A Predictive Model for 90-day Postoperative Joint Infection Following Primary Total Knee Arthroplasty

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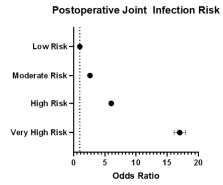
INTRODUCTION: Postoperative joint infection (PJI) is one of the most severe complications following primary total knee arthroplasty (TKA). Although relatively rare with an incidence of 1% it can be devastating. Therefore, validated risk assessment tools are needed to predict the risk of PJI in the TKA population. This study aims to compare different machine learning models to create a predictive model using the Elixhauser Comorbidity Index for PJI risk stratification following primary TKA.

METHODS: A total of 1,166,972 patients who underwent primary elective TKA were identified via ICD-10 codes from the National Readmissions Database for the years 2016-2020. Of these, 80% were included in a training dataset, while the remaining 20% were used as a testing dataset. Four machine learning models with cost-sensitive analysis were employed for predicting PJI: logistic regression, gradient boost modeling (GBM), neural network (NN), and random forest (RF). The independent variables tested for PJI prediction were the 31 Elixhauser variables, along with age and gender. The best model's coefficients were normalized on a scale of -5 to 5, and patients were stratified by score. A final predictive model was then generated for PJI prediction using the entire patient population.

RESULTS: Among the four machine learning models, logistic regression was superior at predicting PJI (AUC 0.776), followed by NN (AUC 0.759), GBM (AUC 0.754), and RF (AUC 0.732). Using the successful logistic regression model, patients were scored and stratified into risk categories: low risk (score <5), moderate risk (6-10), high risk (11-15), and very high risk (16+). Patients in the moderate-risk category had a 2.64 times greater risk of PJI (p<0.001) compared to those in the low-risk category. High-risk patients had a 6.04 times greater risk (p<0.001), while very high-risk patients had a 16.99 times greater risk (p<0.001) than those in the low-risk category.

DISCUSSION AND CONCLUSION:

PJI is a devastating complication, and risk stratification tools can assist in patient selection and risk modification. This study developed a weighted predicative model based on the comorbidities in the Elixhauser Comorbidity Index to predict PJI within 90 days of primary TKA in a representative national dataset.



	OR	95% Lower CI	95% Upper CI	P
Low Risk	1.00			
Moderate Risk	2.64	1.64	1.98	<0.001
High Risk	6.04	5.68	6.43	<0.001
Very High Risk	16.99	16.12	17.91	<0.001