Racial Disparities in the Management and Outcomes of Cancer and Comorbid Heart Failure

Analysis for RCOP NIS Med3

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## Preamble:

* **Study Objective**: Examine racial disparities in patients with cancer and heart failure.
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection**: Included all inpatient admissions with a diagnosis of cancer and heart failure.
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* **Secondary Outcomes**:
  + Cardiac Arrest
  + Cardiogenic Shock
  + Acute Kidney Injury
  + Acute Respiratory Failure
* **Statistical Analysis**: Multiple logistic and linear regression to determine racial disparities in in-hospital mortality, length of stay, total charges (inflation adjusted), and complications, respectively, adjusted for:
  + Demographics: Age, sex, race, residential income, insurance, hospital region.
  + Medical History: Hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease, peripheral vascular disease, chronic kidney disease, chronic obstructive pulmonary disease, cerebrovascular disease, and liver disease.
  + 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 = 842,850*1* | **White** N = 628,090*1* | **Asian or Pacific Islander** N = 16,970*1* | **Black** N = 126,660*1* | **Hispanic** N = 50,240*1* | **Native American** N = 3,345*1* | **Other** N = 17,545*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Age, y | 76 (67, 83) | 77 (69, 84) | 76 (68, 83) | 70 (62, 78) | 73 (64, 82) | 71 (63, 79) | 74 (66, 82) | <0.001 |
| Sex |  |  |  |  |  |  |  | <0.001 |
| Female | 357,175 (42%) | 258,035 (41%) | 7,105 (42%) | 61,390 (48%) | 21,630 (43%) | 1,630 (49%) | 7,385 (42%) |  |
| Male | 485,665 (58%) | 370,055 (59%) | 9,865 (58%) | 65,265 (52%) | 28,610 (57%) | 1,715 (51%) | 10,155 (58%) |  |
| Income quartile by ZIP |  |  |  |  |  |  |  | <0.001 |
| $1 - $51,999 | 235,135 (28%) | 143,270 (23%) | 1,830 (11%) | 65,800 (53%) | 18,295 (37%) | 1,445 (46%) | 4,495 (26%) |  |
| $52,000 - $65,999 | 218,600 (26%) | 171,710 (28%) | 3,035 (18%) | 26,525 (21%) | 12,640 (26%) | 885 (28%) | 3,805 (22%) |  |
| $66,000 - $87,999 | 202,310 (24%) | 161,585 (26%) | 4,750 (28%) | 20,045 (16%) | 11,260 (23%) | 555 (18%) | 4,115 (24%) |  |
| $88,000 or more | 174,440 (21%) | 142,720 (23%) | 7,200 (43%) | 12,445 (10.0%) | 7,110 (14%) | 275 (8.7%) | 4,690 (27%) |  |
| Healthcare payer |  |  |  |  |  |  |  | <0.001 |
| Medicaid | 45,940 (5.5%) | 21,160 (3.4%) | 1,710 (10%) | 14,315 (11%) | 6,465 (13%) | 450 (14%) | 1,840 (11%) |  |
| Medicare | 675,180 (80%) | 520,420 (83%) | 12,440 (73%) | 91,195 (72%) | 35,850 (71%) | 2,400 (72%) | 12,875 (73%) |  |
| No charge | 695 (<0.1%) | 390 (<0.1%) | 20 (0.1%) | 170 (0.1%) | 85 (0.2%) | 5 (0.2%) | 25 (0.1%) |  |
| Other | 17,455 (2.1%) | 13,170 (2.1%) | 220 (1.3%) | 2,610 (2.1%) | 890 (1.8%) | 180 (5.4%) | 385 (2.2%) |  |
| Private | 94,600 (11%) | 67,950 (11%) | 2,405 (14%) | 16,210 (13%) | 5,665 (11%) | 280 (8.4%) | 2,090 (12%) |  |
| Self-pay | 8,200 (1.0%) | 4,455 (0.7%) | 170 (1.0%) | 1,995 (1.6%) | 1,265 (2.5%) | 10 (0.3%) | 305 (1.7%) |  |
| Hospital region |  |  |  |  |  |  |  | <0.001 |
| Midwest | 210,225 (25%) | 173,515 (28%) | 1,620 (9.5%) | 28,785 (23%) | 3,665 (7.3%) | 795 (24%) | 1,845 (11%) |  |
