The Association of Malignancy With Vascular Outcomes in Atrial Fibrillation: A National Inpatient Sample Analysis

Analysis for RCOP 2025-NIS-13-Internal Medicine

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## Preamble:

* **Reference Papers:**
  + [Elbadawi et al. 2017](https://pubmed.ncbi.nlm.nih.gov/29352566/)
  + [El-Rayes et al. 2025](https://www.jacc.org/doi/10.1016/j.jaccao.2024.10.014)

## Preamble:

* **Study Objective**: To examine the impact of malignancy on outcomes among admissions with atrial fibrillation.
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020. The NIS is part of the Healthcare Cost and Utilization Project (HCUP) and provides a stratified sample of inpatient discharges from U.S. community hospitals across all payers.
* **Cohort Definition:** Patients were included if they met the following criteria
  + Age ≥18 years
  + Had a diagnosis of atrial fibrillation and cancer
  + Patients undergoing catheter ablation were excluded
* **Primary Outcomes**:
  + Acute ischemic stroke
  + Venous thromboembolism
  + Major bleeding
* **Secondary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* **Covariates for Adjustment:** All models adjusted for the following
  + Demographics: Age, sex, race, income, insurance, location of patient’s residence, hospital region, hospital bedsize, hospital location, and teaching status.
  + Medical History: Hypertension, diabetes mellitus, obesity, hyperlipidemia, coronary artery disease, peripheral vascular disease, heart failure, dementia, chronic kidney disease, chronic pulmonary disease, obstructive sleep apnea, liver disease, valvular heart disease, valvular heart disease, alcohol abuse, smoker, prior stroke, prior cardiac surgery, and type of cancer.
  + Comorbidities: Elixhauser comorbidity index.
* **Statistical Methods:**
  + **Univariable Analysis:**
    - Categorical variables: Compared using Pearson’s chi-square test with Rao & Scott adjustment
    - Continuous variables: Analyzed using the design-based Kruskal–Wallis test, a non-parametric alternative suitable for survey-weighted data
  + **Multivariable Analysis:**
    - Binary outcomes (e.g., mortality): Survey-weighted logistic regression using the quasibinomial family
    - Continuous outcomes (e.g., LOS, hospital charges): Survey-weighted linear regression using the gaussian family
    - Results reported as adjusted odds ratios (aORs) or beta coefficients with 95% confidence intervals
* **Software:** All statistical analyses were performed using the R Statistical Language (Version 4.5.0; R Foundation for Statistical Computing, Vienna, Austria), incorporating survey-weighted procedures via the *survey* package to account for the complex sampling design of NIS.

## Baseline Table:

| **Characteristic** | **Overall** N = 8,689,195*1* | **Atrial Fibrillation without Cancer** N = 7,852,590*1* | **Atrial Fibrillation with Cancer** N = 836,605*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age, y | 75 (11) | 75 (11) | 76 (10) | <0.001 |
| Sex |  |  |  | <0.001 |
| Female | 4,086,450 (47%) | 3,757,835 (48%) | 328,615 (39%) |  |
| Male | 4,602,580 (53%) | 4,094,605 (52%) | 507,975 (61%) |  |
| Race |  |  |  | <0.001 |
| White | 6,908,785 (81%) | 6,223,915 (81%) | 684,870 (84%) |  |
| Asian or Pacific Islander | 169,230 (2.0%) | 152,270 (2.0%) | 16,960 (2.1%) |  |
| Black | 764,920 (9.0%) | 700,605 (9.1%) | 64,315 (7.9%) |  |
| Hispanic | 467,070 (5.5%) | 431,655 (5.6%) | 35,415 (4.3%) |  |
| Native American | 32,760 (0.4%) | 30,135 (0.4%) | 2,625 (0.3%) |  |
| Other | 158,235 (1.9%) | 143,255 (1.9%) | 14,980 (1.8%) |  |
| Elixhauser comorbidity index | 6.23 (2.23) | 6.15 (2.22) | 6.97 (2.22) | <0.001 |
| Residential income |  |  |  | <0.001 |
| $1 - $51,999 | 2,227,640 (26%) | 2,037,580 (26%) | 190,060 (23%) |  |
| $52,000 - $65,999 | 2,320,125 (27%) | 2,103,625 (27%) | 216,500 (26%) |  |
| $66,000 - $87,999 | 2,164,955 (25%) | 1,951,180 (25%) | 213,775 (26%) |  |
| $88,000 or more | 1,853,715 (22%) | 1,648,755 (21%) | 204,960 (25%) |  |
| Expected primary payer |  |  |  | <0.001 |
| Private | 1,074,980 (12%) | 970,775 (12%) | 104,205 (12%) |  |
| Medicaid | 399,055 (4.6%) | 370,675 (4.7%) | 28,380 (3.4%) |  |
| Medicare | 7,049,660 (81%) | 6,362,460 (81%) | 687,200 (82%) |  |
| Other | 158,490 (1.8%) | 142,320 (1.8%) | 16,170 (1.9%) |  |
| Hospital region |  |  |  | <0.001 |
| Midwest | 2,238,361 (26%) | 2,015,161 (26%) | 223,200 (27%) |  |
| Northeast | 1,616,830 (19%) | 1,450,135 (18%) | 166,695 (20%) |  |
| South | 3,307,330 (38%) | 3,012,750 (38%) | 294,580 (35%) |  |
| West | 1,526,675 (18%) | 1,374,545 (18%) | 152,130 (18%) |  |
| Location of patient’s residence |  |  |  | <0.001 |
| Central metro ≥1 million | 2,145,785 (25%) | 1,932,385 (25%) | 213,400 (26%) |  |
| Fringe metro ≥1 million | 2,270,556 (26%) | 2,042,696 (26%) | 227,860 (27%) |  |
| Metro 250,000-999,999 | 1,880,905 (22%) | 1,704,160 (22%) | 176,745 (21%) |  |
| Metro 50,000-249,999 | 876,865 (10%) | 795,200 (10%) | 81,665 (9.8%) |  |
| Micropolitan | 864,770 (10.0%) | 787,265 (10%) | 77,505 (9.3%) |  |
| Other | 628,655 (7.3%) | 570,605 (7.3%) | 58,050 (7.0%) |  |
| Hypertension | 7,500,190 (86%) | 6,826,235 (87%) | 673,955 (81%) | <0.001 |
| Diabetes mellitus | 3,367,605 (39%) | 3,090,275 (39%) | 277,330 (33%) | <0.001 |
| Hyperlipidemia | 4,926,950 (57%) | 4,497,325 (57%) | 429,625 (51%) | <0.001 |
| Coronary artery disease | 3,724,325 (43%) | 3,422,270 (44%) | 302,055 (36%) | <0.001 |
| Peripheral vascular disease | 1,404,890 (16%) | 1,287,620 (16%) | 117,270 (14%) | <0.001 |
| Heart failure | 4,980,685 (57%) | 4,583,820 (58%) | 396,865 (47%) | <0.001 |
| Chronic kidney disease | 3,273,720 (38%) | 2,990,655 (38%) | 283,065 (34%) | <0.001 |
| Chronic obstructive pulmonary disease | 2,979,005 (34%) | 2,688,725 (34%) | 290,280 (35%) | 0.001 |
| Valvular heart disease | 2,003,830 (23%) | 1,856,330 (24%) | 147,500 (18%) | <0.001 |
| Liver disease | 501,590 (5.8%) | 445,405 (5.7%) | 56,185 (6.7%) | <0.001 |
| Obstructive sleep apnea | 1,306,110 (15%) | 1,203,445 (15%) | 102,665 (12%) | <0.001 |
| Anemia | 685,910 (7.9%) | 608,040 (7.7%) | 77,870 (9.3%) | <0.001 |
| Alcohol use disorder | 2,588,676 (30%) | 2,341,806 (30%) | 246,870 (30%) | 0.3 |
| Obesity | 1,798,950 (21%) | 1,677,525 (21%) | 121,425 (15%) | <0.001 |
| Prior stroke | 1,452,515 (17%) | 1,349,980 (17%) | 102,535 (12%) | <0.001 |
| Prior cardiac surgery | 1,243,925 (14%) | 1,152,450 (15%) | 91,475 (11%) | <0.001 |
| Smoker | 42,095 (0.5%) | 38,600 (0.5%) | 3,495 (0.4%) | <0.001 |
| *1*Mean (SD); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

| **Characteristic** | **Atrial Fibrillation without Cancer** N = 7,852,590*1* | **Atrial Fibrillation with Cancer** N = 836,605*1* | **p-value***2* |
| --- | --- | --- | --- |
| Died during hospitalization | 319,815 (4.1%) | 61,825 (7.4%) | <0.001 |
| Acute ischemic stroke | 5,315 (<0.1%) | 1,135 (0.1%) | <0.001 |
| Venous thromboembolism | 216,550 (2.8%) | 59,825 (7.2%) | <0.001 |
| Major bleeding | 709,350 (9.0%) | 104,150 (12%) | <0.001 |
| Length of stay (days) | 6.0 (6.6) | 7.3 (7.9) | <0.001 |
| Inflation-adjusted total charge ($) | 75,977 (116,316) | 92,804 (144,045) | <0.001 |
| *1*n (%); Mean (SD) | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | |

## Multivariable Logistic Regression:

### All-Cause Mortality:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Atrial Fibrillation without Cancer | — | — |  |
| Atrial Fibrillation with Cancer | 1.02 | 0.99, 1.04 | 0.2 |
| Age, y | 1.03 | 1.03, 1.03 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.25 | 1.22, 1.27 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.36 | 1.29, 1.43 | <0.001 |
| Black | 1.14 | 1.10, 1.17 | <0.001 |
| Hispanic | 1.20 | 1.15, 1.24 | <0.001 |
| Native American | 1.25 | 1.11, 1.41 | <0.001 |
| Other | 1.19 | 1.13, 1.26 | <0.001 |
