

Can Septic Shock Be Identified Early? Evaluating Performance Of A Targeted Real-Time Early Warning Score (trewscore) For Septic Shock In A Community Hospital: Global And Subpopulation Performance

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RATIONALE: Septic shock is a life-threatening condition; early intervention is critical for improving outcomes. The Targeted Real-Time Early Warning Score (TREWScore) is a recently validated statistical method to identify patients likely to develop septic shock hours prior to shock onset. While TREWScore showed high sensitivity and specificity in an unselected group of ICU patients, performance outside the ICU and in patient subgroups has not previously been characterized. In this study, the performance of TREWScore is demonstrated in (1) unselected patients admitted to a community hospital (ICU and non-ICU patients), (2) three common comorbid conditions that are reliably identified by ICD-9 codes, and (3) three specific sources of infection.

METHODS: Data were collected from 27,504 patients admitted to a community hospital in Maryland between 2013-2015. Of these, 1,105 adult ICU patients were randomly selected to retrain TREWScore. Twenty-seven measurements, including vital signs and routinely reported laboratory test values, were used to compute TREWScore. We used ICD-9 codes and provider notes to define subgroups of patients with either specific comorbid conditions or sources of infection. Comorbid conditions included congestive heart failure (CHF), end-stage renal disease (ESRD), and malignancy. Sources of infection included the urinary tract (UTI), skin (cellulitis), and peritoneum (peritonitis). Patients with more than one comorbidity could belong to multiple subgroups. The sensitivity and specificity of TREWScore in predicting septic shock are characterized, as is time of identification prior to shock onset for the validation population overall, for each patient subgroup, and for each underlying infection type.

RESULTS: With a sensitivity of 0.85 and specificity of 0.90, the AUC of TREWScore in unselected hospitalized patients was of 0.94 (95% CI 0.93-0.95). The performance among patients within pre-specified subgroup is detailed in Table 1. Performance was consistently high across subgroups with no statistically significant difference in the median time patients were identified prior to shock onset. Notably, sensitivity was above 0.80 at a corresponding specificity of at least 0.80 regardless of infection source. ESRD had lower specificity; however, this may be due to the relatively small number of observed cases.

CONCLUSIONS: TREWScore is robust when applied outside of the ICU and across the six patient subgroups considered in this study. This suggests that TREWScore could be a useful clinical tool to facilitate early identification of patients at high risk for septic shock, independent of comorbid conditions and source of infection.

Table 1. TREWScore performance in the validation set

| | Number of cases in the validation set | Cases with septic shock in the validation set | Sensitivity | Specificity | Median hours identified prior to shock onset (IQR) |
|------------------------------|---------------------------------------|---|-------------|-------------|--|
| All patients | 25436 | 404 | 0.85 | 0.90 | 4.2 (2.3-10.4) |
| Chronic comorbidities | | | | | |
| CHF | 2559 | 60 | 0.73 | 0.92 | 4.6 (2.3-14.7) |
| ESRD | 638 | 28 | 0.82 | 0.65 | 9.4 (4.6-38.6) |
| Malignancy | 3737 | 12 | 0.92 | 0.78 | 3.8 (1.6-15.9) |
| Infection diagnosis | | | | | |
| UTI | 5299 | 186 | 0.82 | 0.87 | 4.0 (2.2-10.3) |
| Cellulitis | 6229 | 187 | 0.89 | 0.88 | 4.1 (2.2-10.3) |
| Peritonitis | 5891 | 190 | 0.86 | 0.86 | 4.2 (2.3-12.1) |

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