Impact of Ventricular Arrhythmias on In-Hospital Outcomes in Patients Hospitalized with Heart Failure: A National Inpatient Sample Study

Analysis for RCOP NIS IM9

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## Preamble:

* *Reference Papers:*
  + [Alenazy et al. 2019](https://pmc.ncbi.nlm.nih.gov/articles/PMC6989287/)
* *Study Objective*: Assess the impact of Ventricular arrhythmias among patients hospitalized for Heart failure.
* *Data Source*: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* *Patient Selection*: All inpatient admissions with a primary diagnosis of heart failure were included, and outcomes were compared between patients who developed ventricular arrhythmias during hospitalization and those who did not.
* *Heart failure categories*:
  + Heart failure without Ventricular Arrhythmias
  + Heart failure with Ventricular Arrhythmias
* *Primary Outcomes*:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* *Secondary Outcomes*:
  + Cardiogenic shock
  + Cardiac arrest
  + Intra aortic balloon pump
  + Acute ischemic stroke
  + Sepsis
* *Statistical Analysis*: Multiple logistic and linear regression models to evaluate the independent association of Ventricular arrhythmias with in-hospital outcomes in patients with HF
  + Demographics: Age, sex, race, residential income, insurance, hospital region, hospital bedsize, hospital location, teaching status and admission type (elective or non-elective).
  + Medical History: Diabetes mellitus, previous congestive heart failure, hypertension, chronic obstructive pulmonary disease, end-stage renal disease, atrial fibrillation, anemia, previous percutaneous coronary intervention, previous coronary artery bypass grafting, previous implantable cardioverter-defibrillator insertion, previous permanent pacemaker or cardiac resynchronization therapy insertion, smoking status, coronary artery disease, previous stroke or transient ischemic attack, previous myocardial infarction, heart failure with reduced ejection fraction, heart failure with preserved ejection fraction, peripheral vascular disease, valvular heart disease, family history of sudden cardiac death, personal history of sudden cardiac arrest, and dilated cardiomyopathy.
  + Comorbidities: Charlson comorbidity index.
* *Software:* All analyses were performed using R Version 4.4.1 (R Foundation for Statistical Computing, Vienna, Austria)

## Baseline Table:

| **Characteristic** | **Heart failure without Ventricular Arrhythmia** N = 3,414,465*1* | **Heart failure with Ventricular Arrhythmia** N = 222,255*1* | **p-value***2* | **Overall** N = 3,636,720*1* |
| --- | --- | --- | --- | --- |
| Age, y | 71 (14) | 68 (14) | <0.001 | 71 (14) |
| Sex |  |  | <0.001 |  |
| Female | 1,652,165 (48%) | 66,045 (30%) |  | 1,718,210 (47%) |
| Male | 1,762,175 (52%) | 156,190 (70%) |  | 1,918,365 (53%) |
| Race |  |  | <0.001 |  |
| White | 2,178,950 (65%) | 132,570 (61%) |  | 2,311,520 (65%) |
| Asian or Pacific Islander | 74,615 (2.2%) | 3,775 (1.7%) |  | 78,390 (2.2%) |
| Black | 710,980 (21%) | 61,865 (28%) |  | 772,845 (22%) |
| Hispanic | 289,435 (8.6%) | 14,480 (6.6%) |  | 303,915 (8.5%) |
| Native American | 18,810 (0.6%) | 1,140 (0.5%) |  | 19,950 (0.6%) |
| Other | 76,715 (2.3%) | 4,490 (2.1%) |  | 81,205 (2.3%) |
| Residential income |  |  | <0.001 |  |
| $1 - $51,999 | 1,139,255 (34%) | 70,640 (32%) |  | 1,209,895 (34%) |
| $52,000 - $65,999 | 904,720 (27%) | 55,970 (26%) |  | 960,690 (27%) |
| $66,000 - $87,999 | 748,470 (22%) | 49,970 (23%) |  | 798,440 (22%) |
| $88,000 or more | 560,340 (17%) | 41,630 (19%) |  | 601,970 (17%) |
| Expected primary payer |  |  | <0.001 |  |
| Private | 378,600 (11%) | 33,310 (15%) |  | 411,910 (11%) |
| Medicaid | 377,990 (11%) | 29,365 (13%) |  | 407,355 (11%) |
| Medicare | 2,481,500 (73%) | 146,865 (66%) |  | 2,628,365 (72%) |
| Other | 173,055 (5.1%) | 12,505 (5.6%) |  | 185,560 (5.1%) |
| Hospital region |  |  | <0.001 |  |
| Midwest | 783,030 (23%) | 52,515 (24%) |  | 835,545 (23%) |
