Clinical Outcomes of Atrial Fibrillation in Acute Ischemic Stroke Patients

Analysis for RCOP NIS Cardio4

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## Preamble:

* **Reference Papers:**
  + [Sidhu et al. 2022](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9207776/pdf/main.pdf)
* **Study Objective**: Examine the impact of atrial fibrillation on in-hospital mortality, length of stay total charges, and stroke morbidity among inpatient admissions with a principal diagnosis of ischemic stroke.
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection**: Included all inpatient admissions with a principal diagnosis of Stroke.
* **Ischemic Stroke + Atrial Fibrillation Categories**:
  + Ischemic Stroke with Atrial Fibrillation
  + Ischemic Stroke without Atrial Fibrillation
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* **Secondary Outcomes**:
  + Stroke-related morbidity
    - Intracranial Hemorrhage
    - Sepsis
* **Statistical Analysis**: Multiple logistic and linear regression to determine the independent association of atrial fibrillation with in-hospital mortality, stroke mortality, length of stay and total charges (inflation adjusted), respectively, adjusted for:
  + Demographics: Age, sex, race, residential income, insurance, hospital region, hospital bedsize, hospital location, and teaching status.
  + Medical History: Hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease, peripheral vascular disease, heart failure, chronic kidney disease, rheumatic valvular disease, chronic obstructive pulmonary disease, dementia, cirrhosis, obstructive sleep apnea, anemia, obesity, prior stroke, prior cardiac surgery, presence of pacemaker/defibrillator, alochol use disorder, tobacco use disorder, use of tissue plasminogen activator and use of thrombectomy.
  + 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** | **Overall** N = 1,616,475*1* | **Ischemic Stroke with Atrial Fibrillation** N = 346,065*1* | **Ischemic Stroke without Atrial Fibrillation** N = 1,270,410*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age, y | 70 (14) | 77 (11) | 68 (14) | <0.001 |
| Sex |  |  |  | <0.001 |
| Female | 796,425 (49) | 180,130 (52) | 616,295 (49) |  |
| Male | 819,985 (51) | 165,930 (48) | 654,055 (51) |  |
| Race |  |  |  | <0.001 |
| White | 1,068,285 (68) | 256,635 (76) | 811,650 (66) |  |
| Asian or Pacific Islander | 49,070 (3.1) | 10,540 (3.1) | 38,530 (3.1) |  |
| Black | 275,775 (18) | 37,790 (11) | 237,985 (19) |  |
| Hispanic | 133,010 (8.4) | 22,785 (6.8) | 110,225 (8.9) |  |
| Native American | 7,675 (0.5) | 975 (0.3) | 6,700 (0.5) |  |
| Other | 41,525 (2.6) | 8,385 (2.5) | 33,140 (2.7) |  |
| Charlson comorbidity index | 3.78 (2.10) | 4.16 (2.18) | 3.68 (2.07) | <0.001 |
| Residential income |  |  |  | <0.001 |
| $1 - $51,999 | 487,600 (31) | 91,180 (27) | 396,420 (32) |  |
| $52,000 - $65,999 | 425,995 (27) | 91,510 (27) | 334,485 (27) |  |
| $66,000 - $87,999 | 376,065 (24) | 84,245 (25) | 291,820 (23) |  |
| $88,000 or more | 301,010 (19) | 74,175 (22) | 226,835 (18) |  |
| Expected primary payer |  |  |  | <0.001 |
| Private | 382,185 (24) | 46,770 (14) | 335,415 (26) |  |
