Predicting Acute Kidney Injury after Elevated Risk Non-cardiac Surgery
Hanbiehn Kim, Hieu Nguyen, Joseph Greenstein, Raimond Winslow, Lee Goeddel
Biomedical Engineering, Johns Hopkins University

Impact Statement
Acute kidney injury occurs in up to 47% of patients after surgery and affects over 10 million people worldwide each year. Machine learning algorithms allow for early detection of elevated risk for acute kidney injury and kidney failure. Armed with this knowledge, clinicians can better prevent kidney injury in the most at risk patients and improve patient outcomes.

Approach
Organize and preprocess patient data and select features from aQI database.
- Demographic data:
  - e.g. age, weight, race, sex
- Time series data:
  - e.g. blood pressure, heart rate
Develop risk model of AKI via machine learning methods
- GLM (generalized linear model)
- SVM (support vector machine)
- QDA (quadratic discriminant analysis)
- XGBoost (extreme gradient boosting)

Results
Random forest results suggest that the top five most important features for AKI prediction are minimum heart rate during surgery, weight, mean MAP, minimum arterial line MAP, and mean arterial line MAP. We built our models with data from 201 patients, in which the ratio of patients with AKI to patients without AKI was 3:1. We found SVM with RBF kernel was the best performing machine learning algorithm (AUC = 0.69), followed by GLM (0.68), XGBoost (0.66), and QDA (0.59). SVM’s performance suggests the data can be linearly separated via a hyperplane after projecting it onto a Gaussian kernel. QDA’s relative poor performance suggests the predictor features are not normally distributed.

Conclusions
Our best AUC for AKI prediction was 0.69, from a SVM with RBF kernel algorithm. Future work includes predicting the proportion of those who develop kidney failure out of those who develop AKI and testing the performance of a recurrent neural network (RNN) relative to our preexisting machine learning algorithms. MAP, heart rate, age, and race are features with strong correlations with AKI development. Further studies are needed to determine the details of their effects on AKI.