Racial Disparities in the Management and Outcomes of Cancer and 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** | **Overall** N = 830,485*1* | **White** N = 619,285*1* | **Asian or Pacific Islander** N = 16,815*1* | **Black** N = 124,815*1* | **Hispanic** N = 49,305*1* | **Native American** N = 3,160*1* | **Other** N = 17,105*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Died during hospitalization | 61,285 (7.4%) | 45,630 (7.4%) | 1,615 (9.6%) | 8,375 (6.7%) | 3,850 (7.8%) | 295 (9.3%) | 1,520 (8.9%) | <0.001 |
| Length of stay (days) | 5 (3, 9) | 5 (3, 9) | 5 (3, 9) | 5 (3, 9) | 5 (3, 9) | 5 (3, 8) | 6 (3, 10) | <0.001 |
| Inflation-adjusted total charge ($) | 51,707 (27,489, 102,359) | 49,592 (26,473, 97,736) | 70,597 (39,182, 141,009) | 51,715 (27,589, 101,933) | 71,385 (38,120, 141,696) | 43,164 (24,194, 84,143) | 68,022 (34,832, 142,940) | <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 | 1.02 | 0.96, 1.08 | 0.5 |
| Hispanic | 1.06 | 0.98, 1.15 | 0.2 |
| Native American | 1.28 | 0.98, 1.67 | 0.068 |
| Other | 1.19 | 1.05, 1.35 | 0.005 |
| Age, y | 1.02 | 1.02, 1.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.14 | 1.09, 1.19 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.95 | 0.90, 1.00 | 0.052 |
| $66,000 - $87,999 | 0.96 | 0.91, 1.01 | 0.15 |
| $88,000 or more | 0.95 | 0.90, 1.01 | 0.12 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.97 | 0.88, 1.06 | 0.5 |
| No charge | 1.07 | 0.50, 2.30 | 0.9 |
| Other | 2.06 | 1.78, 2.38 | <0.001 |
| Private | 1.42 | 1.28, 1.58 | <0.001 |
| Self-pay | 1.42 | 1.17, 1.74 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.21 | 1.13, 1.29 | <0.001 |
| South | 1.03 | 0.97, 1.09 | 0.3 |
| West | 1.16 | 1.09, 1.23 | <0.001 |
| Cancer type |  |  |  |
| Respiratory organs | — | — |  |
| Bone and articular cartilage | 0.79 | 0.55, 1.15 | 0.2 |
| Breast | 0.46 | 0.41, 0.51 | <0.001 |
| Endocrine organs | 0.60 | 0.21, 1.69 | 0.3 |
| Gastrointestinal tract | 0.69 | 0.64, 0.74 | <0.001 |
| Genital organs | 0.48 | 0.44, 0.53 | <0.001 |
| Head and neck | 0.75 | 0.64, 0.87 | <0.001 |
| Leukemia | 0.81 | 0.76, 0.86 | <0.001 |
| Lymphoma | 0.75 | 0.70, 0.81 | <0.001 |
| Mesothelium and soft tissue | 0.75 | 0.64, 0.88 | <0.001 |
| Myeloma | 0.65 | 0.60, 0.70 | <0.001 |
| Neuroendocrine | 1.67 | 1.52, 1.83 | <0.001 |
| Others | 0.66 | 0.57, 0.76 | <0.001 |
| Renal | 0.50 | 0.46, 0.55 | <0.001 |
| Charlson comorbidity index | 0.99 | 0.97, 1.02 | 0.7 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.67 | 0.64, 0.71 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.87, 0.97 | 0.004 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.10 | 1.03, 1.18 | 0.007 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.64 | 0.62, 0.67 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.76, 0.83 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.30 | 2.15, 2.47 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.92, 1.01 | 0.14 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.84, 0.95 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 1.11 | 1.07, 1.15 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.57 | 1.47, 1.69 | <0.001 |
| Tobbacco use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.66 | 0.48, 0.92 | 0.014 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 1.08 | 1.03, 1.13 | 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 | 1.1 | 0.71, 1.6 | <0.001 |
| Black | 0.41 | 0.27, 0.56 | <0.001 |
| Hispanic | 0.45 | 0.23, 0.67 | <0.001 |
| Native American | -0.46 | -1.0, 0.12 | 0.12 |
| Other | 1.2 | 0.79, 1.6 | <0.001 |
| Age, y | -0.06 | -0.07, -0.05 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.04 | -0.05, 0.13 | 0.4 |
| 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 | 0.052 |
| $88,000 or more | 0.28 | 0.14, 0.43 | <0.001 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -0.29 | -0.58, 0.00 | 0.054 |
| No charge | 0.67 | -1.2, 2.5 | 0.5 |
| Other | -0.53 | -1.0, -0.04 | 0.033 |
| Private | 0.07 | -0.27, 0.41 | 0.7 |
| Self-pay | -0.72 | -1.3, -0.17 | 0.010 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.78 | 0.59, 0.96 | <0.001 |
| South | 0.40 | 0.25, 0.54 | <0.001 |
| West | -0.07 | -0.26, 0.12 | 0.5 |
| Cancer type |  |  |  |
| Respiratory organs | — | — |  |
| Bone and articular cartilage | 1.2 | 0.41, 2.1 | 0.003 |
| Breast | -0.88 | -1.0, -0.71 | <0.001 |
| Endocrine organs | 2.2 | -0.59, 4.9 | 0.12 |
| Gastrointestinal tract | 0.94 | 0.80, 1.1 | <0.001 |
| Genital organs | -0.48 | -0.61, -0.34 | <0.001 |
| Head and neck | 2.2 | 1.7, 2.7 | <0.001 |
| Leukemia | 0.91 | 0.74, 1.1 | <0.001 |
| Lymphoma | 0.48 | 0.32, 0.63 | <0.001 |
| Mesothelium and soft tissue | 0.31 | -0.03, 0.66 | 0.076 |
| Myeloma | 0.13 | -0.04, 0.30 | 0.13 |
| Neuroendocrine | 1.7 | 1.4, 1.9 | <0.001 |
| Others | -0.08 | -0.35, 0.20 | 0.6 |
| Renal | -0.03 | -0.17, 0.12 | 0.7 |
| Charlson comorbidity index | 0.30 | 0.23, 0.36 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -0.53 | -0.69, -0.37 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | -0.62 | -0.75, -0.48 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -0.45 | -0.62, -0.27 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -0.92 | -1.0, -0.83 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -0.84 | -0.92, -0.75 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 0.24 | 0.04, 0.44 | 0.017 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | -0.53 | -0.63, -0.42 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -0.65 | -0.77, -0.53 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 0.33 | 0.24, 0.41 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.4 | 1.2, 1.6 | <0.001 |
| Tobbacco use disorder |  |  |  |
| No | — | — |  |
| Yes | -1.2 | -1.6, -0.82 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.06 | -0.07, 0.20 | 0.4 |
| *1*CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| RACE |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 24,841 | 15,180, 34,502 | <0.001 |
| Black | 3,335 | 442, 6,228 | 0.024 |
| Hispanic | 26,772 | 21,389, 32,154 | <0.001 |
| Native American | -23,697 | -32,282, -15,112 | <0.001 |
| Other | 31,541 | 22,897, 40,184 | <0.001 |
| Age, y | -1,693 | -1,854, -1,532 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 5,231 | 3,512, 6,951 | <0.001 |
| Income quartile by ZIP |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1,390 | -782, 3,561 | 0.2 |
| $66,000 - $87,999 | 5,860 | 3,419, 8,300 | <0.001 |
| $88,000 or more | 15,575 | 12,000, 19,149 | <0.001 |
| Healthcare payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 9,480 | 4,035, 14,925 | <0.001 |
| No charge | 1,359 | -22,817, 25,534 | >0.9 |
| Other | 4,403 | -4,148, 12,954 | 0.3 |
| Private | 18,325 | 11,509, 25,141 | <0.001 |
| Self-pay | -13,571 | -21,627, -5,515 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 23,495 | 18,209, 28,781 | <0.001 |
| South | 13,999 | 10,785, 17,212 | <0.001 |
| West | 48,865 | 41,096, 56,634 | <0.001 |
| Cancer type |  |  |  |
| Respiratory organs | — | — |  |
| Bone and articular cartilage | 28,884 | 8,810, 48,957 | 0.005 |
| Breast | -11,031 | -13,584, -8,478 | <0.001 |
| Endocrine organs | 44,477 | -23,047, 112,001 | 0.2 |
| Gastrointestinal tract | 13,954 | 11,555, 16,353 | <0.001 |
| Genital organs | -3,519 | -5,829, -1,210 | 0.003 |
| Head and neck | 44,559 | 34,318, 54,801 | <0.001 |
| Leukemia | 14,201 | 10,675, 17,728 | <0.001 |
| Lymphoma | 9,973 | 6,723, 13,224 | <0.001 |
| Mesothelium and soft tissue | 7,253 | 561, 13,946 | 0.034 |
| Myeloma | -3,369 | -5,941, -797 | 0.010 |
| Neuroendocrine | 50,893 | 44,739, 57,047 | <0.001 |
| Others | -265 | -5,061, 4,530 | >0.9 |
| Renal | 4,213 | 1,698, 6,727 | 0.001 |
| Charlson comorbidity index | 890 | -262, 2,043 | 0.13 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -9,716 | -12,995, -6,437 | <0.001 |
| Diabetes mellitus |  |  |  |
| No | — | — |  |
| Yes | -6,901 | -9,334, -4,468 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -4,120 | -7,201, -1,038 | 0.009 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -9,128 | -10,712, -7,544 | <0.001 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -4,990 | -6,483, -3,497 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 17,019 | 12,631, 21,408 | <0.001 |
| COPD |  |  |  |
| No | — | — |  |
| Yes | -7,540 | -9,546, -5,535 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -4,698 | -6,904, -2,491 | <0.001 |
| Atrial fibrillation |  |  |  |
| No | — | — |  |
| Yes | 2,985 | 1,434, 4,536 | <0.001 |
| Cerebrovascular disease |  |  |  |
| No | — | — |  |
| Yes | 28,065 | 24,230, 31,899 | <0.001 |
| Tobbacco use disorder |  |  |  |
| No | — | — |  |
| Yes | -16,124 | -23,270, -8,978 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 6,062 | 1,682, 10,441 | 0.007 |
| *1*CI = Confidence Interval | | | |