439   |
| Chronic pulmonary disease                      | 1.21 (1.15-1.28)            | <0.001  |
| Chronic kidney disease                         | 1.21 (1.15-1.27)            | <0.001  |
| Chronic kidney disease on HD                   | 1.43 (1.33-1.54)            | <0.001  |
| Liver disease                                  | 1.06 (0.97-1.17)            | 0.219   |
| Anemia                                         | 1.07 (1.02-1.12)            | 0.004   |
| Atrial fibrillation                            | 1.05 (1.00-1.10)            | 0.051   |
| Coagulopathy                                   | 1.01 (0.95-1.07)            | 0.771   |
| Collagen vascular disease                      | 1.04 (0.92-1.18)            | 0.505   |
| Electrolyte disorders                          | 1.01 (0.96-1.05)            | 0.836   |
| Obesity                                        | 0.96 (0.90-1.02)            | 0.145   |
| Pulmonary circulation disorders                 | 1.04 (0.96-1.14)            | 0.335   |
| Valvular heart disease                         | 0.94 (0.86-1.02)            | 0.119   |
| Elixhauser comorbidity scores > 4              | 1.05 (0.99-1.12)            | 0.099   |
| Weekend admission                               | 0.99 (0.95-1.03)            | 0.631   |
| Coronary angiography                            | 0.97 (0.91-1.04)            | 0.386   |
| PCI                                            | 1.03 (0.92-1.15)            | 0.590   |
| TTM                                            | 0.94 (0.70-1.00)            | 0.045   |
| Mechanical ventilation                         | 1.01 (0.96-1.07)            | 0.608   |
| Hemodialysis                                   | 1.10 (1.02-1.18)            | 0.009   |
| Median household income                        |                            | 0.400   |

*Length of stay dichotomized at 75th percentile (≥ 12 days) of the entire stay days.
| First quartile          | 1 (reference) | -          |
|------------------------|---------------|------------|
| Second quartile        | 1.00 (0.95-1.05) | 0.967     |
| Third quartile         | 1.02 (0.96-1.07) | 0.567     |
| Fourth quartile        | 1.05 (0.99-1.11) | 0.128     |

| Primary payer                  |               | <0.001    |
|--------------------------------|---------------|-----------|
| Medicare                       | 1 (reference) | -         |
| Medicaid                       | 1.06 (0.99-1.14) | 0.085    |
| Private including HMO          | 0.76 (0.71-0.81) | <0.001   |
| Self-pay/no charge/other       | 0.65 (0.59-0.71) | <0.001   |

| Hospital bed size               |               | 0.046     |
|--------------------------------|---------------|-----------|
| Small                          | 1 (reference) | -         |
| Medium                         | 0.98 (0.90-1.08) | 0.719    |
| Large                          | 1.04 (0.96-1.14) | 0.326    |

| Length of stay (≥ 12 days)*     | 1.36 (1.27-1.46) | <0.001   |

| Discharge disposition          |               | 0.198     |
|--------------------------------|---------------|-----------|
| Home                           | 1 (reference) | -         |
| Facility                       | 1.04 (0.99-1.09) | 0.089    |
| AMA/unknown                    | 1.08 (0.91-1.28) | 0.412    |

*Length of stay dichotomized at 75th percentile (≥ 12 days) of the entire stay days.

**Figure S1:** Timing of 30-day readmission by post-discharge day in all patients after index admission with cardiac arrest

42.3%, 53.9%, and 66.0% readmitted within 7, 10, and 14 days of discharge, respectively. Median time to readmission (IQR): 9 (3-18): 50.2% readmitted within 9 days of discharge.
Figure S2: Timing of 30-day readmission by post-discharge day in all patients after index admission with in-hospital cardiac arrest

Median time to readmission (IQR): 9 (4-18) and 9 (3-17) for VT/VF and PEA/Asystole, respectively.
Figure S3: Timing of 30-day readmission by post-discharge day in all patients after index admission with out-of-hospital cardiac arrest

Median time to readmission (IQR): 9 (3-18) and 9 (4-17) for VT/VF and PEA/Asystole, respectively.