Developing machine learning models to predict critical illness and mortality in COVID-19 patients

November 10 2020

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Mount Sinai researchers have developed machine learning models that predict the likelihood of critical events and mortality in COVID-19 patients within clinically relevant time windows. The new models outlined in the study—one of the first to use machine learning for risk prediction in COVID-19 patients among a large and diverse population,

and published November 6 in the *Journal of Medical Internet Research*—could aid clinical practitioners at Mount Sinai and across the world in the care and management of COVID-19 patients.

"From the initial outburst of COVID-19 in New York City, we saw that COVID-19 presentation and disease course are heterogeneous and we have built machine learning models using patient data to predict outcomes," said Benjamin Glicksberg, Ph.D., Assistant Professor of Genetics and Genomic Sciences at the Icahn School of Medicine at Mount Sinai, member of the Hasso Plattner Institute for Digital Health at Mount Sinai and Mount Sinai Clinical Intelligence Center (MSCIC), and one of the study's principal investigators. "Now in the early stages of a second wave, we are much better prepared than before. We are currently assessing how these models can aid clinical practitioners in managing care of their patients in practice."

In the retrospective study using electronic health records from more than 4,000 adult patients admitted to five Mount Sinai Health System hospitals from March to May, researchers and clinicians from the MSCIC analyzed characteristics of COVID-19 patients, including past medical history, comorbidities, vital signs, and laboratory test results at admission, to predict critical events such as intubation and mortality within various clinically relevant time windows that can forecast short and medium-term risks of patients over the hospitalization.

The researchers used the models to predict a critical event or mortality at time windows of 3, 5, 7, and 10 days from admission. At the one-week mark—which performed best overall, correctly flagging the most critical events while returning the fewest false positives—acute kidney injury, fast breathing, high blood sugar, and elevated lactate dehydrogenase (LDH) indicating tissue damage or disease were the strongest drivers in predicting critical illness. Older age, blood level imbalance, and C-reactive protein levels indicating inflammation, were the strongest

drivers in predicting mortality.

"We have created high-performing predictive models using machine learning to improve the care of our patients at Mount Sinai," said Girish Nadkarni, MD, Assistant Professor of Medicine (Nephrology) at the Icahn School of Medicine, Clinical Director of the Hasso Plattner Institute for Digital Health at Mount Sinai, and Co-Chair of MSCIC. "More importantly, we have created a method that identifies important health markers that drive likelihood estimates for acute care prognosis and can be used by health institutions across the world to improve care decisions, at both the physician and hospital level, and more effectively manage patients with COVID-19."

More information: Akhil Vaid et al. Machine Learning to Predict Mortality and Critical Events in a Cohort of Patients With COVID-19 in New York City: Model Development and Validation, *Journal of Medical Internet Research* (2020). DOI: 10.2196/24018

Provided by The Mount Sinai Hospital