Impacts of Insurance on Colorectal Cancer Mortality: Insights from the National Inpatient Sample

Analysis for RCOP NIS GI10

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## Preamble:

* **Reference Papers:**
  + [Akinyemiju et al. 2016](https://doi.org/10.1186/s12885-016-2738-7)
  + [Galoosian et al. 2019](https://doi.org/10.1007/s10620-019-05809-x)
* **Study Objective**: Examine the impact of healthcare insurance on in-hospital mortality, length of stay, and inflation adjusted charges among inpatient admissions with colorectal cancer (CRC).
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* **Patient Selection**: Included all inpatient admissions diagnosed with CRC.
* **Insurance Categories**:
  + Private
  + Medicaid
  + Medicare
  + Other
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($) [adjusted to 2020 dollars, using CPI data by the U.S. Bureau of Labor Statistics]
* **Statistical Analysis**: Multiple logistic and linear regression to determine the independent association of insurance categories with in-hospital mortality, length of stay, and inflation-adjusted total charge, respectively, adjusted for:
  + Demographics: Age, gender, race, residential income, residential region.
  + Medical History: Cancer metastasis.
  + 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 = 784,2851 | **Private**, N = 248,9901 | **Medicaid**, N = 90,3351 | **Medicare**, N = 426,3751 | **Other**, N = 18,5851 | **p-value**2 |
| --- | --- | --- | --- | --- | --- | --- |
| Sex |  |  |  |  |  | <0.001 |
| Female | 368,205 (47%) | 111,255 (45%) | 40,280 (45%) | 210,710 (49%) | 5,960 (32%) |  |
| Male | 416,060 (53%) | 137,725 (55%) | 50,055 (55%) | 215,655 (51%) | 12,625 (68%) |  |
| Age, y | 66 (14) | 56 (11) | 54 (11) | 74 (10) | 62 (14) | <0.001 |
| Race |  |  |  |  |  | <0.001 |
| White | 534,500 (70%) | 169,615 (70%) | 42,395 (48%) | 310,395 (75%) | 12,095 (67%) |  |
| Asian or Pacific Islander | 26,840 (3.5%) | 10,140 (4.2%) | 4,660 (5.3%) | 11,530 (2.8%) | 510 (2.8%) |  |
| Black | 104,745 (14%) | 29,955 (12%) | 20,170 (23%) | 52,140 (13%) | 2,480 (14%) |  |
| Hispanic | 74,665 (9.7%) | 24,445 (10%) | 16,915 (19%) | 31,280 (7.5%) | 2,025 (11%) |  |
| Native American | 4,185 (0.5%) | 1,000 (0.4%) | 960 (1.1%) | 1,985 (0.5%) | 240 (1.3%) |  |
| Other | 21,600 (2.8%) | 8,215 (3.4%) | 3,500 (4.0%) | 9,265 (2.2%) | 620 (3.5%) |  |
| Metastasis | 340,965 (43%) | 117,930 (47%) | 46,450 (51%) | 167,625 (39%) | 8,960 (48%) | <0.001 |
| Residential income |  |  |  |  |  | <0.001 |
| $1 - $51,999 | 217,645 (28%) | 57,300 (23%) | 34,145 (39%) | 120,230 (29%) | 5,970 (33%) |  |
| $52,000 - $65,999 | 204,675 (27%) | 61,500 (25%) | 23,845 (27%) | 114,310 (27%) | 5,020 (28%) |  |
| $66,000 - $87,999 | 185,050 (24%) | 62,715 (26%) | 18,520 (21%) | 99,870 (24%) | 3,945 (22%) |  |
| $88,000 or more | 163,800 (21%) | 63,465 (26%) | 11,850 (13%) | 85,360 (20%) | 3,125 (17%) |  |
| Residential region |  |  |  |  |  | <0.001 |
| Large metro | 418,710 (54%) | 139,875 (56%) | 52,325 (58%) | 218,720 (51%) | 7,790 (42%) |  |
| Micropolitan | 136,490 (17%) | 38,330 (15%) | 12,945 (14%) | 81,110 (19%) | 4,105 (22%) |  |
| Small metro | 226,455 (29%) | 69,795 (28%) | 24,200 (27%) | 125,895 (30%) | 6,565 (36%) |  |
| Charlson comorbidity index | 5.07 (2.52) | 4.68 (2.39) | 5.13 (2.48) | 5.29 (2.58) | 5.13 (2.50) | <0.001 |
| 1n (%); Mean (SD) | | | | | | |
| 2chi-squared test with Rao & Scott's second-order correction; Wilcoxon rank-sum test for complex survey samples | | | | | | |

## Outcomes Table:

| **Characteristic** | **Overall**, N = 784,2851 | **Private**, N = 248,9901 | **Medicaid**, N = 90,3351 | **Medicare**, N = 426,3751 | **Other**, N = 18,5851 | **p-value**2 |
| --- | --- | --- | --- | --- | --- | --- |
| Died during hospitalization | 33,880 (4.3%) | 8,645 (3.5%) | 3,160 (3.5%) | 20,300 (4.8%) | 1,775 (9.6%) | <0.001 |
| Length of stay (days) | 5.0 (3.0, 8.0) | 4.0 (3.0, 7.0) | 5.0 (3.0, 9.0) | 5.0 (3.0, 8.0) | 4.0 (2.0, 7.8) | <0.001 |
| Inflation-adjusted total charge ($) | 57,780 (31,514, 104,159) | 58,889 (32,833, 102,105) | 56,515 (29,346, 108,317) | 57,677 (31,547, 104,971) | 49,288 (22,683, 96,044) | <0.001 |
| 1n (%); Median (IQR) | | | | | | |
| 2chi-squared test with Rao & Scott's second-order correction; Wilcoxon rank-sum test for complex survey samples | | | | | | |

## Multivariable Logistic Regression:

### All-Cause Mortality:

| **Characteristic** | **OR**1 | **95% CI**1 | **p-value** |
| --- | --- | --- | --- |
| Insurance type |  |  |  |
| Private | — | — |  |
| Medicaid | 0.96 | 0.87, 1.06 | 0.4 |
| Medicare | 0.89 | 0.82, 0.96 | 0.005 |
| Other | 2.44 | 2.11, 2.83 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.09 | 1.04, 1.15 | <0.001 |
| Age, y | 1.02 | 1.02, 1.03 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.14 | 0.99, 1.30 | 0.063 |
| Black | 1.19 | 1.10, 1.29 | <0.001 |
| Hispanic | 1.05 | 0.95, 1.15 | 0.3 |
| Native American | 1.16 | 0.83, 1.61 | 0.4 |
| Other | 1.35 | 1.16, 1.57 | <0.001 |
| Metastasis |  |  |  |
| No | — | — |  |
| Yes | 1.37 | 1.27, 1.48 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.90 | 0.84, 0.97 | 0.006 |
| $66,000 - $87,999 | 0.93 | 0.86, 1.00 | 0.062 |
| $88,000 or more | 0.95 | 0.87, 1.03 | 0.2 |
| Residential region |  |  |  |
| Large metro | — | — |  |
| Micropolitan | 1.04 | 0.95, 1.13 | 0.4 |
| Small metro | 0.94 | 0.88, 1.02 | 0.12 |
| Charlson comorbidity index | 1.17 | 1.16, 1.19 | <0.001 |
| 1OR = Odds Ratio, CI = Confidence Interval | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI**1 | **p-value** |
| --- | --- | --- | --- |
| Insurance type |  |  |  |
| Private | — | — |  |
| Medicaid | 1.2 | 1.1, 1.4 | <0.001 |
| Medicare | 0.61 | 0.48, 0.74 | <0.001 |
| Other | -0.04 | -0.30, 0.22 | 0.8 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.09 | 0.01, 0.17 | 0.022 |
| Age, y | 0.00 | -0.01, 0.00 | 0.8 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | -0.06 | -0.29, 0.18 | 0.6 |
| Black | 0.84 | 0.70, 0.98 | <0.001 |
| Hispanic | 0.13 | -0.04, 0.30 | 0.14 |
| Native American | 0.48 | -0.32, 1.3 | 0.2 |
| Other | 0.71 | 0.32, 1.1 | <0.001 |
| Metastasis |  |  |  |
| No | — | — |  |
| Yes | -1.4 | -1.6, -1.3 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.17 | -0.29, -0.06 | 0.002 |
| $66,000 - $87,999 | -0.19 | -0.32, -0.07 | 0.003 |
| $88,000 or more | -0.31 | -0.45, -0.16 | <0.001 |
| Residential region |  |  |  |
| Large metro | — | — |  |
| Micropolitan | -0.61 | -0.74, -0.48 | <0.001 |
| Small metro | -0.26 | -0.37, -0.15 | <0.001 |
| Charlson comorbidity index | 0.40 | 0.37, 0.43 | <0.001 |
| 1CI = Confidence Interval | | | |

### **Inflation-Adjusted Total Charge:**

| **Characteristic** | **Beta** | **95% CI**1 | **p-value** |
| --- | --- | --- | --- |
| Insurance type |  |  |  |
| Private | — | — |  |
| Medicaid | 5,445 | 2,374, 8,516 | <0.001 |
| Medicare | 8,104 | 5,577, 10,631 | <0.001 |
| Other | -5,029 | -9,190, -869 | 0.018 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 3,983 | 2,658, 5,307 | <0.001 |
| Age, y | -467 | -586, -349 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 14,869 | 10,478, 19,260 | <0.001 |
| Black | 412 | -1,994, 2,818 | 0.7 |
| Hispanic | 19,079 | 15,406, 22,753 | <0.001 |
| Native American | 1,394 | -6,513, 9,300 | 0.7 |
| Other | 20,034 | 11,186, 28,883 | <0.001 |
| Metastasis |  |  |  |
| No | — | — |  |
| Yes | -27,820 | -30,398, -25,243 | <0.001 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -620 | -2,618, 1,378 | 0.5 |
| $66,000 - $87,999 | -2,348 | -4,742, 47 | 0.055 |
| $88,000 or more | 646 | -2,428, 3,720 | 0.7 |
| Residential region |  |  |  |
| Large metro | — | — |  |
| Micropolitan | -27,379 | -30,176, -24,582 | <0.001 |
| Small metro | -13,242 | -15,984, -10,499 | <0.001 |
| Charlson comorbidity index | 4,497 | 3,996, 4,998 | <0.001 |
| 1CI = Confidence Interval | | | |