New tools find COVID patients at highest risk of mechanical ventilation and death

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Two novel calculators for predicting which patients admitted to the hospital with COVID-19 are at greatest risk of requiring mechanical ventilation or of in-hospital death have been developed and validated by Massachusetts General Hospital (MGH). In a study published in The Lancet's *EClinicalMedicine*, researchers describe how these models could enable clinicians to better stratify risk in COVID-infected patients to optimize care and resource utilization in hospitals faced with ICU capacity constraints.

"Information that can accurately predict severity of the clinical course at the time of hospital admission has been limited," says senior author Rajeev Malhotra, MD, a cardiologist at MGH and investigator in the MGH Cardiovascular Research Center. "Using a combination of past medical history, vital signs, and laboratory results at the time of patient admission, we developed models that can differentiate between risk for mechanical ventilation and risk for in-hospital mortality. While other studies have focused on 30-day hospital outcomes, we followed all COVID-19 patients to the end of their hospital course since a significant number are hospitalized well beyond 30 days."

The research team compiled this clinical information from 1,042 patients confirmed with COVID-19 who were admitted to five hospitals in the Mass General Brigham health care system during the first three months of the pandemic. Significant associations between clinical, hemodynamic, and laboratory data and the endpoints of in-hospital mortality and mechanical ventilation provided the building blocks for two separate risk stratification models known as the VICE (Ventilation in COVID Estimate) and DICE (Death in COVID Estimate) scores.

Predictive VICE factors uncovered by researchers were diabetes mellitus, oxygen saturation of the blood, and two inflammatory markers: C-reactive protein and lactate dehydrogenase. DICE factors

predictive of mortality were age, male sex, coronary artery disease, diabetes mellitus, body mass index, platelet count, and a variety of inflammatory and infectious markers.

"By inputting clinical values into these online calculators, physicians can risk-stratify COVID-19 patients upon admission and determine which ones may need the most intensive care and management," says lead author Christopher Nicholson, Ph.D., a senior research fellow with the MGH Cardiovascular Research Center. "These risk scores allow them to predict with greater than 80% accuracy—higher than established models—patient outcomes, as well as demand for mechanical ventilators and ICU beds, which could impact end-of-life decisions involving COVID-19 patients."

Researchers were surprised to learn that age was not a significant predictor of whether a patient would require mechanical ventilation. Indeed, other than the youngest patients, the percentage of hospitalized COVID-19 patients requiring mechanical ventilation was similar in each decade of life, though there was a clear correlation between age and risk of in-hospital death, with only 15% survival in patients over 84 requiring mechanical ventilation. Nor was age a predictor of how long a patient would need ventilation. The study found that 59% of patients in the 25-to-34 age group required more than 14 days of ventilation, similar to older age groups.

"We were astonished to see the impact of this disease on young people admitted to the hospital," emphasizes Nicholson. "Our data showed they are just as likely to be put on a mechanical ventilator as older people, and to require a long duration of ventilation."

Another significant finding from the study was that regular use of statins was associated with reduced in-hospital mortality, underscoring the strong links among COVID-19, cardiovascular disease, and

inflammation. In another encouraging finding, researchers did not observe any relationship between minority ethnic background of COVID-19 patients and worse clinical outcomes after adjusting for clinical risk.

"What we've generally learned from this disease is how different it is from any other we've seen in the ICU," says Malhotra, who has managed COVID patients in the cardiac intensive care unit at MGH over the past year. "For that reason, we were focused on developing a novel approach to evaluate and predict outcomes with our risk stratification calculator."

More information: Christopher J. Nicholson et al, Estimating risk of mechanical ventilation and in-hospital mortality among adult COVID-19 patients admitted to Mass General Brigham: The VICE and DICE scores, *EClinicalMedicine* (2021). DOI: 10.1016/j.eclinm.2021.100765

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