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### Transcatheter Aortic Valve Replacement: Volume Impact on Length of Stay and Readmissions

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## Introduction

Transcatheter Aortic Valve Replacement (TAVR) is a minimally invasive procedure recommended for patients with symptomatic severe aortic stenosis at prohibitive risk or select patients with high surgical risk.<sup>1</sup> Upon its approval in 2011, the Centers for Medicare and Medicaid Services (CMS) created a policy that required hospitals to perform a minimum of 20 TAVR procedures per year or 40 procedures over 2 years to qualify for reimbursement.<sup>2</sup> Associations between procedural volume and outcomes have been demonstrated for cardiovascular procedures in the past<sup>3-5</sup> but volume-outcome relationship data was unavailable for TAVR when the CMS created its reimbursement policy. TAVR has since shown potential to decrease all-cause mortality over conventional surgical options<sup>6</sup> but its widespread use in low-risk patients remains in question due to high post-procedural readmissions.<sup>6-8</sup> This study examines the role of hospital procedural volume on temporal trends in length of stay (LOS) and 30-day all-cause readmission rates for TAVR patients.

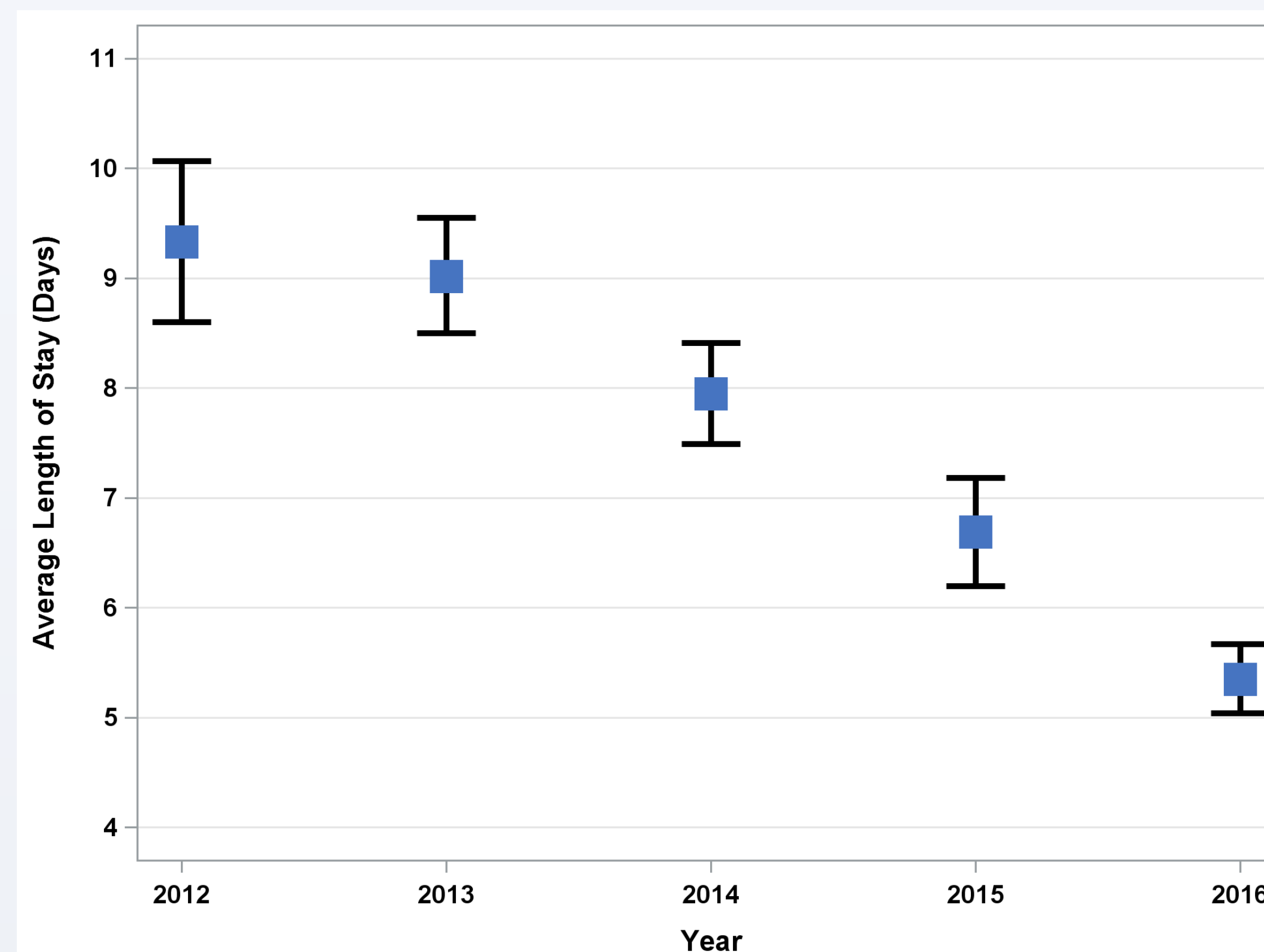
## Aims and Objectives

- Identify and compare temporal trends in hospital LOS and readmission rates for TAVR patients.
- Assess the impact of procedural volume on TAVR LOS and readmission rates over time.
- Determine if additional measures are indicated to lower readmission rates associated with TAVR.

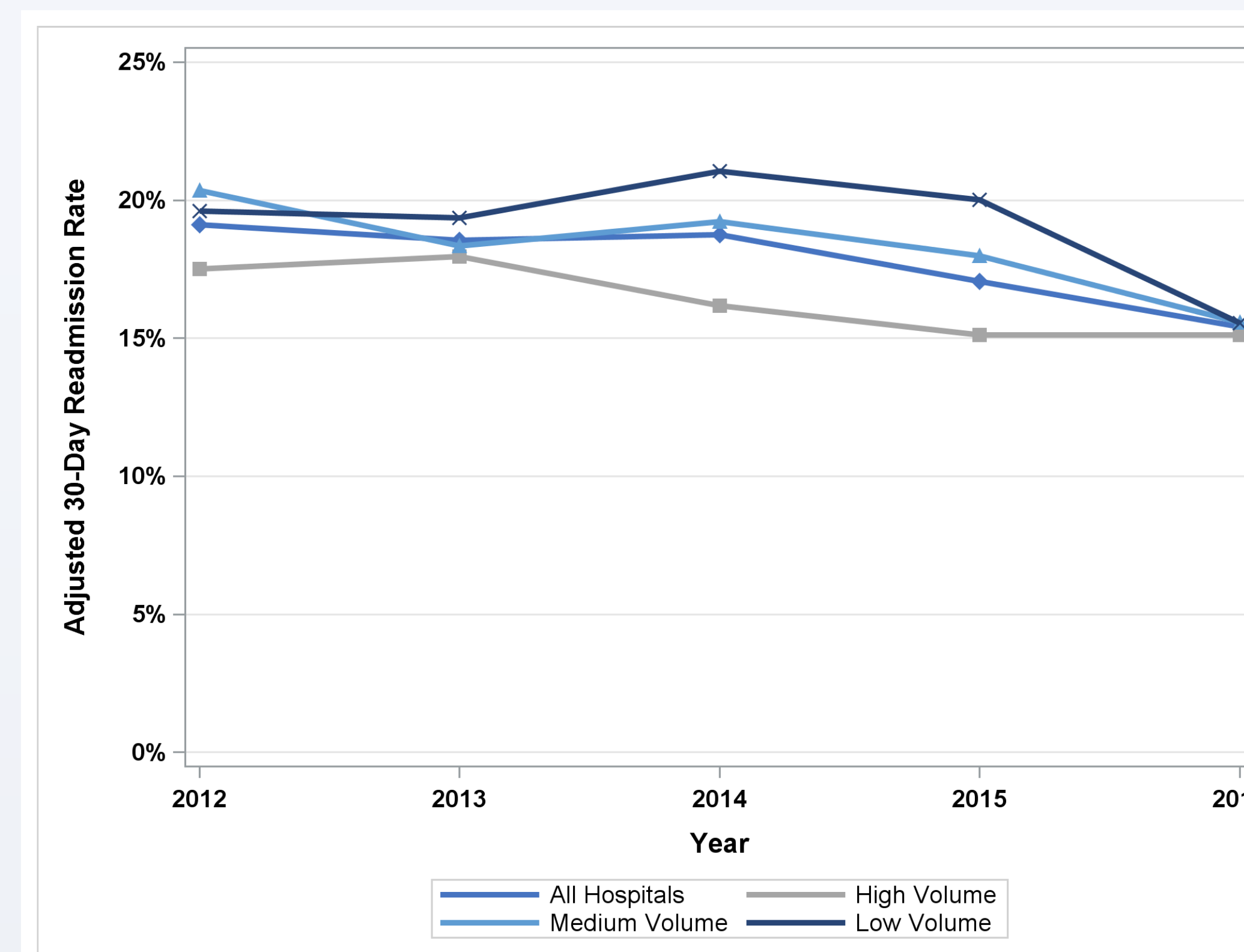
## Materials and Methods

- 102,059 TAVR cases were identified in the 2012-2016 Nationwide Readmissions Database (NRD) and evaluated for any 30-day all-cause hospital readmissions.
- We defined annual hospital TAVR case volume as:
  - High-volume ( $\geq 100$  cases/year)
  - Medium-volume (50-99 cases/year)
  - Low-volume ( $< 50$  cases/year)
- Numbers were discharge-weighted and the NRD survey design was taken into consideration.
- Rao-Scott chi-square tests, t-tests, and logistic regression were used for univariate and multivariate analysis.
- A p-value  $< 0.05$  was considered statistically significant and all analysis was done in SAS 9.4 (SAS Institute Inc., Cary, NC, USA).
- This study was reviewed and approved by the Oakland University IRB (IRBNet ID: 1396761-1).

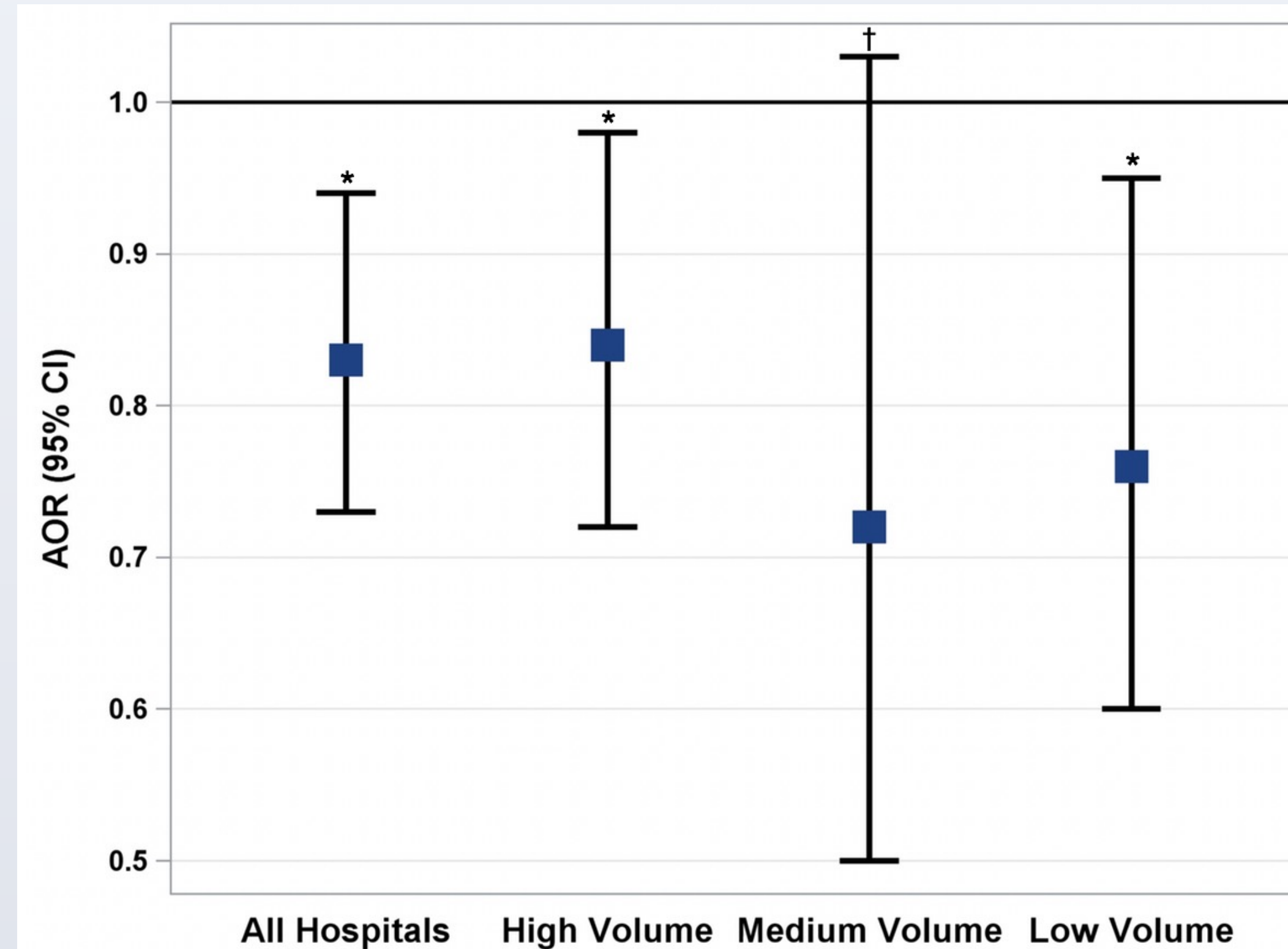
## Results



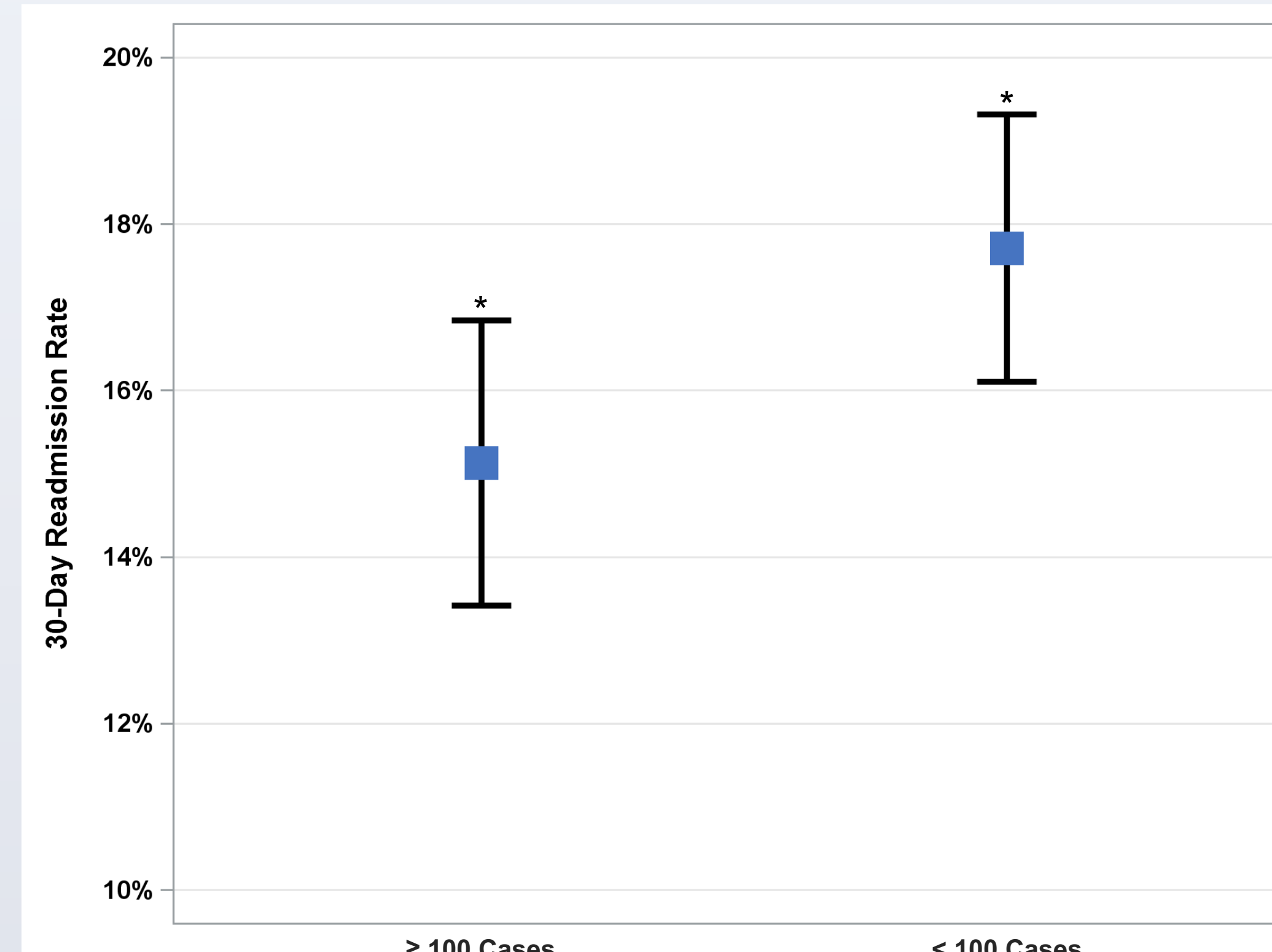
**Figure 1:** Average length of stay for transcatheter aortic valve replacement patients from 2012 to 2016. During the study period, average length of stay decreased from 9.34 days to 5.35 days ( $p = < 0.0001$ ).  $p < 0.05$  was considered statistically significant.



**Figure 2:** Adjusted 30-day readmission rate categorized by hospital procedural volume. All hospital adjusted readmission rate decreased from 19.12% in 2012 to 15.42% in 2016 ( $p = 0.0029$ ).  $p < 0.05$  was considered statistically significant.



**Figure 3:** Adjusted odds of 30-day all-cause hospital readmission for transcatheter aortic valve replacement procedures in 2016 compared to 2012. Readmission rate declined significantly in low-volume facilities (19.60% to 15.55%;  $p = 0.0007$ ) and high-volume facilities (17.50% to 15.52%;  $p = < 0.0001$ ), with a decreasing trend in medium-volume facilities (20.36% to 15.57%;  $p = 0.0754$ ). \*  $p < 0.05$ ; †  $p = 0.0754$ .  $p < 0.05$  was considered statistically significant. AOR = adjusted odds ratio



**Figure 4:** Thirty-day readmission rate over the study period for transcatheter aortic valve replacement procedural volume  $\geq 100$  cases vs  $< 100$  cases. Across the study period, hospitals performing  $\geq 100$  TAVR procedures per year were associated with improved readmissions compared to hospitals performing  $< 100$  TAVR procedures per year (15.13% vs 17.71%;  $p = < 0.0001$ ). \*  $p < 0.0001$ .  $p < 0.05$  was considered statistically significant.

- From 2012 to 2016, TAVR procedural volume increased (6,924 cases to 39,914 cases) and LOS (9.34 days to 5.35 days;  $p = < 0.0001$ ) decreased (**Figure 1**).
- After adjustment for available patient and hospital factors, 30-day readmission rate decreased from 19.12% in 2012 to 15.42% in 2016 ( $p = 0.0029$ ) on multivariate logistic regression analysis (**Figure 2**).
- This decline in readmission rate was also seen on univariate analysis in low-volume facilities (19.60% to 15.55%;  $p = 0.0007$ ) and high-volume facilities (17.50% to 15.52%;  $p = < 0.0001$ ), with a decreasing trend in medium-volume facilities (20.36% to 15.57%;  $p = 0.0754$ ) (**Figure 3**).
- On multivariate analysis, hospitals performing  $\geq 100$  TAVR procedures per year were associated with improved readmissions compared to hospitals performing  $< 100$  TAVR procedures per year (15.13% vs 17.71%;  $p = < 0.0001$ ) (**Figure 4**).

## Discussion

- This analysis of the NRD database including more than 102,000 TAVR procedures over a 5-year period in the United States resulted in three key findings:
  - Higher annual hospital procedural volumes were associated with significantly lower 30-day readmissions over five years.
  - Mean LOS significantly decreased for TAVR patients over five years and was inversely associated with procedural volume.
  - Hospitals performing at least 100 TAVR procedures per year were associated with improved readmissions when compared to hospitals performing less than 100 TAVR procedures per year.
- Readmission rates for TAVR remain high despite improved patient selection, technology, and intervention techniques but have notably declined in recent years.

## Limitations and Challenges

The NRD does not include patients who are readmitted in a state different from their main procedure. Therefore, patients living near state lines and cases of medical tourism may have been missed in this analysis. A limited set of variables may have resulted in missing variable bias and unmeasured confounding variables may have influenced outcomes. The NRD does not track patient deaths outside of hospitals, so mortality could not be accurately assessed in this study.

## Conclusion

- Higher annual TAVR procedural volumes were associated with decreased average LOS and lower 30-day readmission rates over five years.
- Hospitals performing TAVR procedures at high yearly volumes were associated with significantly decreased readmission rates.
- These data suggest improved efficacy of TAVR procedures with increasing procedural volume over time.

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