| Northeast | 619,990 (18%) | 43,330 (19%) |  | 663,320 (18%) |
| South | 1,418,150 (42%) | 88,135 (40%) |  | 1,506,285 (41%) |
| West | 593,295 (17%) | 38,275 (17%) |  | 631,570 (17%) |
| Hospital bedsize |  |  | <0.001 |  |
| Large | 1,590,935 (47%) | 121,270 (55%) |  | 1,712,205 (47%) |
| Medium | 1,015,665 (30%) | 60,180 (27%) |  | 1,075,845 (30%) |
| Small | 807,865 (24%) | 40,805 (18%) |  | 848,670 (23%) |
| Hospital location and teaching status |  |  | <0.001 |  |
| Rural | 363,080 (11%) | 11,690 (5.3%) |  | 374,770 (10%) |
| Urban, non-teaching | 700,780 (21%) | 35,660 (16%) |  | 736,440 (20%) |
| Urban, teaching | 2,350,605 (69%) | 174,905 (79%) |  | 2,525,510 (69%) |
| Admission type |  |  | <0.001 |  |
| Elective | 126,615 (3.7%) | 10,500 (4.7%) |  | 137,115 (3.8%) |
| Non-elective | 3,285,575 (96%) | 211,605 (95%) |  | 3,497,180 (96%) |
| Charlson comorbidity index | 4.16 (2.00) | 4.26 (2.03) | <0.001 | 4.16 (2.00) |
| Diabetes Mellitus | 1,720,520 (50%) | 98,625 (44%) | <0.001 | 1,819,145 (50%) |
| Previous congestive heart failure | 806,290 (24%) | 100,510 (45%) | <0.001 | 906,800 (25%) |
| Heart failure with reduced ejection fraction | 211,055 (6.2%) | 26,980 (12%) | <0.001 | 238,035 (6.5%) |
| Heart failure with preserved ejection fraction | 2,672,335 (78%) | 190,995 (86%) | <0.001 | 2,863,330 (79%) |
| Peripheral vascular disease | 258,150 (7.6%) | 18,345 (8.3%) | <0.001 | 276,495 (7.6%) |
| Family history of sudden cardiac death | 1,770 (<0.1%) | 225 (0.1%) | <0.001 | 1,995 (<0.1%) |
| Personal history of sudden cardiac arrest | 21,825 (0.6%) | 3,210 (1.4%) | <0.001 | 25,035 (0.7%) |
| Dilated cardiomyopathy | 184,210 (5.4%) | 35,370 (16%) | <0.001 | 219,580 (6.0%) |
| Hypertension | 1,359,655 (40%) | 78,335 (35%) | <0.001 | 1,437,990 (40%) |
| Chronic obstructive pulmonary disease | 1,218,835 (36%) | 72,475 (33%) | <0.001 | 1,291,310 (36%) |
| End stage renal disease | 302,245 (8.9%) | 12,185 (5.5%) | <0.001 | 314,430 (8.6%) |
| Atrial fibrillation | 1,588,145 (47%) | 113,230 (51%) | <0.001 | 1,701,375 (47%) |
| Anemia | 1,286,890 (38%) | 76,235 (34%) | <0.001 | 1,363,125 (37%) |
| Previous PCI | 474,930 (14%) | 32,075 (14%) | 0.004 | 507,005 (14%) |
| Previous CABG | 458,380 (13%) | 29,630 (13%) | 0.6 | 488,010 (13%) |
| Previous ICD insertion | 290,970 (8.5%) | 53,005 (24%) | <0.001 | 343,975 (9.5%) |
| Previous PPM or CRT insertion | 304,905 (8.9%) | 12,630 (5.7%) | <0.001 | 317,535 (8.7%) |
| Smoking status | 411,120 (12%) | 30,260 (14%) | <0.001 | 441,380 (12%) |
| Coronary artery disease | 1,652,140 (48%) | 122,610 (55%) | <0.001 | 1,774,750 (49%) |
| Previous stroke/TIA | 461,465 (14%) | 27,340 (12%) | <0.001 | 488,805 (13%) |
| Valvular heart disease | 979,725 (29%) | 77,690 (35%) | <0.001 | 1,057,415 (29%) |
| Previous myocardial infarction | 513,235 (15%) | 42,055 (19%) | <0.001 | 555,290 (15%) |
| *1*Mean (SD); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Outcomes Table:

| **Characteristic** | **Heart failure without Ventricular Arrhythmia** N = 3,414,465*1* | **Heart failure with Ventricular Arrhythmia** N = 222,255*1* | **p-value***2* | **Overall** N = 3,636,720*1* |
| --- | --- | --- | --- | --- |
| Died during hospitalization | 79,255 (2.3%) | 15,175 (6.8%) | <0.001 | 94,430 (2.6%) |
| Length of stay (days) | 4.0 (2.0, 6.0) | 6.0 (3.0, 10.0) | <0.001 | 4.0 (3.0, 7.0) |
| Inflation-adjusted total charge ($) | 33,921 (19,959, 60,274) | 52,532 (28,563, 109,732) | <0.001 | 34,712 (20,301, 62,352) |
| Cardiogenic shock | 78,090 (2.3%) | 27,905 (13%) | <0.001 | 105,995 (2.9%) |
| Cardiac arrest | 18,660 (0.5%) | 7,170 (3.2%) | <0.001 | 25,830 (0.7%) |
| Intra aortic balloon pump | 6,460 (0.2%) | 4,630 (2.1%) | <0.001 | 11,090 (0.3%) |
| Acute ischemic stroke | 14,815 (0.4%) | 1,970 (0.9%) | <0.001 | 16,785 (0.5%) |
| Sepsis | 37,320 (1.1%) | 7,285 (3.3%) | <0.001 | 44,605 (1.2%) |
| *1*n (%); Median (Q1, Q3) | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | |

## Multivariable Logistic Regression:

### All-Cause Mortality:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Heart failure categories |  |  |  |
| Heart failure without Ventricular Arrhythmia | — | — |  |
| Heart failure with Ventricular Arrhythmia | 3.29 | 3.14, 3.44 | <0.001 |
| Age, y | 1.03 | 1.03, 1.03 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.08 | 1.05, 1.12 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.90 | 0.81, 1.00 | 0.052 |
| Black | 0.67 | 0.63, 0.70 | <0.001 |
| Hispanic | 0.80 | 0.75, 0.86 | <0.001 |
| Native American | 1.20 | 0.98, 1.48 | 0.084 |
| Other | 0.95 | 0.85, 1.06 | 0.3 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.96 | 0.92, 1.00 | 0.050 |
| $66,000 - $87,999 | 0.92 | 0.88, 0.97 | <0.001 |
| $88,000 or more | 0.92 | 0.88, 0.97 | 0.003 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.83 | 0.77, 0.91 | <0.001 |
| Medicare | 0.76 | 0.71, 0.80 | <0.001 |
| Other | 1.18 | 1.06, 1.30 | 0.002 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.20 | 1.14, 1.27 | <0.001 |
| South | 1.04 | 0.99, 1.09 | 0.091 |
| West | 1.15 | 1.09, 1.22 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.87 | 0.83, 0.91 | <0.001 |
| Small | 0.82 | 0.79, 0.86 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.93 | 0.87, 1.00 | 0.038 |
| Urban, teaching | 1.08 | 1.02, 1.15 | 0.007 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.65 | 0.58, 0.73 | <0.001 |
| Charlson comorbidity index | 1.15 | 1.14, 1.17 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.63 | 0.61, 0.66 | <0.001 |
| Previous congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.76, 0.84 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.76, 0.83 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.93 | 0.90, 0.96 | <0.001 |
| End stage renal disease |  |  |  |
| No | — | — |  |
| Yes | 1.48 | 1.40, 1.57 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.26 | 1.22, 1.30 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.00 | 0.96, 1.03 | 0.9 |
| Previous PCI |  |  |  |
| No | — | — |  |
| Yes | 0.77 | 0.73, 0.81 | <0.001 |
| Previous CABG |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.86, 0.95 | <0.001 |
| Previous ICD insertion |  |  |  |
| No | — | — |  |
| Yes | 0.74 | 0.70, 0.79 | <0.001 |
| Previous PPM or CRT insertion |  |  |  |
| No | — | — |  |
| Yes | 0.71 | 0.67, 0.75 | <0.001 |
| Smoking status |  |  |  |
| No | — | — |  |
| Yes | 0.67 | 0.63, 0.72 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.91 | 0.88, 0.94 | <0.001 |
| Previous stroke/TIA |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.72, 0.79 | <0.001 |
| Previous myocardial infarction |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.77, 0.84 | <0.001 |
| Heart failure with reduced ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 2.17 | 2.05, 2.29 | <0.001 |
| Heart failure with preserved ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 1.02 | 0.97, 1.06 | 0.5 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.90, 1.00 | 0.061 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.89, 0.95 | <0.001 |
| Family history of sudden cardiac death |  |  |  |
| No | — | — |  |
| Yes | 0.58 | 0.23, 1.42 | 0.2 |
| Personal history of sudden cardiac arrest |  |  |  |
| No | — | — |  |
| Yes | 1.23 | 1.04, 1.47 | 0.016 |
| Dilated cardiomyopathy |  |  |  |
| No | — | — |  |
| Yes | 1.11 | 1.02, 1.20 | 0.012 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Cardiogenic shock

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Heart failure categories |  |  |  |
| Heart failure without Ventricular Arrhythmia | — | — |  |
| Heart failure with Ventricular Arrhythmia | 3.36 | 3.23, 3.50 | <0.001 |
| Age, y | 0.97 | 0.97, 0.98 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.31 | 1.27, 1.35 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.09 | 0.98, 1.21 | 0.10 |
| Black | 0.76 | 0.72, 0.80 | <0.001 |
| Hispanic | 0.80 | 0.74, 0.86 | <0.001 |
| Native American | 1.03 | 0.86, 1.25 | 0.7 |
