Upcoming Operations Research Master’s Oral Exam

Jennifer Mason

Optimal Timing of Statin Initiation for Patients with Type 2 Diabetes
(Under the direction of Dr. Brian Denton)

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Abstract:
HMG Co-A reductase inhibitors (statins) are an important part of the treatment plan for patients with type 2 diabetes. However, the optimal time to initiate treatment is influenced by many factors. We investigate two such factors in this thesis: (1) the patient's long-term adherence to treatment and (2) the decision maker's criteria for optimal treatment initiation.

Statins are effective in reducing cholesterol, a primary risk factor for cardiovascular disease in patients with diabetes. However, patients who are prescribed statins stop taking the drug altogether or take less than the prescribed amount. This imperfect adherence can lessen the drug's benefit. We propose a Markov decision process model to optimize the treatment decision for hypercholesterolemia for patients with type 2 diabetes while considering issues of adherence to statins. Our model incorporates a discrete time Markov process for adherence states of the patient. We found that in the long run approximately 25% of patients remain highly adherent, taking 80 to 100% of their medication. We also found that patients with imperfect adherence should start statins 5 to 7 years later than their perfectly adherent counterparts. Although adherence levels greatly affect the optimal start time for statins, we found that starting statins later in life did not significantly increase the expected quality adjusted life years for patients with imperfect adherence. We conclude that it is more important for patients to improve their adherence than to adjust the timing of initiation to help compensate for imperfect adherence.

We also consider three different decision making criteria with our model: society, patient, and third-party payer. Decision makers with these different perspectives have different objectives in mind. The patient is concerned with his or her quality of life, the third-party payer is concerned with minimizing expected costs, and society is concerned with maximizing expected rewards minus costs. These decision maker objectives are reflected in different reward functions in our MDP model. We find that it is optimal for patients to initiate statins early in the decision horizon under the patient perspective while the earliest optimal start times under the society and third-party payer perspectives are generally 4 and 15 years later, respectively.