Utilization and Outcomes of Transcatheter Aortic Valve Replacement in Younger vs Older Patients: An Analysis of the National Inpatient Sample (NIS) Database

Analysis for RCOP NIS Cardio1

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## Preamble:

* **Reference Papers:**
  + [Coylewright et al. 2024](https://jamanetwork.com/journals/jamacardiology/fullarticle/2825505)
* **Study Objective**: Compare the utilization and clinical outcomes of transcatheter aortic valve replacement (TAVR) in younger (<65 years) versus older (≥65 years) patients.
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection**: Included all inpatient admissions for patients aged 18 and older undergoing TAVR.
* **Age Categories**:
  + Younger patients (<65 years)
  + Older patients (≥65 years)
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Length of stay (days)
  + Inflation-adjusted total charge ($)
* **Secondary Outcomes**:
  + Ischemic stroke
  + Acute kidney injury
  + Major bleeding
  + Bleeding requiring transfusion
  + Acute myocardial infarction
  + Vascular complications
  + Acute respiratory failure
  + Cardiogenic shock
  + Permanent pacemaker implantation
* **Statistical Analysis**: Multiple logistic and linear regression models were used to evaluate independent associations of age group with TAVR utilization and clinical outcomes, adjusting for:
  + Demographics: Sex, race, residential income, insurance type, hospital region, hospital bedsize, hospital location, and teaching status, and admission type (elective or non-elective).
  + Medical History: Diabetes, previous heart failure, hypertension, obesity, chronic pulmonary disease, chronic kidney disease, atrial fibrillation, liver disease, congenital heart disease, bicuspid aortic valve, previous PCI, previous CABG, previous ICD insertion, previous PPM or CRT insertion, smoking status, coronary artery disease, dementia, previous stroke or transient ischemic attack, and previous myocardial infarction.
  + 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** | **Age >=65 y** N = 192,395*1* | **Age <65 y** N = 13,115*1* | **p-value***2* | **Overall** N = 205,510*1* |
| --- | --- | --- | --- | --- |
| Sex |  |  | <0.001 |  |
| Female | 85,410 (44) | 4,890 (37) |  | 90,300 (44) |
| Male | 106,975 (56) | 8,225 (63) |  | 115,200 (56) |
| Race |  |  | <0.001 |  |
| White | 164,980 (88) | 9,935 (78) |  | 174,915 (87) |
| Asian or Pacific Islander | 2,580 (1.4) | 165 (1.3) |  | 2,745 (1.4) |
| Black | 6,950 (3.7) | 1,205 (9.5) |  | 8,155 (4.1) |
| Hispanic | 8,770 (4.7) | 1,020 (8.0) |  | 9,790 (4.9) |
| Native American | 495 (0.3) | 105 (0.8) |  | 600 (0.3) |
| Other | 3,910 (2.1) | 310 (2.4) |  | 4,220 (2.1) |
| Residential income |  |  | <0.001 |  |
| $1 - $51,999 | 39,270 (21) | 3,510 (27) |  | 42,780 (21) |
| $52,000 - $65,999 | 49,215 (26) | 3,675 (29) |  | 52,890 (26) |
| $66,000 - $87,999 | 50,600 (27) | 3,320 (26) |  | 53,920 (27) |
| $88,000 or more | 50,670 (27) | 2,380 (18) |  | 53,050 (26) |
| Expected primary payer |  |  | <0.001 |  |
| Private | 12,270 (6.4) | 6,205 (47) |  | 18,475 (9.0) |
| Medicaid | 985 (0.5) | 2,005 (15) |  | 2,990 (1.5) |
| Medicare | 175,300 (91) | 4,350 (33) |  | 179,650 (87) |
| Other | 3,690 (1.9) | 530 (4.0) |  | 4,220 (2.1) |
| Hospital region |  |  | <0.001 |  |
| Midwest | 44,255 (23) | 2,930 (22) |  | 47,185 (23) |
| Northeast | 43,370 (23) | 2,490 (19) |  | 45,860 (22) |
| South | 64,960 (34) | 5,045 (38) |  | 70,005 (34) |
| West | 39,810 (21) | 2,650 (20) |  | 42,460 (21) |
| Hospital bedsize |  |  | <0.001 |  |
| Large | 135,420 (70) | 9,770 (74) |  | 145,190 (71) |
| Medium | 42,345 (22) | 2,460 (19) |  | 44,805 (22) |
| Small | 14,630 (7.6) | 885 (6.7) |  | 15,515 (7.5) |
| Hospital location and teaching status |  |  | 0.35 |  |
| Rural | 2,545 (1.3) | 180 (1.4) |  | 2,725 (1.3) |
| Urban, non-teaching | 17,550 (9.1) | 1,075 (8.2) |  | 18,625 (9.1) |
| Urban, teaching | 172,300 (90) | 11,860 (90) |  | 184,160 (90) |
| Elective procedure status |  |  | <0.001 |  |
| Elective | 161,420 (84) | 9,630 (74) |  | 171,050 (84) |
| Non-elective | 30,355 (16) | 3,430 (26) |  | 33,785 (16) |
| Charlson comorbidity index | 2.97 (2.00) | 3.14 (2.06) | <0.001 | 2.98 (2.00) |
| Diabetes Mellitus | 72,125 (37) | 5,765 (44) | <0.001 | 77,890 (38) |
| Previous heart failure | 75,840 (39) | 5,485 (42) | 0.017 | 81,325 (40) |
| Hypertension | 111,700 (58) | 7,165 (55) | <0.001 | 118,865 (58) |
| Obesity | 38,685 (20) | 4,500 (34) | <0.001 | 43,185 (21) |
| Chronic pulmonary disease | 50,120 (26) | 3,835 (29) | <0.001 | 53,955 (26) |
| Chronic kidney disease | 64,250 (33) | 4,075 (31) | 0.021 | 68,325 (33) |
| Atrial fibrillation | 73,930 (38) | 3,215 (25) | <0.001 | 77,145 (38) |
| Liver disease | 6,240 (3.2) | 1,535 (12) | <0.001 | 7,775 (3.8) |
| Coronary artery disease | 130,530 (68) | 7,250 (55) | <0.001 | 137,780 (67) |
| Congenital heart disease | 5,135 (2.7) | 1,450 (11) | <0.001 | 6,585 (3.2) |
| *1*n (%); Mean (SD) | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | |

## Outcomes Table:

| **Characteristic** | **Age >=65 y** N = 192,395*1* | **Age <65 y** N = 13,115*1* | **p-value***2* | **Overall** N = 205,510*1* |
| --- | --- | --- | --- | --- |
| Died during hospitalization | 2,405 (1.3) | 155 (1.2) | 0.77 | 2,560 (1.2) |
| Length of stay (days) | 2.0 (1.0 – 3.0) | 2.0 (1.0 – 6.0) | <0.001 | 2.0 (1.0 – 3.0) |
| Inflation-adjusted total charge ($) | 179,202 (134,078 – 261,437) | 186,807 (139,018 – 278,412) | <0.001 | 179,712 (134,278 – 262,271) |
| Ischemic stroke | 3,470 (1.8) | 210 (1.6) | 0.44 | 3,680 (1.8) |
| Acute kidney injury | 17,780 (9.2) | 1,440 (11) | 0.004 | 19,220 (9.4) |
| Major bleeding | 13,600 (7.1) | 1,160 (8.8) | <0.001 | 14,760 (7.2) |
| Bleeding requiring transfusion | 9,855 (5.1) | 735 (5.6) | 0.29 | 10,590 (5.2) |
| Acute myocardial infarction | 4,800 (2.5) | 575 (4.4) | <0.001 | 5,375 (2.6) |
| Vascular complications | 22,925 (12) | 1,615 (12) | 0.54 | 24,540 (12) |
| Acute respiratory failure | 7,730 (4.0) | 920 (7.0) | <0.001 | 8,650 (4.2) |
| Cardiogenic shock | 3,375 (1.8) | 675 (5.1) | <0.001 | 4,050 (2.0) |
| Permanent pacemaker implantation | 17,415 (9.1) | 835 (6.4) | <0.001 | 18,250 (8.9) |
| *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)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 0.51 (0.32 to 0.80) | 0.003 |
| Sex |  |  |
| Female | — |  |
| Male | 0.61 (0.51 to 0.75) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.76 (0.30 to 1.90) | 0.56 |
| Black | 0.75 (0.43 to 1.29) | 0.30 |
| Hispanic | 1.37 (0.97 to 1.94) | 0.078 |
| Native American | 0.00 (0.00 to 0.00) | <0.001 |
| Other | 1.14 (0.61 to 2.14) | 0.67 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.90 (0.68 to 1.19) | 0.45 |
| $66,000 - $87,999 | 0.98 (0.75 to 1.27) | 0.86 |
| $88,000 or more | 0.78 (0.59 to 1.03) | 0.080 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.22 (0.59 to 2.52) | 0.59 |
| Medicare | 0.80 (0.59 to 1.08) | 0.15 |
| Other | 0.49 (0.19 to 1.26) | 0.14 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.77 (0.57 to 1.02) | 0.070 |
| South | 0.91 (0.70 to 1.17) | 0.45 |
| West | 0.67 (0.50 to 0.89) | 0.006 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.91 (0.71 to 1.17) | 0.46 |
| Small | 0.92 (0.62 to 1.36) | 0.67 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.56 (0.25 to 1.28) | 0.17 |
| Urban, teaching | 0.85 (0.40 to 1.78) | 0.66 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 2.46 (2.02 to 3.00) | <0.001 |
| Charlson comorbidity index | 1.29 (1.22 to 1.37) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.52 (0.42 to 0.65) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.61 (0.50 to 0.74) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.41 (0.31 to 0.54) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.52 (0.40 to 0.68) | <0.001 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.89 (0.72 to 1.10) | 0.28 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.43 (0.31 to 0.58) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.25 (1.04 to 1.51) | 0.019 |
| Liver disease |  |  |
| No | — |  |
| Yes | 3.56 (2.65 to 4.78) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.84 (1.02 to 3.33) | 0.043 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 0.55 (0.23 to 1.27) | 0.16 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.62 (0.46 to 0.84) | 0.002 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.87 (0.63 to 1.19) | 0.38 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.92 (0.50 to 1.69) | 0.79 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.51 (0.33 to 0.80) | 0.003 |
| Smoking status |  |  |
| No | — |  |
| Yes | 0.57 (0.32 to 1.00) | 0.050 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.97 (0.79 to 1.19) | 0.76 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.54 (0.32 to 0.90) | 0.018 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.94 (0.71 to 1.23) | 0.63 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.77 (0.56 to 1.07) | 0.12 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Ischemic Stroke

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 0.80 (0.52 to 1.23) | 0.31 |
| Sex |  |  |
| Female | — |  |
| Male | 0.64 (0.54 to 0.77) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.19 (0.59 to 2.39) | 0.62 |
| Black | 0.97 (0.63 to 1.47) | 0.87 |
| Hispanic | 1.05 (0.71 to 1.56) | 0.79 |
| Native American | 2.30 (0.88 to 6.05) | 0.090 |
| Other | 0.54 (0.24 to 1.21) | 0.14 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 1.02 (0.79 to 1.32) | 0.86 |
| $66,000 - $87,999 | 0.99 (0.76 to 1.27) | 0.92 |
| $88,000 or more | 1.00 (0.76 to 1.31) | >0.99 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.17 (0.52 to 2.62) | 0.71 |
| Medicare | 1.09 (0.77 to 1.55) | 0.63 |
| Other | 0.83 (0.37 to 1.84) | 0.65 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.83 (0.63 to 1.09) | 0.19 |
| South | 0.97 (0.77 to 1.22) | 0.79 |
| West | 0.72 (0.54 to 0.95) | 0.020 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.86 (0.69 to 1.07) | 0.17 |
| Small | 0.74 (0.53 to 1.04) | 0.080 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.15 (0.51 to 2.60) | 0.73 |
| Urban, teaching | 1.05 (0.48 to 2.28) | 0.91 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 1.05 (0.84 to 1.32) | 0.64 |
| Charlson comorbidity index | 2.11 (2.02 to 2.21) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.40 (0.33 to 0.48) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.72 (0.61 to 0.85) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.72 (0.56 to 0.94) | 0.016 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.74 (0.59 to 0.92) | 0.008 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.40 (0.33 to 0.49) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.13 (0.10 to 0.18) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.13 (0.95 to 1.34) | 0.18 |
| Liver disease |  |  |
| No | — |  |
| Yes | 0.28 (0.17 to 0.46) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.89 (1.09 to 3.30) | 0.025 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 0.60 (0.27 to 1.35) | 0.22 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.79 (0.63 to 1.00) | 0.053 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.89 (0.67 to 1.19) | 0.44 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.25 (0.11 to 0.56) | <0.001 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.69 (0.48 to 0.99) | 0.042 |
| Smoking status |  |  |
| No | — |  |
| Yes | 0.76 (0.47 to 1.22) | 0.25 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.91 (0.75 to 1.11) | 0.35 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.78 (0.55 to 1.10) | 0.16 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 1.04 (0.82 to 1.33) | 0.74 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.50 (0.38 to 0.67) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Acute Kidney Injury

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 0.74 (0.62 to 0.89) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 0.96 (0.88 to 1.04) | 0.30 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.00 (0.72 to 1.39) | 0.99 |
| Black | 0.98 (0.82 to 1.18) | 0.86 |
| Hispanic | 1.31 (1.09 to 1.58) | 0.004 |
| Native American | 0.91 (0.48 to 1.75) | 0.78 |
| Other | 0.97 (0.75 to 1.24) | 0.79 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.97 (0.87 to 1.09) | 0.64 |
| $66,000 - $87,999 | 0.90 (0.80 to 1.01) | 0.077 |
| $88,000 or more | 0.94 (0.83 to 1.06) | 0.33 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.97 (0.71 to 1.34) | 0.87 |
| Medicare | 0.83 (0.71 to 0.96) | 0.011 |
| Other | 0.86 (0.64 to 1.15) | 0.30 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.88 (0.77 to 1.01) | 0.060 |
| South | 0.88 (0.77 to 1.00) | 0.052 |
| West | 0.80 (0.69 to 0.92) | 0.001 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.94 (0.84 to 1.05) | 0.25 |
| Small | 0.78 (0.62 to 0.98) | 0.030 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.02 (0.67 to 1.56) | 0.91 |
| Urban, teaching | 1.11 (0.74 to 1.66) | 0.60 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 5.91 (5.39 to 6.49) | <0.001 |
| Charlson comorbidity index | 1.25 (1.21 to 1.29) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.83 (0.76 to 0.91) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.77 (0.71 to 0.84) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.38 (0.33 to 0.44) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 1.05 (0.96 to 1.16) | 0.29 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.93 (0.85 to 1.02) | 0.14 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.33 (1.14 to 1.55) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.46 (1.34 to 1.58) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.50 (1.26 to 1.77) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.06 (0.77 to 1.46) | 0.73 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 1.06 (0.69 to 1.62) | 0.79 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.73 (0.66 to 0.82) | <0.001 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.92 (0.82 to 1.04) | 0.19 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.90 (0.71 to 1.15) | 0.39 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.79 (0.68 to 0.91) | 0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | 0.95 (0.78 to 1.15) | 0.58 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 1.09 (1.0 to 1.19) | 0.065 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.83 (0.68 to 1.01) | 0.059 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.77 (0.69 to 0.87) | <0.001 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.80 (0.70 to 0.91) | 0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Major Bleeding

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 1.05 (0.88 to 1.25) | 0.62 |
| Sex |  |  |
| Female | — |  |
| Male | 0.95 (0.88 to 1.04) | 0.27 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.91 (0.65 to 1.28) | 0.60 |
| Black | 1.00 (0.82 to 1.22) | >0.99 |
| Hispanic | 1.03 (0.85 to 1.25) | 0.76 |
| Native American | 1.28 (0.71 to 2.27) | 0.41 |
| Other | 1.00 (0.76 to 1.32) | >0.99 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.91 (0.81 to 1.02) | 0.12 |
| $66,000 - $87,999 | 0.99 (0.87 to 1.11) | 0.81 |
| $88,000 or more | 1.03 (0.91 to 1.17) | 0.63 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.94 (0.67 to 1.33) | 0.73 |
| Medicare | 1.04 (0.89 to 1.22) | 0.59 |
| Other | 1.05 (0.76 to 1.44) | 0.77 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.02 (0.88 to 1.18) | 0.79 |
| South | 1.00 (0.88 to 1.13) | >0.99 |
| West | 1.04 (0.90 to 1.20) | 0.60 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 1.01 (0.89 to 1.13) | 0.93 |
| Small | 0.84 (0.70 to 1.00) | 0.052 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.67 (1.04 to 2.68) | 0.033 |
| Urban, teaching | 1.57 (1.00 to 2.48) | 0.051 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 1.75 (1.58 to 1.94) | <0.001 |
| Charlson comorbidity index | 1.44 (1.40 to 1.48) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.58 (0.52 to 0.63) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.85 (0.78 to 0.92) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 1.01 (0.87 to 1.17) | 0.88 |
| Obesity |  |  |
| No | — |  |
| Yes | 1.00 (0.90 to 1.11) | >0.99 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.71 (0.65 to 0.79) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.47 (0.40 to 0.56) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 0.99 (0.91 to 1.08) | 0.81 |
| Liver disease |  |  |
| No | — |  |
| Yes | 2.33 (1.99 to 2.73) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.33 (0.97 to 1.82) | 0.079 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 0.68 (0.45 to 1.03) | 0.070 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 1.00 (0.90 to 1.12) | 0.98 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.81 (0.71 to 0.92) | 0.002 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.64 (0.48 to 0.85) | 0.002 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.95 (0.82 to 1.09) | 0.45 |
| Smoking status |  |  |
| No | — |  |
| Yes | 1.04 (0.86 to 1.27) | 0.66 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.99 (0.90 to 1.09) | 0.79 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.72 (0.59 to 0.87) | <0.001 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 4.26 (3.90 to 4.67) | <0.001 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.69 (0.61 to 0.79) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Bleeding Requiring Transfusion

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 1.12 (0.91 to 1.39) | 0.28 |
| Sex |  |  |
| Female | — |  |
| Male | 0.61 (0.56 to 0.68) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.17 (0.80 to 1.71) | 0.43 |
| Black | 1.35 (1.10 to 1.66) | 0.005 |
| Hispanic | 1.68 (1.30 to 2.18) | <0.001 |
| Native American | 1.05 (0.45 to 2.45) | 0.90 |
| Other | 0.87 (0.63 to 1.20) | 0.41 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.87 (0.76 to 1.00) | 0.056 |
| $66,000 - $87,999 | 1.02 (0.89 to 1.18) | 0.74 |
| $88,000 or more | 1.17 (1.01 to 1.37) | 0.042 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.95 (0.65 to 1.39) | 0.78 |
| Medicare | 1.16 (0.95 to 1.42) | 0.13 |
| Other | 1.10 (0.76 to 1.61) | 0.60 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 2.19 (1.74 to 2.76) | <0.001 |
| South | 1.63 (1.28 to 2.07) | <0.001 |
| West | 1.05 (0.81 to 1.36) | 0.71 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.96 (0.80 to 1.16) | 0.67 |
| Small | 0.80 (0.63 to 1.03) | 0.081 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.32 (0.76 to 2.28) | 0.32 |
| Urban, teaching | 0.83 (0.49 to 1.39) | 0.48 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 2.28 (2.04 to 2.56) | <0.001 |
| Charlson comorbidity index | 1.25 (1.21 to 1.30) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.73 (0.65 to 0.81) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.75 (0.68 to 0.84) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.85 (0.72 to 1.00) | 0.047 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.92 (0.82 to 1.04) | 0.18 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.97 (0.87 to 1.07) | 0.51 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.79 (0.65 to 0.96) | 0.015 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.33 (1.20 to 1.47) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.43 (1.16 to 1.75) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.19 (0.83 to 1.72) | 0.35 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 0.81 (0.49 to 1.33) | 0.41 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 1.01 (0.89 to 1.15) | 0.86 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.86 (0.74 to 1.00) | 0.044 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.64 (0.46 to 0.89) | 0.008 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.84 (0.71 to 1.00) | 0.049 |
| Smoking status |  |  |
| No | — |  |
| Yes | 1.02 (0.82 to 1.28) | 0.83 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 1.13 (1.02 to 1.26) | 0.021 |
| Dementia |  |  |
| No | — |  |
| Yes | 1.05 (0.85 to 1.31) | 0.65 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.93 (0.81 to 1.06) | 0.29 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.75 (0.64 to 0.88) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Acute Myocardial Infarction