| Medicaid | 154,420 (9.6) | 15,610 (4.5) | 138,810 (11) |  |
| Medicare | 1,039,315 (64) | 276,965 (80) | 762,350 (60) |  |
| Other | 38,385 (2.4) | 6,440 (1.9) | 31,945 (2.5) |  |
| Hospital region |  |  |  | <0.001 |
| Midwest | 349,315 (22) | 76,660 (22) | 272,655 (21) |  |
| Northeast | 278,005 (17) | 65,150 (19) | 212,855 (17) |  |
| South | 685,800 (42) | 134,915 (39) | 550,885 (43) |  |
| West | 303,355 (19) | 69,340 (20) | 234,015 (18) |  |
| Hospital bedsize |  |  |  | <0.001 |
| Large | 855,655 (53) | 188,105 (54) | 667,550 (53) |  |
| Medium | 465,410 (29) | 98,710 (29) | 366,700 (29) |  |
| Small | 295,410 (18) | 59,250 (17) | 236,160 (19) |  |
| Hospital location and teaching status |  |  |  | <0.001 |
| Rural | 115,015 (7.1) | 23,040 (6.7) | 91,975 (7.2) |  |
| Urban, non-teaching | 284,665 (18) | 56,985 (16) | 227,680 (18) |  |
| Urban, teaching | 1,216,795 (75) | 266,040 (77) | 950,755 (75) |  |
| Hypertension | 1,371,415 (85) | 306,490 (89) | 1,064,925 (84) | <0.001 |
| Diabetes mellitus | 637,165 (39) | 126,115 (36) | 511,050 (40) | <0.001 |
| Hyperlipidemia | 984,900 (61) | 213,820 (62) | 771,080 (61) | <0.001 |
| Coronary artery disease | 381,665 (24) | 111,210 (32) | 270,455 (21) | <0.001 |
| Peripheral vascular disease | 149,030 (9.2) | 41,030 (12) | 108,000 (8.5) | <0.001 |
| Heart failure | 309,465 (19) | 115,885 (33) | 193,580 (15) | <0.001 |
| Chronic kidney disease | 303,070 (19) | 83,050 (24) | 220,020 (17) | <0.001 |
| Rheumatic valvular disease | 48,845 (3.0) | 18,945 (5.5) | 29,900 (2.4) | <0.001 |
| Chronic obstructive pulmonary disease | 261,675 (16) | 64,300 (19) | 197,375 (16) | <0.001 |
| Dementia | 178,840 (11) | 54,170 (16) | 124,670 (9.8) | <0.001 |
| Cirrhosis | 19,615 (1.2) | 4,835 (1.4) | 14,780 (1.2) | <0.001 |
| Obstructive sleep apnea | 112,705 (7.0) | 28,885 (8.3) | 83,820 (6.6) | <0.001 |
| Anemia | 54,145 (3.3) | 13,845 (4.0) | 40,300 (3.2) | <0.001 |
| Obesity | 245,670 (15) | 47,940 (14) | 197,730 (16) | <0.001 |
| Prior stroke | 246,410 (15) | 55,960 (16) | 190,450 (15) | <0.001 |
| Prior cardiac surgery | 119,320 (7.4) | 38,695 (11) | 80,625 (6.3) | <0.001 |
| Pacemaker/ICD | 71,430 (4.4) | 34,135 (9.9) | 37,295 (2.9) | <0.001 |
| Alcohol use disorder | 493,800 (31) | 113,510 (33) | 380,290 (30) | <0.001 |
| Tobbacco use disorder | 14,885 (0.9) | 1,745 (0.5) | 13,140 (1.0) | <0.001 |
| Tissue plasminogen activator | 152,670 (9.4) | 33,060 (9.6) | 119,610 (9.4) | 0.29 |
| Thrombectomy use | 67,690 (4.2) | 26,595 (7.7) | 41,095 (3.2) | <0.001 |
| *1*Mean (SD); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Outcomes Table:

| **Characteristic** | **Overall** N = 1,616,475*1* | **Ischemic Stroke with Atrial Fibrillation** N = 346,065*1* | **Ischemic Stroke without Atrial Fibrillation** N = 1,270,410*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Died during hospitalization | 62,560 (3.9) | 22,940 (6.6) | 39,620 (3.1) | <0.001 |
| Length of stay (days) | 5.1 (6.8) | 5.7 (7.0) | 4.9 (6.8) | <0.001 |
| Inflation-adjusted total charge ($) | 72,547 (97,730) | 82,654 (108,618) | 69,797 (94,364) | <0.001 |
| Stroke-related morbidity | 106,880 (6.6) | 34,750 (10) | 72,130 (5.7) | <0.001 |
| Intracranial Hemorrhage | 95,055 (5.9) | 31,330 (9.1) | 63,725 (5.0) | <0.001 |
| Sepsis | 14,340 (0.9) | 4,170 (1.2) | 10,170 (0.8) | <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)***1* | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Ischemic Stroke with Atrial Fibrillation | — |  |
| Ischemic Stroke without Atrial Fibrillation | 0.66 (0.63 to 0.68) | <0.001 |
| Age, y | 1.04 (1.03 to 1.04) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.01 (0.97 to 1.05) | 0.75 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.07 (0.96 to 1.19) | 0.20 |
| Black | 0.81 (0.76 to 0.87) | <0.001 |
| Hispanic | 0.88 (0.81 to 0.96) | 0.003 |
| Native American | 0.95 (0.72 to 1.27) | 0.75 |
| Other | 1.15 (1.02 to 1.29) | 0.024 |
| Charlson comorbidity index | 1.18 (1.16 to 1.19) | <0.001 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.93 (0.89 to 0.98) | 0.011 |
| $66,000 - $87,999 | 0.86 (0.81 to 0.91) | <0.001 |
| $88,000 or more | 0.82 (0.77 to 0.87) | <0.001 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.05 (0.96 to 1.15) | 0.26 |
| Medicare | 0.79 (0.74 to 0.85) | <0.001 |
| Other | 1.68 (1.45 to 1.94) | <0.001 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.12 (1.03 to 1.22) | 0.006 |
| South | 1.00 (0.94 to 1.07) | 0.97 |
| West | 1.17 (1.09 to 1.26) | <0.001 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.82 (0.77 to 0.87) | <0.001 |
| Small | 0.65 (0.61 to 0.70) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.88 (0.79 to 0.97) | 0.011 |
| Urban, teaching | 1.24 (1.13 to 1.35) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.63 (0.60 to 0.66) | <0.001 |
| Diabetes mellitus |  |  |
| No | — |  |
| Yes | 0.86 (0.82 to 0.90) | <0.001 |
| Hyperlipidemia |  |  |
| No | — |  |
| Yes | 0.54 (0.52 to 0.57) | <0.001 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 1.00 (0.95 to 1.05) | 0.92 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.89 (0.83 to 0.95) | <0.001 |
| Heart failure |  |  |
| No | — |  |
| Yes | 1.46 (1.39 to 1.53) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.80 (0.75 to 0.84) | <0.001 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.89 (0.84 to 0.94) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.85 (0.80 to 0.90) | <0.001 |
| Cirrhosis |  |  |
| No | — |  |
| Yes | 2.67 (2.38 to 2.98) | <0.001 |
| Obstructive sleep apnea |  |  |
| No | — |  |
| Yes | 0.75 (0.68 to 0.82) | <0.001 |
| Anemia |  |  |
| No | — |  |
| Yes | 0.73 (0.66 to 0.82) | <0.001 |
| Alcohol use disorder |  |  |
| No | — |  |
| Yes | 0.98 (0.93 to 1.04) | 0.55 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.80 (0.75 to 0.86) | <0.001 |
| Rheumatic valvular disease |  |  |
| No | — |  |
| Yes | 0.71 (0.63 to 0.79) | <0.001 |
| Prior stroke |  |  |
| No | — |  |
| Yes | 0.75 (0.71 to 0.80) | <0.001 |
| Prior cardiac surgery |  |  |
| No | — |  |
| Yes | 0.85 (0.79 to 0.92) | <0.001 |
| Pacemaker/ICD |  |  |
| No | — |  |
| Yes | 0.89 (0.82 to 0.97) | 0.011 |
| Tobbacco use disorder |  |  |
| No | — |  |
| Yes | 0.68 (0.52 to 0.90) | 0.006 |
| Tissue plasminogen activator |  |  |
| No | — |  |
| Yes | 0.98 (0.92 to 1.04) | 0.49 |
| Thrombectomy use |  |  |
| No | — |  |
| Yes | 2.45 (2.29 to 2.63) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Stroke-Related Morbidity (ICH and Sepsis):

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Ischemic Stroke with Atrial Fibrillation | — |  |
| Ischemic Stroke without Atrial Fibrillation | 0.64 (0.62 to 0.66) | <0.001 |
| Age, y | 1.00 (1.00 to 1.00) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.15 (1.11 to 1.18) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.40 (1.29 to 1.51) | <0.001 |
| Black | 0.94 (0.90 to 0.99) | 0.015 |
| Hispanic | 1.19 (1.12 to 1.26) | <0.001 |
| Native American | 0.83 (0.65 to 1.06) | 0.14 |
| Other | 1.31 (1.20 to 1.43) | <0.001 |
| Charlson comorbidity index | 1.10 (1.09 to 1.11) | <0.001 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.95 (0.91 to 0.99) | 0.014 |
| $66,000 - $87,999 | 0.95 (0.91 to 0.99) | 0.019 |
| $88,000 or more | 0.96 (0.92 to 1.01) | 0.13 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.20 (1.13 to 1.27) | <0.001 |
| Medicare | 1.14 (1.09 to 1.19) | <0.001 |
| Other | 1.14 (1.03 to 1.26) | 0.013 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.21 (1.13 to 1.29) | <0.001 |
| South | 1.04 (0.98 to 1.10) | 0.22 |
| West | 1.02 (0.96 to 1.09) | 0.45 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.72 (0.69 to 0.76) | <0.001 |
| Small | 0.54 (0.51 to 0.57) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.70 (1.49 to 1.94) | <0.001 |
| Urban, teaching | 2.83 (2.51 to 3.19) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.79 (0.76 to 0.83) | <0.001 |
| Diabetes mellitus |  |  |
| No | — |  |
| Yes | 0.97 (0.93 to 1.00) | 0.060 |
| Hyperlipidemia |  |  |
| No | — |  |
| Yes | 0.77 (0.75 to 0.80) | <0.001 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.96 (0.92 to 1.00) | 0.034 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.88 (0.83 to 0.93) | <0.001 |
| Heart failure |  |  |
| No | — |  |
| Yes | 1.38 (1.32 to 1.43) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.75 (0.72 to 0.79) | <0.001 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.82 (0.79 to 0.85) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.90 (0.86 to 0.95) | <0.001 |
| Cirrhosis |  |  |
| No | — |  |
| Yes | 1.78 (1.61 to 1.97) | <0.001 |
| Obstructive sleep apnea |  |  |
| No | — |  |
| Yes | 0.94 (0.88 to 1.00) | 0.042 |
| Anemia |  |  |
| No | — |  |
| Yes | 0.98 (0.90 to 1.06) | 0.59 |
| Alcohol use disorder |  |  |
| No | — |  |
| Yes | 1.11 (1.06 to 1.16) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.90 (0.86 to 0.94) | <0.001 |
| Rheumatic valvular disease |  |  |
| No | — |  |
| Yes | 0.96 (0.88 to 1.05) | 0.36 |
| Prior stroke |  |  |
| No | — |  |
| Yes | 0.79 (0.75 to 0.82) | <0.001 |
| Prior cardiac surgery |  |  |
| No | — |  |
| Yes | 0.89 (0.83 to 0.95) | <0.001 |
| Pacemaker/ICD |  |  |
| No | — |  |
| Yes | 0.67 (0.62 to 0.72) | <0.001 |
| Tobbacco use disorder |  |  |
| No | — |  |
| Yes | 0.75 (0.63 to 0.90) | 0.002 |
| Tissue plasminogen activator |  |  |
| No | — |  |
| Yes | 1.58 (1.52 to 1.65) | <0.001 |
| Thrombectomy use |  |  |
| No | — |  |