| Other | 1.13 | 1.03, 1.24 | 0.012 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.02 | 0.98, 1.06 | 0.4 |
| $66,000 - $87,999 | 0.99 | 0.94, 1.04 | 0.6 |
| $88,000 or more | 1.03 | 0.97, 1.10 | 0.3 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.81 | 0.76, 0.85 | <0.001 |
| Medicare | 0.85 | 0.81, 0.89 | <0.001 |
| Other | 0.73 | 0.67, 0.79 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.03 | 0.93, 1.15 | 0.6 |
| South | 1.12 | 1.02, 1.23 | 0.019 |
| West | 1.11 | 1.01, 1.22 | 0.035 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.58 | 0.54, 0.61 | <0.001 |
| Small | 0.45 | 0.42, 0.48 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.54 | 1.38, 1.71 | <0.001 |
| Urban, teaching | 2.94 | 2.66, 3.24 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.59 | 0.54, 0.63 | <0.001 |
| Charlson comorbidity index | 1.02 | 1.00, 1.03 | 0.008 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.72, 0.78 | <0.001 |
| Previous congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.29 | 1.24, 1.34 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.59, 0.65 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.77 | 0.74, 0.80 | <0.001 |
| End stage renal disease |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.58, 0.67 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.55 | 1.49, 1.60 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.21 | 1.17, 1.25 | <0.001 |
| Previous PCI |  |  |  |
| No | — | — |  |
| Yes | 0.87 | 0.82, 0.91 | <0.001 |
| Previous CABG |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.74, 0.82 | <0.001 |
| Previous ICD insertion |  |  |  |
| No | — | — |  |
| Yes | 1.25 | 1.18, 1.31 | <0.001 |
| Previous PPM or CRT insertion |  |  |  |
| No | — | — |  |
| Yes | 0.60 | 0.55, 0.64 | <0.001 |
| Smoking status |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.79, 0.87 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.17 | 1.13, 1.22 | <0.001 |
| Previous stroke/TIA |  |  |  |
| No | — | — |  |
| Yes | 0.69 | 0.66, 0.73 | <0.001 |
| Previous myocardial infarction |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.92, 1.02 | 0.2 |
| Heart failure with reduced ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 3.57 | 3.37, 3.78 | <0.001 |
| Heart failure with preserved ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 1.93 | 1.82, 2.03 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.90, 1.01 | 0.13 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 1.27 | 1.23, 1.32 | <0.001 |
| Family history of sudden cardiac death |  |  |  |
| No | — | — |  |
| Yes | 1.12 | 0.69, 1.82 | 0.6 |
| Personal history of sudden cardiac arrest |  |  |  |
| No | — | — |  |
| Yes | 1.04 | 0.90, 1.20 | 0.6 |
| Dilated cardiomyopathy |  |  |  |
| No | — | — |  |
| Yes | 1.51 | 1.43, 1.59 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Cardiac arrest

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Heart failure categories |  |  |  |
| Heart failure without Ventricular Arrhythmia | — | — |  |
| Heart failure with Ventricular Arrhythmia | 6.49 | 6.05, 6.97 | <0.001 |
| Age, y | 1.00 | 1.00, 1.01 | 0.045 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.07 | 1.01, 1.14 | 0.026 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.33 | 1.11, 1.59 | 0.002 |
| Black | 1.07 | 0.99, 1.16 | 0.086 |
| Hispanic | 1.17 | 1.06, 1.30 | 0.003 |
| Native American | 1.07 | 0.75, 1.51 | 0.7 |
| Other | 1.24 | 1.03, 1.49 | 0.022 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.96 | 0.89, 1.04 | 0.3 |
| $66,000 - $87,999 | 0.88 | 0.81, 0.95 | 0.002 |
| $88,000 or more | 0.83 | 0.75, 0.91 | <0.001 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.07 | 0.95, 1.20 | 0.3 |
| Medicare | 1.00 | 0.90, 1.10 | >0.9 |
| Other | 1.06 | 0.92, 1.24 | 0.4 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.96 | 0.86, 1.06 | 0.4 |
| South | 1.20 | 1.11, 1.30 | <0.001 |
| West | 1.06 | 0.96, 1.17 | 0.3 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.03 | 0.96, 1.11 | 0.4 |
| Small | 1.01 | 0.93, 1.09 | 0.8 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.06 | 0.94, 1.21 | 0.3 |
| Urban, teaching | 1.06 | 0.95, 1.19 | 0.3 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.05 | 0.91, 1.21 | 0.5 |
| Charlson comorbidity index | 1.08 | 1.06, 1.11 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.83, 0.96 | 0.002 |
| Previous congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.87, 1.02 | 0.15 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.79, 0.92 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.91 | 0.86, 0.98 | 0.008 |
| End stage renal disease |  |  |  |
| No | — | — |  |
| Yes | 1.64 | 1.50, 1.80 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.23 | 1.16, 1.31 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.10 | 1.03, 1.17 | 0.003 |
| Previous PCI |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.82, 0.99 | 0.029 |
| Previous CABG |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.86, 1.03 | 0.2 |
| Previous ICD insertion |  |  |  |
| No | — | — |  |
| Yes | 0.56 | 0.50, 0.62 | <0.001 |
| Previous PPM or CRT insertion |  |  |  |
| No | — | — |  |
| Yes | 0.61 | 0.54, 0.69 | <0.001 |
| Smoking status |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.71, 0.86 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.13 | 1.06, 1.21 | <0.001 |
| Previous stroke/TIA |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.68, 0.82 | <0.001 |
| Previous myocardial infarction |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.81, 0.97 | 0.010 |
| Heart failure with reduced ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 1.20 | 1.08, 1.33 | <0.001 |
| Heart failure with preserved ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 0.81 | 0.75, 0.87 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.93, 1.15 | 0.5 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.86, 0.98 | 0.014 |
| Family history of sudden cardiac death |  |  |  |
| No | — | — |  |
| Yes | 1.00 | 0.32, 3.12 | >0.9 |
| Personal history of sudden cardiac arrest |  |  |  |
| No | — | — |  |
| Yes | 1.26 | 0.94, 1.68 | 0.12 |
| Dilated cardiomyopathy |  |  |  |
| No | — | — |  |
| Yes | 1.06 | 0.94, 1.20 | 0.3 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Intra aortic balloon pump

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Heart failure categories |  |  |  |
| Heart failure without Ventricular Arrhythmia | — | — |  |
| Heart failure with Ventricular Arrhythmia | 5.24 | 4.69, 5.86 | <0.001 |
| Age, y | 0.96 | 0.96, 0.97 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.52 | 1.37, 1.69 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.39 | 1.06, 1.81 | 0.017 |
| Black | 0.69 | 0.61, 0.78 | <0.001 |
| Hispanic | 0.88 | 0.72, 1.07 | 0.2 |
| Native American | 0.48 | 0.21, 1.09 | 0.081 |
| Other | 1.57 | 1.23, 2.01 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.23 | 1.09, 1.39 | 0.001 |
| $66,000 - $87,999 | 1.23 | 1.07, 1.42 | 0.003 |
| $88,000 or more | 1.39 | 1.20, 1.61 | <0.001 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.53 | 0.46, 0.63 | <0.001 |
| Medicare | 0.57 | 0.50, 0.65 | <0.001 |
| Other | 0.57 | 0.45, 0.71 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.83 | 0.66, 1.04 | 0.11 |
| South | 1.02 | 0.84, 1.24 | 0.8 |
| West | 0.66 | 0.53, 0.82 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.41 | 0.35, 0.49 | <0.001 |
| Small | 0.23 | 0.18, 0.30 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 2.05 | 1.31, 3.20 | 0.002 |
| Urban, teaching | 6.32 | 4.18, 9.56 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.43 | 0.37, 0.50 | <0.001 |
| Charlson comorbidity index | 0.90 | 0.86, 0.94 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.96 | 0.85, 1.08 | 0.5 |
| Previous congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.73, 0.94 | 0.003 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.69 | 0.61, 0.79 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.63 | 0.56, 0.71 | <0.001 |
| End stage renal disease |  |  |  |