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 1.34 (1.04 to 1.71) | 0.022 |
| Sex |  |  |
| Female | — |  |
| Male | 1.04 (0.90 to 1.20) | 0.62 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.87 (0.48 to 1.59) | 0.65 |
| Black | 1.05 (0.75 to 1.46) | 0.77 |
| Hispanic | 1.09 (0.81 to 1.45) | 0.57 |
| Native American | 1.26 (0.51 to 3.13) | 0.62 |
| Other | 1.25 (0.82 to 1.91) | 0.31 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 1.02 (0.83 to 1.25) | 0.85 |
| $66,000 - $87,999 | 1.01 (0.82 to 1.24) | 0.92 |
| $88,000 or more | 0.80 (0.63 to 1.01) | 0.056 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.19 (0.75 to 1.90) | 0.46 |
| Medicare | 1.14 (0.88 to 1.47) | 0.33 |
| Other | 0.95 (0.55 to 1.65) | 0.85 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.12 (0.90 to 1.40) | 0.31 |
| South | 0.85 (0.69 to 1.06) | 0.15 |
| West | 1.06 (0.84 to 1.32) | 0.64 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 1.11 (0.93 to 1.33) | 0.24 |
| Small | 0.64 (0.44 to 0.93) | 0.019 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.48 (0.30 to 0.79) | 0.004 |
| Urban, teaching | 0.49 (0.32 to 0.77) | 0.002 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 17.1 (14.2 to 20.7) | <0.001 |
| Charlson comorbidity index | 1.72 (1.65 to 1.79) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.47 (0.40 to 0.55) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.64 (0.55 to 0.75) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.75 (0.60 to 0.94) | 0.011 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.96 (0.80 to 1.14) | 0.61 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.45 (0.38 to 0.54) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.28 (0.22 to 0.36) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 0.93 (0.81 to 1.08) | 0.36 |
| Liver disease |  |  |
| No | — |  |
| Yes | 0.69 (0.52 to 0.92) | 0.011 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 0.67 (0.35 to 1.28) | 0.22 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 1.64 (0.74 to 3.63) | 0.23 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.93 (0.77 to 1.12) | 0.47 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.95 (0.78 to 1.17) | 0.64 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.21 (0.10 to 0.43) | <0.001 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.58 (0.42 to 0.81) | 0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | 0.95 (0.67 to 1.33) | 0.75 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 1.98 (1.64 to 2.38) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.55 (0.39 to 0.76) | <0.001 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.85 (0.70 to 1.05) | 0.12 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.56 (0.45 to 0.71) | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Vascular Complications

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 1.05 (0.91 to 1.22) | 0.51 |
| Sex |  |  |
| Female | — |  |
| Male | 0.74 (0.69 to 0.79) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.08 (0.82 to 1.42) | 0.60 |
| Black | 1.05 (0.89 to 1.24) | 0.54 |
| Hispanic | 1.06 (0.89 to 1.26) | 0.50 |
| Native American | 0.70 (0.37 to 1.33) | 0.27 |
| Other | 0.92 (0.72 to 1.18) | 0.52 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 1.03 (0.93 to 1.14) | 0.56 |
| $66,000 - $87,999 | 1.09 (0.97 to 1.22) | 0.17 |
| $88,000 or more | 1.09 (0.96 to 1.24) | 0.20 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.10 (0.83 to 1.46) | 0.51 |
| Medicare | 1.09 (0.95 to 1.25) | 0.21 |
| Other | 0.91 (0.70 to 1.20) | 0.51 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.79 (0.62 to 0.99) | 0.045 |
| South | 0.95 (0.77 to 1.17) | 0.62 |
| West | 0.72 (0.58 to 0.89) | 0.002 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.86 (0.74 to 1.00) | 0.054 |
| Small | 0.92 (0.73 to 1.17) | 0.50 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.14 (0.70 to 1.85) | 0.59 |
| Urban, teaching | 1.36 (0.85 to 2.17) | 0.20 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 1.65 (1.47 to 1.84) | <0.001 |
| Charlson comorbidity index | 1.17 (1.14 to 1.21) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.72 (0.66 to 0.78) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.87 (0.79 to 0.96) | 0.004 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.83 (0.75 to 0.93) | 0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.93 (0.86 to 1.01) | 0.076 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.93 (0.86 to 1.01) | 0.085 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.79 (0.69 to 0.91) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.22 (1.14 to 1.31) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.19 (1.03 to 1.38) | 0.017 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.13 (0.85 to 1.51) | 0.40 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 0.79 (0.54 to 1.15) | 0.22 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.96 (0.88 to 1.05) | 0.33 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.82 (0.74 to 0.91) | <0.001 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.56 (0.44 to 0.72) | <0.001 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.80 (0.70 to 0.91) | <0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | 1.04 (0.89 to 1.21) | 0.65 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 1.11 (1.02 to 1.20) | 0.012 |
| Dementia |  |  |
| No | — |  |
| Yes | 1.01 (0.87 to 1.18) | 0.89 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.84 (0.76 to 0.92) | <0.001 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.92 (0.82 to 1.02) | 0.13 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Acute Respiratory Failure

