

# Can Machine Learning Predict Continued Opiate Use after Spine Surgery?

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## INTRODUCTION:

Although spine surgery usually results in improvement of pain, deformity, and neurological deficits, it is also associated with chronic opiate use postoperatively. Because chronic opioid use is associated with adverse outcomes and complications, spine surgeons are increasingly wary of patient variables that put them at high risk of continued opiate use. Medical scientists have been turning to machine learning for answers to similar questions in prediction of surgical outcomes. Although algorithms rely on different equations and methodology, machine learning at its core is based on computers recognizing patterns in data. By applying machine learning in prediction of continued opiate use after spine surgery, authors wanted to gain insight into the top risk factors that may not be obvious with traditional statistical analyses.

## METHODS:

The authors reviewed the home institution's database from 2013 to 2022 for all patients aged 18 and above undergoing spine surgeries ranging from ACDF, ALIF, laminectomy, artificial disc replacement, etc. Exclusion criteria were surgery for tumor and infection, patients who expired, and patients with missing information. Within the database were columns containing medication ordering mode and medication name. Patients were distinguished into those who received additional opiate medications at their initial outpatient postoperative visit versus those who did not get additional opiate prescriptions after discharge. Demographic information, comorbidities, preoperative lab values, and other operative variables were used to train five machine learning algorithms including gradient boosting trees in addition to multiple logistic regression. Once algorithm performance was evaluated with area under the curve (AUC), permutation feature importance was used to rank variables algorithms considered important. Statistical significance of intergroup difference by variable was calculated using t-test for continuous variables and chi square test for categorical variables.

## RESULTS:

Total of 3,407 patients were part of the study, with 2,441 patients not receiving more opiates at follow up while 966 patients received opiates at the first postoperative visit. The highest performing algorithm was gradient boosting trees which had AUC of 0.80. All machine learning algorithms outperformed logistic regression, which has AUC of 0.66. Gradient boosting trees ranked BMI (0.109), history of opiate abuse (0.0131), age (0.103), Medicare HMO insurance (0.0098), and specialty (0.0075) in order of permutation feature importance. Patients who received opiate medications at their postoperative appointments tended to be thinner (BMI 29.3 vs. BMI 29.5), more opiate tolerant (14.0% vs. 4.4%), younger (55.9 years vs. 58.9 years), less likely to have Medicare HMO (10.7% vs. 19.2%), and likely to be operated by an orthopaedic surgeon rather than a neurosurgeon (56.9% vs. 50.2%). P-value was less than 0.05 for all except for specialty, which had p-value 0.057.

## DISCUSSION AND CONCLUSION:

Majority of spine surgery patients did not receive additional opiates at their postoperative visits. In prediction of additional opiate prescription, gradient boosting trees and other machine learning algorithms outperformed multiple logistic regression. Variables considered most important by gradient boosting trees were BMI, history of opiate abuse, age, insurance, and surgical specialty. Spine surgeons can use machine learning as a tool to recognize risk and protective factors for continued opiate use.