| Yes | 3.95 (3.76 to 4.15) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Intracranial Hemorrhage:

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Ischemic Stroke with Atrial Fibrillation | — |  |
| Ischemic Stroke without Atrial Fibrillation | 0.63 (0.61 to 0.65) | <0.001 |
| Age, y | 1.00 (1.00 to 1.00) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.13 (1.10 to 1.17) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.39 (1.28 to 1.51) | <0.001 |
| Black | 0.94 (0.90 to 0.99) | 0.021 |
| Hispanic | 1.21 (1.14 to 1.29) | <0.001 |
| Native American | 0.83 (0.64 to 1.08) | 0.16 |
| Other | 1.29 (1.18 to 1.41) | <0.001 |
| Charlson comorbidity index | 1.09 (1.08 to 1.10) | <0.001 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.98 (0.94 to 1.03) | 0.43 |
| $66,000 - $87,999 | 0.97 (0.93 to 1.02) | 0.28 |
| $88,000 or more | 0.99 (0.94 to 1.05) | 0.78 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.13 (1.06 to 1.21) | <0.001 |
| Medicare | 1.09 (1.04 to 1.14) | <0.001 |
| Other | 1.06 (0.95 to 1.18) | 0.28 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.22 (1.13 to 1.31) | <0.001 |
| South | 1.00 (0.94 to 1.06) | 0.88 |
| West | 1.00 (0.93 to 1.07) | 0.99 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.72 (0.68 to 0.76) | <0.001 |
| Small | 0.52 (0.49 to 0.55) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.65 (1.43 to 1.91) | <0.001 |
| Urban, teaching | 2.83 (2.48 to 3.23) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.88 (0.84 to 0.92) | <0.001 |
| Diabetes mellitus |  |  |
| No | — |  |
| Yes | 0.96 (0.93 to 1.00) | 0.055 |
| Hyperlipidemia |  |  |
| No | — |  |
| Yes | 0.82 (0.79 to 0.85) | <0.001 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.98 (0.94 to 1.02) | 0.25 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.87 (0.83 to 0.93) | <0.001 |
| Heart failure |  |  |
| No | — |  |
| Yes | 1.28 (1.23 to 1.34) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.72 (0.69 to 0.76) | <0.001 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.81 (0.77 to 0.85) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.89 (0.84 to 0.94) | <0.001 |
| Cirrhosis |  |  |
| No | — |  |
| Yes | 1.15 (1.02 to 1.30) | 0.021 |
| Obstructive sleep apnea |  |  |
| No | — |  |
| Yes | 0.98 (0.92 to 1.04) | 0.50 |
| Anemia |  |  |
| No | — |  |
| Yes | 0.92 (0.84 to 1.00) | 0.046 |
| Alcohol use disorder |  |  |
| No | — |  |
| Yes | 1.09 (1.04 to 1.14) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.90 (0.86 to 0.95) | <0.001 |
| Rheumatic valvular disease |  |  |
| No | — |  |
| Yes | 0.95 (0.87 to 1.04) | 0.26 |
| Prior stroke |  |  |
| No | — |  |
| Yes | 0.83 (0.79 to 0.87) | <0.001 |
| Prior cardiac surgery |  |  |
| No | — |  |
| Yes | 0.89 (0.83 to 0.95) | <0.001 |
| Pacemaker/ICD |  |  |
| No | — |  |
| Yes | 0.72 (0.66 to 0.78) | <0.001 |
| Tobbacco use disorder |  |  |
| No | — |  |
| Yes | 0.81 (0.67 to 0.97) | 0.026 |
| Tissue plasminogen activator |  |  |
| No | — |  |
| Yes | 1.69 (1.61 to 1.77) | <0.001 |
| Thrombectomy use |  |  |
| No | — |  |
| Yes | 4.21 (4.00 to 4.42) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Sepsis:

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Ischemic Stroke with Atrial Fibrillation | — |  |
| Ischemic Stroke without Atrial Fibrillation | 0.76 (0.69 to 0.84) | <0.001 |
| Age, y | 1.00 (0.99 to 1.00) | 0.089 |
| Sex |  |  |
| Female | — |  |
| Male | 1.28 (1.18 to 1.39) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.42 (1.16 to 1.75) | <0.001 |
| Black | 0.95 (0.85 to 1.06) | 0.39 |
| Hispanic | 1.09 (0.95 to 1.25) | 0.21 |
| Native American | 0.92 (0.52 to 1.61) | 0.76 |
| Other | 1.46 (1.19 to 1.77) | <0.001 |
| Charlson comorbidity index | 1.13 (1.11 to 1.15) | <0.001 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.78 (0.70 to 0.86) | <0.001 |
| $66,000 - $87,999 | 0.82 (0.74 to 0.92) | <0.001 |
| $88,000 or more | 0.80 (0.71 to 0.90) | <0.001 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.69 (1.47 to 1.95) | <0.001 |
| Medicare | 1.49 (1.32 to 1.70) | <0.001 |
| Other | 1.63 (1.29 to 2.07) | <0.001 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.07 (0.92 to 1.23) | 0.40 |
| South | 1.33 (1.19 to 1.50) | <0.001 |
| West | 1.18 (1.03 to 1.36) | 0.017 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.77 (0.69 to 0.85) | <0.001 |
| Small | 0.68 (0.60 to 0.77) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 2.11 (1.64 to 2.71) | <0.001 |
| Urban, teaching | 2.88 (2.28 to 3.63) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.43 (0.39 to 0.47) | <0.001 |
| Diabetes mellitus |  |  |
| No | — |  |
| Yes | 0.98 (0.90 to 1.08) | 0.71 |
| Hyperlipidemia |  |  |
| No | — |  |
| Yes | 0.51 (0.47 to 0.55) | <0.001 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.87 (0.78 to 0.97) | 0.009 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 0.94 (0.82 to 1.09) | 0.42 |
| Heart failure |  |  |
| No | — |  |
| Yes | 2.26 (2.06 to 2.49) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.05 (0.94 to 1.17) | 0.40 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | 0.92 (0.83 to 1.02) | 0.12 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.93 (0.81 to 1.05) | 0.25 |
| Cirrhosis |  |  |
| No | — |  |
| Yes | 4.83 (4.14 to 5.64) | <0.001 |
| Obstructive sleep apnea |  |  |
| No | — |  |
| Yes | 0.61 (0.50 to 0.75) | <0.001 |
| Anemia |  |  |
| No | — |  |
| Yes | 1.25 (1.05 to 1.48) | 0.010 |
| Alcohol use disorder |  |  |
| No | — |  |
| Yes | 1.20 (1.10 to 1.32) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.91 (0.81 to 1.02) | 0.11 |
| Rheumatic valvular disease |  |  |
| No | — |  |
| Yes | 1.07 (0.86 to 1.32) | 0.55 |
| Prior stroke |  |  |
| No | — |  |
| Yes | 0.50 (0.43 to 0.58) | <0.001 |
| Prior cardiac surgery |  |  |
| No | — |  |
| Yes | 0.81 (0.67 to 0.98) | 0.028 |
| Pacemaker/ICD |  |  |
| No | — |  |
| Yes | 0.37 (0.28 to 0.48) | <0.001 |
| Tobbacco use disorder |  |  |
| No | — |  |
| Yes | 0.43 (0.24 to 0.78) | 0.006 |
| Tissue plasminogen activator |  |  |
| No | — |  |
| Yes | 0.81 (0.71 to 0.93) | 0.003 |
| Thrombectomy use |  |  |
| No | — |  |
| Yes | 1.79 (1.56 to 2.05) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Ischemic Stroke with Atrial Fibrillation | — |  |
| Ischemic Stroke without Atrial Fibrillation | -0.59 (-0.65 to -0.52) | <0.001 |
| Age, y | 0.00 (-0.01 to 0.00) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 0.24 (0.19 to 0.29) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.61 (0.45 to 0.77) | <0.001 |
| Black | 0.92 (0.83 to 1.0) | <0.001 |
| Hispanic | 0.48 (0.37 to 0.59) | <0.001 |
| Native American | 0.08 (-0.26 to 0.42) | 0.65 |
| Other | 0.83 (0.63 to 1.0) | <0.001 |
| Charlson comorbidity index | 0.39 (0.37 to 0.41) | <0.001 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | -0.18 (-0.25 to -0.11) | <0.001 |
| $66,000 - $87,999 | -0.23 (-0.30 to -0.15) | <0.001 |
| $88,000 or more | -0.30 (-0.39 to -0.21) | <0.001 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 2.0 (1.8 to 2.1) | <0.001 |
| Medicare | 0.16 (0.09 to 0.23) | <0.001 |
| Other | 0.39 (0.19 to 0.59) | <0.001 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.63 (0.50 to 0.75) | <0.001 |
| South | 0.51 (0.42 to 0.60) | <0.001 |
| West | -0.08 (-0.19 to 0.03) | 0.14 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | -0.62 (-0.71 to -0.53) | <0.001 |
| Small | -1.1 (-1.2 to -0.97) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.32 (0.20 to 0.44) | <0.001 |
| Urban, teaching | 1.1 (1.0 to 1.2) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | -0.30 (-0.39 to -0.21) | <0.001 |
| Diabetes mellitus |  |  |
| No | — |  |
| Yes | -0.17 (-0.23 to -0.11) | <0.001 |
| Hyperlipidemia |  |  |
| No | — |  |
| Yes | -0.58 (-0.64 to -0.53) | <0.001 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | -0.13 (-0.19 to -0.07) | <0.001 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | -0.10 (-0.19 to -0.02) | 0.020 |
| Heart failure |  |  |
| No | — |  |
| Yes | 1.0 (0.91 to 1.1) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | -0.44 (-0.52 to -0.36) | <0.001 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | -0.30 (-0.36 to -0.23) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.82 (0.73 to 0.92) | <0.001 |
| Cirrhosis |  |  |
| No | — |  |
| Yes | 1.4 (1.0 to 1.7) | <0.001 |
| Obstructive sleep apnea |  |  |
| No | — |  |
| Yes | -0.16 (-0.24 to -0.07) | <0.001 |
| Anemia |  |  |
| No | — |  |
| Yes | 1.4 (1.3 to 1.6) | <0.001 |
| Alcohol use disorder |  |  |
| No | — |  |
| Yes | 0.25 (0.16 to 0.33) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.02 (-0.05 to 0.09) | 0.61 |
| Rheumatic valvular disease |  |  |
| No | — |  |
| Yes | 0.31 (0.17 to 0.45) | <0.001 |
| Prior stroke |  |  |
| No | — |  |
| Yes | -0.62 (-0.68 to -0.56) | <0.001 |
| Prior cardiac surgery |  |  |
| No | — |  |
| Yes | -0.42 (-0.50 to -0.34) | <0.001 |
| Pacemaker/ICD |  |  |
| No | — |  |
| Yes | -0.82 (-0.91 to -0.73) | <0.001 |
| Tobbacco use disorder |  |  |
| No | — |  |
| Yes | -0.20 (-0.43 to 0.03) | 0.092 |
| Tissue plasminogen activator |  |  |
| No | — |  |
| Yes | -0.16 (-0.24 to -0.08) | <0.001 |
| Thrombectomy use |  |  |
| No | — |  |
| Yes | 2.4 (2.2 to 2.6) | <0.001 |
| *1*CI = Confidence Interval | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Atrial fibrillation categories |  |  |
| Ischemic Stroke with Atrial Fibrillation | — |  |
| Ischemic Stroke without Atrial Fibrillation | -9,021 (-10,001 to -8,042) | <0.001 |
| Age, y | -380 (-423 to -336) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 3,512 (2,837 to 4,186) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 12,295 (8,357 to 16,232) | <0.001 |
| Black | 7,517 (5,712 to 9,323) | <0.001 |
| Hispanic | 20,399 (17,391 to 23,407) | <0.001 |
| Native American | -11,859 (-15,810 to -7,907) | <0.001 |
| Other | 23,052 (19,122 to 26,983) | <0.001 |
| Charlson comorbidity index | 4,350 (4,063 to 4,636) | <0.001 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | -1,261 (-2,610 to 89) | 0.067 |
| $66,000 - $87,999 | -1,518 (-3,200 to 165) | 0.077 |
| $88,000 or more | 1,766 (-704 to 4,236) | 0.16 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 13,191 (11,238 to 15,144) | <0.001 |
| Medicare | 3,979 (2,906 to 5,052) | <0.001 |
| Other | 1,547 (-1,237 to 4,331) | 0.28 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 21,009 (17,184 to 24,833) | <0.001 |
| South | 13,201 (11,058 to 15,345) | <0.001 |
| West | 31,025 (27,645 to 34,405) | <0.001 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | -7,647 (-10,285 to -5,009) | <0.001 |
| Small | -15,249 (-18,043 to -12,455) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 23,063 (20,596 to 25,529) | <0.001 |
| Urban, teaching | 30,646 (28,931 to 32,362) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | -5,266 (-6,654 to -3,877) | <0.001 |
| Diabetes mellitus |  |  |
| No | — |  |
| Yes | -2,470 (-3,371 to -1,569) | <0.001 |
| Hyperlipidemia |  |  |
| No | — |  |
| Yes | -5,780 (-6,641 to -4,919) | <0.001 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 751 (-119 to 1,622) | 0.091 |
| Peripheral vascular disease |  |  |
| No | — |  |
| Yes | 615 (-719 to 1,949) | 0.37 |
| Heart failure |  |  |
| No | — |  |
| Yes | 10,936 (9,774 to 12,099) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | -7,577 (-8,753 to -6,401) | <0.001 |
| Chronic obstructive pulmonary disease |  |  |
| No | — |  |
| Yes | -2,112 (-3,089 to -1,136) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | -2,038 (-3,049 to -1,027) | <0.001 |
| Cirrhosis |  |  |
| No | — |  |
| Yes | 32,551 (25,847 to 39,255) | <0.001 |
| Obstructive sleep apnea |  |  |
| No | — |  |
| Yes | -4,483 (-5,760 to -3,207) | <0.001 |
| Anemia |  |  |
| No | — |  |
| Yes | 15,573 (13,274 to 17,872) | <0.001 |
| Alcohol use disorder |  |  |
| No | — |  |
| Yes | 5,959 (3,252 to 8,666) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 2,178 (1,023 to 3,334) | <0.001 |
| Rheumatic valvular disease |  |  |
| No | — |  |
| Yes | 1,489 (-589 to 3,568) | 0.16 |
| Prior stroke |  |  |
| No | — |  |
| Yes | -5,831 (-6,813 to -4,850) | <0.001 |
| Prior cardiac surgery |  |  |
| No | — |  |
| Yes | -5,394 (-6,565 to -4,224) | <0.001 |
| Pacemaker/ICD |  |  |
| No | — |  |
| Yes | -11,882 (-13,240 to -10,524) | <0.001 |
| Tobbacco use disorder |  |  |
| No | — |  |
| Yes | -3,219 (-6,410 to -29) | 0.048 |
| Tissue plasminogen activator |  |  |
| No | — |  |
| Yes | 44,658 (42,895 to 46,421) | <0.001 |
| Thrombectomy use |  |  |
| No | — |  |
| Yes | 113,224 (108,066 to 118,383) | <0.001 |
| *1*CI = Confidence Interval | | |