| No | — | — |  |
| Yes | 0.49 | 0.40, 0.59 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 1.12, 1.38 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 2.62 | 2.34, 2.94 | <0.001 |
| Previous PCI |  |  |  |
| No | — | — |  |
| Yes | 0.67 | 0.57, 0.79 | <0.001 |
| Previous CABG |  |  |  |
| No | — | — |  |
| Yes | 0.53 | 0.44, 0.63 | <0.001 |
| Previous ICD insertion |  |  |  |
| No | — | — |  |
| Yes | 1.04 | 0.90, 1.20 | 0.6 |
| Previous PPM or CRT insertion |  |  |  |
| No | — | — |  |
| Yes | 0.36 | 0.26, 0.50 | <0.001 |
| Smoking status |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.60, 0.82 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.85 | 1.65, 2.08 | <0.001 |
| Previous stroke/TIA |  |  |  |
| No | — | — |  |
| Yes | 0.64 | 0.54, 0.76 | <0.001 |
| Previous myocardial infarction |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.84, 1.12 | 0.7 |
| Heart failure with reduced ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 3.02 | 2.65, 3.45 | <0.001 |
| Heart failure with preserved ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 1.28 | 1.11, 1.47 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.30 | 1.09, 1.56 | 0.004 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 1.27 | 1.14, 1.40 | <0.001 |
| Family history of sudden cardiac death |  |  |  |
| No | — | — |  |
| Yes | 2.13 | 0.79, 5.79 | 0.14 |
| Personal history of sudden cardiac arrest |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.69, 1.49 | >0.9 |
| Dilated cardiomyopathy |  |  |  |
| No | — | — |  |
| Yes | 1.82 | 1.59, 2.09 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Acute ischemic stroke

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Heart failure categories |  |  |  |
| Heart failure without Ventricular Arrhythmia | — | — |  |
| Heart failure with Ventricular Arrhythmia | 2.02 | 1.81, 2.27 | <0.001 |
| Age, y | 1.00 | 1.00, 1.00 | >0.9 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.87 | 0.81, 0.94 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.19 | 0.95, 1.49 | 0.12 |
| Black | 1.03 | 0.94, 1.14 | 0.5 |
| Hispanic | 0.92 | 0.80, 1.06 | 0.2 |
| Native American | 0.69 | 0.38, 1.27 | 0.2 |
| Other | 1.61 | 1.32, 1.97 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.01 | 0.92, 1.12 | 0.8 |
| $66,000 - $87,999 | 0.96 | 0.86, 1.07 | 0.4 |
| $88,000 or more | 0.92 | 0.82, 1.03 | 0.2 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.02 | 0.88, 1.18 | 0.8 |
| Medicare | 0.80 | 0.72, 0.90 | <0.001 |
| Other | 1.10 | 0.92, 1.31 | 0.3 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.03 | 0.91, 1.16 | 0.6 |
| South | 1.12 | 1.02, 1.24 | 0.020 |
| West | 0.99 | 0.87, 1.12 | 0.8 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.91 | 0.84, 0.99 | 0.027 |
| Small | 0.72 | 0.65, 0.80 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.18 | 1.00, 1.39 | 0.044 |
| Urban, teaching | 1.30 | 1.13, 1.50 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.80 | 0.67, 0.96 | 0.015 |
| Charlson comorbidity index | 1.64 | 1.62, 1.65 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.41 | 0.38, 0.44 | <0.001 |
| Previous congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.15 | 1.04, 1.27 | 0.005 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 2.53 | 2.33, 2.74 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.43 | 0.39, 0.47 | <0.001 |
| End stage renal disease |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.78, 1.04 | 0.2 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.12 | 1.04, 1.21 | 0.004 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.72, 0.84 | <0.001 |
| Previous PCI |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.62, 0.80 | <0.001 |
| Previous CABG |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.76, 0.99 | 0.030 |
| Previous ICD insertion |  |  |  |
| No | — | — |  |
| Yes | 0.32 | 0.27, 0.37 | <0.001 |
| Previous PPM or CRT insertion |  |  |  |
| No | — | — |  |
| Yes | 0.61 | 0.52, 0.71 | <0.001 |
| Smoking status |  |  |  |
| No | — | — |  |
| Yes | 0.93 | 0.82, 1.05 | 0.2 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.93, 1.10 | 0.8 |
| Previous stroke/TIA |  |  |  |
| No | — | — |  |
| Yes | 1.50 | 1.37, 1.65 | <0.001 |
| Previous myocardial infarction |  |  |  |
| No | — | — |  |
| Yes | 0.57 | 0.51, 0.64 | <0.001 |
| Heart failure with reduced ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 1.20 | 1.04, 1.38 | 0.012 |
| Heart failure with preserved ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.83, 1.01 | 0.064 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.72 | 0.63, 0.83 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.88 | 0.81, 0.95 | 0.002 |
| Family history of sudden cardiac death |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.09, 4.49 | 0.6 |
| Personal history of sudden cardiac arrest |  |  |  |
| No | — | — |  |
| Yes | 1.00 | 0.64, 1.57 | >0.9 |
| Dilated cardiomyopathy |  |  |  |
| No | — | — |  |
| Yes | 1.33 | 1.15, 1.54 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Heart failure categories |  |  |  |
| Heart failure without Ventricular Arrhythmia | — | — |  |
| Heart failure with Ventricular Arrhythmia | 3.1 | 2.9, 3.2 | <0.001 |
| Age, y | -0.02 | -0.02, -0.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | -0.08 | -0.11, -0.05 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | -0.12 | -0.23, -0.01 | 0.039 |
| Black | -0.34 | -0.39, -0.29 | <0.001 |
| Hispanic | -0.27 | -0.35, -0.19 | <0.001 |
| Native American | -0.04 | -0.25, 0.17 | 0.7 |
| Other | 0.08 | -0.05, 0.21 | 0.2 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.01 | -0.03, 0.06 | 0.6 |
| $66,000 - $87,999 | -0.02 | -0.07, 0.03 | 0.3 |
| $88,000 or more | 0.07 | 0.00, 0.13 | 0.048 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | -0.07 | -0.16, 0.01 | 0.10 |
| Medicare | -0.22 | -0.29, -0.16 | <0.001 |
| Other | -0.45 | -0.54, -0.35 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.77 | 0.66, 0.88 | <0.001 |
| South | 0.31 | 0.23, 0.39 | <0.001 |
| West | -0.29 | -0.39, -0.19 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -0.81 | -0.88, -0.73 | <0.001 |
| Small | -1.2 | -1.3, -1.1 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.56 | 0.50, 0.63 | <0.001 |
| Urban, teaching | 1.3 | 1.3, 1.4 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | -1.3 | -1.5, -1.2 | <0.001 |
| Charlson comorbidity index | 0.20 | 0.18, 0.21 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | -0.12 | -0.16, -0.09 | <0.001 |
| Previous congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | -0.16 | -0.21, -0.12 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -0.43 | -0.48, -0.39 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.14 | 0.11, 0.17 | <0.001 |
| End stage renal disease |  |  |  |
| No | — | — |  |
| Yes | 0.01 | -0.08, 0.09 | 0.9 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 0.73 | 0.70, 0.77 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.2 | 1.2, 1.3 | <0.001 |
| Previous PCI |  |  |  |
| No | — | — |  |
| Yes | -0.61 | -0.65, -0.57 | <0.001 |
| Previous CABG |  |  |  |
| No | — | — |  |
| Yes | -0.54 | -0.58, -0.50 | <0.001 |
| Previous ICD insertion |  |  |  |
| No | — | — |  |
| Yes | -0.82 | -0.88, -0.75 | <0.001 |
| Previous PPM or CRT insertion |  |  |  |
| No | — | — |  |
| Yes | -0.60 | -0.64, -0.56 | <0.001 |
| Smoking status |  |  |  |
| No | — | — |  |
| Yes | -0.67 | -0.71, -0.62 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.04 | 0.00, 0.07 | 0.043 |
| Previous stroke/TIA |  |  |  |
| No | — | — |  |
| Yes | -0.32 | -0.36, -0.28 | <0.001 |
| Previous myocardial infarction |  |  |  |
| No | — | — |  |
| Yes | -0.57 | -0.61, -0.53 | <0.001 |
| Heart failure with reduced ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 1.6 | 1.4, 1.7 | <0.001 |
| Heart failure with preserved ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.90, 0.98 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.06 | 0.00, 0.12 | 0.057 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.15 | 0.11, 0.19 | <0.001 |
| Family history of sudden cardiac death |  |  |  |
| No | — | — |  |
| Yes | -0.77 | -1.2, -0.38 | <0.001 |
| Personal history of sudden cardiac arrest |  |  |  |
| No | — | — |  |
| Yes | -0.29 | -0.46, -0.12 | <0.001 |
| Dilated cardiomyopathy |  |  |  |
| No | — | — |  |
| Yes | 0.76 | 0.66, 0.86 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Heart failure categories |  |  |  |
| Heart failure without Ventricular Arrhythmia | — | — |  |
| Heart failure with Ventricular Arrhythmia | 62,534 | 57,496, 67,572 | <0.001 |
| Age, y | -673 | -726, -620 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1,973 | 1,393, 2,553 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 9,069 | 5,251, 12,887 | <0.001 |
| Black | -5,501 | -6,747, -4,256 | <0.001 |
| Hispanic | 7,955 | 5,965, 9,945 | <0.001 |
| Native American | -9,172 | -13,207, -5,137 | <0.001 |
| Other | 14,818 | 10,800, 18,836 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1,155 | 124, 2,186 | 0.028 |
| $66,000 - $87,999 | 1,419 | 185, 2,653 | 0.024 |
| $88,000 or more | 6,499 | 4,623, 8,376 | <0.001 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | -12,471 | -14,987, -9,956 | <0.001 |
| Medicare | -8,151 | -9,932, -6,370 | <0.001 |
| Other | -13,815 | -16,210, -11,419 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 18,812 | 15,577, 22,047 | <0.001 |
| South | 10,724 | 8,809, 12,640 | <0.001 |
| West | 26,572 | 22,516, 30,628 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -13,603 | -15,907, -11,299 | <0.001 |
| Small | -20,380 | -22,527, -18,233 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 17,696 | 16,142, 19,249 | <0.001 |
| Urban, teaching | 28,167 | 26,608, 29,725 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | -30,417 | -33,951, -26,884 | <0.001 |
| Charlson comorbidity index | 1,287 | 928, 1,646 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | -2,845 | -3,688, -2,001 | <0.001 |
| Previous congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | -1,601 | -2,721, -480 | 0.005 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -3,514 | -4,632, -2,397 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 2,296 | 1,655, 2,936 | <0.001 |
| End stage renal disease |  |  |  |
| No | — | — |  |
| Yes | 6,824 | 5,078, 8,570 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 8,197 | 7,458, 8,935 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 18,637 | 17,423, 19,851 | <0.001 |
| Previous PCI |  |  |  |
| No | — | — |  |
| Yes | -6,808 | -7,529, -6,087 | <0.001 |
| Previous CABG |  |  |  |
| No | — | — |  |
| Yes | -8,395 | -9,146, -7,645 | <0.001 |
| Previous ICD insertion |  |  |  |
| No | — | — |  |
| Yes | -12,507 | -13,894, -11,119 | <0.001 |
| Previous PPM or CRT insertion |  |  |  |
| No | — | — |  |
| Yes | -8,256 | -8,964, -7,547 | <0.001 |
| Smoking status |  |  |  |
| No | — | — |  |
| Yes | -11,959 | -12,981, -10,937 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 5,771 | 4,939, 6,603 | <0.001 |
| Previous stroke/TIA |  |  |  |
| No | — | — |  |
| Yes | -5,661 | -6,320, -5,002 | <0.001 |
| Previous myocardial infarction |  |  |  |
| No | — | — |  |
| Yes | -8,176 | -8,970, -7,382 | <0.001 |
| Heart failure with reduced ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 30,759 | 27,304, 34,213 | <0.001 |
| Heart failure with preserved ejection fraction |  |  |  |
| No | — | — |  |
| Yes | 8,781 | 7,762, 9,799 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 2,302 | 962, 3,642 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 2,196 | 1,447, 2,945 | <0.001 |
| Family history of sudden cardiac death |  |  |  |
| No | — | — |  |
| Yes | 1,381 | -8,985, 11,747 | 0.8 |
| Personal history of sudden cardiac arrest |  |  |  |
| No | — | — |  |
| Yes | -3,510 | -6,879, -141 | 0.041 |
| Dilated cardiomyopathy |  |  |  |
| No | — | — |  |
| Yes | 21,536 | 18,584, 24,487 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |