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ORIGINAL RESEARCH

# Anxiety and Depression Following Aortic Valve Replacement

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**BACKGROUND:** The aim of this study was to identify patients vulnerable for anxiety and/or depression following aortic valve replacement (AVR) and to evaluate factors that may mitigate this risk.

**METHODS AND RESULTS:** This is a retrospective cohort study conducted using a claims database; 18 990 patients (1/2013–12/2018) ≥55 years of age with 6 months of pre-AVR data were identified. Anxiety and/or depression risk was compared at 3 months, 6 months, and 1 year following transcatheter aortic valve replacement or surgical AVR (SAVR) after risk adjustment using logistic regression and Cox proportional hazards models. Separate models were estimated for patients with and without surgical complications and discharge location. Patients with SAVR experienced a higher relative risk of anxiety and/or depression at 3 months (12.4% versus 8.8%; adjusted hazard ratio [HR] 1.39 [95% CI, 1.19–1.63]) and 6 months (15.6% versus 13.0%; adjusted HR, 1.24 [95% CI, 1.08–1.42]), with this difference narrowing by 12 months (20.1% versus 19.3%; adjusted HR, 1.14 [95% CI, 1.01–1.29]) after AVR. This association was most pronounced among patients discharged to home, with patients with SAVR having a higher relative risk of anxiety and/or depression. In patients who experienced operative complications, there was no difference between SAVR and transcatheter aortic valve replacement. However, among patients without operative complications, patients with SAVR had an increased risk of postoperative anxiety and/or depression at 3 months (adjusted HR, 1.47 [95% CI, 1.23–1.75]) and 6 months (adjusted HR 1.26 [95% CI, 1.08–1.46]), but not at 12 months.

**CONCLUSIONS:** There is an associated reduction in the risk of new-onset anxiety and/or depression among patients undergoing transcatheter aortic valve replacement (versus SAVR), particularly in the first 3 and 6 months following treatment.

**Key Words:** aortic valve replacement ■ postoperative anxiety ■ postoperative depression ■ surgical aortic valve replacement ■ transcatheter aortic valve replacement

Generalized anxiety disorder and major depressive disorder, commonly referred to as anxiety and depression, are 2 of the most commonly diagnosed and disabling mental health conditions in the United States.[1,2] Both conditions have a higher prevalence in patients with cardiovascular disease[3] and are often comorbid.[4] Undertreated mental health conditions, particularly anxiety and depression, are recognized risk factors for adverse outcomes among patients with acute and chronic cardiac conditions, including acute myocardial infarction[5–7] and heart failure.[8] Pre- and postoperative anxiety and depression are associated with increased morbidity and reduced survival following cardiac surgery.[9–11] Worse medical and surgical outcomes in these settings may be driven by the interaction between mental health and health behaviors, which includes the impact of anxiety and depression on smoking, substance abuse, decreased physical activity, poor medication compliance, decreased dietary adherence, social isolation, and decreased willingness to seek medical attention.[12–14] Compared with surgical aortic

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## CLINICAL PERSPECTIVE

### What Is New?

- This is the largest study to date examining the prevalence and factors associated with anxiety and/or depression following aortic valve replacement.
- This study also examines the role of complications and discharge location on postoperative anxiety and/or depression.

### What Are the Clinical Implications?

- Mental health issues (anxiety and or depression) are common (20%) following aortic valve replacement.
- Patients undergoing transcatheter aortic valve replacement have a reduced risk of depression and/or anxiety compared with surgical aortic valve replacement.
- This difference appears to be most pronounced in the first 3 to 6 months, in patients discharged to home, and in patients without postoperative complications.

### Nonstandard Abbreviations and Acronyms

| | |
|---|---|
| **AVR** | aortic valve replacement |
| **DXRX** | diagnosis codes and pharmacy claims |
| **SAVR** | surgical aortic valve replacement |
| **TAVR** | transcatheter aortic valve replacement |

valve replacement (SAVR), transcatheter aortic valve replacement (TAVR) is associated with equivalent or improved morbidity and mortality across all levels of surgical risk.[15–21] Because TAVR is less invasive than traditional SAVR, patient recovery times are more rapid, and hospital length of stay is reduced.[22] With a faster return to an improved quality of life[23] among patients with transfemoral TAVR, one may hypothesize that patients with TAVR experience a lower incidence of postoperative anxiety and/or depression. Nevertheless, this hypothesis has not been studied previously. Additionally, it is unknown whether certain groups of patients undergoing AVR are at higher risk of developing postoperative anxiety and/or depression and whether interventions such as cardiac rehabilitation may help modify this risk.

In this analysis, we sought to (1) compare the incidence of new-onset anxiety and/or depression among patients treated with TAVR and SAVR and (2) identify features associated with an increased incidence of these conditions.

## METHODS

### Study Population

The data that support the findings of this study are available from the corresponding author upon reasonable request. Data were derived from the IBM MarketScan Research Databases, which contain Commercial Claims and Medicare Supplemental and Coordination of Benefits databases (Truven Health Analytics Inc., Greenwood Village, CO). The composition of these databases has been previously described[24] and draw medical claims data from 150 employers, 21 health plans, and 130 unique carriers. The databases are composed of fully integrated, de-identified, individual-level health care claims data that include complete payment records for insurance and patient payments for health care services. They can be used for a comprehensive assessment of health care resource utilization and expenditures, because of the integration of claims from inpatient stays, outpatient visits, specialty and mail-order pharmacy use, and claims paid under a coordination-of-benefit arrangement. Since this study was a retrospective analysis of a de-identified database, this research was exempt from Institutional Review Board review under 45 CFR 46.101(b)(4).

The initial cohort for this study was defined as patients ≥55 years of age who underwent AVR between January 2013 and December 2018. A subanalysis of patients with index AVR between 2016 and 2018 was conducted to evaluate the consistency of results in more recent data years. The results of this subanalysis are provided in Tables S1, S2, and Figure S1. Patients were grouped according to whether they underwent TAVR or SAVR. AVR procedures were identified using *International Classification of Diseases*, *Ninth Revision* (*ICD-9*) and *Tenth Revision* (*ICD-10*) codes (Table S3). Data were excluded for cases of AVR coding discrepancies between database files (facility versus physician files) or patients who underwent both procedures to ensure the groups remained as specific as possible (n=356). Patients were required to have at least 6 months of enrollment data, defined as complete medical and pharmacy data, available before AVR to be included in the analysis to determine baseline rates and control for anxiety and depression in the 2 groups (patients with a record of anxiety or depression in the 6-month baseline period were not included in this analysis, n=7784).

### Outcomes of Interest

The primary outcome of this study was time to development of incident anxiety and/or depression following AVR among patients treated with TAVR and SAVR. This composite end point was measured in days from the date of discharge from AVR index hospitalization (time

zero) through 3 months, time zero through 6 months, and time zero through 12 months of follow-up. Anxiety and depression were defined in this study as a patient having (1) a record of an inpatient or outpatient visit with a diagnosis code of either anxiety, depression, or both[25] (Table S4); or (2) 1 or more prescriptions for an antianxiety or antidepressant medication, based on clinician author's expert rules (see Table S5 for full medication listing). To evaluate the impact of including pharmacy claims in this outcome definition, a Kaplan–Meier curve was generated where patients were identified using diagnostic codes only.

Analyses were run to assess variables of interest with a potential to affect postoperative depression and anxiety; these included dementia, Elixhauser Comorbidity Index score (as a surrogate for a patient's overall health status), surgical complications, discharge destination following AVR, and utilization of outpatient cardiac rehabilitation after AVR. History of dementia before or at the time of AVR was collected, although dementia type and severity was not available. Patient demographics and information on comorbid conditions were collected from all inpatient and outpatient claims available 6 months before AVR and used to calculate each patient's Elixhauser Comorbidity Index, a previously described tool for predicting the risk of mortality based on chronic medical conditions.[26] Surgical complications were defined as 1 or more diagnoses of a condition known to be a complication of surgery[27] as defined in Table S6. Discharge status was treated as a dichotomous variable, with patients either discharged home or discharged not to home, including locations such as a nursing facility or rehabilitation center.

Cardiac rehabilitation utilization[28] (Table S7) was treated as a time-dependent, dichotomous variable measured as time to third visit to make sure patients were reasonably established in the rehabilitation program.

## Statistical Analysis

Summary statistics were compiled for patient demographics, comorbidities, and index characteristics for patients with TAVR and SAVR. Time to the composite end point for each cohort (TAVR and SAVR) was assessed using an adjusted survival curve, treating death and end of enrollment as censoring events. The relative risk of developing the anxiety and/or depression composite end point was estimated using the proportional hazard Cox regression model for each cohort at 3, 6, and 12 months following AVR. The Cox model was used since each patient had a different total follow-up period for the outcomes measured and, therefore, had different times they were at risk for each event. All models were estimated using the partial likelihood method, and model adequacy was assessed using residual diagnostics. To test the proportional hazard assumption, the interactions of time and the independent variables were tested for statistical significance. Separate models were generated on the basis of whether or not patients experienced a surgical complication, as well as discharge location. Hazard ratios (HR) and CIs comparing SAVR to TAVR were reported for each model, with any CI including or crossing one considered statistically not significant. Covariates were chosen based on the Andersen Behavioral Model Framework for factors that have a potential to impact postoperative anxiety and depression. The covariates included in each model were as follows: age, sex, region, insurance coverage, dementia, surgical complications, discharge status, and Elixhauser score. Cardiac rehabilitation was also considered as a time-dependent covariate. In surgical complication and discharge status subset models, the respectively variables were not included. All statistical analyses were performed using SAS software version 9.4 (SAS Institute, Inc., Cary, NC).

# RESULTS

Of 33 002 patients undergoing AVR from January 2013 through December 2018, 18 990 (58%) were at least ≥55 years of age with at least 6 months of data available before their AVR. Patients with a record of anxiety or depression before AVR (n=5566, 29.3%) were removed, reducing the final sample to 13 421 (TAVR, n=3095; SAVR, n=10 329) (Figure 1).

Patients treated with TAVR (versus SAVR) were older (80.8 versus 68.5 years old, $P<0.0001$), more likely female (40.0% versus 26.6%, $P<0.0001$), with a higher rate of dementia (1.4% versus 0.3%, $P=0.0001$), and a greater burden of comorbidities (Elixhauser Comorbidity Index score 6.7 versus 5.4, $P<0.0001$) as reported in Table 1.

Figure 2 displays an unadjusted Kaplan–Meier curve for time to new-onset anxiety and/or depression for all patients with AVR when the outcome variable is defined by using both diagnosis codes and pharmacy claims (DXRX) and simply using diagnosis codes. At 1 year post AVR, 20% of patients experienced new-onset depression and/or anxiety or filled a new prescription for treatment of the same (DXRX), while 10% of patients experienced new-onset anxiety and/or depression as measured by diagnosis code alone. Interestingly, 50% of those of patients diagnosed with new-onset anxiety and/or depression had not been treated with medication at the 1-year follow-up. This may indicate they had accessed other treatment options, such as counseling, which has been shown to be effective; however, this was not measured in the present study.

The adjusted 1-year survival curve for time to incident (new-onset) anxiety and/or depression (DXRX)

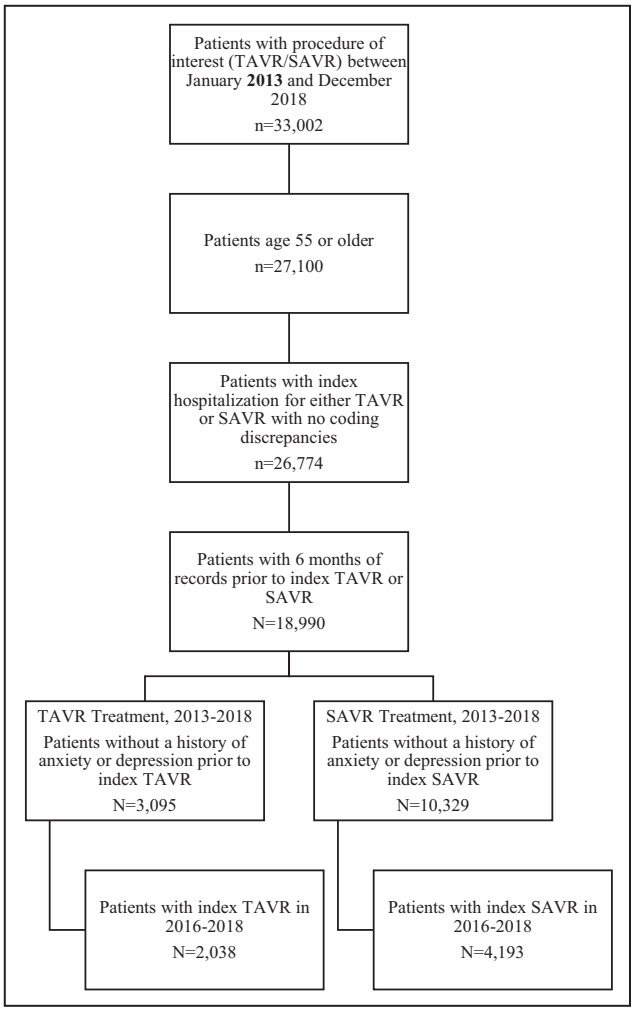



**Figure 1. Study cohort selection process.**
This figure displays the study cohort selection process, from the initial population through exclusions. The final population comprised 3095 patients with TAVR and 10 329 patients with SAVR. SAVR indicates surgical aortic valve replacement; and TAVR, transcatheter aortic valve replacement.

for TAVR versus SAVR is shown in Figure 3 and the adjusted HRs at 3, 6, and 12 months are provided in Table 2. Patients with SAVR experienced a higher relative risk of anxiety and/or depression (DXRX) at 3 months (12.4% versus 8.8%; adjusted HR, 1.39 [95% CI, 1.19–1.63]) and 6 months (15.6% versus 13.0%; adjusted HR, 1.24 [95% CI, 1.08–1.42]), with this difference narrowing by 12 months (20.1% versus 19.3%; adjusted HR, 1.14 [95% CI, 1.01–1.29]) after AVR. This association was most pronounced among patients discharged to home, with patients with SAVR having a higher relative risk of anxiety and/or depression (DXRX) at 3 months (adjusted HR, 1.66 [95% CI, 1.37, 2.01]), 6 months (adjusted HR, 1.39 [95% CI, 1.18–1.64]), and 12 months (adjusted HR, 1.23 [95% CI, 1.07–1.42]). No difference in anxiety and/or depression was observed across treatments among those discharged to a location other than home.

**Table 1. Patient Characteristics**

| | TAVR | SAVR | |
|---|---|---|---|
| | n (%) | n (%) | *P* value |
| Total patients | 3095 | 10 329 | |
| Age, y | | | <0.0001 |
| Mean (SD) | 80.8 (8.6) | 68.5 (9.0) | |
| Sex | | | <0.0001 |
| Male | 1856 (60.0) | 7580 (73.4) | |
| Female | 1239 (40.0) | 2749 (26.6) | |
| Region | | | <0.0001 |
| Northeast | 859 (27.8) | 2512 (24.3) | |
| North Central | 948 (30.6) | 3101 (30.0) | |
| South | 837 (27.0) | 3273 (31.7) | |
| West | 447 (14.4) | 1373 (13.3) | |
| Missing/unknown | 4 (0.1) | 70 (0.7) | |
| Insurance coverage | | | <0.0001 |
| Commercial | 231 (7.5) | 4559 (44.1) | |
| Medicare supplemental | 2864 (92.5) | 5770 (55.9) | |
| Dementia before index | 43 (1.4) | 32 (0.3) | <0.0001 |
| Surgical complications | 220 (7.1) | 2161 (20.9) | <0.0001 |
| Discharge status at index | | | |
| Not home | 321 (10.4) | 1687 (16.3) | |
| Home | 2644 (85.4) | 8106 (78.5) | |
| Death | 130 (4.2) | 536 (5.2) | |
| Elixhauser Comorbidity Index, mean (SD) | 6.7 (2.2) | 5.4 (2.1) | <0.0001 |
| Comorbidities | | | |
| Congestive heart failure | 2411 (77.9) | 4303 (41.7) | <0.0001 |
| Peripheral vascular disorders | 1768 (57.1) | 4593 (44.5) | <0.0001 |
| Hypertension | 2834 (91.6) | 8415 (81.5) | <0.0001 |
| Chronic pulmonary disease | 1171 (37.8) | 2797 (27.1) | <0.0001 |
| Diabetes | 1652 (39.7) | 3371 (32.6) | <0.0001 |
| Renal failure | 984 (31.8) | 1234 (11.9) | <0.0001 |
| Liver disease | 233 (7.5) | 534 (5.2) | <0.0001 |
| Cancer | 491 (15.9) | 982 (9.5) | <0.0001 |
| Obesity | 516 (16.7) | 2025 (19.6) | 0.0003 |

SAVR indicates surgical aortic value replacement; and TAVR, transcatheter aortic value replacement.

In patients who experienced operative complications, there was no difference in the risk of the composite anxiety and/or depression end point (DXRX) between SAVR and TAVR. However, among patients without operative complications, SAVR was associated with an increased risk of developing postoperative anxiety and/or depression at 3 months (adjusted HR, 1.47 [95% CI, 1.23–1.75]) and 6 months (adjusted

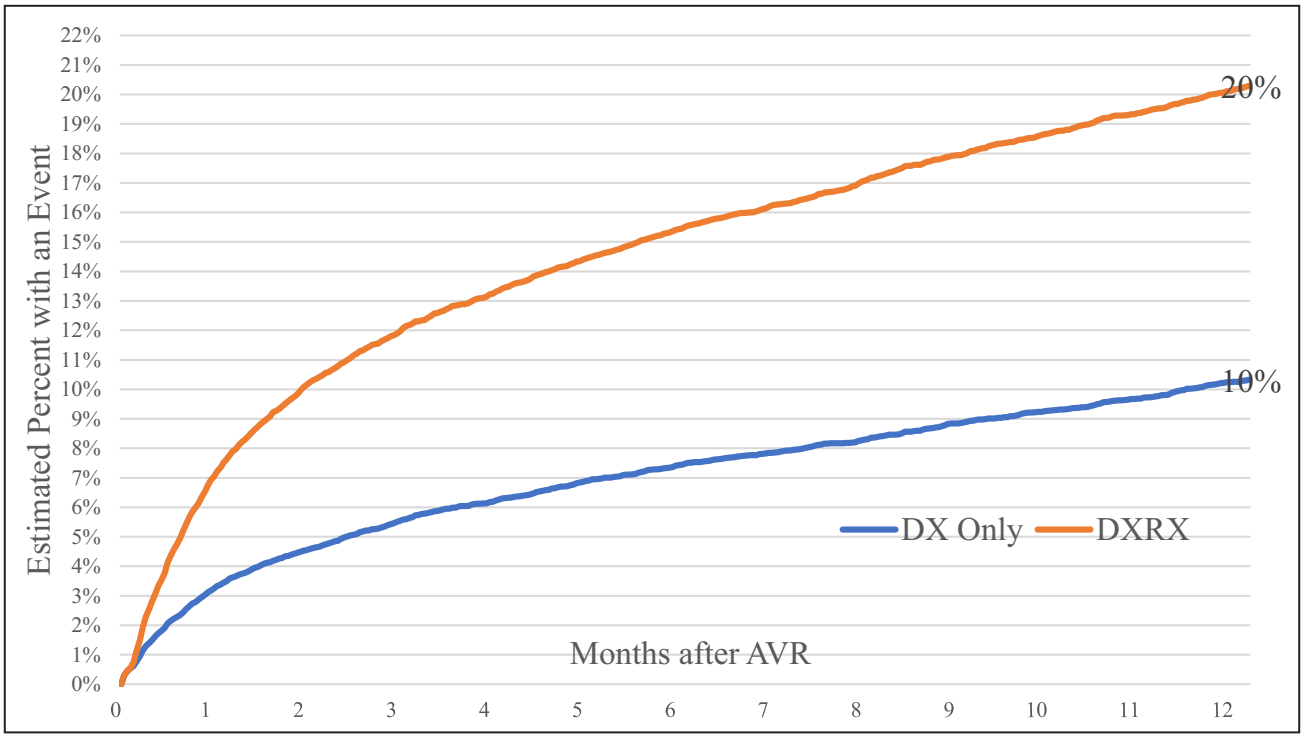



**Figure 2. Time to new-onset anxiety and/or depression by DXRX and by DX only.**
Unadjusted KM estimates showing time to the composite end point of new-onset anxiety and/or depression in patients undergoing aortic valve replacement through 1 year of follow-up when using definition of anxiety and/or depression with diagnosis codes (DX Only) and pharmacy claims with diagnosis codes (DXRX). It is notable that 50% of patients with new-onset anxiety and/or depression remained untreated with medication to 1 year postoperatively.

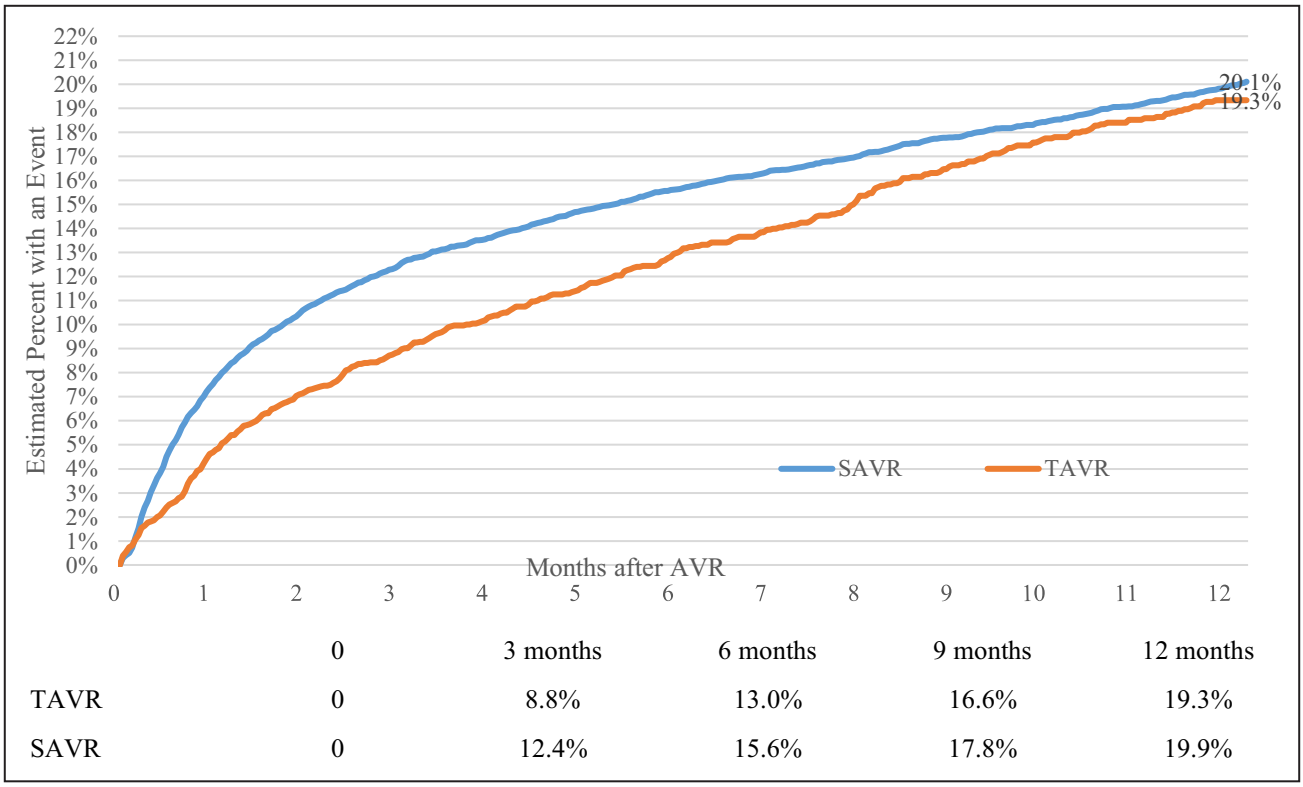
HR, 1.26 [95% CI, 1.08–1.46]), but not at 12 months (adjusted HR 1.13 [95% CI, 0.99–1.30]). Finally, when sustained engagement in outpatient cardiac rehabilitation (≥3 sessions) in the first 3 months (adjusted HR, 0.94 [95% CI, 0.84–1.05]), 6 months (adjusted HR, 0.93 [95% CI, 0.84–1.02]), or 12 months (adjusted HR, 0.92 [95% CI, 0.84–1.01]) following AVR was included as a time-varying covariate, it was not statistically significant; hence, it did not affect the likelihood of developing the composite anxiety and/or depression end point. Furthermore, interactions between AVR and discharge status, as well as surgical complications and AVR were explored but were not significant. All model outputs are provided in Table S8.

Given the evolving landscape of TAVR and SAVR populations, a subgroup analysis was performed using the population from 2016 to 2018 inclusive of intermediate-risk commercial TAVR. Similar results were noted when compared with the overall population (Table S2and Figure S1). Patients with SAVR were at higher risk of new-onset anxiety and/or depression at 3 months (adjusted HR, 1.54 [95% CI, 1.21–1.95]) and 6 months (adjusted HR, 1.33 [95% CI, 1.08–1.64]) compared with TAVR, but there was no significant difference between the 2 groups at 12 months following AVR (Table S2; adjusted HR, 1.17 [95% CI, 0.97–1.41]).

## DISCUSSION

In this largest-to-date study, we have demonstrated high rates of incident anxiety and/or depression following AVR. Additionally, there is an associated reduction in the relative risk of anxiety and/or depression among patients undergoing TAVR (versus SAVR), most apparent in the first 3 and 6 months following treatment. These findings highlight an important issue affecting those recovering from AVR and indicate a need for further research to mitigate this risk, especially among the most vulnerable patients.

The high incidence of anxiety and/or depression following AVR observed in this study is consistent with prior work. Drudi et al[10] found that 31.5% of patients screened positive for prevalent depression following surgical AVR and Faria et al[29] reported that 51.9% of patients experienced prevalent depression symptoms at 6 months following surgical AVR. Similar rates have been reported in patients undergoing coronary artery bypass grafting.[9] Despite a substantial early reduction in the risk of anxiety and/or depression with TAVR (versus SAVR), there was only a 1% absolute reduction in the incidence of new-onset anxiety and/or depression with TAVR at 1 year. Ultimately, the incidence of anxiety and depression remained high following AVR,




| | 0 | 3 months | 6 months | 9 months | 12 months |
|---|---|---|---|---|---|
| TAVR | 0 | 8.8% | 13.0% | 16.6% | 19.3% |
| SAVR | 0 | 12.4% | 15.6% | 17.8% | 19.9% |

**Figure 3. Adjusted 1-KM estimates showing time to new-onset anxiety following AVR in patients with TAVR and SAVR.**
Adjusted 1-KM estimates showing time to the composite end point of new-onset anxiety and/or depression following AVR in patients having SAVR versus TAVR. AVR indicates aortic valve replacement; SAVR, surgical aortic valve replacement; and TAVR, transcatheter aortic valve replacement.

regardless of operative modality, and suggests that screening for mood disorders should be incorporated into the pre- and postoperative assessment as suggested by other studies.[30]

The incidence of anxiety and/or depression was high among patients with operative complications (24.2%). Findings of our study show that patients with operative complications were equally likely to experience anxiety and/or depression, independent of treatment (TAVR versus SAVR). Previously published work has reported an association between operative complications and postoperative anxiety and depression following surgical AVR.[29] Changes to quality of life or prognosis driven by the operative complications are likely explanatory factors for development of postoperative anxiety and depression. Effects of operative complications on development of postoperative anxiety or depression likely supersede any effects from the procedure itself, as noted by the similar risk between patients with TAVR and SAVR with operative complications at all measured time points. This reinforces prior findings that operative complications are an important risk factor for postoperative anxiety and depression.

Similar to the results seen in patients with operative complications, patients who were not discharged to home from their index hospitalization after AVR had a high overall incidence of postoperative anxiety and/or depression (33.9%), and a similar incidence of postoperative anxiety and/or depression was observed in these patients following TAVR compared with SAVR. Published research has not addressed discharge location as a risk factor for postoperative anxiety and/or depression. This association may be a reflection of the interrelated nature of mental and physical health, with discharge location indicating health-related issues that cannot easily be measured, such as limitations in physical activity following surgery[31] and increased postoperative pain.[32] This association may also reflect the gap between patient expectations of a smooth recovery and the reality of a complicated postoperative course. These data highlight the reality that while discharge to a location other than home may be necessary for the patient's physical recovery, it can be a major blow to their mental health. Further work is needed to better understand this association and to develop strategies to support these vulnerable patients.

The TAVR and SAVR procedures have evolved over the years. Over time, smaller delivery catheters were used, intended to reduce the risk of major vascular injuries. Additionally, improvements in the TAVR

**Table 2. Multivariable Results Cox Regressions**

| Time frame | Subset | Hazard ratio with CI | *P* value |
|---|---|---|---|
| 3 mo | Overall | 1.39 (1.19, 1.63) | <0.0001 |
| | Home | 1.66 (1.37, 2.01) | <0.0001 |
| | Not home | 0.87 (0.66, 1.16) | 0.3443 |
| | With complications | 1.06 (0.71, 1.57) | 0.7840 |
| | No complications | 1.47 (1.23, 1.75) | <0.0001 |
| 6 mo | Overall | 1.24 (1.08, 1.42) | 0.0026 |
| | Home | 1.39 (1.18, 1.64) | <0.0001 |
| | Not home | 0.89 (0.68, 1.15) | 0.3739 |
| | With complications | 1.11 (0.78, 1.59) | 0.5597 |
| | No complications | 1.26 (1.08, 1.46) | 0.0035 |
| 12 mo | Overall | 1.14 (1.01, 1.29) | 0.0376 |
| | Home | 1.23 (1.07, 1.42) | 0.0041 |
| | Not home | 0.89 (0.69, 1.13) | 0.3237 |
| | With complications | 1.14 (0.82, 1.60) | 0.4357 |
| | No complications | 1.13 (0.99, 1.30) | 0.0675 |

Time to incident (new onset) anxiety and/or depression for SAVR vs TAVR at 3, 6, and 12 months. Covariates included in each model were: age, sex, region, insurance coverage, dementia, surgical complications, discharge status, and Elixhauser score. In surgical complication and discharge status subset models, the respective variables were not included. Full results for each model including each covariate are provided in Table S8. SAVR indicates surgical aortic value replacement; and TAVR, transcatheter aortic value replacement.

delivery system and procedural techniques as well as carotid shielding devices aimed to lower the incidence of stroke over time with TAVR. On the surgical side, the use of less invasive surgical AVR has become more widespread, including the use of sutureless valves and parasternal surgical access sites. These surgical improvements are still used in a minority of cases and have led to shorter recovery times for some.

Although the characteristics of patients with AVR continue to shift toward lower-risk profiles as TAVR is now commercially approved for all risk profiles, our study showed similar risks of anxiety and/or depression in a subgroup analysis of a time period inclusive of intermediate-risk commercial TAVR. This held true when evaluating patients with and without operative complications, as well as those discharged home and to a location other than home after their index hospitalization. This suggests that our findings are generalizable across patient risk strata within an AVR population.

## Study Limitations

There are limitations to our study that should be acknowledged. First, our study focused on incident anxiety and depression and excluded patients with pre-AVR anxiety or depression. However, this was necessary for methodological reasons, not because prevalent anxiety or depression is unimportant. Secondly, this was a retrospective cohort study using health care claims data. While this allowed for examination of the largest cohort on this topic to date, this type of study relies on the assumption that cases of anxiety and/or depression following AVR are accurately captured by either (1) diagnoses billed by providers; or (2) prescriptions filled by patients. The diagnosis codes used in this analysis have been previously validated, although prior work has suggested that the use of claims data alone may underestimate the incidence of anxiety and/or depression, since milder cases may not have been specifically billed or treated. Conversely, the use of pharmacy data to estimate cases of anxiety or depression may lead to overestimation because of use of antidepressants and anxiolytics for other indications, such as insomnia or chronic pain. Third, anxiety and depression are complex conditions, with a number of poorly understood and highly individualized factors contributing to their development. Consequently, there are a number of components that likely contribute to postoperative anxiety and depression that may not be captured in our models, potentially affecting the completeness of our risk adjustment. Finally, this analysis should be interpreted in light of the differences between the 2 AVR cohorts. The data set spans 2013 to 2018, so the majority of TAVR cases in the first 3 years of the primary analysis reflect inoperable and high surgical risk patients, with US Food and Drug Administration approval of intermediate-risk TAVR occurring in 2016. While differences between the 2 populations were adjusted for via multivariable modeling, it is impossible to fully account for all of the differences. As a result, findings would be expected to skew more in favor of SAVR (versus TAVR), because of the lower-risk profile of the SAVR cohort. Importantly, results from a subgroup analysis of the population from 2016 to 2018 after commercial approval of intermediate-risk TAVR showed results similar to those of the overall population, suggesting consistency of the results across risk strata.

# CONCLUSIONS

Our study found an associated reduction in the risk of new-onset anxiety and/or depression among patients undergoing TAVR (versus SAVR), particularly in the first 3 and 6 months following treatment. More work is needed to better understand the causes of postoperative anxiety and depression, as well as effective interventions to combat the effects of anxiety and depression in the postoperative setting.

## ARTICLE INFORMATION

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## Disclosures

Dr Mack reports being Co-PI, Partner Trial (Edwards Lifesciences); Co-PI, Coapt Trial (Abbott); Study Chair, Apollo Trial (Medtronic); and travel expenses paid for trial-related activities. Dr Thompson reports being a full-time employee and shareholder of Edwards Lifesciences. Dr Gunnarsson and Michael Ryan are paid consultants to Edwards Lifesciences. Dr Cohen reports research grant support from Edwards Lifesciences, Abbott Vascular, Boston Scientific, Medtronic, Svelte, Volcano/Phillips, Corvia, Ancora Heart; and consulting income from Edwards Lifesciences, Abbott Vascular, Boston Scientific, Ancora Heart. Dr Brennan reports consulting and speaking fees from Edwards LifeSciences and Atricure, an advisory board commitment for CardioCare, and grant funding from the Burroughs Wellcome Fund. The remaining authors have no disclosures to report.

## Supplemental Material

Tables S1–S8
Figure S1

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# Supplemental Material

***Sub Analysis years 2016-2018***

**Table S1. Patient Characteristics.**

| | TAVR | | SAVR | | P-Value |
|---|---|---|---|---|---|
| **Total Patients** | **2,038** | | **4,193** | | |
| **Age** | | | | | <.0001 |
| Median | 82 | | 64 | | |
| Mean | 80.3 | | 66.9 | | |
| Std Dev | 8.8 | | 8.4 | | |
| **Sex** | | | | | <.0001 |
| Male | 1,211 | 59.4 | 3,140 | 74.9 | |
| Female | 827 | 40.6 | 1,053 | 25.1 | |
| **Region** | | | | | <.0001 |
| Northeast | 577 | 28.3 | 941 | 22.4 | |
| North Central | 584 | 28.7 | 1,291 | 30.8 | |
| South | 574 | 28.2 | 1,440 | 34.3 | |
| West | 302 | 14.8 | 512 | 12.2 | |
| Missing/Unknown | 1 | 0.0 | 9 | 0.2 | |
| **Insurance Coverage** | | | | | <.0001 |
| Commercial | 176 | 8.6 | 2,198 | 52.4 | |
| Medicare | 1,862 | 91.4 | 1,995 | 47.6 | |
| **Dementia** | 29 | 1.4 | 7 | 0.2 | <.0001 |
| **Surgical Complications** | 101 | 5.0 | 762 | 18.2 | <.0001 |
| **Discharge Status at Index** | | | | | <.0001 |
| Not Home | 154 | 7.6 | 564 | 13.5 | |
| Home | 1,788 | 87.7 | 3,394 | 80.9 | |
| Death | 96 | 4.7 | 235 | 5.6 | |
| **Elixhauser Comorbidity Index, mean (SD)** | | | | | <.0001 |
| Median | 6.0 | | 5.0 | | |
| Mean | 6.6 | | 5.5 | | |
| Std Dev | 2.2 | | 2.0 | | |
| Congestive Heart Failure | 1,553 | 76.2 | 1,785 | 42.6 | <.0001 |
| Peripheral Vascular Disorders | 1,116 | 54.8 | 1,947 | 46.4 | <.0001 |
| Hypertension | 1,888 | 92.6 | 3,538 | 84.4 | <.0001 |
| Chronic Pulmonary Disease | 635 | 31.2 | 803 | 19.2 | <.0001 |
| Diabetes | 809 | 39.7 | 1,379 | 32.9 | <.0001 |
| Renal Failure | 615 | 30.2 | 474 | 11.3 | <.0001 |
| Liver Disease | 149 | 7.3 | 225 | 5.4 | 0.0024 |
| Cancer | 321 | 15.8 | 357 | 8.5 | <.0001 |
| Obesity | 377 | 18.5 | 1,072 | 25.6 | <.0001 |

**Table S2. Multivariable Results Cox Regressions 2016-2018 Time Period SAVR versus TAVR.**

*Time to Anxiety and/or Depression at 3 months, 6 months, and 12 months post AVR*

| Time Frame | Subset | Hazard Ratio with CI | P-Value |
|---|---|---|---|
| 3 months | Overall | 1.54 (1.21, 1.95) | 0.0005 |
| | Home | 1.65 (1.24, 2.18) | 0.0005 |
| | Not Home | 1.12 (0.70, 1.81) | 0.6338 |
| | With Complications | 1.20 (0.59, 2.43) | 0.6172 |
| | No Complications | 1.59 (1.22, 2.07) | 0.0005 |
| 6 months | Overall | 1.33 (1.08, 1.64) | 0.0076 |
| | Home | 1.38 (1.09, 1.76) | 0.0082 |
| | Not Home | 1.13 (0.72, 1.76) | 0.6072 |
| | With Complications | 1.23 (0.65, 2.34) | 0.5306 |
| | No Complications | 1.34 (1.07, 1.68) | 0.0117 |
| 12 months | Overall | 1.17 (0.97, 1.41) | 0.1071 |
| | Home | 1.21 (0.97, 1.50) | 0.0873 |
| | Not Home | 1.01 (0.67, 1.52) | 0.9593 |
| | With Complications | 1.21 (0.66, 2.23) | 0.544 |
| | No Complications | 1.16 (0.95, 1.42) | 0.1569 |

**Table S3. AVR procedure Codes International Classification of Diseases, Ninth Revision (ICD-9) and Tenth Revision (ICD-10) codes.**

| Code | Description | ICD Type |
|---|---|---|
| **TAVR** | | |
| 35.05 | Endovascular replacement of aortic valve | 9 |
| 35.06 | Transapical replacement of aortic valve | 9 |
| 02RF37Z | Replacement of Aortic Valve with Autologous Tissue Substitute, Percutaneous Approach | 10 |
| 02RF38Z | Replacement of Aortic Valve with Zooplastic Tissue, Percutaneous Approach | 10 |
| 02RF3JZ | Replacement of Aortic Valve with Synthetic Substitute, Percutaneous Approach | 10 |
| 02RF3KZ | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Approach | 10 |
| 02RF37H | Replacement of Aortic Valve with Autologous Tissue Substitute, Transapical, Percutaneous Approach | 10 |
| 02RF38H | Replacement of Aortic Valve with Zooplastic Tissue, Transapical, Percutaneous Approach | 10 |
| 02RF3JH | Replacement of Aortic Valve with Synthetic Substitute, Transapical, Percutaneous Approach | 10 |
| 02RF3KH | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Transapical, Percutaneous Approach | 10 |
| SAVR | | |
| 35.21 | Open and other replacement of aortic valve with tissue graft | 9 |
| 35.22 | Open and other replacement of aortic valve | 9 |
| 02RF07Z | Replacement of Aortic Valve with Autologous Tissue Substitute, Open Approach | 10 |
| 02RF08Z | Replacement of Aortic Valve with Zooplastic Tissue, Open Approach | 10 |
| 02RF0KZ | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Open Approach | 10 |
| 02RF47Z | Replacement of Aortic Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach | 10 |
| 02RF48Z | Replacement of Aortic Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach | 10 |
| 02RF4KZ | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach | 10 |
| 02RF0JZ | Replacement of Aortic Valve with Synthetic Substitute, Open Approach | 10 |
| 02RF4JZ | Replacement of Aortic Valve with Synthetic Substitute, Percutaneous Endoscopic Approach | 10 |

## Table S4. Anxiety and Depression ICD-9 and ICD-10 Codes.

| Code | Description | ICD Type |
|---|---|---|
| **Anxiety** | | |
| 293.84 | Anxiety disorder in conditions classified elsewhere | 9 |
| 300.0 | Anxiety state, unspecified | 9 |
| 300.02 | Generalized anxiety disorder | 9 |
| 300.09 | Other anxiety states | 9 |
| 300.23 | Social phobia | 9 |
| 300.29 | Other isolated or specific phobias | 9 |
| 308.0 | Predominant disturbance of emotion | 9 |
| 309.21 | Separation anxiety disorder | 9 |
| 309.24 | Adjustment disorder with anxiety | 9 |
| 309.28 | Adjustment disorder with mixed anxiety and depressed mood | 9 |
| 313.0 | Overanxious disorder | 9 |
| F06.4 | Anxiety disorder due to known physiological condition | 10 |
| F41.0 | Panic disorder [episodic paroxysmal anxiety] | 10 |
| F41.1 | Generalized anxiety disorder | 10 |
| F41.3 | Other mixed anxiety disorders | 10 |
| F41.8 | Other specified anxiety disorders | 10 |
| F41.9 | Anxiety disorder, unspecified | 10 |
| F43.23 | Adjustment disorder with mixed anxiety and depressed mood | 10 |
| **Depression** | | |
| 293.83 | Mood disorder in conditions classified elsewhere | 9 |
| 296.20-296.26 | Major depressive disorder, single episode | 9 |
| 296.30-296.36 | Major depressive disorder, recurrent episode | 9 |
| 296.82 | Atypical depressive disorder | 9 |
| 298 | Depressive type psychosis | 9 |
| 300.4 | Dysthymic disorder | 9 |
| 308 | Predominant disturbance of emotion | 9 |
| 309 | Adjustment disorder with depressed mood | 9 |
| 309.1 | Prolonged depressive reaction | 9 |
| 309.28 | Adjustment disorder with mixed anxiety and depressed mood | 9 |
| 311 | Depressive disorder, not elsewhere classified | 9 |
| F06.31 | Mood disorder due to known physiological condition with depressive features | 10 |
| F06.32 | Mood disorder due to known physiological condition with major depressive-like episode | 10 |
| F06.34 | Mood disorder due to known physiological condition with mixed features | 10 |
| F32.0 | Major depressive disorder, single episode, mild | 10 |
| F32.1 | Major depressive disorder, single episode, moderate | 10 |
| F32.2 | Major depressive disorder, single episode, severe without psychotic features | 10 |
| F32.3 | Major depressive disorder, single episode, severe with psychotic features | 10 |
| F32.4 | Major depressive disorder, single episode, in partial remission | 10 |
| F32.5 | Major depressive disorder, single episode, in full remission | 10 |
| F32.89 | Other specified depressive episodes | 10 |
| F32.9 | Major depressive disorder, recurrent, unspecified | 10 |
| F33.0 | Major depressive disorder, recurrent, mild | 10 |
| F33.1 | Major depressive disorder, recurrent, moderate | 10 |
| F33.2 | Major depressive disorder, recurrent, severe without psychotic features | 10 |
| F33.3 | Major depressive disorder, recurrent, severe with psychotic features | 10 |
| F33.40 | Major depressive disorder, recurrent, in remission, unspecified | 10 |
| F33.42 | Major depressive disorder, recurrent, in partial remission, unspecified | 10 |
| F33.42 | Major depressive disorder, recurrent, in full remission, unspecified | 10 |
| F33.8 | Other recurrent depressive episodes | 10 |
| F33.9 | Major depressive disorder, recurrent, unspecified | 10 |
| F34.1 | Dysthymic disorder | 10 |
| F41.8 | Other specified anxiety disorders | 10 |
| F43.21 | Adjustment disorder with depressed mood | 10 |
| F43.23 | Adjustment disorder with mixed anxiety and depressed mood | 10 |

## Table S5. Anxiety and Depression Medications.

| Therapeutic Class | Generic Name |
|---|---|
| **Anxiety** | |
| ASH, Benzodiazepines | Alprazolam |
| ASH, Benzodiazepines | Alprazolam; Medical Food |
| Anxiolytic/Sedative/Hypnot NEC | Aspirin/Meprobamate |
| Anxiolytic/Sedative/Hypnot NEC | Benactyzine/Meprobamate |
| Anxiolytic/Sedative/Hypnot NEC | Buspirone Hydrochloride |
| Anxiolytic/Sedative/Hypnot NEC | Chloral Hydrate |
| ASH, Benzodiazepines | Chlordiazepoxide |
| ASH, Benzodiazepines | Chlordiazepoxide Hydrochloride |
| Anxiolytic/Sedative/Hypnot NEC | Chlormezanone |
| Anticonvulsant, Benzodiazepine | Clobazam |
| Anticonvulsant, Benzodiazepine | Clonazepam |
| ASH, Benzodiazepines | Clorazepate Dipotassium |
| ASH, Benzodiazepines | Dextrose/Lorazepam |
| ASH, Benzodiazepines | Dextrose/Midazolam Hydrochloride |
| ASH, Benzodiazepines | Diazepam |
| ASH, Benzodiazepines | Diazepam; Lubricant |
| ASH, Benzodiazepines | Diazepam; Medical Food |
| ASH, Benzodiazepines | Estazolam |
| ASH, Benzodiazepines | Flurazepam Hydrochloride |
| ASH, Benzodiazepines | Halazepam |
| ASH, Benzodiazepines | Lorazepam |
| ASH, Benzodiazepines | Lorazepam/Sodium Chloride |
| ASH, Benzodiazepines | Midazolam Hydrochloride |
| ASH, Benzodiazepines | Midazolam Hydrochloride/Sodium Chloride |
| ASH, Benzodiazepines | Oxazepam |
| ASH, Benzodiazepines | Prazepam |
| ASH, Benzodiazepines | Quazepam |
| ASH, Benzodiazepines | Temazepam |
| ASH, Benzodiazepines | Triazolam |
| **Depression** | |
| Psychother,Tranq/Antipsychotic | Actophenazine Maleate |
| Psychother, Antidepressants | Amantadine HCl;Amitriptyline HCl;Cyclobenzaprine H |
| Psychother, Antidepressants | Amitriptyline HCl;Cream, Multi Ingredient |
| Psychother, Antidepressants | Amitriptyline HCl;Medical Food |
| Psychother, Antidepressants | Amitriptyline Hydrochloride |
| Psychother,Tranq/Antipsychotic | Aripiprazole |
| Psychother,Tranq/Antipsychotic | Aripiprazole Lauroxil |
| Psychother,Tranq/Antipsychotic | Asenapine |
| Psychother,Tranq/Antipsychotic | Brexpiprazole |
| Psychother, Antidepressants | Bupropion HCl;Medical Food |

| | |
|---|---|
| Psychother, Antidepressants | Bupropion Hydrochloride |
| Psychother, Antidepressants | Citalopram Hydrobromide |
| Psychother, Antidepressants | Clomipramine Hydrochloride |
| Psychother, Antidepressants | Desipramine Hydrochloride |
| Psychother, Antidepressants | Desvenlafaxine |
| Psychother, Antidepressants | Desvenlafaxine Succinate |
| Psychother, Antidepressants | Doxepin Hydrochloride |
| Psychother, Antidepressants | Duloxetine Hydrochloride |
| Psychother, Antidepressants | Duloxetine Hydrochloride;Lidocaine/Menthol |
| Psychother, Antidepressants | Escitalopram Oxalate |
| Psychother, Antidepressants | Fluoxetine HCl;Medical Food |
| Psychother, Antidepressants | Fluoxetine Hydrochloride |
| Psychother, Antidepressants | Fluvoxamine Maleate |
| Psychother, Antidepressants | Imipramine Hydrochloride |
| Psychother, Antidepressants | Imipramine Pamoate |
| Psychother, Antidepressants | Isocarboxazid |
| Psychother, Antidepressants | Levomilnacipran Hydrochloride |
| Psychother,Tranq/Antipsychotic | Lurasidone Hydrochloride |
| Psychother, Antidepressants | Mirtazapine |
| Psychother, Antidepressants | Nortriptyline Hydrochloride |
| Psychother,Tranq/Antipsychotic | Olanzapine |
| Psychother,Tranq/Antipsychotic | Olanzapine Pamoate |
| Psychother, Antidepressants | Paroxetine Hydrochloride |
| Psychother, Antidepressants | Paroxetine Mesylate |
| Psychother, Antidepressants | Phenelzine Sulfate |
| Psychother, Antidepressants | Protriptyline Hydrochloride |
| Psychother, Antidepressants | Selegiline |
| Psychother, Antidepressants | Selegiline Hydrochloride |
| Psychother, Antidepressants | Tranylcypromine Sulfate |
| Psychother, Antidepressants | Trazodone HCl;Medical Food |
| Psychother, Antidepressants | Trazodone Hydrochloride |
| Psychother, Antidepressants | Trimipramine Maleate |
| Psychother, Antidepressants | Venlafaxine Hydrochloride |
| Psychother, Antidepressants | Vilazodone Hydrochloride |
| Psychother, Antidepressants | Vortioxetine Hydrobromide |
| **Anxiety and Depression** | |
| Psychother, Antidepressants | Amitriptyline Hydrochloride/Chlordiazepoxide |
| Psychother, Antidepressants | Amitriptyline Hydrochloride/Perphenazine |
| Anticonvulsant, Benzodiazepine | Gabapentin; Medical Food |
| Psychother, Antidepressants | Maprotiline Hydrochloride |
| Psychother,Tranq/Antipsychotic | Quetiapine Fumarate |

## Table S6. Surgical Complication Diagnoses defined by ICD-9, ICD-10 and CPT Codes.

| Complication | ICD-9 Coding | ICD-10 Coding | CPT Coding |
|---|---|---|---|
| Septicemia | 998.59 + (038.xx or 790.7) | T81.4XXA + (A40.#, A41.#, or R78.81) | |
| Postoperative Infection | 998.51, 998.59 | K68.11, T81.4XXA | |
| Respiratory Failure | 518.51 | J95.82# | |
| Aortic Rupture | (997.2, 997.79, or 998.89) + (441.1, 441.3, 441.5, or 441.6) | T81.71#A + (I71.1, I71.3, I71.5, or I71.8) | |
| Acute Kidney Injury | 997.5 + 584.x | N99.0 + N17.# | |
| Stroke | 997.02 + (430-432, 433.x1, or 434.x1) | (G97.3# or G97.5#) + (I60.##-I62.##, I97.81#, I97.82#) + I63.## | |
| Vascular Complication | 997.2, 997.79 | T81.71#A, T71.72#A | |
| Hemorrhage | 998.11, 998.12 | D78.0#, D78.2#, D78.31, D78.32, E36.0#, E89.81#, E89.820, E89.821, G97.3#, G97.5#, G97.61, G97.62, H59.1#, H59.31#, H59.32#, H59.33#, H59.34#, H95.2#, H95.4#, H95.51, H95.52, I97.4#, I97.61#, I97.62, I97.620, I97.621, I97.63#, J95.6#, J95.83#, J95.860, J95.861, K91.6#, K91.84#, K91.870, K91.871, L76.0#, L76.2#, L76.31, L76.32, M96.81#, M96.83#, M96.840, M96.841, N99.6#, N99.82#, N99.840, or N99.841 | |
| Atrial Fibrillation | 997.1 + 427.31 | (I97.88 or I97.89) + (I48.0, I48.1, I48.2, or I48.91) | |
| Extended Ventilator Use | 96.72 | 5A1955Z | 94002 + 99403 (for 3 days or more) |

## Table S7. Outpatient Cardiac Rehabilitation CPT Codes.

| Code | Description |
|---|---|
| 93797 | Physician or other healthcare professional services for outpatient cardiac rehabilitation, without continuous ECG monitoring (per session) |
| 93798 | Physician or other healthcare professional services for outpatient cardiac rehabilitation, with continuous ECG monitoring (per session) |
| G0422 | Intensive cardiac rehabilitation; with or without continuous ECG monitoring with exercise, per session |
| G0423 | Intensive cardiac rehabilitation; with or without continuous ECG monitoring without exercise, per session |
| S9472 | Cardiac rehabilitation program, non-physician provider, per diem |

## Table S8. Regression output for all models.

| Outcome | Dataset | Variable | Hazard Ratio | HR Lower | HR Upper | P-Value |
|---|---|---|---|---|---|---|
| 3 Months | Overall | SAVR vs TAVR | 1.39 | 1.19 | 1.63 | <.0001 |
| 3 Months | Overall | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.5446 |
| 3 Months | Overall | Male vs Female | 0.81 | 0.72 | 0.90 | <.0001 |
| 3 Months | Overall | West (yes vs no) | 0.96 | 0.82 | 1.12 | 0.5796 |
| 3 Months | Overall | Commercial (yes vs no) | 1.02 | 0.85 | 1.23 | 0.8018 |
| 3 Months | Overall | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.01 | 1.06 | 0.0023 |
| 3 Months | Overall | Dementia (yes vs no) | 1.40 | 0.80 | 2.44 | 0.2384 |
| 3 Months | Overall | Complications (yes vs no) | 1.30 | 1.16 | 1.47 | <.0001 |
| 3 Months | Overall | Home (yes vs no) | 0.47 | 0.42 | 0.53 | <.0001 |
| 3 Months | Overall | Outpatient Rehab (yes vs no) | 0.94 | 0.84 | 1.05 | 0.2350 |
| 3 Months | Home | SAVR vs TAVR | 1.66 | 1.37 | 2.01 | <.0001 |
| 3 Months | Home | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.6939 |
| 3 Months | Home | Male vs Female | 0.81 | 0.71 | 0.92 | 0.0012 |
| 3 Months | Home | West (yes vs no) | 0.93 | 0.77 | 1.11 | 0.4141 |
| 3 Months | Home | Commercial (yes vs no) | 1.01 | 0.81 | 1.25 | 0.9468 |
| 3 Months | Home | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.01 | 1.07 | 0.0083 |
| 3 Months | Home | Dementia (yes vs no) | 1.65 | 0.78 | 3.49 | 0.1881 |
| 3 Months | Home | Complications (yes vs no) | 1.33 | 1.14 | 1.55 | 0.0003 |
| 3 Months | Home | Outpatient Rehab (yes vs no) | 0.97 | 0.85 | 1.10 | 0.5951 |
| 3 Months | Not Home | SAVR vs TAVR | 0.87 | 0.66 | 1.16 | 0.3443 |
| 3 Months | Not Home | Age (per unit increase) | 1.00 | 0.98 | 1.01 | 0.6246 |
| 3 Months | Not Home | Male vs Female | 0.81 | 0.67 | 0.99 | 0.0351 |
| 3 Months | Not Home | West (yes vs no) | 1.05 | 0.79 | 1.39 | 0.7474 |
| 3 Months | Not Home | Commercial (yes vs no) | 1.00 | 0.69 | 1.44 | 0.9922 |
| 3 Months | Not Home | Elixhauser Comorbidity Index (per unit increase) | 1.03 | 0.99 | 1.07 | 0.1442 |
| 3 Months | Not Home | Dementia (yes vs no) | 1.14 | 0.49 | 2.69 | 0.7610 |
| 3 Months | Not Home | Complications (yes vs no) | 1.26 | 1.03 | 1.53 | 0.0253 |
| 3 Months | Not Home | Outpatient Rehab (yes vs no) | 0.84 | 0.67 | 1.06 | 0.1452 |
| 3 Months | With Complications | SAVR vs TAVR | 1.06 | 0.71 | 1.57 | 0.7840 |
| 3 Months | With Complications | Age (per unit increase) | 0.99 | 0.97 | 1.01 | 0.2901 |
| 3 Months | With Complications | Male vs Female | 0.78 | 0.63 | 0.97 | 0.0273 |
| 3 Months | With Complications | West (yes vs no) | 0.94 | 0.67 | 1.31 | 0.7087 |
| 3 Months | With Complications | Commercial (yes vs no) | 0.93 | 0.65 | 1.33 | 0.6833 |
| 3 Months | With Complications | Elixhauser Comorbidity Index (per unit increase) | 1.02 | 0.97 | 1.07 | 0.4577 |
| 3 Months | With Complications | Dementia (yes vs no) | 0.37 | 0.05 | 2.51 | 0.3079 |
| 3 Months | With Complications | Home (yes vs no) | 0.50 | 0.40 | 0.62 | <.0001 |
| 3 Months | With Complications | Outpatient Rehab (yes vs no) | 0.88 | 0.70 | 1.11 | 0.2915 |
| 3 Months | No Complications | SAVR vs TAVR | 1.47 | 1.23 | 1.75 | <.0001 |
| 3 Months | No Complications | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.9168 |
| 3 Months | No Complications | Male vs Female | 0.81 | 0.72 | 0.92 | 0.0011 |
| 3 Months | No Complications | West (yes vs no) | 0.96 | 0.81 | 1.15 | 0.6765 |
| 3 Months | No Complications | Commercial (yes vs no) | 1.06 | 0.85 | 1.31 | 0.6249 |
| 3 Months | No Complications | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.02 | 1.07 | 0.0024 |
| 3 Months | No Complications | Dementia (yes vs no) | 1.86 | 1.06 | 3.27 | 0.0320 |

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| 3 Months | No Complications | Home (yes vs no) | 0.46 | 0.40 | 0.54 | <.0001 |
| 3 Months | No Complications | Outpatient Rehab (yes vs no) | 0.95 | 0.84 | 1.08 | 0.4106 |
| 6 Months | Overall | SAVR vs TAVR | 1.24 | 1.08 | 1.42 | 0.0026 |
| 6 Months | Overall | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.4061 |
| 6 Months | Overall | Male vs Female | 0.80 | 0.73 | 0.88 | <.0001 |
| 6 Months | Overall | West (yes vs no) | 0.95 | 0.83 | 1.09 | 0.4634 |
| 6 Months | Overall | Commercial (yes vs no) | 1.03 | 0.87 | 1.21 | 0.7704 |
| 6 Months | Overall | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.02 | 1.06 | 0.0001 |
| 6 Months | Overall | Dementia (yes vs no) | 1.52 | 0.93 | 2.46 | 0.0938 |
| 6 Months | Overall | Complications (yes vs no) | 1.22 | 1.10 | 1.37 | 0.0004 |
| 6 Months | Overall | Home (yes vs no) | 0.48 | 0.43 | 0.54 | <.0001 |
| 6 Months | Overall | Outpatient Rehab (yes vs no) | 0.93 | 0.84 | 1.02 | 0.1230 |
| 6 Months | Home | SAVR vs TAVR | 1.39 | 1.18 | 1.64 | <.0001 |
| 6 Months | Home | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.5748 |
| 6 Months | Home | Male vs Female | 0.79 | 0.70 | 0.88 | <.0001 |
| 6 Months | Home | West (yes vs no) | 0.95 | 0.81 | 1.12 | 0.5253 |
| 6 Months | Home | Commercial (yes vs no) | 1.00 | 0.82 | 1.21 | 0.9713 |
| 6 Months | Home | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.02 | 1.07 | 0.0020 |
| 6 Months | Home | Dementia (yes vs no) | 1.80 | 0.97 | 3.37 | 0.0646 |
| 6 Months | Home | Complications (yes vs no) | 1.23 | 1.07 | 1.42 | 0.0036 |
| 6 Months | Home | Outpatient Rehab (yes vs no) | 0.97 | 0.86 | 1.08 | 0.5701 |
| 6 Months | Not Home | SAVR vs TAVR | 0.89 | 0.68 | 1.15 | 0.3739 |
| 6 Months | Not Home | Age (per unit increase) | 1.00 | 0.98 | 1.01 | 0.6134 |
| 6 Months | Not Home | Male vs Female | 0.85 | 0.71 | 1.01 | 0.0714 |
| 6 Months | Not Home | West (yes vs no) | 0.95 | 0.72 | 1.25 | 0.7244 |
| 6 Months | Not Home | Commercial (yes vs no) | 1.09 | 0.78 | 1.53 | 0.6021 |
| 6 Months | Not Home | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.01 | 1.08 | 0.0265 |
| 6 Months | Not Home | Dementia (yes vs no) | 1.20 | 0.55 | 2.61 | 0.6507 |
| 6 Months | Not Home | Complications (yes vs no) | 1.19 | 0.99 | 1.43 | 0.0666 |
| 6 Months | Not Home | Outpatient Rehab (yes vs no) | 0.81 | 0.65 | 0.99 | 0.0426 |
| 6 Months | No Complications | SAVR vs TAVR | 1.11 | 0.78 | 1.59 | 0.5597 |
| 6 Months | No Complications | Age (per unit increase) | 0.99 | 0.98 | 1.01 | 0.4582 |
| 6 Months | No Complications | Male vs Female | 0.75 | 0.61 | 0.93 | 0.0069 |
| 6 Months | No Complications | West (yes vs no) | 0.94 | 0.69 | 1.28 | 0.6905 |
| 6 Months | No Complications | Commercial (yes vs no) | 0.95 | 0.67 | 1.33 | 0.7531 |
| 6 Months | No Complications | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.00 | 1.09 | 0.0573 |
| 6 Months | No Complications | Dementia (yes vs no) | 0.30 | 0.04 | 2.09 | 0.2261 |
| 6 Months | No Complications | Home (yes vs no) | 0.51 | 0.41 | 0.63 | <.0001 |
| 6 Months | No Complications | Outpatient Rehab (yes vs no) | 0.88 | 0.71 | 1.08 | 0.2201 |
| 6 Months | NOTCOMP | SAVR vs TAVR | 1.26 | 1.08 | 1.46 | 0.0035 |
| 6 Months | NOTCOMP | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.6106 |
| 6 Months | NOTCOMP | Male vs Female | 0.82 | 0.73 | 0.91 | 0.0003 |
| 6 Months | NOTCOMP | West (yes vs no) | 0.95 | 0.82 | 1.11 | 0.5526 |
| 6 Months | NOTCOMP | Commercial (yes vs no) | 1.05 | 0.87 | 1.27 | 0.6083 |
| 6 Months | NOTCOMP | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.02 | 1.07 | 0.0008 |
| 6 Months | NOTCOMP | Dementia (yes vs no) | 2.05 | 1.26 | 3.32 | 0.0037 |
| 6 Months | NOTCOMP | Home (yes vs no) | 0.47 | 0.41 | 0.54 | <.0001 |
| 6 Months | NOTCOMP | Outpatient Rehab (yes vs no) | 0.94 | 0.84 | 1.05 | 0.2608 |

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| 12 Months | Overall | SAVR vs TAVR | 1.14 | 1.01 | 1.29 | 0.0376 |
| 12 Months | Overall | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.6910 |
| 12 Months | Overall | Male vs Female | 0.80 | 0.73 | 0.87 | <.0001 |
| 12 Months | Overall | West (yes vs no) | 0.95 | 0.84 | 1.08 | 0.4266 |
| 12 Months | Overall | Commercial (yes vs no) | 1.06 | 0.91 | 1.23 | 0.4764 |
| 12 Months | Overall | Elixhauser Comorbidity Index (per unit increase) | 1.05 | 1.03 | 1.07 | <.0001 |
| 12 Months | Overall | Dementia (yes vs no) | 1.39 | 0.87 | 2.23 | 0.1745 |
| 12 Months | Overall | Complications (yes vs no) | 1.17 | 1.05 | 1.30 | 0.0030 |
| 12 Months | Overall | Home (yes vs no) | 0.51 | 0.46 | 0.57 | <.0001 |
| 12 Months | Overall | Outpatient Rehab (yes vs no) | 0.92 | 0.84 | 1.01 | 0.0659 |
| 12 Months | Home | SAVR vs TAVR | 1.23 | 1.07 | 1.42 | 0.0041 |
| 12 Months | Home | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.9165 |
| 12 Months | Home | Male vs Female | 0.78 | 0.70 | 0.86 | <.0001 |
| 12 Months | Home | West (yes vs no) | 0.93 | 0.80 | 1.07 | 0.2989 |
| 12 Months | Home | Commercial (yes vs no) | 1.05 | 0.89 | 1.25 | 0.5646 |
| 12 Months | Home | Elixhauser Comorbidity Index (per unit increase) | 1.05 | 1.03 | 1.08 | <.0001 |
| 12 Months | Home | Dementia (yes vs no) | 1.68 | 0.95 | 3.00 | 0.0770 |
| 12 Months | Home | Complications (yes vs no) | 1.20 | 1.06 | 1.36 | 0.0048 |
| 12 Months | Home | Outpatient Rehab (yes vs no) | 0.96 | 0.87 | 1.06 | 0.4093 |
| 12 Months | Not Home | SAVR vs TAVR | 0.89 | 0.69 | 1.13 | 0.3237 |
| 12 Months | Not Home | Age (per unit increase) | 1.00 | 0.98 | 1.01 | 0.5823 |
| 12 Months | Not Home | Male vs Female | 0.86 | 0.73 | 1.02 | 0.0773 |
| 12 Months | Not Home | West (yes vs no) | 1.02 | 0.80 | 1.31 | 0.8683 |
| 12 Months | Not Home | Commercial (yes vs no) | 1.05 | 0.76 | 1.44 | 0.7835 |
| 12 Months | Not Home | Elixhauser Comorbidity Index (per unit increase) | 1.04 | 1.01 | 1.07 | 0.0209 |
| 12 Months | Not Home | Dementia (yes vs no) | 1.04 | 0.46 | 2.31 | 0.9309 |
| 12 Months | Not Home | Complications (yes vs no) | 1.09 | 0.92 | 1.30 | 0.3241 |
| 12 Months | Not Home | Outpatient Rehab (yes vs no) | 0.80 | 0.66 | 0.98 | 0.0271 |
| 12 Months | No Complications | SAVR vs TAVR | 1.14 | 0.82 | 1.60 | 0.4357 |
| 12 Months | With Complications | Age (per unit increase) | 0.99 | 0.98 | 1.01 | 0.3674 |
| 12 Months | With Complications | Male vs Female | 0.76 | 0.62 | 0.92 | 0.0041 |
| 12 Months | With Complications | West (yes vs no) | 0.93 | 0.69 | 1.24 | 0.6070 |
| 12 Months | With Complications | Commercial (yes vs no) | 0.89 | 0.65 | 1.23 | 0.4745 |
| 12 Months | With Complications | Elixhauser Comorbidity Index (per unit increase) | 1.05 | 1.01 | 1.09 | 0.0231 |
| 12 Months | With Complications | Dementia (yes vs no) | 0.26 | 0.04 | 1.84 | 0.1781 |
| 12 Months | With Complications | Home (yes vs no) | 0.57 | 0.47 | 0.69 | <.0001 |
| 12 Months | With Complications | Outpatient Rehab (yes vs no) | 0.87 | 0.71 | 1.05 | 0.1435 |
| 12 Months | NOTCOMP | SAVR vs TAVR | 1.13 | 0.99 | 1.30 | 0.0675 |
| 12 Months | NOTCOMP | Age (per unit increase) | 1.00 | 0.99 | 1.01 | 0.9553 |
| 12 Months | NOTCOMP | Male vs Female | 0.81 | 0.73 | 0.89 | <.0001 |
| 12 Months | NOTCOMP | West (yes vs no) | 0.96 | 0.83 | 1.10 | 0.5313 |
| 12 Months | NOTCOMP | Commercial (yes vs no) | 1.11 | 0.94 | 1.32 | 0.2251 |
| 12 Months | NOTCOMP | Elixhauser Comorbidity Index (per unit increase) | 1.05 | 1.03 | 1.07 | <.0001 |
| 12 Months | NOTCOMP | Dementia (yes vs no) | 1.88 | 1.18 | 3.01 | 0.0084 |
| 12 Months | NOTCOMP | Home (yes vs no) | 0.49 | 0.44 | 0.56 | <.0001 |
| 12 Months | NOTCOMP | Outpatient Rehab (yes vs no) | 0.93 | 0.84 | 1.03 | 0.1800 |

**Figure S1. Time to Anxiety and/or Depression 2016-2018 Time Period.**