Deep Neural Network System for Prediction of In-Hospital Mortality

Evan Kharasch, Editor-in-Chief of Anesthesiology, opens this month with a look at a deep neural network system, a type of machine learning that can be used to develop highly non-linear prediction models. Dr. Christine K. Lee of the University of California, Irvine, and colleagues there and at UCI Health, tested the hypothesis that deep neural networks trained on intraoperative features can predict postoperative in-hospital mortality. They used data from 87 features found in nearly 60,000 surgical patients to train and validate their algorithm. Feed-forward networks with a logistic output were trained using stochastic gradient descent with momentum. The deep neural networks were trained on 80% of the data, with 20% of the data reserved for testing. They assessed improvement of the deep neural network over applying American Society of Anesthesiologists Physical Status Classification and robustness of the deep neural network to a reduced feature set. The networks were then compared to ASA Physical Status, logistic regression, and other published clinical scores. The investigators concluded that the deep neural network had the best prediction, and highest area under the receiver operating characteristic curve, at 0.91. The highest diagnostic accuracy on a per-patient basis was 0.82, with 0.92 sensitivity and 0.66 specificity. For a feature set of the 80 most important features, the algorithm achieved 0.93 AUC, 0.92 sensitivity and 0.65 specificity. Thus, the deep neural network demonstrated the capability to predict postoperative in-hospital mortality with high accuracy.

In the second study, K. Lee of the University of California, Irvine, and colleagues there and at UCLA, tested the hypothesis that deep neural networks can predict in-hospital mortality by applying American Society of Anesthesiologists Physical Status Classification and robustness of the deep neural network to a reduced feature set. The networks were then compared to ASA Physical Status, logistic regression, and other published clinical scores. The investigators concluded that the deep neural network had the best prediction, and highest area under the receiver operating characteristic curve, at 0.91. The highest diagnostic accuracy on a per-patient basis was 0.82, with 0.92 sensitivity and 0.66 specificity. For a feature set of the 80 most important features, the algorithm achieved 0.93 AUC, 0.92 sensitivity and 0.65 specificity. Thus, the deep neural network demonstrated the capability to predict postoperative in-hospital mortality with high accuracy.

In the third study, K. Lee of the University of California, Irvine, and colleagues there and at UCLA, tested the hypothesis that deep neural networks can predict in-hospital mortality by applying American Society of Anesthesiologists Physical Status Classification and robustness of the deep neural network to a reduced feature set. The networks were then compared to ASA Physical Status, logistic regression, and other published clinical scores. The investigators concluded that the deep neural network had the best prediction, and highest area under the receiver operating characteristic curve, at 0.91. The highest diagnostic accuracy on a per-patient basis was 0.82, with 0.92 sensitivity and 0.66 specificity. For a feature set of the 80 most important features, the algorithm achieved 0.93 AUC, 0.92 sensitivity and 0.65 specificity. Thus, the deep neural network demonstrated the capability to predict postoperative in-hospital mortality with high accuracy.