Burden and predictors of 30-day readmission in patients with aortic dissection

2025\_June\_NRD\_A15

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## Preamble:

* **Reference Studies:**
  + [Carroll et al., 2023](https://pubmed.ncbi.nlm.nih.gov/31839347/)
* **Study Objective:**
* To identify patient- and hospital-level predictors of 30-day all-cause hospital readmission among adults hospitalized with aortic dissection using a nationally representative dataset. This study also evaluates the clinical and economic burden of readmission in this high-risk population, including its association with in-hospital mortality.
* **Data Source:**
* A retrospective cohort study using the 2016–2017 Nationwide Readmissions Database (NRD), developed by the Healthcare Cost and Utilization Project (HCUP). The NRD enables tracking of individual patients across hospitalizations within a given year via synthetic identifiers, capturing discharges from U.S. community hospitals and supporting survey-weighted national estimates through complex sampling design.
* **Cohort Definition:**
* Index hospitalizations were included if they met all of the following criteria:
  + Adults aged ≥18 years
  + Principal diagnosis of thoracic or thoracoabdominal aortic dissection, identified using ICD-10-CM codes: I7101 and I7103
  + Non-elective admission
  + Index discharge by the end of November to allow for a complete 30-day follow-up period
  + Complete data on NRD\_DAYSTOEVENT, required to compute discharge dates
* **Outcomes of Interest:**
  + Primary Outcome:
    - Binary indicator of 30-day readmission (Yes/No)
  + Secondary Outcomes:
    - In-hospital mortality (binary)
* **Outcome Definitions:**
  + Readmission:
    - Defined using NRD’s linkage variables. Readmissions were identified only among patients with qualifying index events.
    - Trauma-related hospitalizations were excluded only from the readmission pool to avoid injury-related returns unrelated to aortic dissection care.
  + Mortality:
    - In-hospital death recorded during index or readmission (DIED = 1)
* **Covariates:**
  + Demographic & Socioeconomic Factors:
    - Age (categorized: 18–49, 50–64, 65–79, 80+)
    - Sex (FEMALE; ref = Male)
    - Primary expected payer (PAY1; Medicare, Medicaid, Private, Other)
    - ZIP-based median income quartile
  + Clinical Characteristics:
    - Hypertension
    - Diabetes
    - Hyperlipidemia
    - Chronic Kidney Disease
    - Congestive heart failure
    - Valvular disease
    - Chronic pulmonary disease
    - Renal failure
    - Coagulopathy
    - Obesity
    - Fluid and electrolyte imbalance
    - Alcohol abuse
    - Drug abuse
    - Marfans syndrome
  + Hospital Characteristics:
    - Hospital bed size (Small, Medium, Large)
    - Urban/rural teaching status (Metropolitan, teaching vs non-teaching, etc.)
    - Admission day (Weekend vs Weekday)
  + Disposition and Severity:
    - Discharge disposition
    - Number of comorbidities
* **Statistical Methods:**
  + Survey Design and Weighting:
    - All analyses incorporated NRD’s complex sampling design via the survey and srvyr packages.
  + Descriptive Statistics:
    - Weighted baseline characteristics of index hospitalizations were summarized and stratified by 30-day readmission status to compare patients who were readmitted versus those who were not.
    - Stratification was performed using a derived binary variable, which categorized patients as:
      * With 30-day readmission
      * Without readmission
    - P-values from statistical tests (Rao–Scott adjusted chi-square for categorical variables; Kruskal–Wallis test for continuous variables).
  + Multivariable Regression:
    - A survey-weighted logistic regression modeled predictors of 30-day readmission.
    - The model included demographic, clinical, hospital-level, and index-stay factors.
    - Results were exponentiated to yield odds ratios (ORs) with 95% confidence intervals.
  + The ten most common principle diagnoses for readmission were reported according to decreasing prevalence
* **Software:** All analyses were conducted in R Statistical Language (Version 4.5.0; R Foundation for Statistical Computing, Vienna, Austria).

## Baseline Characteristics

| **Characteristic** | **Overall** N = 6,548*1* | **Without Readmission** N = 6,244*1* | **With 30-day readmission** N = 304*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age (years) | 63 (15) | 63 (15) | 64 (13) | 0.9 |
| Sex |  |  |  | 0.4 |
| Male | 4,063 (62%) | 3,863 (62%) | 199 (66%) |  |
| Female | 2,485 (38%) | 2,381 (38%) | 104 (34%) |  |
| Primary Expected Payer |  |  |  | 0.8 |
| Private | 1,803 (28%) | 1,729 (28%) | 74 (24%) |  |
| Medicaid | 814 (12%) | 774 (12%) | 40 (13%) |  |
| Medicare | 3,215 (49%) | 3,057 (49%) | 157 (52%) |  |
| Other | 706 (11%) | 675 (11%) | 31 (10%) |  |
| Median Household Income Quartile |  |  |  | 0.7 |
| 0-25th percentile | 1,917 (30%) | 1,829 (30%) | 88 (30%) |  |
| 26th to 50th percentile | 1,704 (26%) | 1,615 (26%) | 89 (30%) |  |
| 51st to 75th percentile | 1,674 (26%) | 1,604 (26%) | 70 (24%) |  |
| 76th to 100th percentile | 1,156 (18%) | 1,110 (18%) | 47 (16%) |  |
| Admission Day |  |  |  | 0.3 |
| Monday-Friday | 4,856 (74%) | 4,620 (74%) | 236 (78%) |  |
| Saturday-Sunday | 1,692 (26%) | 1,624 (26%) | 68 (22%) |  |
| Hospital Bed Size |  |  |  | 0.6 |
| Small | 306 (4.7%) | 291 (4.7%) | 15 (5.0%) |  |
| Large | 5,048 (77%) | 4,825 (77%) | 223 (73%) |  |
| Medium | 1,193 (18%) | 1,128 (18%) | 65 (22%) |  |
| Hospital Location and Teaching Status |  |  |  | 0.4 |
| Metropolitan, non-teaching | 711 (11%) | 669 (11%) | 42 (14%) |  |
| Metropolitan, teaching | 5,731 (88%) | 5,472 (88%) | 259 (85%) |  |
| Non-metropolitan | 106 (1.6%) | 103 (1.7%) | 3 (1.0%) |  |
| Number of comorbidities |  |  |  | 0.7 |
| One comorbidity | 2,250 (34%) | 2,141 (34%) | 109 (36%) |  |
| Two or more comorbidities | 4,298 (66%) | 4,103 (66%) | 195 (64%) |  |
| Congestive heart failure | 613 (9.4%) | 571 (9.1%) | 42 (14%) | 0.067 |
| Valvular Disease | 1,556 (24%) | 1,489 (24%) | 67 (22%) | 0.6 |
| Coagulopathy | 1,694 (26%) | 1,616 (26%) | 78 (26%) | >0.9 |
| Obesity | 1,241 (19%) | 1,185 (19%) | 56 (19%) | 0.9 |
| Fluid and electrolyte disorders | 3,005 (46%) | 2,858 (46%) | 148 (49%) | 0.5 |
| Chronic pulmonary disease | 1,387 (21%) | 1,320 (21%) | 68 (22%) | 0.8 |
| Renal failure | 1,391 (21%) | 1,305 (21%) | 86 (28%) | 0.038 |
| Hypertension | 5,254 (80%) | 5,024 (80%) | 230 (76%) | 0.14 |
| Diabetes | 732 (11%) | 689 (11%) | 43 (14%) | 0.3 |
| Hyperlipidemia | 2,410 (37%) | 2,294 (37%) | 116 (38%) | 0.7 |
| Marfan's syndrome | 140 (2.1%) | 135 (2.2%) | 5 (1.7%) | 0.7 |
| Alcohol abuse | 408 (6.2%) | 398 (6.4%) | 10 (3.4%) | 0.094 |
| Drug abuse | 496 (7.6%) | 475 (7.6%) | 21 (6.9%) | 0.7 |
| *1*Mean (SD); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Unadjusted Outcomes

### Outcomes of Index Hospitalizations

| **Characteristic** | **Overall** N = 6,548*1* | **Without Readmission** N = 6,244*1* | **With 30-day readmission** N = 304*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| In-Hospital Mortality | 965 (15%) | 965 (15%) | 0 (0%) | <0.001 |
| Length of Stay (days) | 7 (4, 13) | 7 (4, 13) | 7 (4, 12) | 0.6 |
| Inflation-Adjusted Total Charges ($) | 169,300 (61,532, 322,023) | 169,322 (61,552, 324,936) | 154,377 (59,160, 282,191) | 0.3 |
| Discharged to Non-Home Setting | 2,467 (38%) | 2,386 (38%) | 81 (27%) | 0.007 |
| *1*n (%); Median (Q1, Q3) | | | | |
| *2*Pearson's X^2: Rao & Scott adjustment; Design-based KruskalWallis test | | | | |

### In-Hospital Mortality by Readmission Status:

Index hospitalizations resulted in:

1. Deaths (n): 965
2. Death Rate (%): 14.75%
3. Death Rate (95% CI): 13.38% to 16.12%

Readmission hospitalizations resulted in:

1. Deaths (n): 4
2. Death Rate (%): 1.5%
3. Death Rate (95% CI): -0.22% to 3.22%

## Multivariable Analyses

## Top Causes of Readmission

| Diagnosis Code | ICD-10 Description | Proportion |
| --- | --- | --- |
| I71 | Aortic aneurysm and dissection | 0.3731 |
| I63 | Cerebral infarction | 0.0380 |
| I48 | Atrial fibrillation and flutter | 0.0377 |
| A41 | Other sepsis | 0.0345 |
| I13 | Hypertensive heart and chronic kidney disease | 0.0345 |
| I50 | Heart failure | 0.0318 |
| N17 | Acute kidney failure | 0.0268 |
| I31 | Other diseases of pericardium | 0.0252 |
| J18 | Pneumonia, unspecified organism | 0.0240 |
| D53 | Other nutritional anemias | 0.0218 |

## Multivariable Regression

### 30-Day Readmission:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Age (years) | 1.00 | 0.98, 1.02 | 0.9 |
| Sex |  |  |  |
| Male | — | — |  |
| Female | 0.82 | 0.54, 1.26 | 0.4 |
| Primary Expected Payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.20 | 0.65, 2.22 | 0.6 |
| Medicare | 1.12 | 0.63, 1.97 | 0.7 |
| Other | 1.14 | 0.59, 2.20 | 0.7 |
| Median Household Income Quartile |  |  |  |
| 0-25th percentile | — | — |  |
| 26th to 50th percentile | 1.13 | 0.75, 1.72 | 0.6 |
| 51st to 75th percentile | 0.92 | 0.60, 1.43 | 0.7 |
| 76th to 100th percentile | 0.85 | 0.50, 1.45 | 0.6 |
| Admission Day |  |  |  |
| Monday-Friday | — | — |  |
| Saturday-Sunday | 0.80 | 0.52, 1.23 | 0.3 |
| Hospital Bed Size |  |  |  |
| Small | — | — |  |
| Large | 1.30 | 0.54, 3.15 | 0.6 |
| Medium | 1.72 | 0.63, 4.69 | 0.3 |
| Hospital Location and Teaching Status |  |  |  |
| Metropolitan, non-teaching | — | — |  |
| Metropolitan, teaching | 0.73 | 0.45, 1.17 | 0.2 |
| Non-metropolitan | 0.46 | 0.07, 2.96 | 0.4 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 1.52 | 0.93, 2.48 | 0.094 |
| Valvular Disease |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.62, 1.43 | 0.8 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 1.01 | 0.66, 1.55 | >0.9 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.85 | 0.50, 1.44 | 0.5 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 1.02 | 0.71, 1.47 | >0.9 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.02 | 0.63, 1.66 | >0.9 |
| Renal failure |  |  |  |
| No | — | — |  |
| Yes | 1.51 | 1.02, 2.23 | 0.038 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 0.70 | 0.48, 1.02 | 0.065 |
| Diabetes |  |  |  |
| No | — | — |  |
| Yes | 1.46 | 0.84, 2.52 | 0.2 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 1.02 | 0.69, 1.51 | >0.9 |
| Marfan's syndrome |  |  |  |
| No | — | — |  |
| Yes | 0.86 | 0.18, 4.06 | 0.9 |
| Alcohol abuse |  |  |  |
| No | — | — |  |
| Yes | 0.56 | 0.25, 1.27 | 0.2 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 0.72 | 0.37, 1.41 | 0.3 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |