Who Pays the Price? Race, Socioeconomic Factors, and Outcomes in Intracranial Tumor Care

Analysis for RCOP NIS Sep Surg1

Ali Salman

## Overview:

* **Study Objective:** Investigate the association between race, income, and insurance status with outcomes among patients admitted with a principal diagnosis of intracranial tumors across U.S. hospitals from 2018 to 2020, while adjusting for demographic, clinical, and hospital-level factors.
* **Data Source:** Cross-sectional analysis utilizing the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection:** Included all inpatient admissions with a principal diagnosis of intracranial tumors, identified using ICD-10 diagnosis codes for benign or malignant neoplasms of the brain and central nervous system, meninges, or eye and adnexa (D31.xx, D32.xx, D33.xx, C69.xx, C70.xx, C71.xx, C72.xx). Patients were categorized by race (White, Asian or Pacific Islander, Black, Hispanic, Other).
* **Outcomes of Interest:**
  + In-hospital Mortality
  + Length of Stay (days)
  + Inflation-Adjusted Total Charge ($) [inflation adjusted to 2020 dollars using CPI data from the U.S. Bureau of Labor Statistics]
* **Statistical Analysis:** Multivariable regression models were performed to assess the independent associations of race, residential income quartile, and insurance payer type with each outcome, adjusting for:
  + **Demographics and Clinical Factors:** Age, sex, tumor location (brain and central nervous system, meninges, or eye and adnexa), tumor type (benign or malignant), admission type (elective or non-elective), and Elixhauser comorbidity index.
  + **Hospital Characteristics:** Hospital region, bed size, and teaching status.
* **Software:** Analyses were conducted using the R Statistical Language (Version 4.4.1; R Foundation for Statistical Computing, Vienna, Austria). Statistical significance was set at a two-tailed alpha of 0.05.

## Baseline Table:

| **Characteristic** | **White** N = 134,800*1* | **Asian or Pacific Islander** N = 6,675*1* | **Black** N = 18,690*1* | **Hispanic** N = 19,105*1* | **Other** N = 8,255*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- | --- |
| Age, y | 57 (19) | 52 (20) | 54 (20) | 49 (22) | 50 (22) | <0.001 |
| Sex |  |  |  |  |  | <0.001 |
| Female | 67,200 (50%) | 3,860 (58%) | 10,645 (57%) | 10,460 (55%) | 4,190 (51%) |  |
| Male | 67,595 (50%) | 2,815 (42%) | 8,045 (43%) | 8,645 (45%) | 4,065 (49%) |  |
| Tumor location |  |  |  |  |  | <0.001 |
| Brain and central nervous system | 91,745 (68%) | 3,920 (59%) | 9,335 (50%) | 12,480 (65%) | 5,520 (67%) |  |
| Eye and adnexa | 1,850 (1.4%) | 65 (1.0%) | 220 (1.2%) | 350 (1.8%) | 175 (2.1%) |  |
| Meninges | 41,205 (31%) | 2,690 (40%) | 9,135 (49%) | 6,275 (33%) | 2,560 (31%) |  |
| Tumor type |  |  |  |  |  | <0.001 |
| Benign | 50,615 (38%) | 3,560 (53%) | 9,900 (53%) | 7,920 (41%) | 3,165 (38%) |  |
| Malignant | 84,185 (62%) | 3,115 (47%) | 8,790 (47%) | 11,185 (59%) | 5,090 (62%) |  |
| Residential income |  |  |  |  |  | <0.001 |
| $1 - $51,999 | 24,545 (18%) | 750 (11%) | 8,325 (45%) | 5,830 (31%) | 1,535 (19%) |  |
| $52,000 - $65,999 | 32,625 (25%) | 1,045 (16%) | 4,080 (22%) | 4,815 (26%) | 1,510 (19%) |  |
| $66,000 - $87,999 | 36,680 (28%) | 1,605 (24%) | 3,555 (19%) | 4,565 (24%) | 2,025 (25%) |  |
| $88,000 or more | 39,255 (29%) | 3,195 (48%) | 2,360 (13%) | 3,470 (19%) | 2,885 (36%) |  |
| Insurance payer |  |  |  |  |  | <0.001 |
| Medicaid | 11,420 (8.5%) | 1,140 (17%) | 4,060 (22%) | 5,180 (27%) | 1,585 (19%) |  |
| Medicare | 55,415 (41%) | 1,655 (25%) | 6,640 (36%) | 4,605 (24%) | 2,225 (27%) |  |
| Other | 6,695 (5.0%) | 405 (6.1%) | 1,595 (8.6%) | 2,430 (13%) | 725 (8.8%) |  |
| Private | 60,990 (45%) | 3,470 (52%) | 6,340 (34%) | 6,835 (36%) | 3,680 (45%) |  |
| Admission type |  |  |  |  |  | <0.001 |
| Elective | 64,765 (48%) | 3,300 (49%) | 6,780 (36%) | 7,530 (39%) | 3,860 (47%) |  |
| Non-elective | 69,880 (52%) | 3,375 (51%) | 11,900 (64%) | 11,550 (61%) | 4,370 (53%) |  |
| No. of comorbidities |  |  |  |  |  | <0.001 |
| No comorbidities | 27,170 (20%) | 2,015 (30%) | 4,025 (22%) | 4,230 (22%) | 1,790 (22%) |  |
| One comorbidity | 10,690 (7.9%) | 740 (11%) | 2,230 (12%) | 1,890 (9.9%) | 710 (8.6%) |  |
| Two or more comorbidities | 96,940 (72%) | 3,920 (59%) | 12,435 (67%) | 12,985 (68%) | 5,755 (70%) |  |
| Hospital region |  |  |  |  |  | <0.001 |
| Midwest | 33,320 (25%) | 680 (10%) | 3,320 (18%) | 1,350 (7.1%) | 835 (10%) |  |
| Northeast | 28,455 (21%) | 1,300 (19%) | 3,260 (17%) | 3,105 (16%) | 2,675 (32%) |  |
| South | 45,420 (34%) | 1,260 (19%) | 10,435 (56%) | 7,540 (39%) | 2,795 (34%) |  |
| West | 27,605 (20%) | 3,435 (51%) | 1,675 (9.0%) | 7,110 (37%) | 1,950 (24%) |  |
| Hospital bedsize |  |  |  |  |  | 0.10 |
| Large | 94,975 (70%) | 4,720 (71%) | 12,620 (68%) | 13,120 (69%) | 6,045 (73%) |  |
| Medium | 26,420 (20%) | 1,305 (20%) | 4,225 (23%) | 4,280 (22%) | 1,480 (18%) |  |
| Small | 13,405 (9.9%) | 650 (9.7%) | 1,845 (9.9%) | 1,705 (8.9%) | 730 (8.8%) |  |
| Hospital location/teaching |  |  |  |  |  | <0.001 |
| Rural | 2,605 (1.9%) | 20 (0.3%) | 220 (1.2%) | 70 (0.4%) | 50 (0.6%) |  |
| Urban, non-teaching | 9,765 (7.2%) | 590 (8.8%) | 1,100 (5.9%) | 1,705 (8.9%) | 430 (5.2%) |  |
| Urban, teaching | 122,430 (91%) | 6,065 (91%) | 17,370 (93%) | 17,330 (91%) | 7,775 (94%) |  |
| *1*Mean (SD); n (%) | | | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | | | |

## Outcomes Table:

| **Characteristic** | **White** N = 134,800*1* | **Asian or Pacific Islander** N = 6,675*1* | **Black** N = 18,690*1* | **Hispanic** N = 19,105*1* | **Other** N = 8,255*1* | **p-value***2* |
| --- | --- | --- | --- | --- | --- | --- |
| Died during hospitalization | 1,920 (1.4%) | 195 (2.9%) | 480 (2.6%) | 425 (2.2%) | 220 (2.7%) | <0.001 |
| Length of stay (days) | 4.0 (2.0, 7.0) | 4.0 (2.0, 8.0) | 5.0 (3.0, 9.0) | 4.0 (2.0, 8.0) | 4.0 (3.0, 8.0) | <0.001 |
| Inflation-adjusted total charge ($) | 94,256 (50,102, 159,880) | 124,803 (61,676, 207,696) | 98,239 (45,734, 178,458) | 118,803 (59,106, 204,985) | 109,795 (54,572, 181,262) | <0.001 |
| *1*n (%); Median (Q1, Q3) | | | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | | | |

## Multivariable Logistic Regression:

### In-Hospital Mortality:

| **Characteristic** | **OR***1* | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 2.65 | 1.87, 3.75 | <0.001 |
| Black | 1.91 | 1.49, 2.45 | <0.001 |
| Hispanic | 1.72 | 1.33, 2.23 | <0.001 |
| Other | 1.98 | 1.35, 2.90 | <0.001 |
| Age, y | 0.99 | 0.99, 1.00 | 0.056 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.24 | 1.06, 1.45 | 0.009 |
| Tumor location |  |  |  |
| Brain and central nervous system | — | — |  |
| Eye and adnexa | 0.44 | 0.14, 1.35 | 0.2 |
| Meninges | 1.18 | 0.77, 1.81 | 0.4 |
| Tumor type |  |  |  |
| Benign | — | — |  |
| Malignant | 2.27 | 1.44, 3.58 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.15 | 0.91, 1.45 | 0.3 |
| $66,000 - $87,999 | 1.07 | 0.85, 1.36 | 0.6 |
| $88,000 or more | 1.00 | 0.78, 1.28 | >0.9 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | 0.90 | 0.68, 1.20 | 0.5 |
| Other | 1.09 | 0.76, 1.56 | 0.6 |
| Private | 0.86 | 0.66, 1.10 | 0.2 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.91 | 1.38, 2.64 | <0.001 |
| Elixhauser comorbidity index | 1.30 | 1.25, 1.35 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.71 | 1.23, 2.37 | 0.001 |
| South | 0.91 | 0.71, 1.16 | 0.4 |
| West | 1.16 | 0.88, 1.52 | 0.3 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.17 | 0.95, 1.44 | 0.14 |
| Small | 1.94 | 1.28, 2.93 | 0.002 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.28 | 0.17, 0.45 | <0.001 |
| Urban, teaching | 0.27 | 0.18, 0.41 | <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 | 0.94 | 0.50, 1.4 | <0.001 |
| Black | 1.0 | 0.63, 1.4 | <0.001 |
| Hispanic | 0.35 | 0.03, 0.67 | 0.034 |
| Other | 0.94 | 0.44, 1.4 | <0.001 |
| Age, y | -0.05 | -0.06, -0.04 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.11 | -0.07, 0.29 | 0.2 |
| Tumor location |  |  |  |
| Brain and central nervous system | — | — |  |
| Eye and adnexa | -1.2 | -2.0, -0.36 | 0.005 |
| Meninges | -0.22 | -0.52, 0.08 | 0.15 |
| Tumor type |  |  |  |
| Benign | — | — |  |
| Malignant | -0.88 | -1.2, -0.57 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.21 | -0.47, 0.04 | 0.10 |
| $66,000 - $87,999 | -0.05 | -0.32, 0.22 | 0.7 |
| $88,000 or more | -0.18 | -0.45, 0.09 | 0.2 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -1.0 | -1.5, -0.56 | <0.001 |
| Other | -1.0 | -1.5, -0.52 | <0.001 |
| Private | -1.6 | -2.0, -1.2 | <0.001 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | 2.1 | 1.9, 2.3 | <0.001 |
| Elixhauser comorbidity index | 1.0 | 0.97, 1.1 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.85 | 0.51, 1.2 | <0.001 |
| South | 0.11 | -0.17, 0.39 | 0.5 |
| West | -0.27 | -0.57, 0.03 | 0.078 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -0.52 | -0.75, -0.29 | <0.001 |
| Small | -0.49 | -0.99, 0.01 | 0.054 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | -0.51 | -1.7, 0.66 | 0.4 |
| Urban, teaching | 0.19 | -0.95, 1.3 | 0.7 |
| *1*CI = Confidence Interval | | | |

### Inflation-Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI***1* | **p-value** |
| --- | --- | --- | --- |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 18,862 | 9,052, 28,672 | <0.001 |
| Black | 5,881 | -106, 11,867 | 0.054 |
| Hispanic | 18,727 | 11,549, 25,905 | <0.001 |
| Other | 19,941 | 7,153, 32,729 | 0.002 |
| Age, y | -1,480 | -1,676, -1,285 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 3,871 | 840, 6,902 | 0.012 |
| Tumor location |  |  |  |
| Brain and central nervous system | — | — |  |
| Eye and adnexa | -39,332 | -52,190, -26,475 | <0.001 |
| Meninges | -4,752 | -10,456, 952 | 0.10 |
| Tumor type |  |  |  |
| Benign | — | — |  |
| Malignant | -39,592 | -46,100, -33,085 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 58 | -4,258, 4,374 | >0.9 |
| $66,000 - $87,999 | -37 | -4,748, 4,674 | >0.9 |
| $88,000 or more | 6,326 | 103, 12,549 | 0.046 |
| Insurance payer |  |  |  |
| Medicaid | — | — |  |
| Medicare | -2,011 | -9,431, 5,409 | 0.6 |
| Other | -8,827 | -17,738, 84 | 0.052 |
| Private | -6,860 | -13,554, -165 | 0.045 |
| Admission type |  |  |  |
| Elective | — | — |  |
| Non-elective | -766 | -4,927, 3,395 | 0.7 |
| Elixhauser comorbidity index | 15,270 | 13,934, 16,605 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 32,322 | 22,574, 42,069 | <0.001 |
| South | 9,414 | 2,462, 16,367 | 0.008 |
| West | 54,823 | 45,477, 64,170 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -16,586 | -22,924, -10,249 | <0.001 |
| Small | -24,922 | -33,126, -16,718 | <0.001 |
| Hospital location/teaching |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 47,737 | 37,165, 58,309 | <0.001 |
| Urban, teaching | 57,965 | 49,430, 66,500 | <0.001 |
| *1*CI = Confidence Interval | | | |