| Elixhauser comorbidity index | 1.57 | 1.56, 1.58 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.96 | 0.93, 0.98 | <0.001 |
| $66,000 - $87,999 | 0.93 | 0.90, 0.95 | <0.001 |
| $88,000 or more | 0.92 | 0.90, 0.95 | <0.001 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.84 | 0.80, 0.88 | <0.001 |
| Medicare | 0.75 | 0.72, 0.77 | <0.001 |
| Other | 1.53 | 1.41, 1.66 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.10 | 1.06, 1.15 | <0.001 |
| South | 0.91 | 0.88, 0.94 | <0.001 |
| West | 0.94 | 0.90, 0.97 | <0.001 |
| Location of patient’s residence |  |  |  |
| Central metro ≥1 million | — | — |  |
| Fringe metro ≥1 million | 0.98 | 0.95, 1.02 | 0.3 |
| Metro 250,000-999,999 | 1.03 | 1.00, 1.07 | 0.079 |
| Metro 50,000-249,999 | 1.06 | 1.02, 1.11 | 0.003 |
| Micropolitan | 1.06 | 1.02, 1.10 | 0.006 |
| Other | 1.14 | 1.09, 1.19 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.45 | 0.44, 0.46 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.67, 0.69 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.69 | 0.67, 0.70 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.94, 0.97 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.67, 0.70 | <0.001 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.92, 0.95 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.76, 0.79 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.67, 0.69 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.53 | 0.52, 0.54 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 1.58 | 1.54, 1.62 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.72 | 0.70, 0.74 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.44 | 0.43, 0.46 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.61 | 0.59, 0.62 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.52 | 0.51, 0.53 | <0.001 |
| Prior stroke |  |  |  |
| No | — | — |  |
| Yes | 0.82 | 0.81, 0.84 | <0.001 |
| Prior cardiac surgery |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.87, 0.91 | <0.001 |
| Smoker |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.61, 0.80 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Acute Ischemic stroke:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Atrial Fibrillation without Cancer | — | — |  |
| Atrial Fibrillation with Cancer | 1.58 | 1.34, 1.88 | <0.001 |
| Age, y | 1.00 | 1.0, 1.01 | 0.8 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.87 | 0.77, 0.98 | 0.023 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.34 | 0.91, 1.97 | 0.14 |
| Black | 1.16 | 0.95, 1.42 | 0.15 |
| Hispanic | 1.45 | 1.15, 1.82 | 0.002 |
| Native American | 1.08 | 0.46, 2.58 | 0.9 |
| Other | 1.23 | 0.85, 1.78 | 0.3 |
| Elixhauser comorbidity index | 1.15 | 1.10, 1.20 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.96 | 0.82, 1.12 | 0.6 |
| $66,000 - $87,999 | 0.90 | 0.76, 1.08 | 0.3 |
| $88,000 or more | 0.96 | 0.79, 1.16 | 0.7 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.12 | 0.83, 1.52 | 0.5 |
| Medicare | 1.12 | 0.93, 1.36 | 0.2 |
| Other | 1.12 | 0.68, 1.85 | 0.7 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.31 | 1.08, 1.60 | 0.007 |
| South | 1.20 | 1.03, 1.39 | 0.022 |
| West | 1.06 | 0.87, 1.29 | 0.6 |
| Location of patient’s residence |  |  |  |
| Central metro ≥1 million | — | — |  |
| Fringe metro ≥1 million | 1.13 | 0.96, 1.33 | 0.13 |
| Metro 250,000-999,999 | 0.94 | 0.79, 1.13 | 0.5 |
| Metro 50,000-249,999 | 1.02 | 0.81, 1.27 | 0.9 |
| Micropolitan | 0.96 | 0.76, 1.21 | 0.7 |