| Northeast | 172,580 (20%) | 133,360 (21%) | 2,710 (16%) | 21,315 (17%) | 9,435 (19%) | 230 (6.9%) | 5,530 (32%) |  |
| South | 316,220 (38%) | 220,880 (35%) | 2,460 (14%) | 65,610 (52%) | 19,850 (40%) | 1,195 (36%) | 6,225 (35%) |  |
| West | 143,825 (17%) | 100,335 (16%) | 10,180 (60%) | 10,950 (8.6%) | 17,290 (34%) | 1,125 (34%) | 3,945 (22%) |  |
| Cancer type |  |  |  |  |  |  |  | <0.001 |
| Thyroid | 3,200 (0.4%) | 2,150 (0.3%) | 130 (0.8%) | 430 (0.3%) | 355 (0.7%) | 35 (1.0%) | 100 (0.6%) |  |
| Bone and articular cartilage | 2,095 (0.2%) | 1,540 (0.2%) | 55 (0.3%) | 285 (0.2%) | 165 (0.3%) | 10 (0.3%) | 40 (0.2%) |  |
| Breast | 44,465 (5.3%) | 30,450 (4.9%) | 865 (5.1%) | 9,400 (7.4%) | 2,650 (5.3%) | 240 (7.2%) | 860 (4.9%) |  |
| Central nervous system | 7,170 (0.9%) | 5,445 (0.9%) | 175 (1.0%) | 875 (0.7%) | 460 (0.9%) | 15 (0.4%) | 200 (1.1%) |  |
| Gastrointestinal tract | 127,715 (15%) | 92,490 (15%) | 3,505 (21%) | 18,455 (15%) | 9,830 (20%) | 720 (22%) | 2,715 (16%) |  |
| Genital organs | 85,760 (10%) | 59,955 (9.6%) | 1,645 (9.7%) | 16,770 (13%) | 5,560 (11%) | 205 (6.1%) | 1,625 (9.3%) |  |
| Head and neck | 19,820 (2.4%) | 14,935 (2.4%) | 290 (1.7%) | 3,055 (2.4%) | 1,010 (2.0%) | 75 (2.2%) | 455 (2.6%) |  |
| Hodgkin Lymphoma | 8,160 (1.0%) | 5,945 (1.0%) | 130 (0.8%) | 1,210 (1.0%) | 600 (1.2%) | 20 (0.6%) | 255 (1.5%) |  |
| Leukemia | 141,400 (17%) | 112,815 (18%) | 2,510 (15%) | 14,820 (12%) | 7,470 (15%) | 355 (11%) | 3,430 (20%) |  |
| Lung | 136,845 (16%) | 107,785 (17%) | 2,180 (13%) | 18,850 (15%) | 5,220 (10%) | 595 (18%) | 2,215 (13%) |  |
| Melanoma | 5,000 (0.6%) | 4,615 (0.7%) | 30 (0.2%) | 115 (<0.1%) | 195 (0.4%) | 20 (0.6%) | 25 (0.1%) |  |
| Mesothelium and soft tissue | 12,655 (1.5%) | 8,770 (1.4%) | 300 (1.8%) | 2,380 (1.9%) | 855 (1.7%) | 45 (1.3%) | 305 (1.7%) |  |
| Multiple Myeloma | 83,895 (10.0%) | 52,165 (8.3%) | 1,675 (9.9%) | 22,145 (18%) | 5,770 (12%) | 320 (9.6%) | 1,820 (10%) |  |
| Neuroendocrine | 290 (<0.1%) | 230 (<0.1%) | 0 (0%) | 35 (<0.1%) | 10 (<0.1%) | 0 (0%) | 15 (<0.1%) |  |
| Non-Hodgkin Lymphoma | 88,900 (11%) | 69,980 (11%) | 2,120 (13%) | 8,675 (6.9%) | 5,830 (12%) | 350 (10%) | 1,945 (11%) |  |
| Others | 7,550 (0.9%) | 5,895 (0.9%) | 180 (1.1%) | 900 (0.7%) | 370 (0.7%) | 30 (0.9%) | 175 (1.0%) |  |
| Renal | 64,785 (7.7%) | 50,550 (8.1%) | 1,115 (6.6%) | 7,890 (6.2%) | 3,650 (7.3%) | 300 (9.0%) | 1,280 (7.3%) |  |
| Charlson comorbidity index | 5.00 (4.00, 7.00) | 5.00 (4.00, 7.00) | 6.00 (4.00, 7.00) | 6.00 (5.00, 7.00) | 6.00 (4.00, 7.00) | 6.00 (4.00, 7.00) | 5.00 (4.00, 7.00) | <0.001 |
| Hypertension | 731,540 (87%) | 538,420 (86%) | 14,600 (86%) | 116,635 (92%) | 44,265 (88%) | 2,720 (81%) | 14,900 (85%) | <0.001 |
| Diabetes mellitus | 347,760 (41%) | 241,190 (38%) | 8,775 (52%) | 61,185 (48%) | 27,210 (54%) | 1,620 (48%) | 7,780 (44%) | <0.001 |
| Chronic kidney disease | 366,160 (43%) | 259,085 (41%) | 8,500 (50%) | 66,805 (53%) | 23,135 (46%) | 1,415 (42%) | 7,220 (41%) | <0.001 |
| Liver disease | 67,845 (8.0%) | 45,075 (7.2%) | 2,125 (13%) | 11,170 (8.8%) | 7,195 (14%) | 455 (14%) | 1,825 (10%) | <0.001 |
| COPD | 344,995 (41%) | 267,035 (43%) | 4,760 (28%) | 49,965 (39%) | 15,695 (31%) | 1,485 (44%) | 6,055 (35%) | <0.001 |
