REWS: Real-time Early Warning Score for Septic Shock

Sepsis is the 11th leading cause of patient mortality. Mortality rates have been reported to be nearly 57.3% in those who experience shock due to sepsis. Currently, there exist no dedicated clinical early warning scores geared towards early recognition of impending shock. We present REWS, a real-time early warning score that identifies patients at high risk of developing septic shock based on routinely collected measurements.

7424 adult patients (age ≥ 15 years) admitted to the ICU at the Beth Israel Deaconess Medical Center between 2001 and 2007 were included in this study (776 with septic shock). Their data were obtained from the MIMIC II Database. From the set of routinely collected clinical, physiological and laboratory results in the ICU, we developed REWS using a machine learning algorithm. REWS combined static (e.g., age) and time-varying (e.g., time since first presentation of Systemic Inflammatory Response Syndrome(SIRS)) factors, including temporal trends (e.g., slope of heart rate (HR) over the past 12 hours) from the past 12 hours of data to compute a predictive risk score. For comparison, a SIRS+BP score was used that quantified risk based on the presence of SIRS and the systolic blood pressure measurement. The main outcome measure was the odds ratio (OR) of impending septic shock at 80% sensitivity. 10-fold cross-validation was used for splitting patients into training and validation sets and reporting test-performance. The Cochran-Mantel-Haenszel test was used for computing the mean odds ratio for shock at a given sensitivity, and the associated 95% confidence interval. We also report specificity (spec) at 80% sensitivity.

Both increased REWS (OR 14.5, 95% CI 11.9-17.7, p=2.78e-227, spec 0.781) and SIRS+BP (OR 8.63, 95% CI 8.63-12.8, p=3.13e-166, spec=0.717) scores were significantly associated with impending septic shock. However, REWS had significantly higher odds (p <0.001) of impending shock compared to SIRS+BP.

An increased REWS was significantly associated with impending septic shock. Implementation of REWS within the electronic medical record can allow for early intervention.