Impact of Diabetes Mellitus on Inpatient Outcomes in Multiple Myeloma: Analysis of the National Inpatient Sample, 2018–2020

Analysis for RCOP 2025-August-NIS-7-Heme/Onc

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## Preamble:

* **Reference Papers:**
  + [Yang et al. 2023](https://pubmed.ncbi.nlm.nih.gov/37798888/)

## Preamble:

* **Study Objective**: To examine the impact of diabetes on outcomes among admissions with multiple myeloma.
* **Data Source**: Cross-sectional analysis of the National Inpatient Sample (NIS) from 2018 to 2020. The NIS is part of the Healthcare Cost and Utilization Project (HCUP) and provides a stratified sample of inpatient discharges from U.S. community hospitals across all payers.
* **Cohort Definition:** Patients were included if they met the following criteria
  + Age ≥18 years
  + Had a primary diagnosis of multiple myeloma
* **Primary Outcomes**:
  + In-hospital all-cause mortality
  + Total hospital length of stay (days)
  + Total charge, inflation adjusted to 2020 ($)
* **Secondary Outcomes**:
  + Requiring mechanical ventilation
  + Sepsis
  + Acute kidney injury
  + Venous thromboembolism
  + Respiratory Failure
  + Non-home discharge
* **Covariates for Adjustment:** All models adjusted for the following
  + Demographics: Age, sex, race, income, insurance, location of patient’s residence, hospital region, hospital bedsize, hospital location, and teaching status.
  + Medical History: Hypertension, hyperlipidemia, coronary artery disease, peripheral vascular disease, heart failure, chronic kidney disease, chronic pulmonary disease, dementia, obstructive sleep apnea, anemia, liver disease, alcohol abuse, drug abuse, obesity, depression, psychoses, coagulopathy, weight loss, electrolyte and fluid imbalance.
* **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** | **Overall** N = 62,870*1* | **Multiple Myeloma without Diabetes** N = 48,890*1* | **Multiple Myeloma with Diabetes** N = 13,980*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age, y | 66 (58, 73) | 65 (57, 73) | 68 (61, 74) | <0.001 |
| Sex |  |  |  | 0.003 |
| Female | 27,760 (44%) | 21,940 (45%) | 5,820 (42%) |  |
| Male | 35,110 (56%) | 26,950 (55%) | 8,160 (58%) |  |
| Race |  |  |  | <0.001 |
| White | 36,580 (59%) | 30,030 (63%) | 6,550 (48%) |  |
| Asian or Pacific Islander | 1,745 (2.8%) | 1,205 (2.5%) | 540 (3.9%) |  |
| Black | 14,385 (23%) | 10,140 (21%) | 4,245 (31%) |  |
| Hispanic | 6,050 (9.8%) | 4,310 (9.0%) | 1,740 (13%) |  |
| Native American | 235 (0.4%) | 180 (0.4%) | 55 (0.4%) |  |
| Other | 2,495 (4.1%) | 1,865 (3.9%) | 630 (4.6%) |  |
| Residential income |  |  |  | <0.001 |
| $1 - $51,999 | 16,265 (26%) | 11,955 (25%) | 4,310 (31%) |  |
| $52,000 - $65,999 | 14,815 (24%) | 11,520 (24%) | 3,295 (24%) |  |
| $66,000 - $87,999 | 15,530 (25%) | 12,210 (25%) | 3,320 (24%) |  |
| $88,000 or more | 15,245 (25%) | 12,430 (26%) | 2,815 (20%) |  |
| Expected primary payer |  |  |  | <0.001 |
| Private | 22,710 (36%) | 18,835 (39%) | 3,875 (28%) |  |
| Medicaid | 5,515 (8.8%) | 4,315 (8.8%) | 1,200 (8.6%) |  |
| Medicare | 32,955 (52%) | 24,465 (50%) | 8,490 (61%) |  |
| Other | 1,635 (2.6%) | 1,220 (2.5%) | 415 (3.0%) |  |
| Hospital region |  |  |  | 0.036 |
| Midwest | 13,885 (22%) | 10,955 (22%) | 2,930 (21%) |  |
| Northeast | 13,690 (22%) | 10,640 (22%) | 3,050 (22%) |  |
| South | 24,045 (38%) | 18,380 (38%) | 5,665 (41%) |  |
| West | 11,250 (18%) | 8,915 (18%) | 2,335 (17%) |  |
| Hypertension | 39,740 (63%) | 28,005 (57%) | 11,735 (84%) | <0.001 |
| Hyperlipidemia | 19,990 (32%) | 12,940 (26%) | 7,050 (50%) | <0.001 |
| Coronary artery disease | 7,090 (11%) | 4,605 (9.4%) | 2,485 (18%) | <0.001 |
| Peripheral vascular disease | 2,485 (4.0%) | 1,840 (3.8%) | 645 (4.6%) | 0.039 |
| Heart failure | 8,815 (14%) | 6,160 (13%) | 2,655 (19%) | <0.001 |
| Chronic kidney disease | 18,425 (29%) | 12,765 (26%) | 5,660 (40%) | <0.001 |
| Chronic obstructive pulmonary disease | 8,350 (13%) | 6,205 (13%) | 2,145 (15%) | <0.001 |
| Dementia | 2,025 (3.2%) | 1,370 (2.8%) | 655 (4.7%) | <0.001 |
| Liver disease | 2,835 (4.5%) | 1,970 (4.0%) | 865 (6.2%) | <0.001 |
| Obstructive sleep apnea | 3,600 (5.7%) | 2,305 (4.7%) | 1,295 (9.3%) | <0.001 |
| Anemia | 4,095 (6.5%) | 3,045 (6.2%) | 1,050 (7.5%) | 0.019 |
| Alcohol use disorder | 17,065 (27%) | 13,225 (27%) | 3,840 (27%) | 0.7 |
| Obesity | 6,705 (11%) | 4,190 (8.6%) | 2,515 (18%) | <0.001 |
| Depression | 8,025 (13%) | 6,270 (13%) | 1,755 (13%) | 0.7 |
| Psychoses | 420 (0.7%) | 300 (0.6%) | 120 (0.9%) | 0.2 |
| Coagulopathy | 12,970 (21%) | 10,070 (21%) | 2,900 (21%) | 0.9 |
| WeightLoss | 12,410 (20%) | 10,055 (21%) | 2,355 (17%) | <0.001 |
| Electrolyte and fluid imbalance | 32,555 (52%) | 25,270 (52%) | 7,285 (52%) | 0.7 |
| Drug\_abuse | 1,430 (2.3%) | 1,135 (2.3%) | 295 (2.1%) | 0.5 |
| *1*Median (Q1, Q3); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Outcomes Table:

| **Characteristic** | **Multiple Myeloma without Diabetes** N = 48,890*1* | **Multiple Myeloma with Diabetes** N = 13,980*1* | **p-value***2* |
| --- | --- | --- | --- |
| Died during hospitalization | 2,340 (4.8%) | 620 (4.4%) | 0.4 |
| Sepsis | 2,975 (6.1%) | 785 (5.6%) | 0.4 |
| Mechanical ventilation | 1,150 (2.4%) | 340 (2.4%) | 0.8 |
| Acute kidney injury | 17,280 (35%) | 5,695 (41%) | <0.001 |
| Venous thromboembolism | 2,190 (4.5%) | 490 (3.5%) | 0.030 |
| Respiratory Failure | 3,110 (6.4%) | 915 (6.5%) | 0.7 |
| Non-home discharge | 2,640 (5.4%) | 685 (4.9%) | 0.3 |
| Length of stay (days) | 10 (4, 16) | 9 (4, 15) | 0.002 |
| Inflation-adjusted total charge ($) | 106,287 (48,200, 184,160) | 96,527 (44,925, 174,093) | 0.002 |
| *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** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | 0.87 | 0.70, 1.08 | 0.2 |
| Age, y | 1.03 | 1.02, 1.04 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.09 | 0.91, 1.30 | 0.3 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.37 | 0.87, 2.16 | 0.2 |
| Black | 1.13 | 0.89, 1.43 | 0.3 |
| Hispanic | 0.92 | 0.65, 1.31 | 0.7 |
| Native American | 2.78 | 0.89, 8.69 | 0.080 |
| Other | 1.13 | 0.72, 1.78 | 0.6 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.02 | 0.79, 1.31 | 0.9 |
| $66,000 - $87,999 | 1.10 | 0.86, 1.40 | 0.5 |
| $88,000 or more | 0.97 | 0.74, 1.27 | 0.8 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.26 | 0.88, 1.79 | 0.2 |
| Medicare | 0.89 | 0.69, 1.15 | 0.4 |
| Other | 2.50 | 1.58, 3.95 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.07 | 0.80, 1.43 | 0.6 |
| South | 0.75 | 0.58, 0.98 | 0.034 |
| West | 1.03 | 0.77, 1.37 | 0.9 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.65, 0.98 | 0.032 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.63, 0.96 | 0.019 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.79, 1.35 | 0.8 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.76 | 0.49, 1.16 | 0.2 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 2.28 | 1.85, 2.82 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.54 | 1.27, 1.87 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.15 | 0.90, 1.48 | 0.3 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 1.45 | 0.99, 2.12 | 0.054 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.78 | 2.06, 3.76 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.74 | 0.48, 1.15 | 0.2 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.55 | 0.37, 0.82 | 0.003 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.75 | 0.60, 0.93 | 0.009 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | 0.88 | 0.45, 1.71 | 0.7 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.84 | 0.60, 1.18 | 0.3 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.00 | 0.75, 1.33 | >0.9 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 0.74 | 0.22, 2.48 | 0.6 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 2.08 | 1.73, 2.50 | <0.001 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 2.02 | 1.67, 2.45 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 1.79 | 1.46, 2.20 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Mechanical Ventilation:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | 1.00 | 0.74, 1.35 | >0.9 |
| Age, y | 0.99 | 0.98, 1.01 | 0.4 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.22 | 0.94, 1.59 | 0.14 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.20 | 0.62, 2.32 | 0.6 |
| Black | 1.07 | 0.77, 1.48 | 0.7 |
| Hispanic | 0.96 | 0.59, 1.55 | 0.9 |
| Native American | 1.08 | 0.13, 8.99 | >0.9 |
| Other | 0.87 | 0.43, 1.75 | 0.7 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.90 | 0.63, 1.28 | 0.5 |
| $66,000 - $87,999 | 1.00 | 0.71, 1.41 | >0.9 |
| $88,000 or more | 0.84 | 0.58, 1.20 | 0.3 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.20 | 0.75, 1.91 | 0.4 |
| Medicare | 0.97 | 0.69, 1.37 | 0.9 |
| Other | 1.82 | 0.94, 3.50 | 0.075 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.02 | 0.70, 1.49 | >0.9 |
| South | 0.92 | 0.65, 1.29 | 0.6 |
| West | 0.99 | 0.66, 1.48 | >0.9 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.77 | 0.58, 1.01 | 0.058 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.68 | 0.50, 0.93 | 0.014 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.57, 1.28 | 0.4 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.51 | 0.25, 1.05 | 0.067 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 3.35 | 2.48, 4.52 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.41 | 1.09, 1.84 | 0.010 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.42 | 1.01, 1.98 | 0.041 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 1.32 | 0.69, 2.54 | 0.4 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.70 | 1.86, 3.93 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.32, 1.20 | 0.2 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.39 | 0.21, 0.74 | 0.004 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.60, 1.07 | 0.14 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | 1.18 | 0.55, 2.52 | 0.7 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.65, 1.50 | >0.9 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 0.81 | 0.54, 1.21 | 0.3 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 0.49 | 0.08, 3.09 | 0.4 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 2.28 | 1.77, 2.94 | <0.001 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 1.71 | 1.32, 2.22 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 5.53 | 3.85, 7.96 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Sepsis:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | 1.06 | 0.86, 1.30 | 0.6 |
| Age, y | 0.99 | 0.98, 1.00 | 0.002 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.21 | 1.02, 1.44 | 0.033 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.10 | 0.70, 1.73 | 0.7 |
| Black | 0.92 | 0.75, 1.13 | 0.4 |
| Hispanic | 1.15 | 0.86, 1.53 | 0.4 |
| Native American | 0.75 | 0.17, 3.38 | 0.7 |
| Other | 0.87 | 0.54, 1.43 | 0.6 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.14 | 0.92, 1.40 | 0.2 |
| $66,000 - $87,999 | 1.24 | 0.99, 1.55 | 0.056 |
| $88,000 or more | 1.04 | 0.81, 1.34 | 0.7 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.16 | 0.87, 1.56 | 0.3 |
| Medicare | 1.08 | 0.89, 1.32 | 0.4 |
| Other | 0.81 | 0.46, 1.43 | 0.5 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.62 | 1.10, 2.37 | 0.014 |
| South | 0.86 | 0.65, 1.12 | 0.3 |
| West | 1.05 | 0.78, 1.43 | 0.7 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.67, 0.94 | 0.009 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.69, 1.01 | 0.060 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.52, 0.95 | 0.022 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.71 | 0.45, 1.12 | 0.14 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.55 | 1.26, 1.90 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 1.04, 1.48 | 0.018 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.08 | 0.83, 1.40 | 0.6 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 0.64 | 0.36, 1.11 | 0.11 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 1.82 | 1.37, 2.42 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 1.05 | 0.77, 1.42 | 0.8 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.59 | 0.41, 0.86 | 0.005 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.68, 1.07 | 0.2 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | 0.58 | 0.31, 1.09 | 0.088 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.75, 1.27 | 0.9 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.74, 1.22 | 0.7 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 0.43 | 0.10, 1.83 | 0.3 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 1.03, 1.51 | 0.026 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 1.86 | 1.53, 2.26 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 2.76 | 2.29, 3.32 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Venous Thromboembolism:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | 0.79 | 0.62, 1.00 | 0.053 |
| Age, y | 1.00 | 0.99, 1.00 | 0.3 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.00 | 0.83, 1.20 | >0.9 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.63 | 0.32, 1.23 | 0.2 |
| Black | 1.36 | 1.09, 1.71 | 0.008 |
| Hispanic | 1.17 | 0.85, 1.60 | 0.3 |
| Native American | 1.88 | 0.60, 5.93 | 0.3 |
| Other | 1.30 | 0.74, 2.28 | 0.4 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.06 | 0.81, 1.37 | 0.7 |
| $66,000 - $87,999 | 1.07 | 0.82, 1.39 | 0.6 |
| $88,000 or more | 1.06 | 0.81, 1.38 | 0.7 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.75 | 0.52, 1.10 | 0.14 |
| Medicare | 1.07 | 0.83, 1.37 | 0.6 |
| Other | 0.65 | 0.33, 1.29 | 0.2 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.94 | 0.70, 1.24 | 0.6 |
| South | 0.83 | 0.65, 1.05 | 0.12 |
| West | 1.05 | 0.78, 1.42 | 0.8 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.80, 1.19 | 0.8 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.68, 1.03 | 0.088 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.23 | 0.94, 1.61 | 0.13 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 1.07 | 0.69, 1.68 | 0.8 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.23 | 0.96, 1.58 | 0.11 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 0.83 | 0.68, 1.02 | 0.072 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.75, 1.27 | 0.9 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.51, 1.57 | 0.7 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.65, 1.49 | >0.9 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 1.47 | 1.07, 2.01 | 0.017 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.54, 1.17 | 0.2 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.78, 1.21 | 0.8 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | 0.57 | 0.27, 1.22 | 0.15 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.10 | 0.82, 1.47 | 0.5 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 0.96 | 0.73, 1.27 | 0.8 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.63 | 0.66, 4.02 | 0.3 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 1.01, 1.51 | 0.042 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 1.60 | 1.31, 1.94 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 1.02, 1.49 | 0.027 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Respiratory Failure:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | 0.93 | 0.76, 1.12 | 0.4 |
| Age, y | 1.01 | 1.00, 1.01 | 0.3 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.04 | 0.89, 1.22 | 0.6 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.02 | 0.65, 1.60 | >0.9 |
| Black | 0.72 | 0.58, 0.89 | 0.002 |
| Hispanic | 0.93 | 0.69, 1.25 | 0.6 |
| Native American | 1.11 | 0.32, 3.89 | 0.9 |
| Other | 0.85 | 0.56, 1.30 | 0.5 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 1.03 | 0.83, 1.29 | 0.8 |
| $66,000 - $87,999 | 1.09 | 0.87, 1.37 | 0.4 |
| $88,000 or more | 0.87 | 0.69, 1.11 | 0.3 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.12 | 0.82, 1.53 | 0.5 |
| Medicare | 1.03 | 0.84, 1.27 | 0.8 |
| Other | 1.44 | 0.89, 2.30 | 0.13 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 0.70 | 0.55, 0.90 | 0.006 |
| South | 0.76 | 0.63, 0.92 | 0.006 |
| West | 0.94 | 0.74, 1.18 | 0.6 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.87 | 0.73, 1.04 | 0.12 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.89 | 0.75, 1.06 | 0.2 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 0.79 | 0.61, 1.02 | 0.066 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.60 | 0.40, 0.91 | 0.016 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 3.30 | 2.73, 3.97 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.46 | 1.23, 1.74 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.24 | 1.00, 1.53 | 0.055 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 1.08 | 0.72, 1.61 | 0.7 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.07 | 1.56, 2.75 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 1.17 | 0.85, 1.60 | 0.3 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.06 | 0.80, 1.41 | 0.7 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 1.00 | 0.85, 1.18 | >0.9 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | 1.00 | 0.57, 1.76 | >0.9 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.16 | 0.91, 1.48 | 0.2 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.80, 1.26 | >0.9 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 0.97 | 0.33, 2.84 | >0.9 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.63 | 1.37, 1.94 | <0.001 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 1.75 | 1.48, 2.07 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 2.98 | 2.47, 3.58 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Acute Kidney Injury:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | 0.95 | 0.86, 1.06 | 0.4 |
| Age, y | 1.02 | 1.01, 1.02 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.22 | 1.12, 1.33 | <0.001 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.77 | 0.59, 1.00 | 0.053 |
| Black | 1.01 | 0.90, 1.12 | >0.9 |
| Hispanic | 0.79 | 0.68, 0.92 | 0.002 |
| Native American | 0.63 | 0.31, 1.30 | 0.2 |
| Other | 0.85 | 0.66, 1.10 | 0.2 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.99 | 0.87, 1.12 | 0.9 |
| $66,000 - $87,999 | 0.93 | 0.82, 1.05 | 0.2 |
| $88,000 or more | 0.88 | 0.77, 1.00 | 0.058 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.23 | 1.03, 1.45 | 0.020 |
| Medicare | 1.08 | 0.96, 1.21 | 0.2 |
| Other | 0.90 | 0.68, 1.20 | 0.5 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.26 | 1.08, 1.49 | 0.005 |
| South | 1.09 | 0.93, 1.28 | 0.3 |
| West | 1.21 | 1.01, 1.44 | 0.039 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 1.07 | 0.97, 1.19 | 0.2 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.92 | 0.84, 1.01 | 0.10 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.87, 1.17 | 0.9 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.76, 1.20 | 0.7 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.39 | 1.23, 1.58 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 3.59 | 3.27, 3.95 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.87, 1.13 | >0.9 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 1.32 | 1.03, 1.69 | 0.026 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 1.35 | 1.11, 1.63 | 0.002 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.82, 1.18 | 0.8 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 1.87 | 1.57, 2.22 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.87, 1.16 | >0.9 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | 1.46 | 1.12, 1.91 | 0.006 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 1.23 | 1.06, 1.43 | 0.006 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.75, 0.98 | 0.020 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.55 | 0.94, 2.56 | 0.089 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.42 | 1.28, 1.58 | <0.001 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 1.20 | 1.07, 1.35 | 0.002 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 3.28 | 2.97, 3.62 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

### Non-Home Discharge:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | 0.84 | 0.68, 1.04 | 0.11 |
| Age, y | 1.02 | 1.01, 1.03 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 1.12 | 0.94, 1.33 | 0.2 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 1.44 | 0.93, 2.21 | 0.10 |
| Black | 1.17 | 0.94, 1.45 | 0.2 |
| Hispanic | 0.98 | 0.71, 1.34 | 0.9 |
| Native American | 2.37 | 0.78, 7.25 | 0.13 |
| Other | 1.09 | 0.70, 1.68 | 0.7 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.99 | 0.78, 1.25 | >0.9 |
| $66,000 - $87,999 | 1.03 | 0.82, 1.31 | 0.8 |
| $88,000 or more | 0.89 | 0.69, 1.16 | 0.4 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.39 | 1.01, 1.91 | 0.042 |
| Medicare | 0.93 | 0.72, 1.19 | 0.6 |
| Other | 2.51 | 1.61, 3.93 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.15 | 0.87, 1.50 | 0.3 |
| South | 0.79 | 0.62, 1.01 | 0.060 |
| West | 1.00 | 0.75, 1.32 | >0.9 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.64, 0.94 | 0.010 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 0.82 | 0.67, 0.99 | 0.044 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | 1.07 | 0.83, 1.38 | 0.6 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | 0.80 | 0.52, 1.22 | 0.3 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 2.32 | 1.90, 2.84 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | 1.51 | 1.25, 1.81 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.12 | 0.89, 1.42 | 0.3 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | 1.51 | 1.05, 2.16 | 0.027 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 2.55 | 1.91, 3.41 | <0.001 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.65 | 0.42, 1.00 | 0.051 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.43, 0.88 | 0.008 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.78 | 0.64, 0.96 | 0.020 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | 1.43 | 0.86, 2.39 | 0.2 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.87 | 0.64, 1.19 | 0.4 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.03 | 0.79, 1.34 | 0.8 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 1.34 | 0.53, 3.36 | 0.5 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.94 | 1.63, 2.30 | <0.001 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 1.80 | 1.50, 2.16 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 1.68 | 1.39, 2.03 | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |

## Multivariable Linear Regression:

### Length of Stay:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | -0.09 | -0.54, 0.36 | 0.7 |
| Age, y | -0.11 | -0.14, -0.08 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 0.22 | -0.12, 0.57 | 0.2 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 0.21 | -1.1, 1.5 | 0.7 |
| Black | -0.09 | -0.61, 0.44 | 0.8 |
| Hispanic | -0.10 | -0.82, 0.63 | 0.8 |
| Native American | -0.99 | -2.8, 0.81 | 0.3 |
| Other | 1.5 | -0.29, 3.3 | 0.10 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | 0.11 | -0.46, 0.69 | 0.7 |
| $66,000 - $87,999 | -0.10 | -0.67, 0.47 | 0.7 |
| $88,000 or more | -0.36 | -0.94, 0.23 | 0.2 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | 0.06 | -0.91, 1.0 | 0.9 |
| Medicare | -0.69 | -1.2, -0.22 | 0.004 |
| Other | -1.4 | -2.4, -0.44 | 0.004 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 1.2 | 0.38, 2.1 | 0.004 |
| South | -0.10 | -0.84, 0.63 | 0.8 |
| West | -0.02 | -0.94, 0.89 | >0.9 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.62 | 0.17, 1.1 | 0.006 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -0.59 | -0.97, -0.20 | 0.003 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -0.51 | -1.1, 0.03 | 0.065 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -1.3 | -2.1, -0.51 | 0.001 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.7 | 0.96, 2.4 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -0.73 | -1.2, -0.30 | <0.001 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -0.07 | -0.61, 0.47 | 0.8 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | -0.74 | -1.7, 0.25 | 0.14 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 0.61 | -0.38, 1.6 | 0.2 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.13, 1.8 | 0.024 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | -1.8 | -2.4, -1.2 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 0.08 | -0.61, 0.77 | 0.8 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | -1.6 | -2.7, -0.58 | 0.002 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.22 | -0.37, 0.82 | 0.5 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 1.5 | 0.91, 2.1 | <0.001 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | 0.41 | -2.1, 2.9 | 0.7 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 0.53 | 0.03, 1.0 | 0.039 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 3.5 | 2.8, 4.2 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 2.8 | 2.4, 3.2 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |

### Inflation Adjusted Total Charge:

| **Characteristic** | **Beta** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Diabetes Categories |  |  |  |
| Multiple Myeloma without Diabetes | — | — |  |
| Multiple Myeloma with Diabetes | -2,742 | -9,834, 4,350 | 0.4 |
| Age, y | -2,096 | -2,588, -1,605 | <0.001 |
| Sex |  |  |  |
| Female | — | — |  |
| Male | 8,224 | 2,138, 14,310 | 0.008 |
| Race |  |  |  |
| White | — | — |  |
| Asian or Pacific Islander | 15,918 | -5,834, 37,670 | 0.2 |
| Black | 1,494 | -6,689, 9,678 | 0.7 |
| Hispanic | 18,395 | 3,540, 33,251 | 0.015 |
| Native American | -42,611 | -69,102, -16,121 | 0.002 |
| Other | 39,300 | 15,026, 63,574 | 0.002 |
| Residential income |  |  |  |
| $1 - $51,999 | — | — |  |
| $52,000 - $65,999 | -1,658 | -11,565, 8,249 | 0.7 |
| $66,000 - $87,999 | -3,199 | -12,897, 6,500 | 0.5 |
| $88,000 or more | -320 | -10,245, 9,604 | >0.9 |
| Expected primary payer |  |  |  |
| Private | — | — |  |
| Medicaid | -13,953 | -30,144, 2,238 | 0.091 |
| Medicare | -6,071 | -15,361, 3,220 | 0.2 |
| Other | -28,137 | -44,746, -11,528 | <0.001 |
| Hospital region |  |  |  |
| Midwest | — | — |  |
| Northeast | 52,635 | 37,669, 67,600 | <0.001 |
| South | 9,532 | -2,494, 21,557 | 0.12 |
| West | 54,212 | 32,181, 76,243 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 8,152 | 919, 15,386 | 0.027 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | -6,411 | -13,777, 955 | 0.088 |
| Coronary artery disease |  |  |  |
| No | — | — |  |
| Yes | -11,088 | -20,300, -1,875 | 0.018 |
| Peripheral vascular disease |  |  |  |
| No | — | — |  |
| Yes | -15,433 | -29,043, -1,822 | 0.026 |
| Heart failure |  |  |  |
| No | — | — |  |
| Yes | 22,099 | 10,029, 34,169 | <0.001 |
| Chronic kidney disease |  |  |  |
| No | — | — |  |
| Yes | -11,029 | -18,329, -3,729 | 0.003 |
| Chronic obstructive pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | -1,477 | -11,916, 8,962 | 0.8 |
| Dementia |  |  |  |
| No | — | — |  |
| Yes | -26,440 | -37,934, -14,946 | <0.001 |
| Liver disease |  |  |  |
| No | — | — |  |
| Yes | 22,788 | 4,840, 40,737 | 0.013 |
| Obstructive sleep apnea |  |  |  |
| No | — | — |  |
| Yes | 8,060 | -5,336, 21,457 | 0.2 |
| Anemia |  |  |  |
| No | — | — |  |
| Yes | -22,782 | -33,002, -12,562 | <0.001 |
| Alcohol use disorder |  |  |  |
| No | — | — |  |
| Yes | 9,065 | -7,235, 25,366 | 0.3 |
| Drug\_abuse |  |  |  |
| No | — | — |  |
| Yes | -25,489 | -40,513, -10,466 | <0.001 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 6,666 | -5,578, 18,910 | 0.3 |
| Depression |  |  |  |
| No | — | — |  |
| Yes | 11,190 | 876, 21,505 | 0.033 |
| Psychoses |  |  |  |
| No | — | — |  |
| Yes | -124 | -31,209, 30,961 | >0.9 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 11,609 | 2,287, 20,931 | 0.015 |
| WeightLoss |  |  |  |
| No | — | — |  |
| Yes | 45,190 | 32,539, 57,840 | <0.001 |
| Electrolyte and fluid imbalance |  |  |  |
| No | — | — |  |
| Yes | 32,975 | 26,386, 39,565 | <0.001 |
| Abbreviation: CI = Confidence Interval | | | |