

A Preoperative Risk Assessment Tool for Predicting Hospital Readmission or Adverse Postoperative Outcomes among Shoulder Arthroplasty Patients

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INTRODUCTION: With the increased utilization of total shoulder arthroplasty (TSA) in the outpatient setting, understanding risk factors for complications as well as hospital readmissions becomes a more significant consideration. This knowledge can aid surgeons in preoperative patient stratification and can help avoid putting TSA patients at undue postoperative risk. Prior developed assessment metrics in the literature consist of hard-to-implement tools or rely on postoperative data to guide decision making. This study aimed to develop a streamlined preoperative risk assessment tool to help predict risk of hospital readmission or postoperative adverse outcomes.

METHODS: We used the complete 2019-2022(Q2) Medicare fee-for-service inpatient and outpatient claims data to predict postoperative adverse outcomes within 90 days post-discharge, including all-cause hospital readmissions, postoperative complications, emergency room visits, and mortality. We screened 108 candidate predictors, including demographics, social determinants of health, TSA indications, prior 12-month hospital and skilled nursing home admissions, comorbidities measured by hierarchical conditional categories, and prior orthopaedic device-related complications. We used two approaches to reduce the number of predictors based on 80% of the data: 1) the Least Absolute Shrinkage and Selection Operator (LASSO) regression and 2) the machine-learning-based cross-validation approach, with the resulting predictor sets being assessed in the remaining 20% of data. A scoring system was created based on regression coefficients, and optimal score cutoff points were determined by maximizing the Youden Index.

RESULTS: A total of 208,634 TSA cases were included. There was a 6.8% hospital readmission rate; 11.2% of cases had at least one postoperative adverse outcome. To predict hospital readmissions, 15 predictors were identified with the area under the curve (AUC) of 0.70. To predict an adverse postoperative outcome, the machine learning approach selected 16 predictors (AUC=0.75) whereas the LASSO regression selected 17 predictors (AUC=0.75). Top predictors for hospital readmissions and at least one adverse outcome included age, anemia, congestive heart failure, heart arrhythmias, or fracture as a surgical indication. The score range for hospital readmission was 0 to 49 (optimal cutoff = 5). The score range for an adverse postoperative outcome was 0 to 67 (optimal cutoff = 7) [Table 1].

DISCUSSION AND CONCLUSION:

We have developed a preoperative risk stratification tool to assess for hospital readmission or adverse surgical outcome following TSA with substantial predictive power. This tool has the potential to assist surgeons in preoperative patient counseling as well as assignment of patients to an appropriate surgical care setting (inpatient versus outpatient). Further investigation is warranted to validate this tool in a variety of diverse demographic settings and improve the tool's predictive performance.

Table 1. Selected Predictors and Scores for 90-Day Hospital Readmissions and the 90-Day Adverse Outcome Based on the Machine Learning Approach

Predictors	Hospital Readmission Score	Adverse Outcome Score
Primary Osteoarthritis (TSA indication)	0	0
Anemia	4	4
Congestive Heart Failure	3	4
Heart Arrhythmias (atrial fibrillation, ventricular tachycardia)	3	3
Chronic Obstructive Pulmonary Disease	3	--
Age: 65-74	1	1
75-84	2	2
≥85	3	4
Fracture due to Orthopedic Devices	5	5
Depression	3	3
Orthopedic Device Mechanical Complications	4	4
Vascular Disease (embolism, thrombosis, atherosclerosis)	3	--
Rotator Cuff Pathology (TSA indication)	1	--
Parkinson's or Huntington's Disease	4	4
Cardio-Respiratory Failure and Shock	4	4
Diabetes	3	--
Inpatient Admission in the Previous 12 Months	3	--
Fracture (TSA indication)	--	7
Acute Renal Failure	--	4
Dual Eligibility	--	3
Stroke	--	5
Dementia	--	4
Pulmonary Embolism	--	6

Note: "--" means not applicable. The score range for hospital readmission and the composite outcome is 0 to 49 (optimal cutoff = 5) and 0 to 67 (optimal cutoff = 7), respectively. For a TSA patient, users can check if these predictors exist prior to the surgery and sum the scores associated with existing predictors. Hospital readmission (or an adverse postoperative outcome) is expected if the total score for hospital readmission (or an adverse postoperative outcome) is greater than 5 (or 7).