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# Learning Representations for the Early Detection of Sepsis with Deep Neural Networks

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## Abstract

**Background:** Sepsis is one of the leading causes of death in intensive care unit patients. Early detection of sepsis is vital because mortality increases as the sepsis stage worsens.

**Objective:** This study aimed to develop detection models for the early stage of sepsis using deep learning methodologies, and to compare the feasibility and performance of the new deep learning methodology with those of the regression method with conventional temporal feature extraction.

**Method:** Study group selection adhered to the InSight model. The results of the deep learning-based models and the InSight model were compared.

**Results:** With deep feedforward networks, the area under the ROC curve (AUC) of the models were 0.887 and 0.915 for the InSight and the new feature sets, respectively. For the model with the combined feature set, the AUC was the same as that of the basic feature set (0.915). For the long short-term memory model, only the basic feature set was applied and the AUC improved to 0.929 compared with the existing 0.887 of the InSight model.

**Conclusions:** The contributions of this paper can be summarized in three ways: (i) improved performance without feature extraction using domain knowledge, (ii) verification of feature extraction capability of deep neural networks through comparison with reference features, and (iii) improved performance with feedforward neural networks using long short-term memory, a neural network architecture that can learn sequential patterns.

**Keywords:** Sepsis, Early detection, Deep learning, Clinical decision support system, Feature extraction, LSTM, Multivariate time-series

## 1. Introduction

Sepsis, a common systemic response to infection, often leads to life-threatening complications in hospitalized patients. In particular, sepsis is one of the leading causes of

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