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Hospital System Uses AI to Predict Deadly Condition

Montefiore Health System harnessed artificial intelligence to improve forecasts of which patients would develop acute respiratory failure



Parsa Mirhaji heads the Center for Health Data Innovations at Montefiore Health System and Albert Einstein College of Medicine. PHOTO: ELENA OLIVO PHOTOGRAPHY

By

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The Montefiore Health System and its affiliated medical school are using artificial intelligence to better predict a common emergency among patients in their care, among other conditions.

The first application focused on using AI to predict which patients will develop respiratory failure that requires mechanical ventilation, a project that has so far yielded better results than traditional alerting systems.

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Parsa Mirhaji heads the entity involved, the Center for Health Data Innovations at Montefiore Health System and Albert Einstein College of Medicine. Dr. Mirhaji said his 23-person team has three AI applications that are live and four more under development, and the results have been promising.

“We’ve only begun to tap into its potential for improving provider workflow processes and overall patient experiences,” he said.

Montefiore has more than 3,000 beds across 11 hospitals in the Bronx, Westchester and the Hudson Valley.

Three Montefiore hospitals use the AI application that predicts acute respiratory failure, or the inability of one’s lungs to distribute oxygen or dispose of carbon dioxide. Officials plan to eventually expand it to more hospitals.

The most severe cases of acute respiratory failure require prolonged mechanical ventilation, or intubation, to aid with breathing. Patients who reach that stage have a 30% rate of dying within six months.

The AI application analyzes more than 40 data points for each patient every few hours, including current medications and vital signs such as blood pressure, and assigns a risk score for patients at risk of intubation or death. Patients whose scores exceed a certain threshold trigger an alert, which prompt a clinician to take intervention steps, such as noninvasive breathing assistance.

The application is part of a study funded by a five-year, \$4 million grant from the National Institutes of Health that is expected to wrap up this summer.

The effort started in early 2016, when data scientists at the Montefiore center collected electronic medical records on roughly 69,000 admissions across four hospitals in 2013. Two of the hospitals were part of Montefiore, and two were part of the Mayo Clinic system in Rochester, Minn.

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The team used those records—demographics, medications, lab results and more—to train and validate a prediction model. To check if the model could make predictions on incoming numbers, they ran tests at one of the hospitals using near-real-time data. Clinicians at the hospital weren't informed of the tests.

“We weren't asking them to do anything or telling them anything that we knew,” Dr. Mirhaji said. “We wanted to make sure that the algorithm we built retrospectively could maintain its validity prospectively in real time as well.”

The initial results were published last fall. The application was able to correctly identify 63% of the patients in the 2013 data died or had a lengthy intubation within 48 hours. That compares with an accuracy rate of 16% to 28% for traditional hospital alert systems that warn about patients at risk of death or other conditions, the study said.

The researchers ran another test in January 2017, this time alerting clinicians. The accuracy rate of that test was 64%, slightly better than the rate for the 2013 data.

The AI application also resulted in lower false-positive rates, or the percentage of patients who were flagged but didn't experience death or intubation within 48 hours. The 2017 false-positive rate was 5%, down from 8% for the 2013 data. The false-positive rates for standard alert systems in 2017 ranged from 14% to 25%.

Dr. Mirhaji said he encountered two main challenges when the full application went live at Montefiore Wakefield Hospital later in 2017. The first was getting clinicians to trust the recommendation alerts. He said his team initially responded by trying to explain the math behind the predictions, which wasn't effective. “They don't care about the math,” he said. Eventually, he started sharing examples of the system's predictions, and trust in the alerts grew over time, he said.

The second challenge was designing a workflow for responding to the alerts, including decisions on which clinicians would get messages and when.

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The Montefiore center recently started using AI to help assess sepsis and detect spinal cancer.

“Successful deployment of the first use case, acute respiratory failure, was critical,” said Chris Gough, general manager at Intel Corp.’s health and life sciences group, which helped scale the platform used by the applications. “We often see that an early win can help establish trust across the organization and overcome cultural challenges that are common when adopting new technology and processes.”