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RESEARCH

Study: Paired kidney exchange better for transplants

Number, quality of transplants greater if national matching program adopted

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A collaboration between Johns Hopkins and MIT scientists has mathematically demonstrated that a national matching program for kidney

paired donation, also called paired kidney exchange, would ensure the best possible kidney for the greatest number of recipients who have incompatible donors.

Kidney paired donation, or KPD, provides organs to patients who have a willing, designated donor who is not compatible. A kidney from such a donor is matched to—and transplanted into—the recipient of a second incompatible donor-patient pair, and vice versa. The transplants are performed simultaneously.

The researchers have developed an interactive Web site, www.OptimizedMatch.com, that provides more details and interactive

demonstrations of the algorithm and its use in transplantation.

“Our findings demonstrate that a national pool of kidney donors and recipients, combined with new mathematical techniques for sorting through them to find the best possible organ matches, will not only allow more people to get the transplants they need but will dramatically cut health care costs, reduce disruptive and unnecessary travel for patients and ensure that transplanted kidneys have the best possible chance of

Continued on page 5

Transplants

Continued from page 1

survival," said Dorry L. Segev, a surgeon at Johns Hopkins and lead author of a report published in the April 20 issue of the *Journal of the American Medical Association*.

"Even if only 7 percent of patients awaiting kidney transplantation participated in an optimized national KPD program, the health care system could save as much as \$750 million," Segev said.

More than 60,000 people await kidney donation and are listed on the United Network of Organ Sharing recipient registry, and nearly one-third of patients with willing donors are excluded from kidney transplantation because of blood type and other incompatibilities, according to the report.

Despite its promise, only 51 patients have received transplants via paired donation because just a handful of institutions are performing the procedures based on local or regional patient databases, added the authors.

"Clearly, a national matching program is the best solution for incompatible donors and recipients, but for such a program to be successful we need to make sure that all patients get the best possible match" Segev said.

Segev, in collaboration with his wife, Sommer E. Gentry, an applied mathematician at MIT, and other colleagues developed a new kidney donor matching system, or algorithm, that uses a technology called optimization. This technology has already proved successful in facilitating tasks such as airline scheduling and online driving directions. They then created a mathematical model that uses simulated pools of incompatible donor/recipient pairs to determine if their new matching algorithm might improve matches that can be found in a small (regional) or large (national) pool. The researchers compared

the optimized algorithm with the scheme currently used in some centers and regions. The model included simulated patients from the general community with characteristics drawn from distributions describing end-stage kidney disease patients eligible for kidney transplantation and live donors.

The researchers found that a national optimized matching algorithm would result in more transplants, better matches and more transplanted kidneys surviving at five years when compared with an extension of the currently used method to a national level. Highly sensitized patients, who are extremely difficult to match and typically wait almost seven years for a deceased donor kidney, would benefit sixfold from a national optimized algorithm (14.1 percent matched vs. 2.3 percent). Furthermore, the results show that optimization would dramatically reduce the number of pairs required to travel (2.9 percent vs. 18.4 percent).

Another benefit of a national KPD model is that patients and doctors will be able to choose which priorities are highest for the patients in the system, the authors added. For example, individual patients can set their own priorities based on distance they are willing to travel or on the quality of the kidney matched to them.

Other authors of the report are Daniel S. Warren, Brigitte Reeb and Robert A. Montgomery, all from Johns Hopkins. The research was funded by an American Society of Transplant Surgeons grant and a U.S. Department of Energy Computational Science Graduate Fellowship.

The Johns Hopkins' Comprehensive Transplant Center has had a kidney paired donation program since 2001. In August 2003, Johns Hopkins surgeons performed the world's first triple swap kidney transplant operation, transplanting the kidneys from three donor and recipient pairs simultaneously. A second successful triple swap kidney transplant was performed at Johns Hopkins in March 2004. **G**