| Peripheral vascular disease | 136,590 (16%) | 103,910 (17%) | 2,695 (16%) | 19,590 (15%) | 7,605 (15%) | 340 (10%) | 2,450 (14%) | <0.001 |
| Atrial fibrillation | 317,755 (38%) | 258,465 (41%) | 5,590 (33%) | 32,130 (25%) | 14,945 (30%) | 1,020 (30%) | 5,605 (32%) | <0.001 |
| Cerebrovascular disease | 61,770 (7.3%) | 43,640 (6.9%) | 1,415 (8.3%) | 11,425 (9.0%) | 3,690 (7.3%) | 195 (5.8%) | 1,405 (8.0%) | <0.001 |
| Hyperlipidemia | 435,160 (52%) | 331,140 (53%) | 9,085 (54%) | 59,655 (47%) | 25,120 (50%) | 1,475 (44%) | 8,685 (50%) | <0.001 |
| Coronary artery disease | 372,555 (44%) | 290,495 (46%) | 6,890 (41%) | 45,930 (36%) | 20,215 (40%) | 1,440 (43%) | 7,585 (43%) | <0.001 |
| Tobbacco use disorder | 4,340 (0.5%) | 3,095 (0.5%) | 40 (0.2%) | 820 (0.6%) | 225 (0.4%) | 40 (1.2%) | 120 (0.7%) | 0.001 |
| Alcohol use disorder | 246,765 (29%) | 181,785 (29%) | 4,770 (28%) | 39,300 (31%) | 15,065 (30%) | 1,235 (37%) | 4,610 (26%) | 0.014 |
| *1*Median (Q1, Q3); n (%) | | | | | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | | | | | |

## Outcomes Table:

| **Characteristic** | **White** N = 628,090*1* | **Asian or Pacific Islander** N = 16,970*1* | **Black** N = 126,660*1* | **Hispanic** N = 50,240*1* | **Native American** N = 3,345*1* | **Other** N = 17,545*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Died during hospitalization | 46,355 (7.4%) | 1,630 (9.6%) | 8,465 (6.7%) | 3,935 (7.8%) | 320 (9.6%) | 1,560 (8.9%) | <0.001 |
| Length of stay (days) | 5 (3, 9) | 5 (3, 9) | 5 (3, 9) | 5 (3, 9) | 5 (3, 8) | 6 (3, 10) | <0.001 |
| Inflation-adjusted total charge ($) | 49,660 (26,500, 97,908) | 70,571 (39,140, 141,009) | 51,735 (27,638, 102,034) | 71,583 (38,151, 141,861) | 43,797 (24,454, 84,694) | 68,111 (34,785, 142,815) | <0.001 |
| Cardiac Arrest | 8,905 (1.4%) | 370 (2.2%) | 2,775 (2.2%) | 1,030 (2.1%) | 90 (2.7%) | 385 (2.2%) | <0.001 |
| Cardiogenic Shock | 12,255 (2.0%) | 525 (3.1%) | 2,495 (2.0%) | 1,010 (2.0%) | 70 (2.1%) | 375 (2.1%) | 0.001 |
| Acute Kidney Injury | 219,725 (35%) | 6,710 (40%) | 49,420 (39%) | 19,145 (38%) | 1,195 (36%) | 6,815 (39%) | <0.001 |
| Acute Respiratory Failure | 120,060 (19%) | 3,745 (22%) | 20,760 (16%) | 10,115 (20%) | 625 (19%) | 3,535 (20%) | <0.001 |
| *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***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.24 | 1.09, 1.40 | <0.001 |
| Black | 1.01 | 0.95, 1.08 | 0.7 |
| Hispanic | 1.05 | 0.97, 1.14 | 0.2 |
| Native American | 1.28 | 0.98, 1.66 | 0.066 |
| Other | 1.20 | 1.06, 1.36 | 0.004 |
| Age, y | 1.02 | 1.02, 1.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.15 | 1.10, 1.20 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.94 | 0.89, 0.99 | 0.030 |
| $66,000 - $87,999 | 0.95 | 0.90, 1.01 | 0.10 |
| $88,000 or more | 0.95 | 0.89, 1.00 | 0.070 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.96 | 0.87, 1.06 | 0.4 |
| No charge | 1.05 | 0.49, 2.25 | >0.9 |
| Other | 2.06 | 1.78, 2.38 | <0.001 |
| Private | 1.42 | 1.28, 1.58 | <0.001 |
| Self-pay | 1.40 | 1.15, 1.72 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.19 | 1.12, 1.27 | <0.001 |
| South | 1.03 | 0.98, 1.09 | 0.3 |
| West | 1.17 | 1.09, 1.24 | <0.001 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 1.58 | 0.93, 2.67 | 0.089 |
| Breast | 0.91 | 0.61, 1.35 | 0.6 |
| Central nervous system | 1.64 | 1.08, 2.51 | 0.022 |
| Gastrointestinal tract | 1.35 | 0.92, 1.98 | 0.12 |
| Genital organs | 0.95 | 0.64, 1.40 | 0.8 |
| Head and neck | 1.37 | 0.91, 2.05 | 0.13 |
| Hodgkin Lymphoma | 1.98 | 1.30, 3.00 | 0.001 |
| Leukemia | 1.75 | 1.20, 2.57 | 0.004 |
| Lung | 2.02 | 1.38, 2.96 | <0.001 |
| Melanoma | 1.08 | 0.68, 1.74 | 0.7 |
| Mesothelium and soft tissue | 1.47 | 0.98, 2.21 | 0.065 |
| Multiple Myeloma | 1.39 | 0.95, 2.05 | 0.090 |
| Neuroendocrine | 1.24 | 0.41, 3.76 | 0.7 |
| Non-Hodgkin Lymphoma | 1.60 | 1.09, 2.36 | 0.016 |
| Others | 1.36 | 0.88, 2.10 | 0.2 |
| Renal | 0.98 | 0.67, 1.45 | >0.9 |
| Charlson comorbidity index | 1.03 | 1.01, 1.06 | 0.008 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.64, 0.71 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.82, 0.91 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.95, 1.09 | 0.7 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.65 | 0.62, 0.67 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.77, 0.84 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.22 | 2.07, 2.38 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.88, 0.97 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.81, 0.91 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.11 | 1.07, 1.16 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.51 | 1.41, 1.62 | <0.001 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

### Cardiac Arrest:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.37 | 1.07, 1.76 | 0.013 |
| Black | 1.48 | 1.32, 1.65 | <0.001 |
| Hispanic | 1.26 | 1.07, 1.48 | 0.005 |
| Native American | 1.59 | 0.96, 2.61 | 0.070 |
| Other | 1.45 | 1.12, 1.88 | 0.005 |
| Age, y | 0.99 | 0.99, 1.00 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.28 | 1.17, 1.39 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.00 | 0.90, 1.11 | >0.9 |
| $66,000 - $87,999 | 0.98 | 0.88, 1.09 | 0.7 |
| $88,000 or more | 1.00 | 0.89, 1.13 | >0.9 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.02 | 0.86, 1.21 | 0.8 |
| No charge | 0.72 | 0.18, 2.92 | 0.6 |
| Other | 1.06 | 0.79, 1.41 | 0.7 |
| Private | 1.13 | 0.93, 1.36 | 0.2 |
| Self-pay | 1.37 | 0.98, 1.92 | 0.067 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.87 | 0.76, 0.99 | 0.035 |
| South | 1.19 | 1.07, 1.33 | <0.001 |
| West | 1.20 | 1.05, 1.36 | 0.006 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 1.04 | 0.44, 2.47 | >0.9 |
| Breast | 0.83 | 0.47, 1.47 | 0.5 |
| Central nervous system | 0.64 | 0.32, 1.31 | 0.2 |
| Gastrointestinal tract | 0.71 | 0.41, 1.24 | 0.2 |
| Genital organs | 0.63 | 0.36, 1.11 | 0.11 |
| Head and neck | 0.84 | 0.46, 1.53 | 0.6 |
| Hodgkin Lymphoma | 0.55 | 0.27, 1.10 | 0.093 |
| Leukemia | 0.79 | 0.45, 1.37 | 0.4 |
| Lung | 0.97 | 0.56, 1.69 | >0.9 |
| Melanoma | 0.98 | 0.48, 2.02 | >0.9 |
| Mesothelium and soft tissue | 0.85 | 0.46, 1.57 | 0.6 |
| Multiple Myeloma | 0.78 | 0.45, 1.36 | 0.4 |
| Neuroendocrine | 0.00 | 0.00, 0.00 | <0.001 |
| Non-Hodgkin Lymphoma | 0.79 | 0.46, 1.38 | 0.4 |
| Others | 0.60 | 0.29, 1.23 | 0.2 |
| Renal | 0.70 | 0.40, 1.23 | 0.2 |
