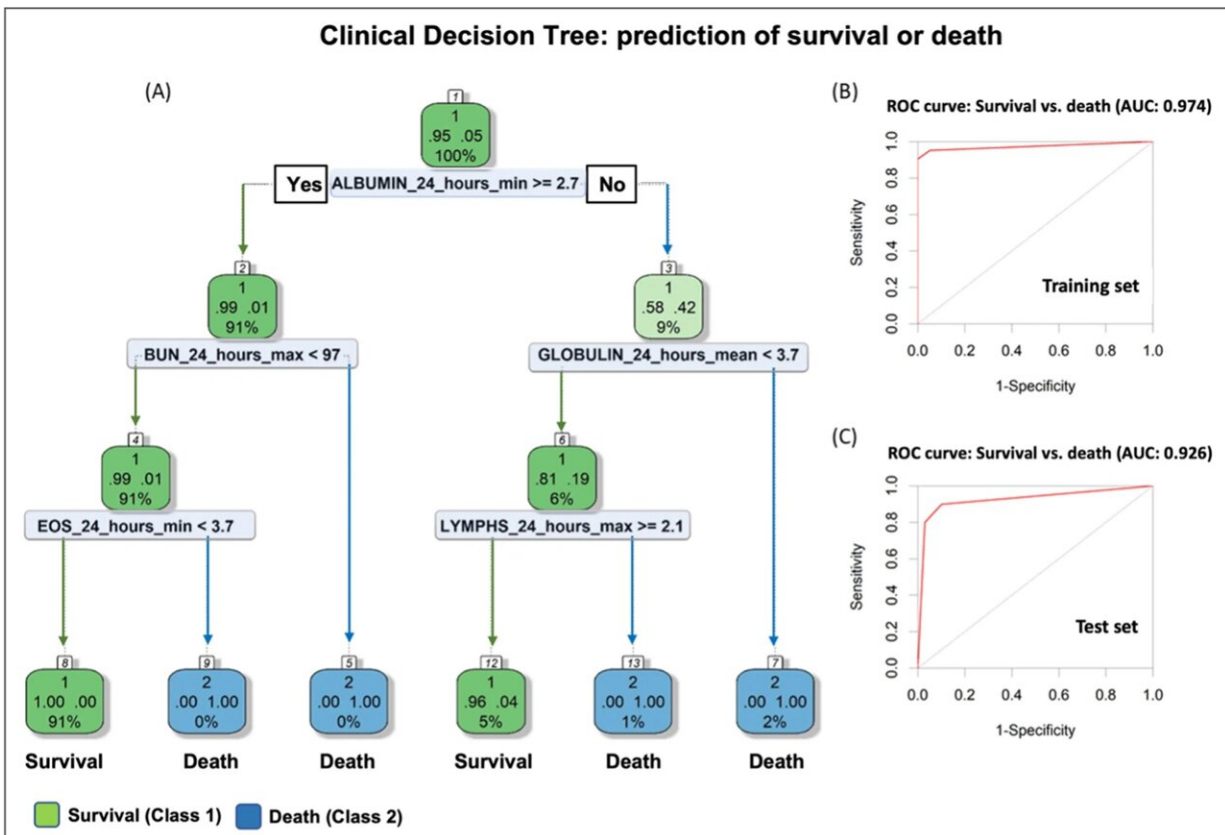


# AI-powered triage platform could aid future viral outbreak response

August 29 2023



Clinical decision tree (DT). A clinical DT model predicting the discharge disposition of a patient (survival or death) was developed. A The tree shows the rules applied to classify each patient into the related classes (survival or death). At the top of the DT, the overall proportion of the patients survived (95%) or died (5%) is shown. Next, the node applies the threshold over clinical data to achieve classification of patients into the two classes. For instance, it applies the threshold of 2.7 g/dL over Albumin\_24\_hours\_min (minimum value obtained from the clinical data), the node evaluates whether if patients show

Albumin\_24\_hours\_min above 2.7. If yes, then the next decision rule in DT is at down to the root's left child node (Yes; depth 2). Ninety-one percent of patients will survive with a survival probability of ninety-nine percent. This way, inspecting the whole DT, the impact of features on the likelihood of survival can be derived. The percentage of patients at each node is provided below the probability values of survival (denoted as 1) or death (denoted as 2) on the DT; the green (survived) /blue (died) shows the fitted/estimated values for the patients in each class at given node. ROC curves for **B** training set and **C** test set. AUC provides an aggregate measure of performance across all possible classification thresholds. Credit: *Human Genomics* (2023). DOI: 10.1186/s40246-023-00521-4

A team of researchers from Yale University and other institutions globally has developed an innovative patient triage platform powered by artificial intelligence (AI) that the researchers say is capable of predicting patient disease severity and length of hospitalization during a viral outbreak.

The [platform](#), which leverages [machine learning](#) and metabolomics data, is intended to improve patient management and help health care providers allocate resources more efficiently during severe viral outbreaks that can quickly overwhelm local health care systems. Metabolomics is the study of small molecules related to cell metabolism.

"Being able to predict which patients can be sent home and those possibly needing intensive care unit admission is critical for health officials seeking to optimize patient health outcomes and use hospital resources most efficiently during an outbreak," said senior author Vasilis Vasiliou, a professor of epidemiology at Yale School of Public Health (YSPH). The researchers developed the platform using COVID-19 as a [disease model](#). The findings were published online in the journal *Human Genomics*.

The platform integrates routine [clinical data](#), patient comorbidity information, and untargeted plasma metabolomics data to drive its predictions.

"Our AI-powered patient triage platform is distinct from typical COVID-19 AI prediction models," said Georgia Charkoftaki, a lead author of the study and an associate research scientist in the Department of Environmental Health Sciences at YSPH. "It serves as the cornerstone for a proactive and methodical approach to addressing upcoming viral outbreaks."

Using machine learning, the researchers built a model of COVID-19 severity and prediction of hospitalization based on clinical data and metabolic profiles collected from patients hospitalized with the disease. "The model led us to identify a panel of unique clinical and metabolic biomarkers that were highly indicative of [disease progression](#) and allows the prediction of patient management needs very soon after hospitalization," the researchers wrote in the study.

For the study, the research team collected comprehensive data from 111 COVID-19 patients admitted to Yale New Haven Hospital during a two-month period in 2020 and 342 healthy individuals (health care workers) who served as controls. The patients were categorized into different classes based on their treatment needs, ranging from not requiring external oxygen to requiring positive airway pressure or intubation.

The study identified a number of elevated metabolites in plasma that had a distinct correlation with COVID-19 severity. They included allantoin, 5-hydroxy tryptophan, and glucuronic acid.

Notably, patients with elevated blood eosinophil levels were found to have a worse disease prognosis, exposing a potential new biomarker for COVID-19 severity. The researchers also noted that patients who

required positive airway pressure or intubation exhibited decreased plasma serotonin levels, an unexpected finding that they said warrants further research.

The AI-assisted patient triage platform has three essential components:

1. **Clinical Decision Tree:** This precision medicine tool incorporates key biomarkers for disease prognosis to provide a real-time prediction of disease progression and the potential duration of a patient's hospital stay. The tested predictive model demonstrated high accuracy in the study.
2. **Hospitalization Estimation:** The platform successfully estimated the length of patient hospitalization within a 5-day margin of error. Respiratory rate (>18 breaths/minute) and minimum blood urea nitrogen (BUN), a byproduct of protein metabolism, were both found to be important factors in extending patient hospitalization.
3. **Disease Severity Prediction:** The platform reliably predicted disease severity and the likelihood of a patient being admitted to an intensive care unit. This helps health care providers identify patients most at risk of developing life-threatening illnesses and allows them to begin treatments quickly to optimize outcomes, the study said.

As part of the study, the research team developed user-friendly software—the [COVID Severity by Metabolomic and Clinical Study \(CSMC\) software](#)—that integrates machine learning and clinical data to provide pre-hospital patient management and classify patients' conditions when they arrive at the emergency department.

"Our model platform provides a personalized approach for managing COVID-19 patients, but it also lays the groundwork for future viral outbreaks," said Vasiliou, chair of the YSPH Department of

Environmental Health Sciences and the Susan Dwight Bliss Professor of Epidemiology (Environmental Health Sciences). "As the world continues to grapple with COVID-19 and we remain vigilant against potential future outbreaks, our AI-powered platform represents a promising step towards a more effective and data-driven public health response."

Limitations of the study include the fact that all samples were collected between March and May 2020, a time period before the emergence of COVID-19 vaccines and before many treatments for the SARS-CoV-2 virus, such as remdesivir, were available. Such treatments could reduce the changes observed in metabolite biomarkers.

Secondly, the population of healthy controls was mainly white, while the COVID-19 patients comprised a higher proportion of Black individuals. As such, the possibility of race /ethnicity being a factor contributing to differences in subjects cannot be excluded.

**More information:** Georgia Charkoftaki et al, An AI-powered patient triage platform for future viral outbreaks using COVID-19 as a disease model, *Human Genomics* (2023). [DOI: 10.1186/s40246-023-00521-4](https://doi.org/10.1186/s40246-023-00521-4)

Provided by Yale University

Citation: AI-powered triage platform could aid future viral outbreak response (2023, August 29) retrieved 28 April 2024 from

<https://medicalxpress.com/news/2023-08-ai-powered-triage-platform-aid-future.html>

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