

# Optimal Policies for the Acceptance of Living- and Cadaveric-Donor Livers: A Markov Decision Processes (MDP) Approach

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## **Abstract**

Transplantation is the only viable therapy for end-stage liver diseases (ESLD). In the United States, patients with ESLD are placed on a waiting list. When organs become available, they are offered to the patients on this waiting list. Although there is a shortage of cadaveric livers, 45% of all liver offers are initially declined by the transplant surgeons/patients. Organs are rejected in the hope that they will receive a better organ offer in the future. Our objective is to solve the decision problem faced by these patients: should an offered organ of a given quality be accepted or rejected? The decision depends on two major components: the patient's current and likely future health as well as the current and future prospects for organs.

Markov decision processes (MDPs) are analytic tools for sequential decision-making under uncertainty. We formulate this problem as a discrete-time infinite-horizon MDP that determines whether to accept or decline a liver offer. We analyze three MDP models, each representing a different situation. The Living-Donor-Only Model considers the problem of optimal timing of living-donor liver transplantation, which is accomplished by removing an entire lobe of a living donor's liver and implanting it into the recipient. The Cadaveric-Donor-Only Model considers the problem of accepting/refusing a cadaveric liver offer when the patient is on the waiting list but has no available living donor. The Living-and-Cadaveric-Donor Model is the most general model, which combines the first two models, in that the patient is both listed on the waiting list and also has an available living donor. The patient can accept the cadaveric liver offer, decline the cadaveric liver offer and use the living-donor liver, or decline both and continue to wait. We solved all three models using clinical data and found the optimal policies.

## **Biographical Sketch**

Oguzhan Alagoz is currently a Visiting Assistant Professor of Operations at the Weatherhead School of Management. He received his PhD in Industrial Engineering from the University of Pittsburgh in 2004. His research interests include medical decision making, discrete-event system simulation, completely and partially observable Markov decision processes, scheduling and stochastic programming. His works have appeared in or been accepted by journals such as *Management Science*, *IIE Transactions*, *Medical Decision Making* and *European Journal of Operational Research*.

*\*Light refreshments will be served at 11:15am*