# A Validated Pre-Operative Risk Prediction Tool For Extended Inpatient Length of Stay Following Anatomic or Reverse Total Shoulder Arthroplasty

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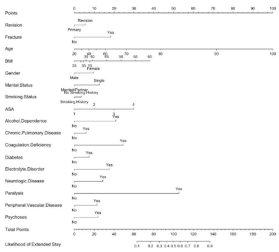
INTRODUCTION:
Recent work has shown inpatient length of stay following shoulder arthroplasty to hold the 2nd strongest association with overall cost (after implant cost itself). In particular, a pre-operative understanding for what patients may be at risk for an extended inpatient stay (3+ days) can allow for optimization and perioperative planning, as well as identifying a population who may be at higher risk for post-operative adverse events.
METHODS:
A multi-center retrospective review was performed of 5,410 anatomic (52%) and reverse (48%) total shoulder arthroplasties done at two large, tertiary referral health systems (Southeast: 07/2013-09/2020; Midwest: 06/2007-02/2020). The primary outcome was a binary variable for patients experiencing an extended inpatient length of stay of at least 3 days, and over 40 pre-operative sociodemographic and comorbidity factors were tested for their predictive ability in a multivariable logistic regression model based on the patient cohort from Institution 1 (derivation, N = 1,773). External validation of model accuracy was tested using the patient cohort from Institution 2 (validation, N = 3,637), including area under the receiver operator characteristic curve (AUC), sensitivity, specificity, and positive and negative predictive values across all possible risk thresholds.
RESULTS:
318 patients (18%) in the derivation cohort and 496 patients (14%) in the validation cohort experienced an extended inpatient length of stay of at least 3 days. Of these 814 patients, 445 (55%) were discharged to a skilled nursing or rehabilitation facility. Patients undergoing an extended inpatient length of stay also had significantly higher rates of unplanned 90-day readmissions (4.7% vs 3.0%, $p = 0.0121$), and although reverses (13.4% vs 5.2%, $p < 0.0001$) and fracture cases (15.0% vs 9.0%, $p = 0.0045$) had higher rates of extended inpatient stay, the association of revision cases with prior metal hardware only trended toward significance (11.6% vs 8.9%, $p = 0.0544$). Following strict parameter selection, a multivariable logistic regression model based on the derivation cohort (Institution 1) demonstrated excellent preliminary accuracy (AUC: 0.826), with minimal decrease in accuracy under external validation when tested against the patients from Institution 2 (AUC: 0.816). The predictive model was composed of only pre-operative factors, in order of descending predictive importance: age, marital status, fracture case, ASA score, paralysis, electrolyte disorder, BMI, gender, neurologic disease, coagulation deficiency, diabetes, chronic pulmonary disease, peripheral vascular disease, alcohol dependence, psychoses, smoking status, and revision case.
DISCUSSION AND CONCLUSION:
A freely-available, pre-operative online clinical decision tool for extended inpatient length of stay (3+ days) after shoulder arthroplasty reaches excellent predictive accuracy under external validation in a sample of patients with considerable diversity from the derivation cohort. As a result, this tool merits consideration for clinical implementation, as many risk factors are potentially modifiable as part of a pre-operative optimization strategy.




# Shoulder Arthroplasty: Extended Length of Stay Risk Calculator

**Predicting Likelihood of Extended Inpatient Length of Stay (3+ Days) After Anatomic and Reverse Shoulder Arthroplasty**