In-Hospital Outcomes Associated with Left Atrial Appendage Closure in Patients with Atrial Fibrillation and Heart Failure with Reduced Ejection Fraction

NIS Analysis for the RCOP Match Mentorship Program

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## Preamble:

* **Study Objective:** To evaluate the association between left atrial appendage closure (LAAC) and in-hospital outcomes and resource utilization among patients hospitalized with atrial fibrillation (AF) and heart failure with reduced ejection fraction (HFrEF), using a nationally representative U.S. inpatient database.
* **Data Source:** Retrospective cross-sectional analysis using the National Inpatient Sample (NIS) from 2018 to 2020. The NIS, part of the Healthcare Cost and Utilization Project (HCUP), includes a stratified 20% sample of all U.S. hospital discharges across payers and hospital types.
* **Cohort Definition:** Patients were included if they met all of the following criteria
  + Age ≥18 years
  + Diagnosis (principal/secondary) of atrial fibrillation (AF): ICD-10-CM codes I48.\*
  + Diagnosis (principal/secondary) of heart failure with reduced ejection fraction (HFrEF): ICD-10-CM codes I502.\* or I504.\*
    - **Excluded:** HF with preserved EF (I503.\*), other/unspecified HF (I508.\*, I509.\*)
  + Non-missing documentation of LAAC procedure status
* **Exposure of Interest:** Undergoing LAAC during hospitalization
  + Catheter-Based LAAC Procedures: Defined using ICD-10-PCS procedure codes for percutaneous and percutaneous-endoscopic occlusion of the left atrial appendage: 02L73DK.\*, 02L73CK.\*, 02L73ZK.\*, 02L74DK.\*, 02L74CK.\*, 02L74ZK.\*
  + This includes intraluminal devices (e.g., Watchman®, Amulet®), extraluminal devices (e.g., LARIAT®), and suture-based approaches.
* **Outcomes of Interest:**
  + **Primary Outcome:**
    - In-hospital mortality
    - Length of stay (LOS), in days
    - Inflation-adjusted total hospital charges (in 2020 USD)
  + **Secondary Outcomes:**
    - In-hospital stroke
    - Cardiogenic shock
    - Major bleeding
    - Favorable discharge disposition (defined as routine discharge to home)
* **Outcome Definitions (ICD-10-CM/PCS Codes):**
  + Stroke:
    - ICD-10-CM: I60.\*, I61.\*, I62.\*, I63.\*, G43601, G43609, G43611, G43619, I97810, I97811, I97820, I97821, R297.\*
    - Encompasses ischemic stroke, hemorrhagic stroke, and procedural cerebrovascular complications.
  + Cardiogenic Shock:
    - ICD-10-CM: R570.\*
    - Includes cardiogenic and unspecified shock.
  + Major Bleeding:
    - ICD-10-CM codes: I6[0-2].\*, I31[24].\*, J942.\*, K661.\*, I97610.\*, K2[5-8][0246].\*, K29(01|21).\*, K31811.\*, K3182.\*, K5521.\*, K625.\*, K57..[13].\*, K92[0-2].\*, R58.\*
    - A composite outcome capturing critical-site hemorrhages and gastrointestinal bleeding requiring transfusion.
  + Favorable Discharge:
    - Defined as routine discharge to home, identified using the NIS DISPUNIFORM variable.
* **Covariates for Adjustment:** All multivariable models included
  + **Demographics:** Age (continuous), sex, race/ethnicity
  + **Socioeconomic Indicators:** Primary payer, ZIP code–level income quartile
  + **Clinical Profile:** Elixhauser comorbidity index (summed score), elective status
  + **Hospital Characteristics:** Hospital region, bed size, and teaching/urban status
* **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, stroke, shock): Survey-weighted logistic regression with a quasibinomial link
    - Continuous outcomes (e.g., LOS, cost): Survey-weighted linear regression (gaussian family)
    - Results presented as adjusted odds ratios (aOR) 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 = 3,007,475*1* | **No** N = 2,997,455*1* | **Yes** N = 10,020*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age, y | 74 (12) | 74 (12) | 75 (9) | 0.041 |
| Sex |  |  |  | <0.001 |
| Female | 1,053,550 (35%) | 1,050,780 (35%) | 2,770 (28%) |  |
| Male | 1,953,845 (65%) | 1,946,600 (65%) | 7,245 (72%) |  |
| Race |  |  |  | <0.001 |
| White | 2,206,195 (75%) | 2,198,050 (75%) | 8,145 (84%) |  |
| Asian or Pacific Islander | 56,635 (1.9%) | 56,490 (1.9%) | 145 (1.5%) |  |
| Black | 416,195 (14%) | 415,465 (14%) | 730 (7.5%) |  |
| Hispanic | 191,160 (6.5%) | 190,675 (6.5%) | 485 (5.0%) |  |
| Other | 74,430 (2.5%) | 74,200 (2.5%) | 230 (2.4%) |  |
| Insurance payer |  |  |  | <0.001 |
| Medicaid | 211,150 (7.0%) | 210,890 (7.0%) | 260 (2.6%) |  |
| Medicare | 2,339,465 (78%) | 2,330,975 (78%) | 8,490 (85%) |  |
| Other | 116,880 (3.9%) | 116,650 (3.9%) | 230 (2.3%) |  |
| Private | 337,355 (11%) | 336,315 (11%) | 1,040 (10%) |  |
| Income quartile |  |  |  | <0.001 |
| $1 - $51,999 | 878,200 (30%) | 875,655 (30%) | 2,545 (26%) |  |
| $52,000 - $65,999 | 811,580 (27%) | 808,980 (27%) | 2,600 (26%) |  |
| $66,000 - $87,999 | 706,640 (24%) | 704,165 (24%) | 2,475 (25%) |  |
| $88,000 or more | 561,475 (19%) | 559,240 (19%) | 2,235 (23%) |  |
| Elective status |  |  |  | <0.001 |
| Elective | 259,965 (8.7%) | 251,000 (8.4%) | 8,965 (90%) |  |
| Non-elective | 2,744,450 (91%) | 2,743,410 (92%) | 1,040 (10%) |  |
| Hospital region |  |  |  | 0.11 |
| Midwest | 755,835 (25%) | 753,465 (25%) | 2,370 (24%) |  |
| Northeast | 551,345 (18%) | 549,760 (18%) | 1,585 (16%) |  |
| South | 1,155,645 (38%) | 1,151,610 (38%) | 4,035 (40%) |  |
| West | 544,650 (18%) | 542,620 (18%) | 2,030 (20%) |  |
| Hospital bedsize |  |  |  | <0.001 |
| Large | 1,542,560 (51%) | 1,536,050 (51%) | 6,510 (65%) |  |
| Medium | 855,360 (28%) | 852,895 (28%) | 2,465 (25%) |  |
| Small | 609,555 (20%) | 608,510 (20%) | 1,045 (10%) |  |
| Hospital location/teaching status |  |  |  | <0.001 |
| Rural | 252,475 (8.4%) | 252,345 (8.4%) | 130 (1.3%) |  |
| Urban, non-teaching | 551,035 (18%) | 550,030 (18%) | 1,005 (10%) |  |
| Urban, teaching | 2,203,965 (73%) | 2,195,080 (73%) | 8,885 (89%) |  |
| Admission year |  |  |  | <0.001 |
| 2018.000 | 991,355 (33%) | 988,615 (33%) | 2,740 (27%) |  |
| 2019.000 | 1,044,335 (35%) | 1,040,850 (35%) | 3,485 (35%) |  |
| 2020.000 | 971,785 (32%) | 967,990 (32%) | 3,795 (38%) |  |
| No. of comorbidities |  |  |  | <0.001 |
| One comorbidity | 248,930 (8.3%) | 247,335 (8.3%) | 1,595 (16%) |  |
| Two or more comorbidities | 2,758,545 (92%) | 2,750,120 (92%) | 8,425 (84%) |  |
| *1*Mean (SD); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Univariable analysis:

| **Characteristic** | **Overall** N = 3,007,475*1* | **No** N = 2,997,455*1* | **Yes** N = 10,020*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| In-hospital mortality | 179,100 (6.0%) | 179,065 (6.0%) | 35 (0.3%) | <0.001 |
| Length of stay (days) | 5.0 (3.0, 8.0) | 5.0 (3.0, 8.0) | 1.0 (1.0, 2.0) | <0.001 |
| Inflation-adjusted total charge ($) | 47,131 (25,017, 97,367) | 46,943 (24,961, 96,936) | 114,249 (85,922, 173,546) | <0.001 |
| In-hospital stroke | 103,305 (3.4%) | 103,210 (3.4%) | 95 (0.9%) | <0.001 |
| Cardiogenic shock | 147,005 (4.9%) | 146,885 (4.9%) | 120 (1.2%) | <0.001 |
| Major bleeding | 186,655 (6.2%) | 186,190 (6.2%) | 465 (4.6%) | 0.004 |
| Favorable discharge | 1,223,005 (41%) | 1,214,385 (41%) | 8,620 (86%) | <0.001 |
| *1*n (%); Median (Q1, Q3) | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | |

## Multivariable logistic regression:

### In-hospital mortality:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| LAAC procedure |  |  |  |
| No | — | — |  |
| Yes | 0.07 | 0.03, 0.16 | <0.001 |
| Age, y | 1.03 | 1.02, 1.03 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.04 | 1.01, 1.06 | 0.002 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.27 | 1.17, 1.37 | <0.001 |
| Black | 0.92 | 0.89, 0.96 | <0.001 |
| Hispanic | 1.02 | 0.97, 1.07 | 0.5 |
| Other | 1.20 | 1.12, 1.29 | <0.001 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.98 | 0.93, 1.04 | 0.5 |
| Other | 1.52 | 1.41, 1.65 | <0.001 |
| Private | 1.23 | 1.16, 1.31 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.95 | 0.92, 0.98 | 0.001 |
| $66,000 - $87,999 | 0.92 | 0.89, 0.95 | <0.001 |
| $88,000 or more | 0.92 | 0.89, 0.96 | <0.001 |
| Elective status |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.39 | 1.31, 1.48 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.24 | 1.19, 1.30 | <0.001 |
| South | 1.06 | 1.02, 1.10 | 0.002 |
| West | 1.15 | 1.10, 1.20 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.91 | 0.88, 0.94 | <0.001 |
| Small | 0.83 | 0.80, 0.87 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.03 | 0.97, 1.09 | 0.3 |
| Urban, teaching | 1.24 | 1.18, 1.30 | <0.001 |
| Elixhauser comorbidity index | 1.22 | 1.21, 1.22 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### In-hospital stroke:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| LAAC procedure |  |  |  |
| No | — | — |  |
| Yes | 0.40 | 0.25, 0.63 | <0.001 |
| Age, y | 1.01 | 1.01, 1.01 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.91 | 0.88, 0.94 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.41 | 1.29, 1.55 | <0.001 |
| Black | 1.29 | 1.24, 1.35 | <0.001 |
| Hispanic | 1.17 | 1.10, 1.24 | <0.001 |
| Other | 1.24 | 1.14, 1.35 | <0.001 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.89 | 0.83, 0.94 | <0.001 |
| Other | 1.16 | 1.06, 1.27 | <0.001 |
| Private | 1.08 | 1.01, 1.16 | 0.031 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.00 | 0.96, 1.04 | >0.9 |
| $66,000 - $87,999 | 1.00 | 0.96, 1.04 | >0.9 |
| $88,000 or more | 1.03 | 0.98, 1.08 | 0.2 |
| Elective status |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.76 | 1.64, 1.89 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.96 | 0.91, 1.02 | 0.2 |
| South | 1.10 | 1.05, 1.15 | <0.001 |
| West | 1.14 | 1.08, 1.20 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.79 | 0.76, 0.83 | <0.001 |
| Small | 0.64 | 0.61, 0.67 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.21 | 1.12, 1.31 | <0.001 |
| Urban, teaching | 1.79 | 1.67, 1.92 | <0.001 |
| Elixhauser comorbidity index | 1.05 | 1.04, 1.06 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Cardiogenic shock:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| LAAC procedure |  |  |  |
| No | — | — |  |
| Yes | 0.24 | 0.16, 0.36 | <0.001 |
| Age, y | 0.97 | 0.97, 0.98 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.16 | 1.12, 1.19 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.37 | 1.26, 1.50 | <0.001 |
| Black | 0.94 | 0.89, 0.99 | 0.013 |
| Hispanic | 1.01 | 0.95, 1.07 | 0.7 |
| Other | 1.26 | 1.17, 1.36 | <0.001 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.02 | 0.97, 1.07 | 0.4 |
| Other | 1.20 | 1.12, 1.29 | <0.001 |
| Private | 1.34 | 1.27, 1.41 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.05 | 1.01, 1.09 | 0.011 |
| $66,000 - $87,999 | 1.04 | 0.99, 1.09 | 0.090 |
| $88,000 or more | 1.14 | 1.08, 1.21 | <0.001 |
| Elective status |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.93 | 0.88, 0.98 | 0.004 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.08 | 1.00, 1.17 | 0.042 |
| South | 1.11 | 1.04, 1.19 | 0.002 |
| West | 1.15 | 1.07, 1.23 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.67 | 0.63, 0.70 | <0.001 |
| Small | 0.53 | 0.50, 0.56 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.50 | 1.37, 1.64 | <0.001 |
| Urban, teaching | 2.46 | 2.26, 2.67 | <0.001 |
| Elixhauser comorbidity index | 1.20 | 1.19, 1.21 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Major bleeding:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| LAAC procedure |  |  |  |
| No | — | — |  |
| Yes | 1.09 | 0.88, 1.36 | 0.4 |
| Age, y | 1.01 | 1.01, 1.01 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.11 | 1.08, 1.13 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.45 | 1.35, 1.56 | <0.001 |
| Black | 1.06 | 1.03, 1.10 | <0.001 |
| Hispanic | 1.05 | 1.00, 1.10 | 0.038 |
| Other | 1.09 | 1.02, 1.17 | 0.011 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.16 | 1.10, 1.22 | <0.001 |
| Other | 1.04 | 0.96, 1.12 | 0.3 |
| Private | 1.16 | 1.09, 1.23 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.02 | 0.99, 1.05 | 0.3 |
| $66,000 - $87,999 | 0.99 | 0.95, 1.02 | 0.4 |
| $88,000 or more | 1.01 | 0.97, 1.05 | 0.6 |
| Elective status |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.58 | 1.50, 1.66 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.11 | 1.07, 1.15 | <0.001 |
| South | 1.00 | 0.96, 1.03 | 0.8 |
| West | 0.93 | 0.89, 0.97 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.85 | 0.83, 0.88 | <0.001 |
| Small | 0.74 | 0.72, 0.77 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.16 | 1.10, 1.23 | <0.001 |
| Urban, teaching | 1.43 | 1.36, 1.50 | <0.001 |
| Elixhauser comorbidity index | 1.13 | 1.12, 1.14 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Favorable discharge:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| LAAC procedure |  |  |  |
| No | — | — |  |
| Yes | 8.12 | 7.03, 9.37 | <0.001 |
| Age, y | 0.96 | 0.96, 0.96 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.26 | 1.24, 1.27 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.09 | 1.03, 1.15 | 0.002 |
| Black | 0.97 | 0.95, 1.0 | 0.016 |
| Hispanic | 1.13 | 1.09, 1.17 | <0.001 |
| Other | 1.02 | 0.98, 1.06 | 0.4 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.88 | 0.85, 0.90 | <0.001 |
| Other | 1.21 | 1.16, 1.26 | <0.001 |
| Private | 1.10 | 1.07, 1.14 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.00 | 0.98, 1.02 | 0.8 |
| $66,000 - $87,999 | 1.00 | 0.98, 1.02 | 0.8 |
| $88,000 or more | 0.97 | 0.94, 0.99 | 0.007 |
| Elective status |  |  |  |
| Elective | — | — |  |
| Non-elective | 0.89 | 0.87, 0.92 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.65 | 0.63, 0.68 | <0.001 |
| South | 0.94 | 0.91, 0.97 | <0.001 |
| West | 1.04 | 1.00, 1.08 | 0.043 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.01 | 0.99, 1.04 | 0.3 |
| Small | 1.00 | 0.97, 1.03 | >0.9 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.98 | 0.94, 1.01 | 0.2 |
| Urban, teaching | 1.02 | 0.98, 1.05 | 0.3 |
| Elixhauser comorbidity index | 0.82 | 0.82, 0.83 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

## Multivariable linear regression:

### Length of stay:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| LAAC procedure |  |  |  |
| No | — | — |  |
| Yes | -4.6 | -4.9, -4.4 | <0.001 |
| Age, y | -0.03 | -0.03, -0.03 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.01 | -0.03, 0.04 | 0.8 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.71 | 0.51, 0.91 | <0.001 |
| Black | 0.14 | 0.06, 0.22 | <0.001 |
| Hispanic | 0.22 | 0.10, 0.34 | <0.001 |
| Other | 0.61 | 0.45, 0.78 | <0.001 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -0.23 | -0.36, -0.11 | <0.001 |
| Other | -0.24 | -0.40, -0.08 | 0.004 |
| Private | 0.16 | 0.02, 0.30 | 0.022 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.01 | -0.05, 0.07 | 0.7 |
| $66,000 - $87,999 | -0.04 | -0.11, 0.02 | 0.2 |
| $88,000 or more | 0.09 | 0.01, 0.18 | 0.034 |
| Elective status |  |  |  |
| Elective | — | — |  |
| Non-elective | -0.79 | -0.90, -0.69 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.1 | 0.97, 1.2 | <0.001 |
| South | 0.45 | 0.34, 0.56 | <0.001 |
| West | -0.16 | -0.28, -0.03 | 0.014 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -0.99 | -1.1, -0.90 | <0.001 |
| Small | -1.4 | -1.5, -1.3 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.71 | 0.61, 0.81 | <0.001 |
| Urban, teaching | 1.7 | 1.6, 1.8 | <0.001 |
| Elixhauser comorbidity index | 0.65 | 0.63, 0.67 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |

### Inflation-adjusted total charge:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| LAAC procedure |  |  |  |
| No | — | — |  |
| Yes | 13,119 | 5,823, 20,414 | <0.001 |
| Age, y | -1,225 | -1,312, -1,139 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 4,129 | 3,341, 4,917 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 26,118 | 18,704, 33,532 | <0.001 |
| Black | -6,216 | -8,159, -4,274 | <0.001 |
| Hispanic | 20,469 | 16,932, 24,007 | <0.001 |
| Other | 25,290 | 19,437, 31,143 | <0.001 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 8,030 | 5,424, 10,635 | <0.001 |
| Other | 7,257 | 3,542, 10,972 | <0.001 |
| Private | 21,890 | 18,081, 25,699 | <0.001 |
| Income quartile |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1,940 | 358, 3,523 | 0.016 |
| $66,000 - $87,999 | 1,662 | -187, 3,512 | 0.078 |
| $88,000 or more | 10,675 | 7,599, 13,752 | <0.001 |
| Elective status |  |  |  |
| Elective | — | — |  |
| Non-elective | -53,728 | -56,829, -50,627 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 29,081 | 24,343, 33,818 | <0.001 |
| South | 18,167 | 15,340, 20,993 | <0.001 |
| West | 45,420 | 38,831, 52,008 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -21,871 | -25,413, -18,329 | <0.001 |
| Small | -33,183 | -36,601, -29,765 | <0.001 |
| Hospital location/teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 29,325 | 26,710, 31,941 | <0.001 |
| Urban, teaching | 49,082 | 46,597, 51,567 | <0.001 |
| Elixhauser comorbidity index | 9,289 | 8,747, 9,830 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |