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Healthcare Predictive Analytics for Risk Profiling in Chronic Care: A Bayesian Multitask Learning Approach

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Abstract

Clinical intelligence about a patient's risk of future adverse health events can support clinical decision making in personalized and preventive care. Healthcare predictive analytics using electronic health records offers a promising direction to address the challenging tasks of risk profiling. Patients with chronic diseases are often facing risks of not just one, but an array of adverse health events. However, existing risk models typically focus on one specific event and do not predict multiple outcomes. To attain enhanced risk profiling, we adopt the design science paradigm and propose a principled approach called Bayesian multitask learning (BMTL). Considering the model development for an event as a single task, our BMTL approach is developed to coordinate a set of baseline models—one for each event—and communicate training information across the models. The BMTL approach allows healthcare providers to achieve multifaceted risk profiling and model an arbitrary number of events simultaneously. Our experimental evaluations demonstrate that the BMTL approach attains an improved predictive performance when compared with the alternatives that model multiple events separately. We also find that, in most cases, the BMTL approach significantly outperforms existing multitask learning techniques. More importantly, our analysis shows that the BMTL approach can create significant potential impacts to clinical practice in reducing the failures and delays in preventive interventions. We discuss several implications of this study for health IT, big data and predictive analytics, and design science research.

Keywords: Health IT, electronic health records, healthcare predictive analytics, multitask learning, design science