Structural Estimation of Kidney Transplant Candidates’ Quality of Life Scores

Extended Abstract

Motivation

Organ Procurement and Transplantation Network (OPTN) facilitates the deceased kidney allocation to patients. The patients are prioritized according to their waiting time and several other biological factors to assure an efficient allocation. Despite the effort, the United States deceased donor kidney wait list has been growing at an alarming rate. In 2009, 37,600 patients registered for the wait list, whereas only 15,800 candidates received transplants. In such a system where demand outmatches the supply, 17.7% of all deceased donor kidneys were discarded. Such kidneys were generally offered to, and rejected by, sufficiently many patients that they ceased functionality before reaching a willing recipient. Accordingly, OPTN strives to update the allocation policy frequently with one that better utilizes the supply of available kidneys, and that does so without disadvantaging any patients on the basis of geographic, age, and other factors.

The most recent policy change in kidney allocation policy became effective in 2014. This
policy change includes complete restructuring of the point system as well as introducing organ and patient classification. The possible effect of the new policy is studied by Israni et al. (2014) using Kidney-Pancreas Simulated Allocation Model (KPSAM). The KPSAM simulates patient’s behavior based on the historical data collected by Scientific Registration of Transplant Research (SRTR). However, historical data fails to capture the shift in patient behavior given the incentives provided by the new policy. In fact, Israni et al. (2014) explicitly states that “The KPSAM cannot account for changes in organ acceptance behavior. Therefore, if the new policy results in dramatic changes in organ acceptance behavior, the estimates of number of transplants from the simulations will differ from reality”.

Model

Our paper develops a framework for assessing the impact of changes to the deceased-donor kidney allocation policy on the transplant candidates’ organ acceptance behavior, the transplant waitlist, organ availability for different patient groups and organ wastage. To be specific, it advances a fluid model of the transplant waitlist and a dynamic structural model of the transplant candidates’ accept/reject decisions for organ offers. We develop a dynamic discrete choice model to capture endogenous patient behavior. Patients receive kidney offers according to a non-homogenous Poisson process whose intensity is determined by the accumulated points. If the patients accept an offer, they would obtain utility of receiving a transplant which depends on the quality of the kidney and the health status of the patient. If the patients reject an offer, the organ will be offered to the patient with next highest points. In the meantime, the rejecting patient will wait in the queue until she receives another offer (or she dies). In this case, she will obtain utility for waiting in the queue.
Since there is limited organ availability, patient behavior is a key factor deciding the intensity of offers that a patient is receiving and vice versa. Given the current point system, we characterize the equilibrium conditions for intensity of patients according to their points and corresponding organ availability. We use these conditions to structurally estimate the choice parameters for accepting or rejecting an organ offer.

Building on the models of patient choice and transplant waitlist, we provide an equilibrium framework, enabling counterfactual studies for assessing the (unintended) consequences of policy changes. Our formulation allows various important features of the transplant system such as the degree of tissue matching between the donor and the transplant candidate, changes in the health states of the transplant candidates, organ quality, geographical sharing of the organs as well as the heterogeneity in transplant candidates’ quality of life scores. Using United Network of Organ Sharing (UNOS) data on transplant candidates, donors and organ offers during June 2000-September 2010, we first estimate the transplant candidates’ quality of life scores. Then, we empirically compare various counterfactual studies including previous and current policy, and predict the impact under current policy addressing the issue raised by Israni et al. (2014). We envision this work to go into the next generation of kidney allocation software used in policy decisions.

References