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 1.37 (1.11 to 1.70) | 0.004 |
| Sex |  |  |
| Female | — |  |
| Male | 0.81 (0.73 to 0.90) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.23 (0.79 to 1.91) | 0.35 |
| Black | 1.00 (0.77 to 1.30) | 0.99 |
| Hispanic | 1.18 (0.94 to 1.49) | 0.14 |
| Native American | 0.89 (0.36 to 2.16) | 0.79 |
| Other | 0.97 (0.66 to 1.42) | 0.86 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 1.05 (0.89 to 1.22) | 0.58 |
| $66,000 - $87,999 | 1.04 (0.88 to 1.22) | 0.64 |
| $88,000 or more | 0.86 (0.72 to 1.02) | 0.077 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 1.33 (0.91 to 1.95) | 0.14 |
| Medicare | 1.16 (0.95 to 1.41) | 0.15 |
| Other | 0.83 (0.51 to 1.36) | 0.46 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.69 (0.57 to 0.84) | <0.001 |
| South | 0.80 (0.68 to 0.94) | 0.006 |
| West | 0.83 (0.70 to 0.99) | 0.037 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 1.13 (0.98 to 1.30) | 0.082 |
| Small | 0.93 (0.73 to 1.20) | 0.58 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 0.92 (0.57 to 1.47) | 0.71 |
| Urban, teaching | 0.84 (0.54 to 1.31) | 0.44 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 5.91 (5.28 to 6.62) | <0.001 |
| Charlson comorbidity index | 1.26 (1.21 to 1.30) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.80 (0.71 to 0.91) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.57 (0.51 to 0.64) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.59 (0.50 to 0.70) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.91 (0.80 to 1.04) | 0.18 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.98 (0.87 to 1.10) | 0.72 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.55 (0.45 to 0.67) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.47 (1.33 to 1.64) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 1.17 (0.93 to 1.46) | 0.17 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.87 (1.30 to 2.68) | <0.001 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 0.55 (0.33 to 0.89) | 0.016 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.74 (0.63 to 0.86) | <0.001 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.81 (0.68 to 0.97) | 0.024 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.51 (0.34 to 0.77) | 0.001 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.53 (0.41 to 0.68) | <0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | 1.06 (0.83 to 1.34) | 0.65 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.90 (0.80 to 1.02) | 0.092 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.72 (0.54 to 0.96) | 0.023 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.71 (0.60 to 0.84) | <0.001 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.79 (0.65 to 0.95) | 0.012 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Cardiogenic Shock

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 1.50 (1.17 to 1.93) | 0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.16 (0.99 to 1.35) | 0.066 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.19 (0.57 to 2.50) | 0.64 |
| Black | 1.20 (0.87 to 1.66) | 0.26 |
| Hispanic | 1.06 (0.77 to 1.47) | 0.70 |
| Native American | 0.65 (0.15 to 2.86) | 0.57 |
| Other | 1.31 (0.84 to 2.05) | 0.24 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 1.19 (0.96 to 1.49) | 0.11 |
| $66,000 - $87,999 | 0.88 (0.70 to 1.11) | 0.27 |
| $88,000 or more | 0.87 (0.69 to 1.11) | 0.27 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.99 (0.62 to 1.57) | 0.97 |
| Medicare | 0.77 (0.61 to 0.98) | 0.033 |
| Other | 0.78 (0.44 to 1.38) | 0.40 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.61 (0.48 to 0.78) | <0.001 |
| South | 0.67 (0.53 to 0.83) | <0.001 |
| West | 0.71 (0.56 to 0.91) | 0.006 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 1.06 (0.84 to 1.33) | 0.63 |
| Small | 0.81 (0.57 to 1.17) | 0.27 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 2.11 (0.92 to 4.88) | 0.079 |
| Urban, teaching | 2.32 (1.05 to 5.10) | 0.037 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 6.58 (5.54 to 7.81) | <0.001 |
| Charlson comorbidity index | 1.18 (1.12 to 1.25) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 0.76 (0.63 to 0.92) | 0.005 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.92 (0.78 to 1.07) | 0.27 |
| Hypertension |  |  |
| No | — |  |
| Yes | 0.48 (0.38 to 0.60) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | 0.76 (0.62 to 0.93) | 0.009 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.83 (0.70 to 1.0) | 0.044 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 0.68 (0.52 to 0.90) | 0.006 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.51 (1.30 to 1.76) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 2.46 (1.92 to 3.16) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.32 (0.75 to 2.32) | 0.34 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 1.21 (0.63 to 2.32) | 0.57 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.59 (0.45 to 0.76) | <0.001 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.76 (0.59 to 0.98) | 0.036 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.87 (0.55 to 1.39) | 0.56 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.45 (0.31 to 0.66) | <0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | 1.31 (0.95 to 1.79) | 0.10 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.88 (0.74 to 1.05) | 0.15 |
| Dementia |  |  |
| No | — |  |
| Yes | 0.73 (0.48 to 1.11) | 0.15 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.60 (0.46 to 0.79) | <0.001 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.93 (0.72 to 1.21) | 0.60 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

### Permanent Pacemaker Implantation

| **Characteristic** | **OR** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 0.72 (0.60 to 0.88) | 0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.14 (1.06 to 1.23) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.94 (0.69 to 1.28) | 0.68 |
| Black | 0.76 (0.62 to 0.93) | 0.009 |
| Hispanic | 1.05 (0.88 to 1.24) | 0.58 |
| Native American | 1.25 (0.69 to 2.25) | 0.46 |
| Other | 0.73 (0.55 to 0.96) | 0.025 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 1.16 (1.04 to 1.29) | 0.010 |
| $66,000 - $87,999 | 1.10 (0.98 to 1.23) | 0.10 |
| $88,000 or more | 1.15 (1.01 to 1.29) | 0.029 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.80 (0.56 to 1.16) | 0.24 |
| Medicare | 1.04 (0.90 to 1.20) | 0.60 |
| Other | 0.90 (0.67 to 1.19) | 0.45 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 1.05 (0.89 to 1.25) | 0.57 |
| South | 0.94 (0.82 to 1.09) | 0.42 |
| West | 0.99 (0.85 to 1.16) | 0.91 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 0.87 (0.77 to 0.98) | 0.026 |
| Small | 0.74 (0.62 to 0.87) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 1.60 (1.05 to 2.42) | 0.028 |
| Urban, teaching | 1.25 (0.88 to 1.76) | 0.21 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 1.17 (1.06 to 1.29) | 0.002 |
| Charlson comorbidity index | 1.06 (1.02 to 1.09) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | 1.05 (0.96 to 1.14) | 0.32 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | 0.95 (0.88 to 1.03) | 0.23 |
| Hypertension |  |  |
| No | — |  |
| Yes | 1.06 (0.93 to 1.20) | 0.40 |
| Obesity |  |  |
| No | — |  |
| Yes | 1.09 (1.00 to 1.20) | 0.047 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | 0.98 (0.89 to 1.07) | 0.65 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | 1.11 (0.95 to 1.29) | 0.17 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 1.21 (1.12 to 1.31) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 0.85 (0.70 to 1.03) | 0.10 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 1.11 (0.80 to 1.53) | 0.53 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | 0.85 (0.56 to 1.30) | 0.45 |
| Previous PCI |  |  |
| No | — |  |
| Yes | 0.94 (0.86 to 1.03) | 0.20 |
| Previous CABG |  |  |
| No | — |  |
| Yes | 0.90 (0.81 to 1.00) | 0.054 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | 0.05 (0.02 to 0.11) | <0.001 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | 0.27 (0.21 to 0.33) | <0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | 0.80 (0.65 to 0.97) | 0.024 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 1.17 (1.08 to 1.28) | <0.001 |
| Dementia |  |  |
| No | — |  |
| Yes | 1.22 (1.04 to 1.44) | 0.017 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | 0.96 (0.87 to 1.07) | 0.49 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | 0.96 (0.85 to 1.09) | 0.53 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 0.59 (0.33 to 0.86) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | -0.29 (-0.38 to -0.20) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 0.24 (-0.15 to 0.63) | 0.22 |
| Black | 0.78 (0.46 to 1.1) | <0.001 |
| Hispanic | 0.35 (0.09 to 0.61) | 0.009 |
| Native American | -0.53 (-1.2 to 0.09) | 0.10 |
| Other | -0.09 (-0.39 to 0.22) | 0.57 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | 0.03 (-0.10 to 0.17) | 0.63 |
| $66,000 - $87,999 | 0.00 (-0.15 to 0.14) | 0.97 |
| $88,000 or more | 0.00 (-0.15 to 0.15) | >0.99 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 0.73 (0.10 to 1.4) | 0.023 |
| Medicare | 0.03 (-0.16 to 0.22) | 0.75 |
| Other | 0.13 (-0.28 to 0.55) | 0.53 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 0.20 (-0.01 to 0.41) | 0.067 |
| South | 0.00 (-0.19 to 0.19) | 0.99 |
| West | -0.40 (-0.59 to -0.22) | <0.001 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | -0.13 (-0.28 to 0.03) | 0.11 |
| Small | -0.62 (-0.92 to -0.32) | <0.001 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | -0.04 (-0.42 to 0.34) | 0.84 |
| Urban, teaching | -0.06 (-0.39 to 0.27) | 0.72 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 6.2 (5.8 to 6.5) | <0.001 |
| Charlson comorbidity index | 0.56 (0.50 to 0.61) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | -0.72 (-0.85 to -0.59) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | -0.63 (-0.74 to -0.51) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | -0.97 (-1.2 to -0.78) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | -0.08 (-0.19 to 0.04) | 0.18 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | -0.28 (-0.40 to -0.16) | <0.001 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | -1.2 (-1.4 to -0.95) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 0.86 (0.76 to 0.96) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 0.82 (0.41 to 1.2) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 0.66 (0.14 to 1.2) | 0.012 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | -0.54 (-1.2 to 0.08) | 0.085 |
| Previous PCI |  |  |
| No | — |  |
| Yes | -0.39 (-0.48 to -0.29) | <0.001 |
| Previous CABG |  |  |
| No | — |  |
| Yes | -0.32 (-0.43 to -0.21) | <0.001 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | -0.63 (-0.95 to -0.32) | <0.001 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | -0.67 (-0.78 to -0.55) | <0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | -0.13 (-0.34 to 0.08) | 0.23 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 0.03 (-0.09 to 0.15) | 0.58 |
| Dementia |  |  |
| No | — |  |
| Yes | -0.04 (-0.28 to 0.19) | 0.71 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | -0.34 (-0.44 to -0.24) | <0.001 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | -0.68 (-0.82 to -0.54) | <0.001 |
| *1*CI = Confidence Interval | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** **(95% CI)***1* | **p-value** |
| --- | --- | --- |
| Age Groups |  |  |
| Age >=65 y | — |  |
| Age <65 y | 11,784 (3,695 to 19,874) | 0.004 |
| Sex |  |  |
| Female | — |  |
| Male | -2,922 (-5,867 to 23) | 0.052 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 11,749 (-7,354 to 30,852) | 0.23 |
| Black | 5,347 (-4,777 to 15,471) | 0.30 |
| Hispanic | 29,699 (17,137 to 42,262) | <0.001 |
| Native American | -37,959 (-56,342 to -19,575) | <0.001 |
| Other | 14,479 (-4,396 to 33,353) | 0.13 |
| Residential income |  |  |
| $1 - $51,999 | — |  |
| $52,000 - $65,999 | -486 (-5,264 to 4,291) | 0.84 |
| $66,000 - $87,999 | 818 (-4,817 to 6,452) | 0.78 |
| $88,000 or more | 12,636 (3,491 to 21,780) | 0.007 |
| Expected primary payer |  |  |
| Private | — |  |
| Medicaid | 25,839 (-956 to 52,634) | 0.059 |
| Medicare | 8,731 (1,636 to 15,826) | 0.016 |
| Other | 6,815 (-10,302 to 23,933) | 0.43 |
| Hospital region |  |  |
| Midwest | — |  |
| Northeast | 44,011 (27,820 to 60,201) | <0.001 |
| South | 31,939 (22,144 to 41,734) | <0.001 |
| West | 59,144 (40,187 to 78,102) | <0.001 |
| Hospital bedsize |  |  |
| Large | — |  |
| Medium | 10,985 (-4,008 to 25,978) | 0.15 |
| Small | -162 (-18,229 to 17,905) | 0.99 |
| Hospital location and teaching status |  |  |
| Rural | — |  |
| Urban, non-teaching | 55,395 (36,206 to 74,583) | <0.001 |
| Urban, teaching | 52,525 (36,942 to 68,107) | <0.001 |
| Elective procedure status |  |  |
| Elective | — |  |
| Non-elective | 97,112 (87,429 to 106,795) | <0.001 |
| Charlson comorbidity index | 8,897 (6,801 to 10,994) | <0.001 |
| Diabetes Mellitus |  |  |
| No | — |  |
| Yes | -12,331 (-16,296 to -8,366) | <0.001 |
| Previous heart failure |  |  |
| No | — |  |
| Yes | -12,783 (-17,537 to -8,028) | <0.001 |
| Hypertension |  |  |
| No | — |  |
| Yes | -14,483 (-20,978 to -7,988) | <0.001 |
| Obesity |  |  |
| No | — |  |
| Yes | -656 (-4,724 to 3,411) | 0.75 |
| Chronic pulmonary disease |  |  |
| No | — |  |
| Yes | -1,181 (-5,673 to 3,310) | 0.61 |
| Chronic kidney disease |  |  |
| No | — |  |
| Yes | -19,793 (-28,468 to -11,118) | <0.001 |
| Atrial fibrillation |  |  |
| No | — |  |
| Yes | 10,445 (7,041 to 13,849) | <0.001 |
| Liver disease |  |  |
| No | — |  |
| Yes | 28,947 (14,634 to 43,260) | <0.001 |
| Congenital heart disease |  |  |
| No | — |  |
| Yes | 25,041 (6,072 to 44,010) | 0.010 |
| Bicuspid aortic valve |  |  |
| No | — |  |
| Yes | -24,005 (-45,584 to -2,426) | 0.029 |
| Previous PCI |  |  |
| No | — |  |
| Yes | -6,418 (-10,371 to -2,466) | 0.001 |
| Previous CABG |  |  |
| No | — |  |
| Yes | -1,992 (-6,225 to 2,241) | 0.36 |
| Previous ICD insertion |  |  |
| No | — |  |
| Yes | -13,069 (-22,284 to -3,854) | 0.005 |
| Previous PPM or CRT insertion |  |  |
| No | — |  |
| Yes | -11,984 (-16,333 to -7,634) | <0.001 |
| Smoking status |  |  |
| No | — |  |
| Yes | -352 (-8,466 to 7,762) | 0.93 |
| Coronary artery disease |  |  |
| No | — |  |
| Yes | 611 (-3,937 to 5,159) | 0.79 |
| Dementia |  |  |
| No | — |  |
| Yes | -6,054 (-13,569 to 1,462) | 0.11 |
| Previous stroke/TIA |  |  |
| No | — |  |
| Yes | -7,898 (-11,357 to -4,439) | <0.001 |
| Previous myocardial infarction |  |  |
| No | — |  |
| Yes | -15,247 (-20,113 to -10,381) | <0.001 |
| *1*CI = Confidence Interval | | |