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 ($)
* **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.
  + Medical History: Hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease, peripheral vascular disease, chronic kidney disease, chronic obstructive pulmonary disease, liver disease, tobacco and alcohol use disorder.
  + 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 = 7,885*1* | **White** N = 5,280*1* | **Black** N = 2,030*1* | **Hispanic** N = 575*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- |
| Age, y | 71 (62, 78) | 72 (65, 80) | 68 (59, 76) | 66 (60, 74) | <0.001 |
| Sex |  |  |  |  | 0.004 |
| Female | 2,840 (36%) | 1,745 (33%) | 840 (41%) | 255 (44%) |  |
| Male | 5,045 (64%) | 3,535 (67%) | 1,190 (59%) | 320 (56%) |  |
| Income quartile by ZIP |  |  |  |  | <0.001 |
| $1 - $51,999 | 1,670 (21%) | 625 (12%) | 860 (43%) | 185 (34%) |  |
| $52,000 - $65,999 | 1,840 (24%) | 1,240 (24%) | 465 (23%) | 135 (25%) |  |
| $66,000 - $87,999 | 2,095 (27%) | 1,580 (30%) | 385 (19%) | 130 (24%) |  |
| $88,000 or more | 2,170 (28%) | 1,765 (34%) | 305 (15%) | 100 (18%) |  |
| Healthcare payer |  |  |  |  | <0.001 |
| Medicaid | 445 (5.7%) | 140 (2.7%) | 190 (9.4%) | 115 (20%) |  |
| Medicare | 5,390 (68%) | 3,865 (73%) | 1,225 (60%) | 300 (52%) |  |
| No charge | 5 (<0.1%) | 5 (<0.1%) | 0 (0%) | 0 (0%) |  |
| Other | 110 (1.4%) | 65 (1.2%) | 35 (1.7%) | 10 (1.7%) |  |
| Private | 1,840 (23%) | 1,165 (22%) | 535 (26%) | 140 (24%) |  |
| Self-pay | 80 (1.0%) | 30 (0.6%) | 40 (2.0%) | 10 (1.7%) |  |
| Charlson comorbidity index | 4.00 (3.00, 6.00) | 4.00 (3.00, 5.00) | 5.00 (3.00, 6.00) | 5.00 (3.00, 6.00) | <0.001 |
| Hypertension | 5,960 (76%) | 3,810 (72%) | 1,685 (83%) | 465 (81%) | <0.001 |
| Diabetes mellitus | 1,985 (25%) | 1,095 (21%) | 625 (31%) | 265 (46%) | <0.001 |
| Chronic kidney disease | 4,965 (63%) | 3,230 (61%) | 1,395 (69%) | 340 (59%) | 0.022 |
| Dialysis dependence | 680 (8.6%) | 380 (7.2%) | 255 (13%) | 45 (7.8%) | 0.005 |
| Liver disease | 640 (8.1%) | 310 (5.9%) | 225 (11%) | 105 (18%) | <0.001 |
| COPD | 1,590 (20%) | 1,045 (20%) | 445 (22%) | 100 (17%) | 0.5 |
| Peripheral vascular disease | 980 (12%) | 560 (11%) | 320 (16%) | 100 (17%) | 0.009 |
| Atrial fibrillation | 3,270 (41%) | 2,375 (45%) | 720 (35%) | 175 (30%) | <0.001 |
| Cerebrovascular disease | 460 (5.8%) | 300 (5.7%) | 160 (7.9%) | 0 (0%) | 0.009 |
| Dementia | 280 (3.6%) | 195 (3.7%) | 80 (3.9%) | 5 (0.9%) | 0.3 |
| Tobbacco use disorder | 35 (0.4%) | 20 (0.4%) | 15 (0.7%) | 0 (0%) | 0.6 |
| Hyperlipidemia | 3,805 (48%) | 2,675 (51%) | 855 (42%) | 275 (48%) | 0.022 |
| Coronary artery disease | 2,255 (29%) | 1,600 (30%) | 515 (25%) | 140 (24%) | 0.12 |
| Cancer | 2,745 (35%) | 1,795 (34%) | 730 (36%) | 220 (38%) | 0.6 |
| Amyloidosis subtype |  |  |  |  | 0.003 |
| Light chain (AL) amyloidosis | 5,835 (74%) | 3,900 (74%) | 1,430 (70%) | 505 (88%) |  |
| Wild-type transtherytin-related (ATTR) amyloidosis | 2,050 (26%) | 1,380 (26%) | 600 (30%) | 70 (12%) |  |
| *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 |
| *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 | 1.10, 1.41 | <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 | 0.069 |
| 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 | 0.029 |
| $66,000 - $87,999 | 0.95 | 0.90, 1.01 | 0.10 |
| $88,000 or more | 0.95 | 0.89, 1.00 | 0.071 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.96 | 0.87, 1.06 | 0.4 |
| No charge | 1.05 | 0.49, 2.26 | 0.9 |
| Other | 2.06 | 1.78, 2.38 | <0.001 |
| Private | 1.42 | 1.28, 1.58 | <0.001 |
| Self-pay | 1.40 | 1.14, 1.71 | 0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.22 | 1.14, 1.30 | <0.001 |
| South | 1.03 | 0.98, 1.09 | 0.3 |
| West | 1.16 | 1.09, 1.24 | <0.001 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 1.57 | 0.93, 2.66 | 0.090 |
| 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 | 0.13 |
| 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 | 1.31, 3.00 | 0.001 |
| Leukemia | 1.75 | 1.20, 2.57 | 0.004 |
| Lung | 2.03 | 1.38, 2.97 | <0.001 |
| Melanoma | 1.09 | 0.68, 1.74 | 0.7 |
| Mesothelium and soft tissue | 1.47 | 0.98, 2.21 | 0.065 |
| Multiple Myeloma | 1.40 | 0.95, 2.05 | 0.089 |
| Neuroendocrine | 1.24 | 0.41, 3.74 | 0.7 |
| Non-Hodgkin Lymphoma | 1.61 | 1.09, 2.36 | 0.015 |
| 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 | 0.010 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.64, 0.71 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.87 | 0.82, 0.92 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.02 | 0.95, 1.09 | 0.6 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.64 | 0.62, 0.67 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.81 | 0.77, 0.84 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.20 | 2.05, 2.36 | <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 | 1.10 | 1.06, 1.15 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.51 | 1.41, 1.62 | <0.001 |
| Tobbacco use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.66 | 0.48, 0.92 | 0.015 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 1.09 | 1.04, 1.14 | <0.001 |
| *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 | 0.5 |
| 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 | -0.59, 0.00 | 0.052 |
| No charge | 0.62 | -1.2, 2.5 | 0.5 |
| Other | -0.53 | -1.0, -0.04 | 0.032 |
| Private | 0.08 | -0.26, 0.41 | 0.7 |
| Self-pay | -0.73 | -1.3, -0.18 | 0.010 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.79 | 0.61, 0.97 | <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 | -0.78, 0.68 | 0.9 |
| Head and neck | 2.5 | 1.7, 3.3 | <0.001 |
| Hodgkin Lymphoma | 0.78 | -0.11, 1.7 | 0.085 |
| Leukemia | 1.4 | 0.69, 2.2 | <0.001 |
| Lung | 0.35 | -0.38, 1.1 | 0.3 |
| Melanoma | -0.05 | -0.87, 0.77 | 0.9 |
| Mesothelium and soft tissue | 0.73 | -0.07, 1.5 | 0.072 |
| Multiple Myeloma | 0.64 | -0.10, 1.4 | 0.090 |
| Neuroendocrine | 2.8 | -0.15, 5.8 | 0.063 |
| Non-Hodgkin Lymphoma | 1.1 | 0.32, 1.8 | 0.005 |
| Others | 0.66 | -0.17, 1.5 | 0.12 |
| Renal | 0.40 | -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 | -0.52 | -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 | 0.19 | 0.00, 0.39 | 0.054 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | -0.56 | -0.67, -0.46 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -0.70 | -0.82, -0.58 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 0.32 | 0.24, 0.41 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.3 | 1.1, 1.6 | <0.001 |
| Tobbacco use disorder |  |  |  |
| No | — | — |  |
| Yes | -1.2 | -1.6, -0.83 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.07 | -0.07, 0.21 | 0.3 |
| *1*CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 25,242 | 15,548, 34,935 | <0.001 |
| Black | 3,185 | 293, 6,077 | 0.031 |
| Hispanic | 26,733 | 21,337, 32,130 | <0.001 |
| Native American | -23,899 | -32,466, -15,332 | <0.001 |
| Other | 31,612 | 22,941, 40,283 | <0.001 |
| Age, y | -1,676 | -1,838, -1,514 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 5,238 | 3,515, 6,962 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1,327 | -849, 3,502 | 0.2 |
| $66,000 - $87,999 | 5,759 | 3,307, 8,212 | <0.001 |
| $88,000 or more | 15,419 | 11,836, 19,003 | <0.001 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 9,510 | 4,033, 14,987 | <0.001 |
| No charge | 450 | -23,730, 24,630 | >0.9 |
| Other | 4,423 | -4,191, 13,036 | 0.3 |
| Private | 18,636 | 11,783, 25,489 | <0.001 |
| Self-pay | -13,517 | -21,604, -5,429 | 0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 23,805 | 18,536, 29,075 | <0.001 |
| South | 14,063 | 10,846, 17,279 | <0.001 |
| West | 49,220 | 41,420, 57,020 | <0.001 |
| Cancer type |  |  |  |
| Thyroid | — | — |  |
| Bone and articular cartilage | 23,127 | 736, 45,517 | 0.043 |
| Breast | -16,984 | -28,896, -5,073 | 0.005 |
| Central nervous system | 9,967 | -3,622, 23,556 | 0.2 |
| Gastrointestinal tract | 7,602 | -4,441, 19,646 | 0.2 |
| Genital organs | -9,658 | -21,608, 2,293 | 0.11 |
| Head and neck | 32,241 | 18,095, 46,388 | <0.001 |
| Hodgkin Lymphoma | 2,820 | -11,818, 17,457 | 0.7 |
| Leukemia | 11,857 | -460, 24,174 | 0.059 |
| Lung | -6,971 | -18,951, 5,009 | 0.3 |
| Melanoma | -9,254 | -22,761, 4,252 | 0.2 |
| Mesothelium and soft tissue | 754 | -12,832, 14,340 | >0.9 |
| Multiple Myeloma | -5,776 | -17,873, 6,322 | 0.3 |
| Neuroendocrine | 42,055 | -30,573, 114,683 | 0.3 |
| Non-Hodgkin Lymphoma | 8,210 | -3,876, 20,296 | 0.2 |
| Others | 1,442 | -12,598, 15,483 | 0.8 |
| Renal | -1,960 | -13,949, 10,028 | 0.7 |
| Charlson comorbidity index | 2,545 | 1,401, 3,689 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -9,792 | -13,090, -6,494 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | -9,559 | -11,987, -7,131 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -7,653 | -10,734, -4,573 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -9,144 | -10,738, -7,550 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -4,368 | -5,859, -2,876 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 15,033 | 10,629, 19,437 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | -9,377 | -11,412, -7,341 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -6,584 | -8,795, -4,373 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 2,801 | 1,239, 4,362 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 26,062 | 22,236, 29,887 | <0.001 |
| Tobbacco use disorder |  |  |  |
| No | — | — |  |
| Yes | -15,982 | -23,145, -8,819 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 6,314 | 1,924, 10,704 | 0.005 |
| *1*CI = Confidence Interval | | | |