| Other | 1.29 | 1.01, 1.65 | 0.040 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.53, 0.72 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 1.15 | 1.01, 1.32 | 0.034 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.74 | 0.65, 0.83 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.88 | 0.77, 1.00 | 0.046 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.87 | 0.74, 1.03 | 0.12 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.76 | 0.67, 0.87 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.88, 1.16 | 0.9 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.69, 0.90 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.64 | 0.54, 0.76 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.67, 1.08 | 0.2 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.67, 0.96 | 0.018 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.13 | 0.93, 1.37 | 0.2 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.82, 1.11 | 0.5 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.89, 1.20 | 0.7 |
| Prior stroke |  |  |  |
| No | — | — |  |
| Yes | 0.93 | 0.79, 1.09 | 0.4 |
| Prior cardiac surgery |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.69, 1.06 | 0.2 |
| Smoker |  |  |  |
| No | — | — |  |
| Yes | 0.18 | 0.02, 1.26 | 0.084 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Venous Thromboembolism:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Atrial Fibrillation without Cancer | — | — |  |
| Atrial Fibrillation with Cancer | 1.57 | 1.53, 1.62 | <0.001 |
| Age, y | 1.00 | 0.99, 1.00 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.23 | 1.21, 1.25 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.82 | 0.76, 0.88 | <0.001 |
| Black | 1.47 | 1.43, 1.52 | <0.001 |
| Hispanic | 1.10 | 1.05, 1.15 | <0.001 |
| Native American | 0.89 | 0.76, 1.04 | 0.15 |
| Other | 1.19 | 1.12, 1.27 | <0.001 |
| Elixhauser comorbidity index | 1.45 | 1.44, 1.46 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.02 | 0.99, 1.05 | 0.2 |
| $66,000 - $87,999 | 1.00 | 0.97, 1.03 | >0.9 |
| $88,000 or more | 0.99 | 0.96, 1.03 | 0.7 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.93 | 0.89, 0.98 | 0.003 |
| Medicare | 0.91 | 0.89, 0.94 | <0.001 |
| Other | 0.97 | 0.90, 1.03 | 0.3 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.89 | 0.85, 0.92 | <0.001 |
| South | 0.92 | 0.89, 0.95 | <0.001 |
| West | 0.94 | 0.90, 0.98 | 0.003 |
| Location of patient’s residence |  |  |  |
| Central metro ≥1 million | — | — |  |
| Fringe metro ≥1 million | 0.94 | 0.91, 0.97 | <0.001 |
| Metro 250,000-999,999 | 0.87 | 0.84, 0.90 | <0.001 |
| Metro 50,000-249,999 | 0.84 | 0.81, 0.88 | <0.001 |
| Micropolitan | 0.81 | 0.78, 0.84 | <0.001 |
| Other | 0.81 | 0.78, 0.85 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.57 | 0.56, 0.59 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.61, 0.64 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.81 | 0.79, 0.82 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.88 | 0.86, 0.90 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.82 | 0.80, 0.84 | <0.001 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.69, 0.72 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.64 | 0.63, 0.66 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.63 | 0.61, 0.64 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.59 | 0.58, 0.61 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 0.71 | 0.69, 0.74 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.91 | 0.89, 0.94 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.73, 0.78 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.58 | 0.56, 0.60 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.73, 0.77 | <0.001 |
| Prior stroke |  |  |  |
| No | — | — |  |
| Yes | 0.84 | 0.82, 0.87 | <0.001 |
| Prior cardiac surgery |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.73, 0.78 | <0.001 |
| Smoker |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.78, 1.01 | 0.081 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Major bleeding:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Atrial Fibrillation without Cancer | — | — |  |
| Atrial Fibrillation with Cancer | 1.06 | 1.04, 1.08 | <0.001 |
| Age, y | 1.01 | 1.01, 1.01 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.43 | 1.41, 1.45 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.42 | 1.38, 1.47 | <0.001 |
| Black | 1.13 | 1.11, 1.16 | <0.001 |
| Hispanic | 1.07 | 1.05, 1.10 | <0.001 |
| Native American | 1.04 | 0.96, 1.14 | 0.3 |
| Other | 1.10 | 1.06, 1.14 | <0.001 |
| Elixhauser comorbidity index | 1.21 | 1.21, 1.22 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.97 | 0.96, 0.99 | 0.001 |
| $66,000 - $87,999 | 0.96 | 0.94, 0.98 | <0.001 |
| $88,000 or more | 0.95 | 0.93, 0.97 | <0.001 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.00 | 0.97, 1.03 | >0.9 |
| Medicare | 1.06 | 1.04, 1.08 | <0.001 |
| Other | 1.06 | 1.02, 1.11 | 0.006 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.97 | 0.95, 0.99 | 0.006 |
| South | 0.95 | 0.93, 0.97 | <0.001 |
| West | 0.89 | 0.88, 0.91 | <0.001 |
| Location of patient’s residence |  |  |  |
| Central metro ≥1 million | — | — |  |
| Fringe metro ≥1 million | 1.03 | 1.01, 1.04 | 0.004 |
| Metro 250,000-999,999 | 1.02 | 1.00, 1.04 | 0.072 |
| Metro 50,000-249,999 | 1.00 | 0.97, 1.02 | 0.8 |
| Micropolitan | 1.01 | 0.98, 1.03 | 0.6 |
| Other | 1.01 | 0.99, 1.04 | 0.3 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.82 | 0.81, 0.84 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.77, 0.79 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.91, 0.93 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.04 | 1.02, 1.05 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.82, 0.84 | <0.001 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.76 | 0.75, 0.77 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.88, 0.90 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.78, 0.80 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.77, 0.79 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 1.20 | 1.18, 1.23 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.88, 0.91 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.64 | 1.61, 1.67 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.77 | 0.76, 0.78 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.78, 0.80 | <0.001 |
| Prior stroke |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 1.00, 1.03 | 0.14 |
| Prior cardiac surgery |  |  |  |
| No | — | — |  |
| Yes | 1.13 | 1.11, 1.15 | <0.001 |
| Smoker |  |  |  |
| No | — | — |  |
| Yes | 0.88 | 0.81, 0.96 | 0.003 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Atrial Fibrillation without Cancer | — | — |  |
| Atrial Fibrillation with Cancer | -0.26 | -0.31, -0.21 | <0.001 |
| Age, y | -0.02 | -0.02, -0.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.57 | 0.55, 0.59 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.88 | 0.75, 1.0 | <0.001 |
| Black | 0.54 | 0.48, 0.60 | <0.001 |
| Hispanic | 0.38 | 0.31, 0.46 | <0.001 |
| Native American | 0.39 | 0.14, 0.64 | 0.002 |
| Other | 0.58 | 0.46, 0.69 | <0.001 |
| Elixhauser comorbidity index | 1.3 | 1.3, 1.3 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.09 | -0.13, -0.05 | <0.001 |
| $66,000 - $87,999 | -0.17 | -0.22, -0.12 | <0.001 |
| $88,000 or more | -0.21 | -0.27, -0.15 | <0.001 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.33 | 0.24, 0.42 | <0.001 |
| Medicare | -0.08 | -0.13, -0.04 | <0.001 |
| Other | -0.07 | -0.18, 0.05 | 0.3 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.42 | 0.32, 0.51 | <0.001 |
| South | 0.03 | -0.04, 0.11 | 0.4 |
| West | -0.48 | -0.58, -0.39 | <0.001 |
| Location of patient’s residence |  |  |  |
| Central metro ≥1 million | — | — |  |
| Fringe metro ≥1 million | -0.15 | -0.22, -0.09 | <0.001 |
| Metro 250,000-999,999 | -0.22 | -0.29, -0.15 | <0.001 |
| Metro 50,000-249,999 | -0.32 | -0.41, -0.24 | <0.001 |
| Micropolitan | -0.41 | -0.49, -0.34 | <0.001 |
