Prediction-driven surge planning with applications in the emergency department

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Abstract

Optimizing emergency department (ED) nurse staffing decisions to balance the quality of service and staffing cost can be extremely challenging, especially when there is a high level of uncertainty in patient-demand. Increasing data availability and continuing advancements in predictive analytics provide an opportunity to mitigate demand-rate uncertainty by utilizing demand forecasts. In this work, we study a two-stage prediction framework that is synchronized with the base (made months in advance) and surge (made nearly real-time) staffing decisions in the ED. We quantify the benefit of the more expensive surge staffing. We also propose a near-optimal two-stage staffing policy that is straightforward to interpret and implement. Lastly, we develop a unified framework that combines parameter estimation, real-time demand forecasts, and staffing in the ED. High fidelity ED simulation experiments demonstrate that the proposed framework can reduce staffing costs by 8% – 17% while guaranteeing timely access to care. Joint work with Jing Dong and Yue Hu.