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The Need for (long) Chains in Kidney Exchange

by Itai Ashlagi, David Gamarnik, Michael A. Rees and Alvin E. Roth

Abstract

It has been previously shown that for sufficiently large pools of patient-donor pairs, (almost) efficient kidney exchange can be achieved by using at most 3-way cycles, i.e., by using cycles among no more than 3 patient-donor pairs. However, as kidney exchange has grown in practice, cycles among n>3 pairs have proved useful, and long chains initiated by non-directed, altruistic donors have proven to be very effective. We explore why this is the case, both empirically and theoretically. We provide an analytical model of exchange when there are many highly sensitized patients and show that large cycles of exchange or long chains can significantly increase efficiency when the opportunities for exchange are sparse. As very large cycles of exchange cannot be used in practice, long non-simultaneous chains initiated by non-directed donors significantly increase efficiency in patient pools of the size and composition that presently exist. Most importantly, long chains benefit highly sensitized patients without harming low-sensitized patients.

Keywords: Networks; Complexity; Performance Efficiency; Medical Specialties; Health Care and Treatment; Philanthropy and Charitable Giving;

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