OrganJet: Overcoming geographical disparities in access to deceased donor kidneys in the United States

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Abstract

There are over 90,000 patients in the US waiting for a kidney transplant. Under the current allocation policy, the vast majority of deceased-organs are allocated locally. This causes significant disparities in waiting times and access to transplant across different geographical areas. To ameliorate this inequity we propose an operational solution that offers affordable jet services (OrganJet) to patients on the transplant waiting list, allowing them to multiple list in different, and possibly very distant, donation service areas (DSA) of their choosing. First, using a fluid approximation we formulate the patients’ problem of choosing a location to multiple list as a selfish routing game in which each patient tries to minimize his “congestion cost”, i.e. maximize his life expectancy. Through a combination of numerical, simulation and analytical results, we show that multiple listing can lead to a significant improvement in geographic equity. In the special case when sufficiently many patients can multiple list, the geographic inequity disappears. Moreover, the supply of deceased-donor organs increases under multiple listing, leading to more transplants and saved lives.

We also consider a diffusion approximation and study the resulting multiple listing game. The equilibrium outcome under the diffusion approximation is a second-order perturbation of that under the selfish routing formulation. In particular, the geographic equity metric, waiting times and the probabilities of receiving a transplant at various DSAs in equilibrium are second order perturbations of those predicted by the selfish routing equilibrium. Hence, the analysis under the diffusion approximation also supports the finding that multiple listing leads to an improvement in geographic equity. In addition, restricting attention to the special case of sufficiently many patients multiple listing leads to an explicit characterization of the equilibria, which in turn yields additional structural insights. Lastly, we undertake a simulation study that supports aforementioned findings.