Using Machine Learning Algorithms for Prediction of Postoperative Length of Hospital Stay and Discharge Disposition After Craniotomy for Resection of Craniopharyngiomas in Adults: A National Surgical Quality Improvement Program Analysis of 2011 to 2017

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Disclosure

• Nothing to disclose
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Introduction

• Craniopharyngiomas are benign epithelial tumors that occur in suprasellar locations

• They are associated with the highest overall mortality of all suprasellar tumors due to invasion of critical adjacent neural structures which makes surgical management challenging.

• Nonhome discharge often negatively impacts patients’ satisfaction and is associated with additional complications.

• This study evaluated machine learning algorithms to predict nonhome discharge following craniotomy for craniopharyngioma in adults from national data.
Methods: *Data Source & Inclusion Criteria*

Total Cases Recorded since ACS-NSQIP Inauguration in 2005
N = 5,578,702

Exclusively 2011-2017 Data:

Query for Craniotomy for excision of craniopharyngioma, CPT Code (61545)
N = 130

Data QC/Cleaning

Predict Postoperative Length of Hospital Stay

Predict Nonhome Discharge Disposition
Methods: Prediction- Machine Learning

- Waikato Environment for Knowledge Analysis (WEKA)
  - Version 3.8.3
- Classifiers Evaluated
  - Bayes
  - Meta
  - function-
  - rules-
  - tree-based classifiers
- 10-folds cross-validation
- Evaluation Metrics
  - Accuracy
  - Precision
  - Recall
  - F-measure
  - Positive and negative predictive values (PPVs and NPVs)
Results: *Prediction of Postoperative Length of Hospital Stay*

- The median number of days from operation to discharge was 6 with a range from 1 to 48.

- The strongest predictors for the *Postoperative Length of Hospital Stay*: 
  - Preoperative Serum Sodium
  - Platelet count
  - Hematocrit
  - White Blood Cell Count
  - Blood Urea Nitrogen
  - Preoperative Length of Hospital Stay
  - Functional Health Status
  - BMI
  - Diagnosis of Diabetes Mellitus.

- The additive regression meta classifier with decision stump base classifier was optimal for predicting the postoperative length of hospital stay with a median residual of 2.98 days.
Results: **Prediction of Nonhome Discharge Disposition**

130 Craniopharyngioma Patients

- **29% (n=38)** Nonhome Discharge
- **71% (n=92)** Home Discharge
Results: *Prediction of Nonhome Discharge Disposition*

• The strongest predictors for the Nonhome Discharge Disposition:
  
  • Total Length of Hospital Stay
  
  • Age
  
  • Preoperative Serum Creatinine
  
• LogitBoost additive logistic regression was optimal for predicting postoperative discharge disposition using **observed** total length of hospital stay (82.31% accuracy, AUC = 0.834).

• The accuracy of the classifier using **predicted** total length of hospital stay was 76.15%.
To the best of our knowledge this is the first study to use machine learning to analyze postoperative total length of hospital stay and nonhome discharge disposition using machine learning following craniopharyngioma.

Our findings provide preliminary evidence with regard to the feasibility of machine learning techniques to predict unfavorable outcomes such as nonhome discharge disposition.

Our study employed machine learning modeling from a national surgical registry than has been shown to have higher quality data than single-institutional traditional claims databases (Etzioni et al., 2018, Lawson et al., 2012)
Conclusions

Machine learning algorithms show promising results for preoperative prediction of postoperative length of hospital stay and nonhome discharge disposition for patients undergoing Craniopharyngioma.

These algorithms could help healthcare professionals to establish a protocol to utilize predictive modeling for preoperative management in elective inpatient surgery for Craniopharyngioma to strategically invest additional time and resources into postoperative plans for this population.