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A Bayesian Multilevel Time-Varying Framework for Joint Modelling of Hospitalization and Survival in Patients on Dialysis

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Over 782,000 individuals in the U.S. have end-stage kidney disease with about 72% of patients on dialysis, a life-sustaining treatment. Dialysis patients experience high mortality and frequent hospitalizations, at about twice per year. These poor outcomes are exacerbated at key time periods, such as the fragile period after the transition to dialysis. In order to study the time-varying effects of modifiable patient and dialysis facility risk factors on hospitalization and mortality, we propose a novel Bayesian multilevel time-varying joint model. Efficient estimation and inference are achieved within the Bayesian framework using Markov Chain Monte Carlo, where multilevel (patient- and dialysis facility-level) varying coefficient functions are targeted via Bayesian P-splines. Applications to the United States Renal Data System, a national database which contains data on nearly all patients on dialysis in the U.S., highlight significant time-varying effects of patient- and facility-level risk factors on hospitalization risk and mortality. Finite sample performance of the proposed methodology is studied through simulations.

Keywords

end-stage kidney disease, mixed-effects models, varying-coefficient models

Classification

Both methodology and application

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