Updating allocation algorithms could help donor hearts reach the transplant patients who need them most

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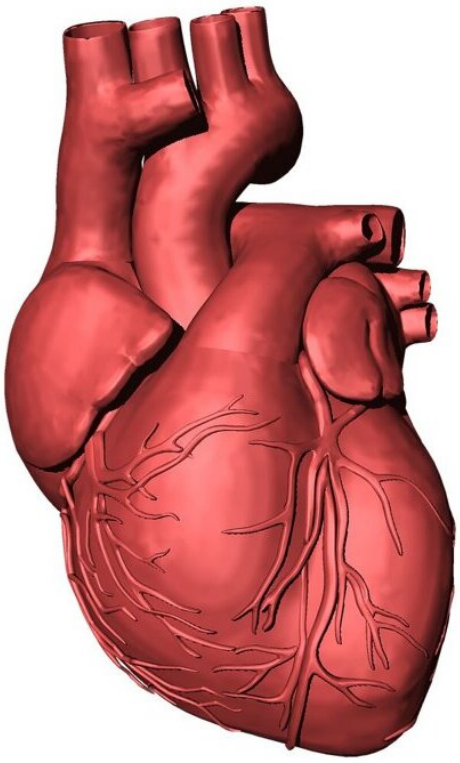

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Receiving a heart transplant is a matter of life and death for many patients. Every time a heart becomes available, a "match run" is created

to generate a list of transplant candidates ranked by an algorithm based on medical urgency, geography and pediatric status. Unfortunately, deceased donor organs are very scarce in the United States—so much so that some patients aren't even placed on waitlists because it's too unlikely that a heart will become available to them.

A research team led by experts at the University of Chicago Medicine has developed a new risk score designed to predict the likelihood that a patient will die without a heart transplant. This innovation aims to address the limitations of the current therapy-based 6-status system, offering a more precise and fair approach to prioritizing candidates based on medical urgency. A paper detailing the development and initial validation of the proposed U.S. Candidate Risk Score (US-CRS) is published in *JAMA*.

"The goal is to identify the sickest patients. Each candidate on the list is sick and needs a heart transplant, but some can wait marginally longer than others," said William F. Parker, MD, Ph.D., Assistant Professor of Medicine and Public Health at UChicago Medicine and senior author on the paper. "This new risk score improves upon the status quo. Among other things, it's not as reliant on the treatment decisions of individual physicians."

Incorporating objective physiological measurements

Instead of only considering the treatments patients were receiving—the metric currently used to allocate deceased donor hearts—Parker and his team also looked at clinical and laboratory measurements associated with end-stage heart failure, such as levels of molecules in the blood associated with liver and kidney failure. They chose an initial list of variables based on the current French Candidate Risk Score (French-CRS) model, which incorporates more clinical measurements than the current U.S. system, and added others they had identified as important.

Combining these variables into a single risk score (the US-CRS), the researchers analyzed data from over 16,900 adult heart transplant candidates from the US heart allocation system to determine the relationship between the US-CRS and mortality within 6 weeks of being placed on the transplant waitlist.

"We initially expected that advanced deep learning and machine learning—more of a black-box algorithm—would lead to a model that was much more accurate, but it turned out that a pretty standard regression was quite accurate in predicting mortality," Parker said. "It just goes to show that we picked good variables to measure. The resulting model has the benefit of being easy to understand."

The team compared their new US-CRS model to the current U.S. heart allocation system and found that it was much better in accurately predicting mortality in patients who didn't receive a heart transplant within 6 weeks.

Parker emphasized the contributions of the entire research team, especially first author Kevin Zhang, MS, a data scientist at UChicago Medicine.

"It was a tremendous amount of data science on his part," Parker said. "He's the first person in the country to pull together all these laboratory values. It's the reason we could do this work."

Turning scientific insights into policy improvements

The US-CRS will need to make it through many additional rounds of validation and committees in order to get adopted. It would also only represent one part of the forthcoming continuous distribution algorithm for allocating hearts. Parker and his collaborators are already working on grant proposals for follow-up research aimed at improving heart

allocation overall. Their broad goals include designing a fair and resilient continuous distribution system for deceased donor hearts that mitigates health inequity.

In the long term, Parker believes this work may lay important groundwork as researchers, technology experts and policymakers tackle the larger problem of how to use algorithms to distribute scarce health care resources.

"Organ transplantation gives us the opportunity to take on this issue in very concrete ways," Parker said. "We're hopeful that the lessons we uncover can be generalized."

More information: Kevin C. Zhang et al, Development and Validation of a Risk Score Predicting Death Without Transplant in Adult Heart Transplant Candidates, *JAMA* (2024). DOI: 10.1001/jama.2023.27029

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