Faster than COVID: A computer model that predicts the disease's next move

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A computational model now in development could give a Michigan hospital and its care providers a leg up on COVID-19 by predicting which patients are likely to quickly deteriorate upon admission. Once implemented, the model could help the hospital anticipate fast-changing patient needs while keeping care providers safe.

Called M-CURES and developed by a team of computer science, industrial operations and engineering and health care researchers at the University of Michigan College of Engineering, Precision Health and Michigan Medicine, the model uses a machine learning algorithm to crunch more than 200 health and demographic variables of individual COVID-19 patients. The researchers have found that some of the most predictive variables include age, underlying health conditions and current medications. The model then outputs a numerical score, updated every four hours, that predicts the patient's likelihood of requiring ICU-level care. Preliminary validation of M-CURES has shown it to be effective in predicting the progression of the disease.

"M-CURES could help the hospital get better answers to questions like who is likely to need ICU care and how many ICU beds it will need within a given time frame," said Jenna Wiens, an associate professor of computer science at engineering and co-director of Precision Health at U-M. "It could also help the families of severely ill COVID patients by giving them more time to evaluate treatment options."

Michael Sjoding, an assistant professor at Michigan Medicine who is working with Wiens on M-CURES, says M-CURES could also be an important way to manage the complexities of treating a highly contagious disease. Donning protective gear and carefully monitoring the number of care providers in a room takes up valuable time in an emergency, and he says M-CURES could help care providers better anticipate patient needs and prevent emergencies before they start.

"Providing care to COVID patients while keeping healthcare providers safe means that everything just takes a little longer. So anything that can help us plan further ahead is very valuable," Sjoding said. "In a non-

COVID crisis, there's often 10 to 15 people outside the patient's room and five to 10 people inside the room, all ready and helping when a patient is deteriorating. That's not possible with COVID patients, so it's important not to be caught off guard, and I think M-CURES could help."

Working with a large interdisciplinary team of researchers including ten graduate students in Wiens' lab, the team developed the model in a matter of weeks—a radically accelerated time frame for models of this type, which normally take months or years to develop and validate. The team used a data processing tool called FIDDLE, previously developed by CSE graduate student Shengpu Tang in collaboration with other researchers in Michigan Medicine and Computer Science and Engineering.

"Any researcher wants time and time was not something that we had," Wiens said. "But we understood the gravity of the situation and worked as hard as we could to deliver something that we felt confident about."

The research team is now completing model validation and determining the best way to integrate the model into hospital operations. They're also working to weed out variables to improve computational efficiency and generalizability of the model. They estimate that the system could be up and running at Michigan Medicine within one to two months.

The project team also includes Michigan Medicine professors Brahmajee Nallamothu and John Ayanian; assistant professors Karandeep Singh and Tom Valley; research investigator John Donnelly; computer science and engineering students Ian Fox, Sarah Jabbour, Fahad Kamran, Meera Krishnamoorthy, Jeeheh Oh, Harry Rubin-Falcone, Shengpu Tang, Donna Tjandra and Jiaxuan Wang; industrial operations and engineering graduate student research assistant Erkin Otles; and Michigan Medicine student Benjamin Li.