Is it possible to predict which patients are at higher risk of infection? A secondary analysis of the VANCO and OXYGEN trials

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INTRODUCTION: While certain clinical factors may be associated with an increased risk of infection, it is difficult to predict which patients will develop this complication. The purpose of this study was to develop, internally validate, and externally validate a prediction model for a deep infection following a tibial plateau or pilon fractures using VANCO and OXYGEN trial data.

METHODS: This study used data from the VANCO (n=980) and OXYGEN (n=875) multicenter randomized treatment trials. We included patients who sustained a tibial plateau or pilon fracture and were definitively treated with plate and screw fixation. In addition, patients met at least 1 of the following 3 criteria: i) treated initially with external fixation, ii) had a Gustilo-Anderson type I, II, or IIIA open fracture, or iii) had ipsilateral compartment syndrome treated with fasciotomy. The primary outcome was deep infection requiring surgical debridement within 6 months of definitive fixation, which occurred in 80 of 980 VANCO patients (8%) and 81 of 875 OXYGEN patients. (9%). Based on existing literature, thirteen baseline predictors were considered for the models, including age, gender, race, education, body mass index, American Society of Anesthesiologists (ASA) class, Injury Severity Score, diabetes, smoking status, intravenous drug abuse, alcoholism, fracture classification, and fracture location. We developed prediction models using the VANCO and OXYGEN data using 3 different approaches: i) logistic regression, ii) stepwise elimination, and iii) machine learning (random forests). The initial models were internally validated using 10-fold cross-validation and then externally validated in the alternative dataset (VANCO in OXYGEN and vice-versa). We assessed model performance using area under the receiver operating characteristic curve (AUC). Based on prior literature, we considered models with an AUC exceeding 0.7 to have acceptable clinical utility.

RESULTS: After internal validation, the stepwise elimination models for VANCO (AUC = 0.65) and OXYGEN (AUC = 0.67) had the highest AUCs compared with logistic regression and machine learning. However, none of the external validation AUCs exceeded 0.65 (range, 0.57 to 0.65).

DISCUSSION AND CONCLUSION: After internal and external validation, all of the predictive models failed to reach an acceptable level of clinical utility (AUC > 0.7). Our models' inability to distinguish high-risk from low-risk patients is likely due to both trials' strict eligibility criteria and, therefore, homogeneous patient populations. Nevertheless, the findings may indicate the usefulness of this patient population for studying infection prevention strategies as the patients appear to have a similar baseline risk of developing a deep surgical site infection.