ABSTRACT
A DATA-DRIVEN SYSTEM FOR SEPSIS MONITORING AND INTERVENTION USING CONTEXTUALLY-TAILORED BAYESIAN ONLINE CHANGE POINT DETECTION

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Considering morbidity, mortality, and annual treatment costs, the dramatic rise in the incidence of sepsis and septic shock among intensive care unit (ICU) admissions in US hospitals is an increasing concern. The recent excruciating statistics regarding sepsis mortality, the average length of hospital stay, and annual treatment costs made sepsis treatment and research a critical domain in medical informatics. Recent changes in the sepsis definition (sepsis-3) have motivated the medical informatics research community to investigate score recalculation and information retrieval and study the intersection between sepsis-3 and sepsis-2. This dissertation manifests three specific contributions to the scientific research community. First, we studied the prevalence and intrarelationship in qSOFA and SIRS in the lens of both sepsis pathophysiology and ICU administration. The objective of this study was threefold: unpacking the most prevalent sepsis criterion, determining the most prevalent sepsis scenario in the ICU (among four possible scenarios for qSOFA and eleven possible scenarios for SIRS), and investigating multicollinearity or dichotomy among qSOFA and SIRS predictors. Second, this dissertation studied existing research gaps in the current machine learning-based solutions for early risk assessment and sepsis outcome prediction. Addressing the pitfalls and challenges, such as natural biases and confounding medical interventions, we proposed SepINav, a novel sepsis ICU Navigator. SepINav is a medical informatics endeavor that helps ICU practitioners and researchers to monitor and intervene on the existing sepsis patients more efficiently and interactively and conduct retrospective studies to seek rationales to different sepsis scenarios in the ICU. Moreover, we developed a Contextually-tailored Bayesian Online Change point Detection algorithm that will help the practitioners understand the structural changes in patients' vital sign regimes potentially visible prior to septic shock. Besides, several features are incorporated into this data-driven software tool based on user feedback to promise efficient monitoring and intervention and address confounding medical interventions in the ICU. Third, this dissertation seeks to investigate whether the Contextually-tailored Bayesian Online Change Point Detection Algorithm can be repurposed for problems across the domain as a step towards computational sustainability. Here, we aim to implement this algorithm to address the resiliency issues of the Internet of Energy.