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Machine learning tools for predicting clinical outcomes

New research findings suggest that machine learning may usher in a new era in digital healthcare tools that are able to predict clinical outcomes in patients with known or potential heart problems. These findings are from several studies being presented at the American College of Cardiology's 67th Annual Scientific Session.

The new studies presented at ACC.18 demonstrate how machine learning can be used to predict outcomes such as diagnosis, death or hospital readmission; improve upon standard risk assessment tools; elucidate factors that contribute to disease progression; or to advance personalised medicine by predicting a patient's response to treatment.

Clinical scoring systems and algorithms have long been used in healthcare, but the increasing use of machine learning in recent years has greatly helped to improve such tools. Compared to traditional algorithms that require all calculations to be pre-programmed, machine learning algorithms deduce the optimal set of calculations by looking for patterns in large collections of patient data.

In one of the studies, for example, researchers used machine learning to predict which patients would ultimately be diagnosed with a heart attack after coming to a hospital emergency department for chest pain. Chest pain is one of the most common complaints among patients visiting the emergency department, yet only a minority of these patients are ultimately diagnosed with a heart attack. In a pilot test, the algorithm showed a 94 percent accuracy rate for predicting the ultimate diagnosis.

"The long-term goal is to identify those who are at highest risk and to treat those patients first," said the study's lead author Daniel Lindholm, MD, PhD, postdoctoral research fellow at Uppsala University in Sweden. "If this work is further validated, hospitals could potentially use it to quickly pick out which patients are sickest when they arrive at the hospital, and that could lead to a shorter time to treatment for those who need it most."

The algorithm was developed using data from more than 8,200 ED visits in Stockholm between 2011 and 2013. In the first (training) phase, the algorithm used data from 5,800 patient visits to iteratively refine decision trees to identify a heart attack diagnosis based on factors such as blood test results, vital signs and the patient's medical history – the same data that a physician would have upon first encountering a patient.

In the second (validation) phase, the algorithm used the same types of patient data from a separate set of 2,400 visits, including blood test results, vital signs and medical history, but information about ultimate heart attack diagnosis was excluded to test how accurately the algorithm could predict which patients were ultimately diagnosed with a heart attack. Overall, the algorithm was able to accurately predict a heart attack diagnosis 94

percent of the time in the validation data set.

"I think that we will see more and more decision support systems based on machine learning," Dr. Lindholm said. "But even as machine learning can enhance medical practice, I do not think these algorithms will ultimately replace physicians but, rather, provide decision support based on the data at hand. Other things, such as empathy, human judgment and the patient-doctor relationship are crucial."

To bring their algorithm closer to clinical application, Dr. Lindholm said the research team will first need to evaluate it in larger data sets that include more hospitals in diverse environments and then validate it in a prospective clinical study.

Other studies involving the application of machine learning being presented at ACC.18 include the following:

- "Machine Learning in Predicting Coronary Heart Disease and Cardiovascular Disease Events: Results from the Multi-ethnic Study of Atherosclerosis (mesa)"
- "A Novel Ensemble Machine Learning-Based Method versus Clinical Risk Scoring for Discrimination of Individuals Who Will versus Will Not Experience Acute Coronary Syndrome After Coronary Computed Tomographic Angiography: Results from the ICONIC Study"
- "Machine Learning Models Significant Improve Outcome Prediction after Cardiac Arrest"
- "Development of High Sensitivity Screening for Assessing Individual Level Risk for Peripheral Arterial Disease"
- "A Highly Predictive Machine Learning Model to Identify Hospitalised Patients at Risk for 30-Day Readmission or Mortality"

The ACC's Annual Scientific Session, which will take place 10-12 March in Orlando, brings together cardiologists and cardiovascular specialists from around the world to share the newest discoveries in treatment and prevention.

Source: American College of Cardiology
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Published on : Tue, 6 Mar 2018