A better kidney waitlist, with an eye to fairness

Dimitris Bertsimas, Boeing Leaders for Global Operations Professor of Management, and Vivek Farias, Robert N. Noyce Career Development Professor

Fewer than 20,000 kidneys are available for transplant in the United States each year, yet more than 80,000 people are waiting for a kidney transplant.

A new method for determining who receives a transplant, developed by MIT Sloan faculty and a former student, can increase the years of life gained by recipients by 8 to 10 percent. And it does so without undermining the fairness criterion that is a central part of the kidney allocation process.

Developed by Dimitris Bertsimas, the Boeing Leaders for Global Operations Professor of Management; Vivek Farias, the Robert N. Noyce Career Development Professor; and Nikolaos Trichakis, PhD '11, the method focuses on the desired outcome—a fair distribution of transplants based on age, race, blood type, illness, and other factors. It also creates a formula for allocation that best matches that outcome while maximizing efficiency.

Until now, selecting who receives a kidney has been determined by a scoring rule that prioritized patients based on their time on dialysis. That rule worked, but was not efficient. A proposed new scoring rule focuses on achieving a fair and equitable distribution of kidneys. Using their method, however, the professors set out to find an equation that not only resulted in the same fair distribution of kidneys achieved by the proposed new rule, but also maximized the number of extra years lived by recipients.

It worked, with an 8 percent bump in life years. In real terms, that's about 2,000 extra years of life distributed among recipients.

What is considered "fair" is, of course, subject to periodic reevaluation. But the beauty of the new method, the professors said, is that it can be easily adjusted to the changing definitions of fairness. The federal committee tasked with determining who goes where on the kidney waitlist could come up with any desired result—directing more transplants to teenagers or diabetics, for example—and the tool would almost instantly determine the best new scoring rule to start with.

"Let's say in the future there are new requirements, new ethical regulations," Bertsimas said. "Our system is built to accommodate these ideas."

"Our aspiration is that the system, because of its flexibility and because it is outcome driven, will become the key tool to design and evaluate future kidney allocation proposals," he said.

Any proposed allocation scheme requires that potential kidney recipients are ranked based on a number of factors, such as wait time, transplant-ready matches, patients with extensive pain, age, and prior donors. On the other side of the equation, kidneys must be distributed in a fair manner relative to race, age, blood type, and other factors.

Working backward, the professors' method uses recipient and waitlist data to determine the allocation rule that gives the greatest outcome in life years, while matching the fairness requirements agreed upon by the federal Kidney Transplantation Committee.

"There is no methodology, prior to our work, that maximizes the outcome while fulfilling fairness requirements," Bertsimas said.

And it's fast. No more hit or miss, testing rules one by one to find the best fit. The desired answer comes first, and the method determines the best rule to get there.

"What we've done is take that entire process and reduce it to a number of hours," Farias said.

While still a proposal, there is some likelihood that the method will be put into use. Farias recently joined the scientific advisory committee of the Scientific Registry of Transplant Recipients, the non-profit group charged with managing the kidney waitlist. As medical realities rapidly change, the need for a flexible tool to fairly and efficiently allocate donor kidneys becomes only more urgent.

"In the arsenal of policymakers," Farias said, "it is a powerful tool."

—*Zach Church*