In-hospital outcomes of patients with liver cirrhosis undergoing colorectal cancer surgery: an analysis of the National Inpatient Sample

Analysis for RCOP 2025Apr-NIS-7-Gastro

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## Preamble:

* **Reference Papers:**
  + [Huang et al. 2025](https://www.nature.com/articles/s41598-024-84758-6)
  + [Lee et al. 2018](https://bmjopen.bmj.com/content/8/7/e020511.long)
* **Study Objective**: Examine the impact of liver cirrhosis on outcomes among inpatient admissions with colorectal cancer undergoing colectomy.
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020.
* **Cohort Definition:** Patients were included if they met the following criteria
  + Age ≥18 years
  + Primary diagnosis of colorectal cancer
  + Undergoing colectomy
  + Non-missing data for liver cirrhosis
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* **Secondary Outcomes**:
  + Wound Infection
  + Sepsis
  + Pneumonia
  + Gastrointestinal Hemorrhage
  + Acute Respiratory Failure
  + Acute Kidney Injury
* **Covariates for Adjustment:** All models adjusted for the following:
  + Patient Demographics: Age, sex (male and female), Race (White, Black, Hispanic, Asian or Pacific Islander, Native American and Other), Household income(Quartile 1, Quartile 2, Quartile 3, Quartile 4), insurance (Medicare, Medicaid, private, other)
  + Hospital Characterstics: Type of admission (non-elective, elective), bed size of hospital (small, medium, large), location and teaching status of hospital (rural, urban non-teaching, urban teaching), location of the hospital (northeast, midwest or north central, south, west), type of surgery(laparoscopic, open, robotic colectomy)
  + Comorbidities: Hypertension, diabetes mellitus, obesity, hyperlipidemia, coronary artery disease, peripheral vascular disease, congestive heart failure, chronic kidney disease, chronic pulmonary disease, anemia, fluid and electrolyte disorders, HIV/AIDS, weight loss, lymphoma, alcohol abuse, drug abuse, depression, psychoses, rheumatoid disease, valvular disease, paralysis, neurological disorders, coagulopathy
* **Statistical Methods:**
  + **Univariable Analysis:**
    - Categorical variables: Compared using Pearson’s chi-square test with Rao & Scott adjustment
    - Continuous variables: Analyzed using the design-based Kruskal–Wallis test, a non-parametric alternative suitable for survey-weighted data
  + **Multivariable Analysis:**
    - Binary outcomes (e.g., mortality): Survey-weighted logistic regression using the quasibinomial family
    - Continuous outcomes (e.g., LOS, hospital charges): Survey-weighted linear regression using the gaussian family
    - Results reported as adjusted odds ratios (aORs) or beta coefficients with 95% confidence intervals
* **Software:** All statistical analyses were performed using the R Statistical Language (Version 4.5.0; R Foundation for Statistical Computing, Vienna, Austria), incorporating survey-weighted procedures via the *survey* package to account for the complex sampling design of NIS.

