Δ Machine Learning Algorithms Exceed Comorbidity Indices in Prediction of Short-Term Complications Following Hip Fracture Surgery

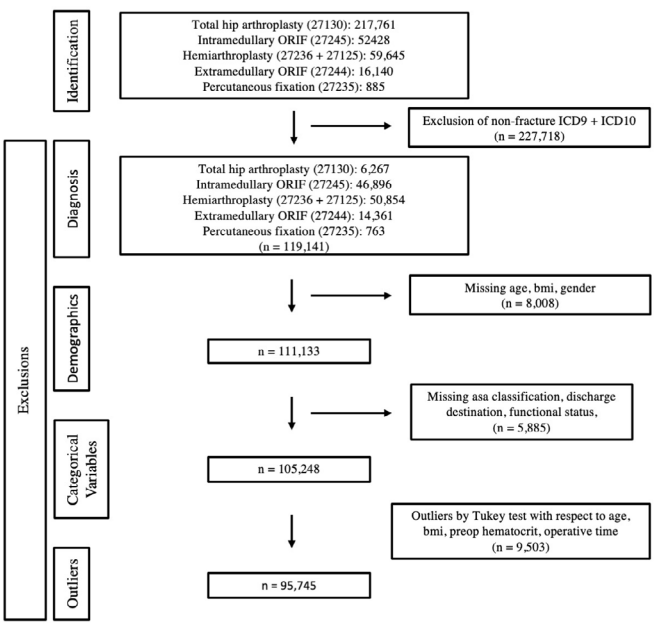
Anirudh Krishna Gowd, MD*; Edward Beck, MD; Avinesh Agarwalla, MD; Dev Patel, BS; Ryan Godwin, PhD; Brian R. Waterman, MD; Milton Thomas M. Little, MD; Joseph Liu, MD*
Wake Forest Baptist Medical Center, Winston-Salem, NC, United States

Purpose: The purpose of the present study is to determine the reliability of assessing operative risk following hip fracture through machine learning algorithms.

Methods: The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) was queried from 2011-2018 and the ACS-NSQIP hip fracture targeted dataset was queried from 2016-2018 for all patients undergoing operative fixation for a diagnosis of an acute primary hip fracture. The dataset was randomly split into training (80%) and testing (20%) sets. Three machine learning algorithms were utilized to train models in the prediction of extended hospital length of stay (LOS) >13 days, death, readmissions, home discharge, transfusion, and any medical complication. Testing sets were assessed by receiver operating characteristic curve, positive predictive value (PPV), and negative predictive value (NPV) and were compared to models constructed from legacy comorbidity indices (American Society of Anesthesiology score [ASA] modified Charlson Comorbidity Index [mCCI], frailty index [FI], and Nottingham Hip Score [NFHS]).

Results: Following inclusion/exclusion criteria, 95,745 cases were available in the overall dataset and 22,344 in the targeted dataset. Machine learning models outperformed comorbidity indices for each complication by AUC (area under the receiver operating characteristic curve) analysis (P<0.01 for each): medical complications (AUC = 0.65, PPV = 67.5, NPV = 71.7), death (AUC = 0.80, PPV = 46.7, NPV = 94.9), extended LOS (AUC = 0.69, PPV = 71.4, NPV = 94.1), transfusion (AUC = 0.79, PPV = 64.2, NPV = 77.4), readmissions (AUC = 0.63, PPV = 0, NPV = 96.8), and home discharge (AUC = 0.74, PPV = 65.9, NPV = 76.7).

Conclusion: Machine learning algorithms offer an improved method to holistically calculate preoperative risk of patient morbidity, mortality, and discharge destination. Through continued validation, risk calculators utilizing these algorithms may inform medical decision-making to providers and payers.



Δ OTA Grant