ICU
MANAGEMENT & PRACTICE

Emergency admission risk: machine learning model works well

Machine learning can be used to analyse electronic health records and predict the risk of emergency hospital admissions, according to a new study from The George Institute for Global Health at the University of Oxford has found.

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The study is published in *PLOS Medicine* [open access]. The researchers suggest that using these techniques could help health practitioners accurately monitor patient risk by predicting whether a patient may need emergency care in the near future and put in place measures to avoid costly unplanned admissions.

Lead author, Fatemeh Rahimian (pictured), former data scientist at The George Institute UK, explained in a media release: "We wanted to provide a tool that would enable healthcare workers to accurately monitor the risks faced by their patients, and as a result make better decisions around patient screening and proactive care that could help reduce the burden of emergency admissions."

The study was conducted using linked electronic health records from the UK's Clinical Practice Research Datalink. The researchers derived, validated and compared a statistical model and two machine learning models (gradient boosting classifier and random forest) for prediction of the first emergency admission. In total the data set included 4.6 million patients aged 18-100 years from 1985 to 2015, and over 1.86 billion patient months.

A wide range of factors was taken into account, including age, sex, ethnicity, socioeconomic status, family history, lifestyle factors, comorbidities, medication and marital status, as well as temporal factors - time since first diagnosis, last use of the health system and latest laboratory tests. A total of 56 variables were used.

Compared to the baseline reference Cox proportional hazards (CPH statistical model) machine learning models were found to provide a more robust prediction of the risk of emergency hospital admission than any models used previously. The final gradient boosting classifier (GBF) model showed a 10.8% higher area under the curve for prediction of risk of emergency admission within 24 months. From the temporal variables, the number and duration of consultations, age and time since last admissions and consultation as well as laboratory test results were shown to be highly predictive.

In an email to *ICU Management & Practice*, co-author Professor Kazem Rahimi, Deep Medicine Program lead

and Deputy Director of The George Institute for Global Health, University of Oxford said: “To my knowledge, the National Health Service (Clinical Commissioning Groups or General Practitioners) are already using a few conventional statistical models for prediction of risk of emergency admissions. These are typically either ‘black-box’ commercial models that have not been validated or conventional statistical models such as Q-Admissions (which we show to be less useful than our model). We have made our modelling codes publicly available and encourage the NHS to replace their existing models with the new one. Of course, a more user-friendly solution would be that we develop an app or application programming interface for direct integration with various systems, but this needs to be co-developed with users, subject to interest and availability of resources.”

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