Burden and predictors of 90-day readmission in patients with aortic dissection

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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 90-day all-cause hospital readmission among adults hospitalized for 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 associations with in-hospital mortality, length of stay (LOS), and hospital charges.
* **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 90-day follow-up period
  + Complete data on NRD\_DAYSTOEVENT, required to compute discharge dates
* **Outcomes of Interest:**
  + Primary Outcomes:
    - Predictors of 90-day readmission
  + Secondary Outcomes:
    - In-hospital mortality (binary)
    - Length of stay (LOS, in days)
    - Total hospitalization charges (inflation-adjusted to 2017 USD)
* **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.
* **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
    - Drug abuse
  + Hospital Characteristics:
    - Hospital bed size (Small, Medium, Large)
    - 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 90-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 90-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 90-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.
* **Software:** All analyses were conducted in R Statistical Language (Version 4.5.0; R Foundation for Statistical Computing, Vienna, Austria).

## Descriptive Statistics:

### Readmission Rate:

Index hospitalizations resulted in:

1. Readmission (n): 4175
2. Readmission Rate (%): 19.49%
3. Readmission Rate (95% CI): 18.56% to 20.42%

### In-Hospital Mortality by Readmission Status:

Index hospitalizations resulted in:

1. Deaths (n): 2692
2. Death Rate (%): 12.57%
3. Death Rate (95% CI): 11.74% to 13.4%

Readmission hospitalizations resulted in:

1. Deaths (n): 135
2. Death Rate (%): 3.26%
3. Death Rate (95% CI): 2.46% to 4.06%

### LOS and Cost by Readmission Status:

Index hospitalizations resulted in:

1. Mean Length of Stay (days): 9.61
2. Mean Length of Stay (95% CI): 9.32 to 9.89
3. Mean Charge ($): 230667
4. Mean Charge (95% CI): 216382 to 244952

Readmission hospitalizations resulted in:

1. Mean Length of Stay (days): 6.22
2. Mean Length of Stay (95% CI): 5.81 to 6.64
3. Mean Charge ($): 105913
4. Mean Charge (95% CI): 95297 to 116530

## Baseline Characteristics

| **Characteristic** | **Overall** N = 21,421*1* | **Without Readmission** N = 17,246*1* | **With 90-day readmission** N = 4,175*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Age (years) | 64 (15) | 64 (15) | 62 (14) | <0.001 |
| Sex |  |  |  | 0.6 |
| Male | 13,378 (62%) | 10,749 (62%) | 2,628 (63%) |  |
| Female | 8,044 (38%) | 6,497 (38%) | 1,547 (37%) |  |
| Primary Expected Payer |  |  |  | <0.001 |
| Private | 5,743 (27%) | 4,745 (28%) | 998 (24%) |  |
| Medicaid | 2,732 (13%) | 2,079 (12%) | 653 (16%) |  |
| Medicare | 10,884 (51%) | 8,761 (51%) | 2,123 (51%) |  |
| Other | 2,021 (9.5%) | 1,628 (9.5%) | 393 (9.4%) |  |
| Median Household Income Quartile |  |  |  | 0.030 |
| 0-25th percentile | 6,482 (31%) | 5,103 (30%) | 1,379 (34%) |  |
| 26th to 50th percentile | 5,439 (26%) | 4,411 (26%) | 1,027 (25%) |  |
| 51st to 75th percentile | 5,127 (24%) | 4,165 (25%) | 961 (23%) |  |
| 76th to 100th percentile | 4,004 (19%) | 3,262 (19%) | 742 (18%) |  |
| Admission Day |  |  |  | 0.12 |
| Monday-Friday | 16,455 (77%) | 13,303 (77%) | 3,152 (75%) |  |
| Saturday-Sunday | 4,966 (23%) | 3,943 (23%) | 1,023 (25%) |  |
| Hospital Bed Size |  |  |  | 0.8 |
| Small | 1,045 (4.9%) | 853 (4.9%) | 192 (4.6%) |  |
| Large | 16,663 (78%) | 13,416 (78%) | 3,246 (78%) |  |
| Medium | 3,714 (17%) | 2,977 (17%) | 737 (18%) |  |
| Number of comorbidities |  |  |  | <0.001 |
| One comorbidity | 7,684 (36%) | 6,313 (37%) | 1,371 (33%) |  |
| Two or more comorbidities | 13,737 (64%) | 10,933 (63%) | 2,805 (67%) |  |
| Congestive heart failure | 1,966 (9.2%) | 1,575 (9.1%) | 392 (9.4%) | 0.7 |
| Valvular Disease | 4,680 (22%) | 3,780 (22%) | 900 (22%) | 0.7 |
| Coagulopathy | 4,796 (22%) | 3,900 (23%) | 896 (21%) | 0.3 |
| Obesity | 3,769 (18%) | 2,996 (17%) | 773 (19%) | 0.2 |
| Fluid and electrolyte disorders | 8,795 (41%) | 7,091 (41%) | 1,704 (41%) | 0.8 |
| Chronic pulmonary disease | 4,611 (22%) | 3,531 (20%) | 1,080 (26%) | <0.001 |
| Renal failure | 4,404 (21%) | 3,383 (20%) | 1,020 (24%) | <0.001 |
| Hypertension | 17,565 (82%) | 14,101 (82%) | 3,463 (83%) | 0.2 |
| Diabetes | 2,556 (12%) | 2,004 (12%) | 552 (13%) | 0.048 |
| Hyperlipidemia | 8,217 (38%) | 6,591 (38%) | 1,625 (39%) | 0.6 |
| Drug abuse | 1,505 (7.0%) | 1,161 (6.7%) | 344 (8.3%) | 0.020 |
| *1*Mean (SD); n (%) | | | | |
| *2*Design-based KruskalWallis test; Pearson's X^2: Rao & Scott adjustment | | | | |

## Multivariable Regression

### 90-Day Readmission:

| **Characteristic** | **OR** | **95% CI** | **p-value** |
| --- | --- | --- | --- |
| Age (years) | 0.99 | 0.98, 0.99 | <0.001 |
| Sex |  |  |  |
| Male | — | — |  |
| Female | 0.98 | 0.88, 1.09 | 0.7 |
| Primary Expected Payer |  |  |  |
| Private | — | — |  |
| Medicaid | 1.36 | 1.12, 1.64 | 0.002 |
| Medicare | 1.29 | 1.11, 1.51 | 0.001 |
| Other | 1.06 | 0.85, 1.33 | 0.6 |
| Median Household Income Quartile |  |  |  |
| 0-25th percentile | — | — |  |
| 26th to 50th percentile | 0.90 | 0.79, 1.03 | 0.13 |
| 51st to 75th percentile | 0.93 | 0.81, 1.07 | 0.3 |
| 76th to 100th percentile | 0.94 | 0.81, 1.09 | 0.4 |
| Admission Day |  |  |  |
| Monday-Friday | — | — |  |
| Saturday-Sunday | 1.09 | 0.97, 1.23 | 0.14 |
| Hospital Bed Size |  |  |  |
| Small | — | — |  |
| Large | 1.04 | 0.81, 1.35 | 0.7 |
| Medium | 1.09 | 0.82, 1.44 | 0.6 |
| Congestive heart failure |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.81, 1.17 | 0.8 |
| Valvular Disease |  |  |  |
| No | — | — |  |
| Yes | 0.99 | 0.87, 1.13 | >0.9 |
| Coagulopathy |  |  |  |
| No | — | — |  |
| Yes | 0.94 | 0.82, 1.06 | 0.3 |
| Obesity |  |  |  |
| No | — | — |  |
| Yes | 0.98 | 0.86, 1.12 | 0.8 |
| Fluid and electrolyte disorders |  |  |  |
| No | — | — |  |
| Yes | 0.95 | 0.86, 1.05 | 0.3 |
| Chronic pulmonary disease |  |  |  |
| No | — | — |  |
| Yes | 1.34 | 1.17, 1.53 | <0.001 |
| Renal failure |  |  |  |
| No | — | — |  |
| Yes | 1.32 | 1.14, 1.53 | <0.001 |
| Hypertension |  |  |  |
| No | — | — |  |
| Yes | 1.05 | 0.92, 1.20 | 0.5 |
| Diabetes |  |  |  |
| No | — | — |  |
| Yes | 1.15 | 0.98, 1.34 | 0.078 |
| Hyperlipidemia |  |  |  |
| No | — | — |  |
| Yes | 1.04 | 0.93, 1.16 | 0.5 |
| Drug abuse |  |  |  |
| No | — | — |  |
| Yes | 1.06 | 0.87, 1.29 | 0.5 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | | |