Can AI Predict Sepsis from Laboratory Values?

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Published: March 21, 2019 | AI in Laboratory Medicine

DOI: 10.5281/zenodo.17998844

Abstract

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Introduction

Sepsis is a life-threatening condition that arises from the body's dysregulated response to infection, leading to organ dysfunction and, in severe cases, death [1]. The global burden of sepsis is immense, affecting an estimated 49 million people and causing 11 million deaths worldwide each year [2]. Early detection and timely intervention are critical to improving patient outcomes, as every hour of delayed treatment is associated with a significant increase in mortality [2]. However, the early diagnosis of sepsis is challenging due to its nonspecific symptoms, which can mimic other common illnesses [2]. In recent years, artificial intelligence (AI) has emerged as a promising tool to aid clinicians in the early prediction of sepsis, with the potential to revolutionize its management.

The Role of AI in Sepsis Prediction

AI algorithms, particularly machine learning and deep learning models, are being developed to analyze vast amounts of clinical data from electronic health records (EHRs) to identify patients at high risk of developing sepsis. These models can continuously monitor a patient's data in real-time, including vital signs, demographics, comorbidities, and, crucially, laboratory test results, to predict the onset of sepsis hours before it becomes clinically apparent [3].

Leveraging Laboratory Values for Prediction

Laboratory values are a cornerstone of sepsis diagnosis and management. AI models can analyze a wide array of laboratory parameters, such as complete blood count (CBC) with differential, C-reactive protein (CRP), procalcitonin

(PCT), lactate levels, and various biomarkers of inflammation and organ dysfunction. By identifying subtle patterns and correlations within these laboratory results, often in conjunction with other clinical data, AI algorithms can achieve a high degree of accuracy in predicting sepsis.

For instance, a study published in *npj Digital Medicine* described an AI algorithm called COMPOSER, which continuously monitors over 150 patient variables, including lab results. The implementation of this tool in emergency departments at UC San Diego Health resulted in a 17% reduction in mortality [4]. The algorithm works by sending an alert to the clinical team when a patient is identified as high-risk, enabling prompt intervention.

The Sepsis ImmunoScore: An FDA-Authorized AI Tool

A significant milestone in the field is the development of the Sepsis ImmunoScore, the first FDA-authorized AI-based software for sepsis prediction. This tool combines demographics, vital signs, and clinical laboratory tests to generate a risk score for sepsis. In a multicenter study published in *NEJM AI*, the Sepsis ImmunoScore demonstrated high diagnostic accuracy, with an area under the curve (AUC) of 0.81 in the external validation cohort [5]. The score categorizes patients into four risk levels (low, medium, high, and very high), which correlate with the likelihood of sepsis and in-hospital mortality. This risk stratification can help clinicians prioritize patients and allocate resources more effectively.

Challenges and Future Directions

Despite the promising results, the widespread implementation of AI for sepsis prediction faces several challenges. These include the need for robust IT infrastructure, the potential for analytical bias in laboratory data, and the importance of clinician trust and acceptance of these new technologies [3, 6]. Furthermore, the performance of AI models can vary depending on the patient population and clinical setting, highlighting the need for external validation and continuous monitoring of these algorithms.

Looking ahead, the integration of AI into clinical workflows holds immense potential to improve sepsis care. Future research will likely focus on refining existing models, developing new algorithms that incorporate novel biomarkers, and conducting large-scale prospective studies to further validate the clinical utility of these tools. The ultimate goal is to create a seamless synergy between AI-powered decision support and clinical expertise to ensure that every patient with sepsis receives the right treatment at the right time.

Conclusion

The use of AI to predict sepsis from laboratory values and other clinical data is no longer a futuristic concept but a rapidly evolving reality. AI-powered tools like COMPOSER and the Sepsis ImmunoScore have demonstrated their potential to improve patient outcomes by enabling earlier and more accurate sepsis detection. While challenges remain, the continued development and integration of these technologies into clinical practice promise to transform the management of this life-threatening condition and save countless lives.

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