

A Machine Learning Model to Predict Surgical Site Infection After Surgery of Lower Extremity Fractures in Orthopaedic Trauma Patients

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Purpose: Predicting the risk of surgical site infection (SSI) in patients at higher risk for complications may have significant clinical implications in the management of orthopaedic trauma patients. We developed machine learning (ML) algorithms to determine predictive factors for postoperative SSI risk in patients with high-energy lower extremity fractures.

Methods: A retrospective cohort study at a Level I trauma center was conducted on patients undergoing surgical fixation of their lower extremity fractures. Variable selection was performed to identify factors contributing to predicting the risk of postoperative SSI. Four different ML algorithms were constructed, internally validated, and assessed by the area under the curve score, Youdon's index, and Brier score. Multivariate adaptive regression splines (MARS) was used to optimize predictor selection.

Results: In total, 1579 patients with lower extremity fractures were included. The models included 14 predictors, specifically age, sex, body mass index (BMI), open versus closed fractures, AO/OTA classification, polytrauma, operating room (OR) time, history of smoking, alcohol or drug use, American Society of Anesthesiologists (ASA) classification of physical health, mechanism of injury, diagnosis of diabetes mellitus, and diagnosis of immunodeficiency. The MARS ML model was the best-performing model. It selected 5 variables, including OR time, AO/OTA type 43 and 44 fractures, grade 3B open fractures, age, and BMI. This model had an area under the receiver operating characteristic curve of 77.8%, sensitivity of 83.3%, and specificity of 62.5% at Youdon's index, and the Brier scores ranged between 5.1 and 5.6%.

Conclusion: Artificial intelligence plays an increasing role in estimating outcomes in orthopaedic trauma surgery. Using these novel strategies, we were able to create a prediction model that may assist surgeons in determining high-risk factors for SSI in patients with lower extremity fractures.