| Charlson comorbidity index | 0.96 | 0.91, 1.01 | 0.10 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.81 | 0.72, 0.90 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 1.10 | 0.99, 1.23 | 0.082 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.28 | 1.11, 1.48 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.65, 0.76 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.93, 1.10 | 0.8 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.03 | 1.75, 2.36 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.82, 0.99 | 0.030 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.79, 1.02 | 0.091 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.21 | 1.11, 1.31 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.28 | 1.10, 1.50 | 0.002 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

### Cardiogenic Shock:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.33 | 1.07, 1.65 | 0.010 |
| Black | 0.97 | 0.87, 1.09 | 0.6 |
| Hispanic | 0.86 | 0.73, 1.00 | 0.054 |
| Native American | 0.94 | 0.53, 1.67 | 0.8 |
| Other | 0.97 | 0.77, 1.24 | 0.8 |
| Age, y | 0.98 | 0.97, 0.98 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.32 | 1.22, 1.42 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.00 | 0.91, 1.10 | >0.9 |
| $66,000 - $87,999 | 1.10 | 0.99, 1.22 | 0.071 |
| $88,000 or more | 1.10 | 0.99, 1.23 | 0.077 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.15 | 0.99, 1.35 | 0.070 |
| No charge | 0.64 | 0.17, 2.38 | 0.5 |
| Other | 1.20 | 0.91, 1.59 | 0.2 |
| Private | 1.41 | 1.20, 1.66 | <0.001 |
| Self-pay | 0.93 | 0.62, 1.39 | 0.7 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.99 | 0.87, 1.11 | 0.8 |
| South | 0.99 | 0.89, 1.11 | >0.9 |
| West | 1.19 | 1.05, 1.35 | 0.005 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 0.81 | 0.39, 1.71 | 0.6 |
| Breast | 0.69 | 0.43, 1.11 | 0.13 |
| Central nervous system | 0.40 | 0.21, 0.76 | 0.005 |
| Gastrointestinal tract | 0.46 | 0.29, 0.73 | <0.001 |
| Genital organs | 0.62 | 0.39, 0.97 | 0.037 |
| Head and neck | 0.67 | 0.40, 1.10 | 0.11 |
| Hodgkin Lymphoma | 1.10 | 0.66, 1.83 | 0.7 |
| Leukemia | 0.66 | 0.42, 1.04 | 0.071 |
| Lung | 0.62 | 0.39, 0.98 | 0.043 |
| Melanoma | 0.69 | 0.36, 1.30 | 0.2 |
| Mesothelium and soft tissue | 0.71 | 0.42, 1.20 | 0.2 |
| Multiple Myeloma | 0.65 | 0.41, 1.03 | 0.068 |
| Neuroendocrine | 0.87 | 0.19, 4.03 | 0.9 |
| Non-Hodgkin Lymphoma | 0.75 | 0.48, 1.18 | 0.2 |
| Others | 0.86 | 0.50, 1.47 | 0.6 |
| Renal | 0.62 | 0.39, 0.99 | 0.046 |
| Charlson comorbidity index | 0.98 | 0.94, 1.02 | 0.3 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.62, 0.75 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.77, 0.93 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.23 | 1.09, 1.38 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.70, 0.82 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.31 | 1.21, 1.42 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 3.13 | 2.76, 3.54 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | 0.74 | 0.68, 0.81 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.22 | 1.10, 1.35 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.31 | 1.21, 1.41 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.23 | 1.07, 1.42 | 0.003 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

### Acute Kidney Injury:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.05 | 0.97, 1.13 | 0.3 |
| Black | 1.06 | 1.03, 1.10 | <0.001 |
| Hispanic | 1.02 | 0.98, 1.08 | 0.3 |
| Native American | 1.02 | 0.86, 1.21 | 0.9 |
| Other | 1.16 | 1.07, 1.25 | <0.001 |
| Age, y | 1.01 | 1.01, 1.01 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.16 | 1.14, 1.19 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.98 | 0.95, 1.01 | 0.3 |
| $66,000 - $87,999 | 1.01 | 0.98, 1.04 | 0.4 |
| $88,000 or more | 1.03 | 1.00, 1.07 | 0.056 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.98 | 0.93, 1.03 | 0.4 |
| No charge | 1.01 | 0.72, 1.42 | >0.9 |
| Other | 1.04 | 0.95, 1.14 | 0.4 |
| Private | 1.11 | 1.05, 1.18 | <0.001 |
| Self-pay | 1.18 | 1.05, 1.33 | 0.005 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.05 | 1.01, 1.09 | 0.021 |
| South | 1.05 | 1.01, 1.08 | 0.007 |
| West | 1.02 | 0.98, 1.06 | 0.3 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 1.09 | 0.82, 1.46 | 0.6 |
| Breast | 1.18 | 0.98, 1.42 | 0.084 |
| Central nervous system | 0.88 | 0.70, 1.10 | 0.3 |
| Gastrointestinal tract | 1.29 | 1.07, 1.55 | 0.007 |
| Genital organs | 1.35 | 1.12, 1.63 | 0.001 |
| Head and neck | 1.08 | 0.89, 1.31 | 0.4 |
| Hodgkin Lymphoma | 1.43 | 1.16, 1.77 | <0.001 |
| Leukemia | 1.48 | 1.23, 1.78 | <0.001 |
| Lung | 1.13 | 0.94, 1.35 | 0.2 |
| Melanoma | 1.03 | 0.82, 1.30 | 0.8 |
| Mesothelium and soft tissue | 1.19 | 0.97, 1.46 | 0.089 |
| Multiple Myeloma | 1.55 | 1.29, 1.86 | <0.001 |
| Neuroendocrine | 2.11 | 1.21, 3.70 | 0.009 |
| Non-Hodgkin Lymphoma | 1.45 | 1.21, 1.75 | <0.001 |
| Others | 1.34 | 1.09, 1.66 | 0.006 |
| Renal | 1.64 | 1.36, 1.97 | <0.001 |
| Charlson comorbidity index | 1.05 | 1.04, 1.06 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.98, 1.05 | 0.5 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.96, 1.02 | 0.5 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 2.67 | 2.57, 2.78 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.81, 0.85 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.87 | 0.85, 0.89 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 1.61 | 1.54, 1.68 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.83, 0.88 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.87, 0.92 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.04 | 1.02, 1.07 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.91, 1.00 | 0.049 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

### Acute Respiratory Failure:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.15 | 1.06, 1.26 | 0.002 |
| Black | 0.86 | 0.82, 0.89 | <0.001 |
| Hispanic | 1.08 | 1.02, 1.14 | 0.012 |
| Native American | 0.98 | 0.80, 1.21 | 0.9 |
| Other | 1.07 | 0.97, 1.17 | 0.2 |
| Age, y | 1.00 | 1.00, 1.01 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.05 | 1.02, 1.08 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.03 | 0.99, 1.06 | 0.2 |
| $66,000 - $87,999 | 1.07 | 1.03, 1.11 | <0.001 |
| $88,000 or more | 1.08 | 1.04, 1.12 | <0.001 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 1.07 | 1.00, 1.14 | 0.048 |
| No charge | 0.78 | 0.49, 1.26 | 0.3 |
| Other | 1.12 | 1.00, 1.24 | 0.046 |
| Private | 1.18 | 1.10, 1.27 | <0.001 |
| Self-pay | 1.08 | 0.94, 1.24 | 0.3 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.90 | 0.86, 0.95 | <0.001 |
| South | 1.01 | 0.97, 1.05 | 0.7 |
| West | 1.09 | 1.04, 1.14 | <0.001 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 0.90 | 0.64, 1.25 | 0.5 |
| Breast | 0.91 | 0.74, 1.12 | 0.4 |
| Central nervous system | 0.83 | 0.65, 1.07 | 0.15 |
| Gastrointestinal tract | 0.78 | 0.64, 0.96 | 0.019 |
| Genital organs | 0.80 | 0.66, 0.99 | 0.038 |
| Head and neck | 1.14 | 0.92, 1.42 | 0.2 |
| Hodgkin Lymphoma | 1.07 | 0.85, 1.36 | 0.6 |
| Leukemia | 1.11 | 0.91, 1.37 | 0.3 |
| Lung | 1.11 | 0.91, 1.37 | 0.3 |
| Melanoma | 0.83 | 0.64, 1.08 | 0.2 |
| Mesothelium and soft tissue | 0.90 | 0.72, 1.13 | 0.4 |
| Multiple Myeloma | 1.02 | 0.83, 1.25 | 0.8 |
| Neuroendocrine | 0.80 | 0.39, 1.65 | 0.6 |
| Non-Hodgkin Lymphoma | 0.98 | 0.80, 1.20 | 0.8 |
| Others | 0.94 | 0.74, 1.20 | 0.6 |
| Renal | 0.79 | 0.64, 0.97 | 0.027 |
| Charlson comorbidity index | 1.04 | 1.03, 1.06 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.86, 0.92 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.88 | 0.84, 0.91 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.85, 0.93 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.84, 0.89 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.82 | 0.80, 0.84 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 1.20 | 1.14, 1.27 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.96, 1.02 | 0.5 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.80, 0.86 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.98, 1.03 | 0.6 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.09 | 1.03, 1.14 | 0.002 |
| *1*OR = Odds Ratio, CI = Confidence Interval | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.2 | 0.72, 1.6 | <0.001 |
| Black | 0.41 | 0.27, 0.56 | <0.001 |
| Hispanic | 0.45 | 0.23, 0.67 | <0.001 |
| Native American | -0.45 | -1.0, 0.13 | 0.13 |
| Other | 1.2 | 0.79, 1.6 | <0.001 |
| Age, y | -0.06 | -0.06, -0.05 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.03 | -0.06, 0.12 | 0.6 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.05 | -0.16, 0.06 | 0.4 |
| $66,000 - $87,999 | 0.12 | 0.00, 0.25 | 0.051 |
| $88,000 or more | 0.28 | 0.13, 0.42 | <0.001 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -0.29 | -0.58, 0.01 | 0.055 |
| No charge | 0.61 | -1.2, 2.4 | 0.5 |
| Other | -0.53 | -1.0, -0.04 | 0.033 |
| Private | 0.08 | -0.26, 0.42 | 0.6 |
| Self-pay | -0.72 | -1.3, -0.17 | 0.010 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.77 | 0.59, 0.95 | <0.001 |
| South | 0.40 | 0.26, 0.54 | <0.001 |
| West | -0.05 | -0.24, 0.14 | 0.6 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 1.7 | 0.61, 2.7 | 0.002 |
| Breast | -0.46 | -1.2, 0.28 | 0.2 |
| Central nervous system | 1.7 | 0.84, 2.6 | <0.001 |
| Gastrointestinal tract | 1.4 | 0.62, 2.1 | <0.001 |
| Genital organs | -0.05 | -0.79, 0.68 | 0.9 |
| Head and neck | 2.5 | 1.7, 3.3 | <0.001 |
| Hodgkin Lymphoma | 0.78 | -0.11, 1.7 | 0.087 |
| Leukemia | 1.4 | 0.69, 2.2 | <0.001 |
| Lung | 0.34 | -0.39, 1.1 | 0.4 |
| Melanoma | -0.06 | -0.88, 0.76 | 0.9 |
| Mesothelium and soft tissue | 0.73 | -0.07, 1.5 | 0.072 |
| Multiple Myeloma | 0.63 | -0.10, 1.4 | 0.092 |
| Neuroendocrine | 2.8 | -0.14, 5.8 | 0.062 |
| Non-Hodgkin Lymphoma | 1.0 | 0.31, 1.8 | 0.005 |
| Others | 0.66 | -0.17, 1.5 | 0.12 |
| Renal | 0.39 | -0.34, 1.1 | 0.3 |
| Charlson comorbidity index | 0.34 | 0.27, 0.40 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -0.54 | -0.70, -0.38 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | -0.68 | -0.82, -0.54 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -0.53 | -0.70, -0.35 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -0.92 | -1.0, -0.83 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -0.82 | -0.90, -0.74 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 0.20 | 0.00, 0.40 | 0.047 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | -0.57 | -0.67, -0.46 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -0.70 | -0.82, -0.58 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 0.33 | 0.24, 0.41 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.3 | 1.1, 1.6 | <0.001 |
| *1*CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 25,108 | 15,407, 34,809 | <0.001 |
| Black | 3,230 | 332, 6,129 | 0.029 |
| Hispanic | 26,711 | 21,296, 32,125 | <0.001 |
| Native American | -23,795 | -32,372, -15,217 | <0.001 |
| Other | 31,587 | 22,901, 40,274 | <0.001 |
| Age, y | -1,683 | -1,845, -1,522 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 5,344 | 3,620, 7,067 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1,352 | -828, 3,531 | 0.2 |
| $66,000 - $87,999 | 5,692 | 3,240, 8,144 | <0.001 |
| $88,000 or more | 15,367 | 11,779, 18,955 | <0.001 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 9,372 | 3,905, 14,840 | <0.001 |
| No charge | 244 | -23,897, 24,386 | >0.9 |
| Other | 4,465 | -4,155, 13,085 | 0.3 |
| Private | 18,577 | 11,730, 25,424 | <0.001 |
| Self-pay | -13,370 | -21,453, -5,287 | 0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 22,019 | 16,910, 27,129 | <0.001 |
| South | 14,036 | 10,804, 17,268 | <0.001 |
| West | 49,215 | 41,412, 57,018 | <0.001 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 23,216 | 847, 45,584 | 0.042 |
| Breast | -17,008 | -28,925, -5,090 | 0.005 |
| Central nervous system | 9,955 | -3,647, 23,557 | 0.2 |
| Gastrointestinal tract | 7,669 | -4,380, 19,718 | 0.2 |
| Genital organs | -9,690 | -21,644, 2,263 | 0.11 |
| Head and neck | 32,384 | 18,231, 46,538 | <0.001 |
| Hodgkin Lymphoma | 2,635 | -12,010, 17,280 | 0.7 |
| Leukemia | 11,791 | -529, 24,111 | 0.061 |
| Lung | -7,067 | -19,052, 4,917 | 0.2 |
| Melanoma | -9,352 | -22,872, 4,168 | 0.2 |
| Mesothelium and soft tissue | 707 | -12,879, 14,294 | >0.9 |
| Multiple Myeloma | -5,908 | -18,006, 6,191 | 0.3 |
| Neuroendocrine | 42,689 | -29,846, 115,223 | 0.2 |
| Non-Hodgkin Lymphoma | 8,086 | -3,999, 20,172 | 0.2 |
| Others | 1,365 | -12,681, 15,411 | 0.8 |
| Renal | -2,032 | -14,027, 9,964 | 0.7 |
| Charlson comorbidity index | 2,617 | 1,471, 3,764 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -9,751 | -13,047, -6,455 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | -9,679 | -12,105, -7,253 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -7,838 | -10,924, -4,751 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -9,005 | -10,609, -7,400 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -4,457 | -5,951, -2,964 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 15,624 | 11,239, 20,009 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | -9,524 | -11,559, -7,489 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -6,670 | -8,883, -4,456 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 3,356 | 1,761, 4,952 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 26,042 | 22,215, 29,870 | <0.001 |
| *1*CI = Confidence Interval | | | |