## Baseline Table:

| **Characteristic** | **With liver cirrhosis** N = 2,945*1* | **Without liver cirrhosis** N = 195,360*1* | **p-value***2* |
| --- | --- | --- | --- |
| Age, y | 67 (11) | 67 (13) | 0.7 |
| Sex |  |  | <0.001 |
| Female | 1,225 (42%) | 95,655 (49%) |  |
| Male | 1,720 (58%) | 99,705 (51%) |  |
| Race |  |  | 0.004 |
| White | 2,155 (75%) | 140,910 (74%) |  |
| Asian or Pacific Islander | 80 (2.8%) | 6,925 (3.6%) |  |
| Black | 210 (7.3%) | 20,755 (11%) |  |
| Hispanic | 345 (12%) | 16,010 (8.4%) |  |
| Native American | 20 (0.7%) | 940 (0.5%) |  |
| Other | 70 (2.4%) | 5,080 (2.7%) |  |
| Residential income |  |  | 0.016 |
| $1 - $51,999 | 895 (31%) | 49,135 (26%) |  |
| $52,000 - $65,999 | 725 (25%) | 51,450 (27%) |  |
| $66,000 - $87,999 | 660 (23%) | 47,545 (25%) |  |
| $88,000 or more | 580 (20%) | 44,420 (23%) |  |
| Expected primary payer |  |  | <0.001 |
| Private | 695 (24%) | 64,565 (33%) |  |
| Medicaid | 330 (11%) | 14,335 (7.3%) |  |
| Medicare | 1,750 (59%) | 107,850 (55%) |  |
| Other | 170 (5.8%) | 8,425 (4.3%) |  |
| Hospital region |  |  | 0.5 |
| Midwest | 620 (21%) | 44,585 (23%) |  |
| Northeast | 490 (17%) | 35,175 (18%) |  |
| South | 1,215 (41%) | 76,475 (39%) |  |
| West | 620 (21%) | 39,125 (20%) |  |
| Hospital bedsize |  |  | 0.5 |
| Large | 1,625 (55%) | 103,055 (53%) |  |
| Medium | 790 (27%) | 55,630 (28%) |  |
| Small | 530 (18%) | 36,675 (19%) |  |
| Hospital location and teaching status |  |  | 0.009 |
| Rural | 160 (5.4%) | 15,610 (8.0%) |  |
| Urban, non-teaching | 420 (14%) | 33,385 (17%) |  |
| Urban, teaching | 2,365 (80%) | 146,365 (75%) |  |
| No. of comorbidities |  |  |  |
| Two or more comorbidities | 2,945 (100%) | 195,360 (100%) |  |
| *1*Mean (SD); n (%) | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | |

## Outcomes Table:

| **Characteristic** | **With liver cirrhosis** N = 2,945*1* | **Without liver cirrhosis** N = 195,360*1* | **p-value***2* |
| --- | --- | --- | --- |
| In-hospital mortality | 150 (5.1%) | 2,460 (1.3%) | <0.001 |
| Length of stay (days) | 6.0 (4.0, 11.0) | 5.0 (3.0, 8.0) | <0.001 |
| Inflation-adjusted total hospital charges | 96,055 (63,135, 167,229) | 80,147 (52,759, 128,310) | <0.001 |
| Sepsis | 265 (9.0%) | 5,785 (3.0%) | <0.001 |
| Wound disruption and infection | 85 (2.9%) | 2,445 (1.3%) | <0.001 |
| Pneumonia | 170 (5.8%) | 4,355 (2.2%) | <0.001 |
| Gastrointestinal Hemorrhage | 370 (13%) | 12,085 (6.2%) | <0.001 |
| Acute respiratory failure | 225 (7.6%) | 6,865 (3.5%) | <0.001 |
| Acute kidney injury | 665 (23%) | 20,385 (10%) | <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** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | 0.44 | 0.28, 0.71 | <0.001 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 2.57 | 1.96, 3.38 | <0.001 |
| Robotic colectomy | 1.34 | 0.79, 2.27 | 0.3 |
| Age, y | 1.04 | 1.03, 1.06 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.40 | 1.14, 1.72 | 0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.05 | 0.56, 2.00 | 0.9 |
| Black | 1.02 | 0.75, 1.40 | 0.9 |
| Hispanic | 0.85 | 0.59, 1.24 | 0.4 |
| Native American | 0.31 | 0.03, 3.02 | 0.3 |
| Other | 0.64 | 0.29, 1.38 | 0.3 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.16 | 0.68, 1.98 | 0.6 |
| Medicare | 1.36 | 0.95, 1.96 | 0.10 |
| Other | 1.59 | 0.93, 2.72 | 0.093 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.93 | 0.73, 1.19 | 0.6 |
| $66,000 - $87,999 | 0.73 | 0.56, 0.97 | 0.028 |
| $88,000 or more | 0.57 | 0.41, 0.78 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.25 | 0.90, 1.75 | 0.2 |
| South | 1.38 | 1.04, 1.82 | 0.024 |
| West | 1.35 | 0.97, 1.88 | 0.074 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.34 | 1.07, 1.68 | 0.010 |
| Small | 1.10 | 0.85, 1.44 | 0.5 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.86 | 0.60, 1.23 | 0.4 |
| Urban, teaching | 0.69 | 0.50, 0.94 | 0.021 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.55 | 1.24, 1.93 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.68, 1.07 | 0.2 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.65, 1.13 | 0.3 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.77, 1.23 | 0.8 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.42 | 1.13, 1.79 | 0.003 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.76 | 1.31, 2.37 | <0.001 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.73 | 0.59, 0.91 | 0.004 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.97 | 1.53, 2.53 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.82 | 0.60, 1.11 | 0.2 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.72 | 0.56, 0.92 | 0.009 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 0.00 | 0.00, 0.00 | <0.001 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.72, 1.30 | 0.8 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 1.78 | 1.42, 2.22 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.36, 2.66 | >0.9 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 1.20 | 0.97, 1.48 | 0.10 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 1.15 | 0.54, 2.45 | 0.7 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 0.76 | 0.52, 1.11 | 0.2 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 3.62 | 2.82, 4.63 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.09 | 0.43, 2.76 | 0.9 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 1.21 | 0.62, 2.35 | 0.6 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.48, 1.03 | 0.068 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 2.25 | 1.08, 4.71 | 0.031 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 3.82 | 2.97, 4.91 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 3.93 | 3.02, 5.12 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Wound Infection:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | 0.73 | 0.43, 1.26 | 0.3 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 1.86 | 1.47, 2.36 | <0.001 |
| Robotic colectomy | 1.31 | 0.87, 1.95 | 0.2 |
| Age, y | 1.00 | 0.99, 1.01 | 0.8 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.78 | 1.46, 2.17 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.40 | 0.18, 0.86 | 0.020 |
| Black | 0.88 | 0.65, 1.19 | 0.4 |
| Hispanic | 1.05 | 0.75, 1.47 | 0.8 |
| Native American | 1.17 | 0.37, 3.64 | 0.8 |
| Other | 0.62 | 0.30, 1.25 | 0.2 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.55 | 1.12, 2.15 | 0.008 |
| Medicare | 0.99 | 0.75, 1.31 | >0.9 |
| Other | 0.98 | 0.62, 1.55 | >0.9 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.90 | 0.70, 1.15 | 0.4 |
| $66,000 - $87,999 | 0.89 | 0.68, 1.16 | 0.4 |
| $88,000 or more | 0.89 | 0.66, 1.19 | 0.4 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.08 | 0.80, 1.47 | 0.6 |
| South | 1.32 | 1.02, 1.70 | 0.037 |
| West | 1.21 | 0.90, 1.65 | 0.2 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.83 | 0.66, 1.03 | 0.091 |
| Small | 0.83 | 0.64, 1.07 | 0.15 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.88 | 0.61, 1.26 | 0.5 |
| Urban, teaching | 0.79 | 0.57, 1.09 | 0.15 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.05 | 0.84, 1.31 | 0.7 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.77, 1.17 | 0.6 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.71, 1.26 | 0.7 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.70, 1.12 | 0.3 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.25 | 0.99, 1.58 | 0.056 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.68, 1.41 | >0.9 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.93 | 0.75, 1.15 | 0.5 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.32 | 1.00, 1.73 | 0.051 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.21 | 0.94, 1.54 | 0.14 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.67, 1.10 | 0.2 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 0.00 | 0.00, 0.00 | <0.001 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | 0.73 | 0.51, 1.03 | 0.077 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 3.29 | 2.63, 4.11 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.26, 2.83 | 0.8 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 0.74 | 0.60, 0.92 | 0.008 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.54, 1.83 | >0.9 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.75, 1.42 | 0.8 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 3.14 | 2.49, 3.94 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.92 | 0.93, 3.97 | 0.077 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 1.18 | 0.60, 2.31 | 0.6 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.62, 1.42 | 0.8 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 1.55 | 0.75, 3.22 | 0.2 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 1.86 | 1.39, 2.49 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.82 | 1.32, 2.51 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Sepsis:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | 0.64 | 0.45, 0.93 | 0.018 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 1.91 | 1.62, 2.26 | <0.001 |
| Robotic colectomy | 1.45 | 1.08, 1.93 | 0.012 |
| Age, y | 1.00 | 0.99, 1.00 | 0.3 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.55 | 1.35, 1.79 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.02 | 0.70, 1.46 | >0.9 |
| Black | 1.04 | 0.84, 1.30 | 0.7 |
| Hispanic | 0.86 | 0.67, 1.09 | 0.2 |
| Native American | 1.14 | 0.50, 2.62 | 0.8 |
| Other | 1.01 | 0.66, 1.56 | >0.9 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.57 | 1.22, 2.03 | <0.001 |
| Medicare | 1.36 | 1.11, 1.67 | 0.003 |
| Other | 1.14 | 0.82, 1.57 | 0.4 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.90 | 0.76, 1.07 | 0.2 |
| $66,000 - $87,999 | 0.97 | 0.80, 1.16 | 0.7 |
| $88,000 or more | 0.92 | 0.75, 1.13 | 0.4 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.06 | 0.85, 1.33 | 0.6 |
| South | 1.23 | 1.03, 1.47 | 0.021 |
| West | 1.16 | 0.94, 1.42 | 0.2 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.01 | 0.87, 1.18 | 0.9 |
| Small | 0.95 | 0.80, 1.13 | 0.6 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.34 | 1.02, 1.76 | 0.037 |
| Urban, teaching | 1.01 | 0.78, 1.30 | >0.9 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.51 | 1.29, 1.77 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.68, 0.93 | 0.003 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.81, 1.20 | 0.9 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 1.00 | 0.85, 1.18 | >0.9 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.87, 1.23 | 0.7 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.40 | 1.11, 1.77 | 0.005 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.68, 0.92 | 0.002 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.79 | 1.49, 2.16 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.10 | 0.92, 1.32 | 0.3 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.87 | 0.73, 1.03 | 0.10 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.13, 7.83 | >0.9 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | 0.82 | 0.65, 1.03 | 0.083 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 2.72 | 2.33, 3.18 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.29, 1.61 | 0.4 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 0.96 | 0.83, 1.11 | 0.6 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.57, 1.40 | 0.6 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.06 | 0.84, 1.32 | 0.6 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 6.15 | 5.22, 7.25 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.15 | 0.65, 2.05 | 0.6 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.62, 1.55 | >0.9 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 0.72 | 0.54, 0.96 | 0.027 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 1.56 | 0.91, 2.70 | 0.11 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 4.17 | 3.48, 4.99 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 3.30 | 2.71, 4.01 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Pneumonia:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | 0.65 | 0.43, 0.98 | 0.038 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 1.61 | 1.35, 1.94 | <0.001 |
| Robotic colectomy | 1.25 | 0.89, 1.74 | 0.2 |
| Age, y | 1.01 | 1.00, 1.02 | 0.10 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.42 | 1.22, 1.65 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.24 | 0.80, 1.90 | 0.3 |
| Black | 1.04 | 0.83, 1.31 | 0.7 |
| Hispanic | 0.95 | 0.72, 1.26 | 0.7 |
| Native American | 1.15 | 0.42, 3.17 | 0.8 |
| Other | 1.13 | 0.71, 1.80 | 0.6 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.43 | 1.06, 1.92 | 0.018 |
| Medicare | 1.38 | 1.09, 1.75 | 0.007 |
| Other | 1.23 | 0.84, 1.79 | 0.3 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.99 | 0.82, 1.19 | >0.9 |
| $66,000 - $87,999 | 0.80 | 0.65, 0.98 | 0.032 |
| $88,000 or more | 0.68 | 0.53, 0.87 | 0.002 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.91 | 0.72, 1.16 | 0.4 |
| South | 1.06 | 0.88, 1.28 | 0.5 |
| West | 0.93 | 0.74, 1.18 | 0.6 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.09 | 0.92, 1.30 | 0.3 |
| Small | 1.38 | 1.15, 1.67 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.73 | 0.56, 0.95 | 0.018 |
| Urban, teaching | 0.56 | 0.45, 0.71 | <0.001 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.75 | 1.47, 2.07 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.72, 1.03 | 0.11 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.06 | 0.86, 1.30 | 0.6 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.87, 1.21 | 0.8 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 2.34 | 2.00, 2.75 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.72, 1.24 | 0.7 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.79, 1.08 | 0.3 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 2.04 | 1.69, 2.46 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.08 | 0.89, 1.32 | 0.4 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.09 | 0.91, 1.30 | 0.3 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 4.97 | 1.66, 14.9 | 0.004 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | 0.74 | 0.58, 0.95 | 0.017 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 1.88 | 1.59, 2.22 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.34, 1.89 | 0.6 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 1.09 | 0.93, 1.27 | 0.3 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 1.36 | 0.84, 2.19 | 0.2 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.02 | 0.80, 1.30 | 0.9 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 3.21 | 2.70, 3.80 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.79 | 1.01, 3.17 | 0.048 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 1.44 | 0.92, 2.26 | 0.11 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.61, 1.11 | 0.2 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 1.77 | 0.96, 3.28 | 0.069 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 2.15 | 1.72, 2.69 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 2.01 | 1.57, 2.56 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Gastrointestinal Hemorrhage:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | 0.56 | 0.42, 0.73 | <0.001 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 0.75 | 0.68, 0.83 | <0.001 |
| Robotic colectomy | 0.74 | 0.61, 0.91 | 0.004 |
| Age, y | 1.01 | 1.01, 1.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.98 | 0.89, 1.07 | 0.6 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.31 | 1.04, 1.64 | 0.020 |
| Black | 1.23 | 1.07, 1.41 | 0.003 |
| Hispanic | 1.13 | 0.97, 1.32 | 0.13 |
| Native American | 2.10 | 1.27, 3.47 | 0.004 |
| Other | 0.90 | 0.66, 1.21 | 0.5 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.99 | 0.82, 1.19 | 0.9 |
| Medicare | 1.07 | 0.93, 1.23 | 0.3 |
| Other | 1.19 | 0.96, 1.49 | 0.12 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.0 | 0.88, 1.12 | >0.9 |
| $66,000 - $87,999 | 1.01 | 0.89, 1.14 | >0.9 |
| $88,000 or more | 0.99 | 0.86, 1.14 | 0.9 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.99 | 0.85, 1.16 | 0.9 |
| South | 1.17 | 1.03, 1.33 | 0.018 |
| West | 1.15 | 0.99, 1.34 | 0.060 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.08 | 0.97, 1.19 | 0.2 |
| Small | 0.95 | 0.84, 1.08 | 0.4 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.02 | 0.84, 1.24 | 0.8 |
| Urban, teaching | 0.95 | 0.79, 1.13 | 0.6 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 4.68 | 4.21, 5.20 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.88, 1.09 | 0.7 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.31 | 1.16, 1.48 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 0.93 | 0.84, 1.04 | 0.2 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.88, 1.11 | 0.8 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.19 | 1.02, 1.40 | 0.027 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.89, 1.08 | 0.7 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.73 | 1.54, 1.96 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.87, 1.11 | 0.7 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.64 | 1.48, 1.81 | <0.001 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 0.28, 5.55 | 0.8 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.83, 1.09 | 0.4 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 1.17 | 1.04, 1.31 | 0.009 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.50, 1.48 | 0.6 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.85, 1.04 | 0.3 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 1.33 | 0.97, 1.82 | 0.082 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.06 | 0.91, 1.23 | 0.5 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 1.18 | 1.07, 1.31 | 0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.42 | 0.92, 2.18 | 0.11 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 0.90 | 0.65, 1.24 | 0.5 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 1.33 | 1.13, 1.56 | <0.001 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.53, 1.61 | 0.8 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 1.05, 1.47 | 0.013 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.88 | 1.57, 2.24 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Acute Respiratory Failure:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | 1.00 | 0.69, 1.45 | >0.9 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 1.58 | 1.36, 1.83 | <0.001 |
| Robotic colectomy | 1.11 | 0.85, 1.46 | 0.4 |
| Age, y | 1.01 | 1.00, 1.02 | 0.004 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.18 | 1.04, 1.35 | 0.010 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.68 | 0.45, 1.04 | 0.073 |
| Black | 0.78 | 0.64, 0.96 | 0.017 |
| Hispanic | 0.90 | 0.71, 1.14 | 0.4 |
| Native American | 1.18 | 0.56, 2.47 | 0.7 |
| Other | 0.69 | 0.44, 1.09 | 0.12 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.28 | 0.98, 1.68 | 0.073 |
| Medicare | 1.36 | 1.11, 1.67 | 0.003 |
| Other | 1.21 | 0.87, 1.70 | 0.3 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.94 | 0.80, 1.10 | 0.4 |
| $66,000 - $87,999 | 0.89 | 0.75, 1.06 | 0.2 |
| $88,000 or more | 0.81 | 0.68, 0.98 | 0.032 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.81 | 0.66, 0.99 | 0.044 |
| South | 0.95 | 0.81, 1.12 | 0.6 |
| West | 1.05 | 0.87, 1.26 | 0.6 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 1.08 | 0.93, 1.24 | 0.3 |
| Small | 1.14 | 0.98, 1.34 | 0.10 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.26 | 0.99, 1.62 | 0.063 |
| Urban, teaching | 1.01 | 0.81, 1.27 | >0.9 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.26 | 1.09, 1.44 | 0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.86, 1.15 | >0.9 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.10 | 0.93, 1.30 | 0.3 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 1.11 | 0.97, 1.28 | 0.14 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.75 | 1.52, 2.01 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.30 | 1.06, 1.59 | 0.012 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.75, 0.98 | 0.022 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 2.31 | 1.97, 2.70 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.04 | 0.88, 1.24 | 0.6 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.66, 0.91 | 0.002 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 2.70 | 0.53, 13.6 | 0.2 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | 0.81 | 0.67, 0.98 | 0.031 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 2.03 | 1.76, 2.34 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.53, 2.00 | >0.9 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 1.11 | 0.98, 1.27 | 0.11 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.51, 1.35 | 0.4 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.13 | 0.93, 1.37 | 0.2 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 4.57 | 3.96, 5.28 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.70 | 1.05, 2.76 | 0.032 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 1.39 | 0.96, 2.00 | 0.077 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 0.93 | 0.73, 1.18 | 0.6 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 1.75 | 1.01, 3.03 | 0.048 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 3.61 | 3.05, 4.28 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 2.75 | 2.27, 3.33 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Acute Kidney Injury:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | 0.60 | 0.47, 0.75 | <0.001 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 1.30 | 1.19, 1.41 | <0.001 |
| Robotic colectomy | 1.29 | 1.12, 1.49 | <0.001 |
| Age, y | 1.01 | 1.01, 1.01 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.75 | 1.62, 1.90 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.98 | 0.79, 1.22 | 0.9 |
| Black | 1.35 | 1.20, 1.53 | <0.001 |
| Hispanic | 0.95 | 0.82, 1.10 | 0.5 |
| Native American | 1.17 | 0.68, 2.00 | 0.6 |
| Other | 1.16 | 0.92, 1.47 | 0.2 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.12 | 0.95, 1.32 | 0.2 |
| Medicare | 1.13 | 1.01, 1.26 | 0.040 |
| Other | 0.94 | 0.77, 1.15 | 0.5 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.02 | 0.92, 1.13 | 0.7 |
| $66,000 - $87,999 | 1.03 | 0.93, 1.15 | 0.6 |
| $88,000 or more | 0.97 | 0.86, 1.09 | 0.6 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.07 | 0.94, 1.21 | 0.3 |
| South | 1.05 | 0.95, 1.17 | 0.4 |
| West | 0.97 | 0.85, 1.11 | 0.7 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | 0.91 | 0.83, 1.00 | 0.043 |
| Small | 0.98 | 0.88, 1.09 | 0.7 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 1.12 | 0.94, 1.33 | 0.2 |
| Urban, teaching | 1.19 | 1.01, 1.39 | 0.034 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 1.78 | 1.63, 1.95 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 1.33 | 1.21, 1.46 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 3.67 | 3.34, 4.04 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 1.28 | 1.17, 1.40 | <0.001 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.93, 1.14 | 0.5 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.13 | 0.98, 1.30 | 0.083 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.93 | 0.85, 1.00 | 0.066 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.69 | 1.52, 1.89 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.28 | 1.17, 1.41 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.81, 0.99 | 0.026 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 1.80 | 0.68, 4.73 | 0.2 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.86, 1.09 | 0.6 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 1.71 | 1.55, 1.89 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 1.12 | 0.73, 1.72 | 0.6 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.92, 1.10 | 0.9 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 0.67 | 0.47, 0.94 | 0.022 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.91, 1.17 | 0.7 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 4.44 | 4.08, 4.83 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.60, 1.45 | 0.8 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.75, 1.27 | 0.8 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.81, 1.10 | 0.4 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.61, 1.59 | >0.9 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 1.69 | 1.47, 1.95 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.90 | 1.62, 2.22 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | -1.1 | -2.1, -0.03 | 0.043 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 1.3 | 1.2, 1.4 | <0.001 |
| Robotic colectomy | 0.78 | 0.59, 0.97 | <0.001 |
| Age, y | 0.02 | 0.01, 0.03 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.54 | 0.43, 0.65 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.23 | -0.12, 0.57 | 0.2 |
| Black | 0.71 | 0.49, 0.92 | <0.001 |
| Hispanic | 0.23 | -0.02, 0.48 | 0.073 |
| Native American | 0.57 | -0.50, 1.7 | 0.3 |
| Other | 0.41 | -0.10, 0.92 | 0.12 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.2 | 0.82, 1.5 | <0.001 |
| Medicare | 0.10 | -0.08, 0.27 | 0.3 |
| Other | 0.17 | -0.12, 0.46 | 0.3 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -0.02 | -0.18, 0.13 | 0.8 |
| $66,000 - $87,999 | -0.12 | -0.29, 0.04 | 0.14 |
| $88,000 or more | -0.23 | -0.41, -0.04 | 0.014 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.73 | 0.53, 0.93 | <0.001 |
| South | 0.45 | 0.29, 0.61 | <0.001 |
| West | 0.12 | -0.06, 0.30 | 0.2 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -0.36 | -0.51, -0.22 | <0.001 |
| Small | -0.60 | -0.76, -0.45 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 0.32 | 0.10, 0.55 | 0.005 |
| Urban, teaching | 0.49 | 0.31, 0.68 | <0.001 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 3.2 | 3.0, 3.4 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -0.11 | -0.25, 0.03 | 0.13 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.56 | 0.34, 0.79 | <0.001 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | -0.05 | -0.20, 0.10 | 0.5 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.23 | 0.06, 0.39 | 0.007 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.04 | -0.21, 0.30 | 0.7 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -0.27 | -0.39, -0.15 | <0.001 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.7 | 1.4, 2.0 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.21 | 0.08, 0.35 | 0.002 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.21 | 0.03, 0.39 | 0.022 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 3.7 | -0.95, 8.4 | 0.12 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | -0.12 | -0.29, 0.05 | 0.2 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 4.7 | 4.3, 5.0 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 0.33 | -0.35, 1.0 | 0.3 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | -0.21 | -0.36, -0.07 | 0.004 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | -0.01 | -0.75, 0.73 | >0.9 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.48, 1.0 | <0.001 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 3.2 | 3.0, 3.4 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 3.4 | 1.2, 5.5 | 0.002 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | 0.13 | -0.23, 0.49 | 0.5 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 0.34 | 0.05, 0.63 | 0.024 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 2.8 | 1.3, 4.4 | <0.001 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 3.2 | 2.7, 3.8 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 2.2 | 1.7, 2.7 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Liver cirrhosis |  |  |  |
| With liver cirrhosis | — | — |  |
| Without liver cirrhosis | -9,879 | -26,341, 6,583 | 0.2 |
| Type of Colectomy |  |  |  |
| Laparoscopic colectomy | — | — |  |
| Open colectomy | 5,536 | 3,048, 8,023 | <0.001 |
| Robotic colectomy | 29,555 | 25,882, 33,227 | <0.001 |
| Age, y | -218 | -346, -90 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 9,286 | 7,216, 11,356 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 10,682 | 3,293, 18,070 | 0.005 |
| Black | 4,811 | 933, 8,689 | 0.015 |
| Hispanic | 20,644 | 15,078, 26,211 | <0.001 |
| Native American | -6,373 | -21,999, 9,253 | 0.4 |
| Other | 18,797 | 8,744, 28,851 | <0.001 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 7,197 | 1,150, 13,244 | 0.020 |
| Medicare | 2,990 | -153, 6,134 | 0.062 |
| Other | -5,813 | -10,673, -952 | 0.019 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -1,576 | -4,676, 1,525 | 0.3 |
| $66,000 - $87,999 | -4,055 | -7,633, -476 | 0.026 |
| $88,000 or more | -809 | -5,004, 3,386 | 0.7 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 19,846 | 14,884, 24,809 | <0.001 |
| South | 19,624 | 15,881, 23,367 | <0.001 |
| West | 52,975 | 47,132, 58,818 | <0.001 |
| Hospital bedsize |  |  |  |
| Large | — | — |  |
| Medium | -7,738 | -11,787, -3,688 | <0.001 |
| Small | -13,490 | -17,558, -9,423 | <0.001 |
| Hospital location and teaching status |  |  |  |
| Rural | — | — |  |
| Urban, non-teaching | 34,447 | 29,754, 39,140 | <0.001 |
| Urban, teaching | 32,966 | 29,289, 36,644 | <0.001 |
| Type of admission |  |  |  |
| Elective | — | — |  |
| Non-elective | 27,689 | 24,262, 31,115 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | -1,231 | -3,660, 1,199 | 0.3 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 4,420 | 537, 8,303 | 0.026 |
| Diabetes Mellitus |  |  |  |
| No | — | — |  |
| Yes | 2,433 | -133, 4,998 | 0.063 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 5,158 | 2,181, 8,135 | <0.001 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 2,071 | -3,012, 7,154 | 0.4 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -3,214 | -5,341, -1,087 | 0.003 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 23,800 | 18,782, 28,818 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 5,880 | 3,250, 8,509 | <0.001 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | -623 | -3,910, 2,664 | 0.7 |
| HIV/AIDS |  |  |  |
| No | — | — |  |
| Yes | 74,437 | -20,814, 169,688 | 0.13 |
| Hypothyroidism |  |  |  |
| No | — | — |  |
| Yes | -2,891 | -6,059, 277 | 0.074 |
| Weight loss |  |  |  |
| No | — | — |  |
| Yes | 54,804 | 48,819, 60,789 | <0.001 |
| Lymphoma |  |  |  |
| No | — | — |  |
| Yes | 1,617 | -10,491, 13,724 | 0.8 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 6,973 | 2,669, 11,276 | 0.002 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 5,942 | -7,047, 18,931 | 0.4 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 4,537 | 0.80, 9,074 | 0.050 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 45,243 | 41,716, 48,770 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 33,963 | 4,489, 63,436 | 0.024 |
| Rheumatoid disease |  |  |  |
| No | — | — |  |
| Yes | -2,110 | -8,607, 4,387 | 0.5 |
| Valvular disease |  |  |  |
| No | — | — |  |
| Yes | 3,710 | -1,541, 8,961 | 0.2 |
| Paralysis |  |  |  |
| No | — | — |  |
| Yes | 30,315 | 4,031, 56,600 | 0.024 |
| Neurological disorders |  |  |  |
| No | — | — |  |
| Yes | 47,597 | 38,006, 57,187 | <0.001 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 54,608 | 42,412, 66,803 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |