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Time: 1 - 1:50 pm

Location: D3 W122

A Mathematical Modeling Framework to Personalize Mammography Screening Decisions

Abstract: Breast cancer is the most common non-skin cancer and the second leading cause of cancer-death in US women. Although mammography is the most effective modality for breast cancer diagnosis, it has several potential risks, including high false positive rates, which are not very rare. Therefore, the balance of benefits and risks, which depend on personal characteristics, is critical in designing a mammography screening schedule. In contrast to prior research and existing guidelines which consider population-based screening recommendations, we propose a personalized mammography screening policy based on the prior screening history and personal risk characteristics of women. We formulate a finite-horizon partially observable Markov decision process (POMDP) model for this problem. Our POMDP model incorporates two methods of detection (self or screen), age-specific unobservable disease progression, and age-specific mammography test characteristics. We use a validated micro-simulation model based on real data in estimating the parameters and solve this POMDP model optimally for individual patients. Our results show that our proposed personalized screening schedules outperform the existing guidelines with respect to the total expected quality-adjusted life years, while significantly decreasing the number of mammograms. We further find that the mammography screening threshold risk increases with age. We derive several structural properties of the model, including the sufficiency conditions that ensure the existence of a control-limit policy.

Biography: Oguzhan Alagoz is a Professor of Industrial and Systems Engineering at the University of Wisconsin-Madison. He is also a professor at the Department of Population Health Sciences and serves as the director of NIH-funded Institute for Clinical and Translational Research (ICTR)-Simulation Center as well as the associated director for Wisconsin Institute for Healthcare Systems Engineering (WIHSE). His research interests include stochastic optimization, medical decision making, completely and partially observable Markov decision processes, simulation, risk-prediction modeling, health technology assessment, and scheduling. He is on the editorial boards of Operations Research, IIE Transactions, and IIE Transactions on Healthcare Engineering and previously served on the board of Medical Decision Making. He has received various awards including a NSF CAREER award, outstanding young industrial engineer in education award from IIE, Dantzig Dissertation Honorable Mention Award from INFORMS, 2nd place award from INFORMS Junior Faculty Interest Group best paper competition, best paper award from INFORMS Service Science Section, and best poster award from UW Carbone Comprehensive Cancer Center. He has been the principal investigator and co-investigator on grants more than $4 million funded by NSF and NIH.