| Other | -0.30 | -0.38, -0.22 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -1.6 | -1.6, -1.6 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | -0.97 | -1.0, -0.93 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -0.66 | -0.68, -0.63 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -0.02 | -0.04, 0.01 | 0.2 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -1.2 | -1.2, -1.1 | <0.001 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | -0.66 | -0.70, -0.63 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -0.98 | -1.0, -0.94 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -1.3 | -1.3, -1.2 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | -1.2 | -1.2, -1.2 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | -0.43 | -0.49, -0.37 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | -0.42 | -0.45, -0.39 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | -0.75 | -0.79, -0.70 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | -1.8 | -1.9, -1.7 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | -1.0 | -1.0, -0.97 | <0.001 |
| Prior stroke |  |  |  |
| No | — | — |  |
| Yes | -0.15 | -0.18, -0.12 | <0.001 |
| Prior cardiac surgery |  |  |  |
| No | — | — |  |
| Yes | -0.70 | -0.73, -0.67 | <0.001 |
| Smoker |  |  |  |
| No | — | — |  |
| Yes | -0.46 | -0.59, -0.33 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Categories |  |  |  |
| Atrial Fibrillation without Cancer | — | — |  |
| Atrial Fibrillation with Cancer | -2,646 | -3,695, -1,597 | <0.001 |
| Age, y | -925 | -974, -875 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 12,163 | 11,664, 12,662 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 21,056 | 17,214, 24,898 | <0.001 |
| Black | 31 | -1,342, 1,405 | >0.9 |
| Hispanic | 18,389 | 16,015, 20,762 | <0.001 |
| Native American | -7,483 | -11,564, -3,403 | <0.001 |
| Other | 21,207 | 17,084, 25,329 | <0.001 |
| Elixhauser comorbidity index | 15,623 | 15,093, 16,153 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 229 | -778, 1,237 | 0.7 |
| $66,000 - $87,999 | -1,068 | -2,341, 204 | 0.10 |
| $88,000 or more | 1,916 | -142, 3,975 | 0.068 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | -8,590 | -10,479, -6,701 | <0.001 |
| Medicare | -1,921 | -2,955, -886 | <0.001 |
| Other | -1,453 | -3,885, 979 | 0.2 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 14,164 | 10,960, 17,369 | <0.001 |
| South | 10,737 | 8,693, 12,781 | <0.001 |
| West | 35,643 | 31,550, 39,735 | <0.001 |
| Location of patient’s residence |  |  |  |
| Central metro ≥1 million | — | — |  |
| Fringe metro ≥1 million | -8,729 | -11,246, -6,212 | <0.001 |
| Metro 250,000-999,999 | -13,510 | -16,280, -10,741 | <0.001 |
| Metro 50,000-249,999 | -20,413 | -23,022, -17,804 | <0.001 |
| Micropolitan | -21,153 | -23,513, -18,794 | <0.001 |
| Other | -21,621 | -24,005, -19,238 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -19,378 | -20,359, -18,397 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | -13,133 | -13,887, -12,379 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -3,802 | -4,367, -3,237 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 11,081 | 10,469, 11,692 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -9,214 | -10,049, -8,379 | <0.001 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | -11,677 | -12,404, -10,950 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -17,551 | -18,302, -16,799 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -19,937 | -20,909, -18,965 | <0.001 |
| Valvular heart disease |  |  |  |
| No | — | — |  |
| Yes | 1,194 | 281, 2,107 | 0.010 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2,590 | 1,151, 4,028 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | -7,561 | -8,224, -6,898 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | -16,522 | -17,491, -15,553 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | -18,772 | -21,312, -16,232 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | -11,717 | -12,642, -10,792 | <0.001 |
| Prior stroke |  |  |  |
| No | — | — |  |
| Yes | -8,672 | -9,203, -8,141 | <0.001 |
| Prior cardiac surgery |  |  |  |
| No | — | — |  |
| Yes | -20,364 | -21,172, -19,556 | <0.001 |
| Smoker |  |  |  |
| No | — | — |  |
| Yes | -6,809 | -9,397, -4,221 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |