

Predicting Length of Stay and Patient Discharge Disposition After Total Joint Arthroplasty using the ACS NSQIP Calculator is Inferior to Novel Models Using In-House Data

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Disclosures: The authors have no relevant disclosures

INTRODUCTION: In recent times, the rates of total joint arthroplasty (TJA) have increased, underscoring the need to study and improve surgical outcomes such as patients' length of stay (LoS) during TJA and discharge disposition. Anticipating these outcomes plays a pivotal role in the optimal allocation of resources and associated costs for both hospitals and patients. In this work, we study the ability of machine learning tools to prognosticate LoS and discharge disposition to determine if such tools can be useful in a clinical setting.

METHODS: The study focused on a cohort of individuals aged 18 and above, who had undergone primary elective total knee and total hip arthroplasty procedures. Inclusion criteria encompassed patients with a minimum of 2 years' worth of clinical follow-up data, while cases involving revision procedures or same-day bilateral interventions were excluded. The study cohort comprised a total of 513 patients. The prediction of LoS and patients' disposition was carried out utilizing the National Surgical Quality Improvement Program (NSQIP) calculator, which considers 21 distinct features to forecast both LoS and disposition. The performance of ACS NSQIP's predictions for assessing LoS and discharge disposition was calculated using correlation and the area under the receiver operating characteristic curve (AUROC), respectively. Similarly, we built a custom machine learning tool using caret's glmnet in R and 5-fold cross validation using the same 21 features as the ACS NSQIP to study how an in-house model would perform.

RESULTS: The ACS NSQIP prediction achieved an R-squared for LoS prediction of 0.12, and a correlation coefficient of 0.34, which is considered to be poor performance (Figure 1(a)). However, the novel machine learning tool created using the same 21 features achieved an R-squared for LoS prediction of 0.30, and a correlation coefficient of 0.63, which is much better than the performance achieved by the ACS NSQIP (Figure 1(b)). For discharge disposition, the AUROC for ACS NSQIP was 0.75 (± 0.05). Likewise, employing the same 21 factors in a novel machine learning model resulted in a significant increase in prediction performance, with an AUROC of 0.86 (± 0.11), Delong's p-value of 0.088 (Figure 1(c)).

DISCUSSION: This study demonstrates that the ACS NSQIP model performance for predicting both LoS and discharge disposition after TJA is inferior to models that can be trained using in-house data. The results highlight that machine learning models could substantially increase prediction accuracy when trained using in-house data. Moving forward, our strategic objective involves the development of customized machine learning models tailored specifically for this genre of research.

SIGNIFICANCE/CLINICAL RELEVANCE: This study bears considerable importance in enhancing the prognostic capabilities within the realm of orthopedic surgery. Furthermore, it serves as a motivating force for clinicians and researchers to embark on the development of bespoke machine learning models, with the potential to revolutionize predictive precision in this domain.

IMAGES AND TABLES:

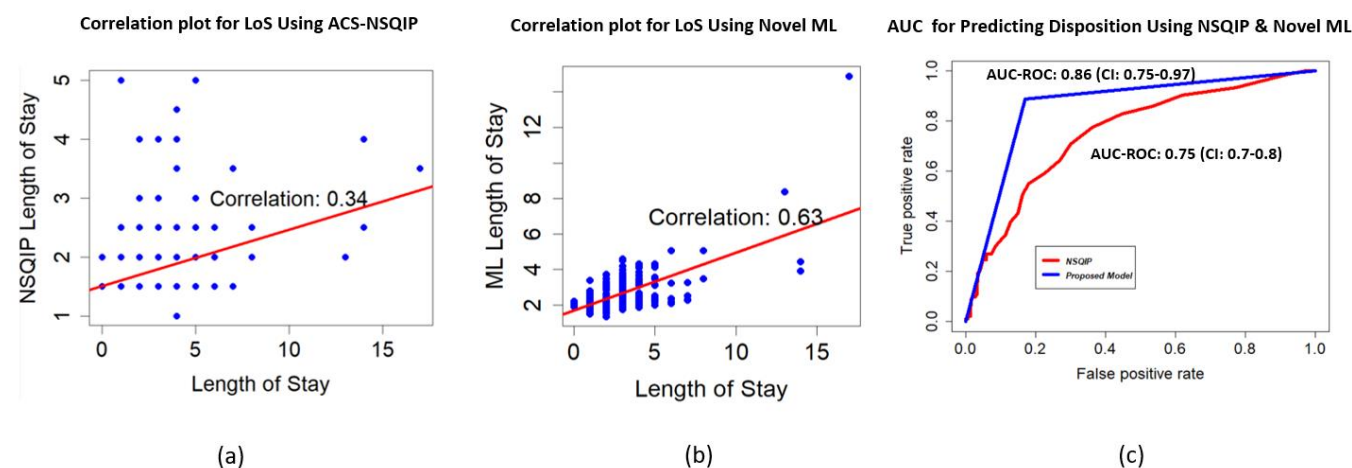


Figure 1: (a) Shows the correlation between original LoS and ACS-NSQIP predicted LoS; (b) Shows the correlation between original LoS and novel ML model predicted LoS (c) Comparison of AUC-ROC for predicting patient disposition using proposed ACS-NSQIP and Novel ML model.