نيوتك

Early Warning System for Sepsis Detection

Haya Alhajri
Lama Almubarak
Fatimah Alhebshi

Problem Overview

- Sepsis is a life-threatening condition with high mortality.
- Early signs are subtle and difficult to detect.
- Delayed detection leads to severe complications.
- Need for early and reliable warning systems.

Clinical Scenario

- ICU patients are continuously monitored.
- Vital signs are collected as hourly time-series data.
- Individual readings may appear normal.
- Temporal patterns indicate early sepsis deterioration.

Proposed Solution

- AI-based early warning system.
- Learns each patient’s normal behavior (baseline).
- Detects deviations indicating sepsis risk.
- Focuses on personalized monitoring.

Dataset &Data Preprocessing

Dataset

- Dataset: Prediction of Sepsis Dataset (PhysioNet 2019).
- Source: Kaggle.
- Data Type: Clinical time-series data.
- Data size : 40,336 patients
- Features: HR, O2Sat, Resp, Temp, MAP, Lactate.

Data Preprocessing

- Selected relevant sepsis-related features.
- Organized data by patient and time.
- Handled missing values within each patient.
- Defined baseline as first 12 hours.

Model Type

A GRU-based multi-task time-series model

specifically designed for sequential medical time-series data.

AI model

Rationale for Medical Data

GRU efficiently models physiological signals with limited and irregular observations, capturing gradual clinical changes while remaining lightweight and suitable for real-time healthcare settings.

Temporal Modeling

The model analyzes the last 12 hours of patient vital signs to learn temporal trends and patient-specific baselines, enabling early detection of subtle deterioration.

Model Type

A GRU-based multi-task time-series model

specifically designed for sequential medical time-series data.

AI model

Decision-Support Outputs

- 6-hour forecasting of key vital signs for visual clinical assessment
- Sepsis risk probability as an early warning signal
- Explainable AI (XAI) highlighting the most influential vitals and time points

Tools & Technologies Used

Frameworks

- PyTorch

Frameworks

- Pandas & NumPy
- Scikit-learn
- Matplotlib

Explainable AI (XAI) Tools

Captum (Integrated Gradients)

Prototyping & Visualization

Interactive Dashboard (Streamlit-based)

Results & Analysis

Sepsis Risk Discrimination (AUC–ROC)

74%

Model Performance

- **AUC–ROC: 0.74**
  - Indicates good ability to distinguish between stable patients and early sepsis risk.
- **Recall (Sensitivity): 40%**
  - The model successfully detects a significant portion of sepsis cases early, prioritizing patient safety.
- **Accuracy: 88%**
  - Reported for completeness, but not the primary metric due to class imbalance in medical data.

Explainable AI (XAI)

This module translates the model’s risk predictions into clear, clinically interpretable insights by highlighting the most influential vital signs and recent physiological trends, enabling transparent and trustworthy clinical decision support.

Dataset link

Prototype link

video link

Prototype

Conclusion

This project introduces an AI-driven early warning system that transforms raw medical time-series into a clear, visual, and explainable clinical story.
By learning patient-specific baselines and predicting short-term physiological trends, the system enables earlier identification of sepsis risk and supports more confident clinical decision-making.

Clinical Impact

- Supports early intervention before overt deterioration occurs
- Reduces reliance on fixed population thresholds
- Enhances clinician trust through explainable AI (XAI)

Future Vision

- **Clinical Deployment:** Integration with hospital monitoring systems (ICU / EHR)
- **Scalability:** Extension to other conditions (e.g., shock, respiratory failure)
- **Personalization:** Continuous baseline adaptation for long-stay patients
- **Validation:** Prospective clinical trials and real-world evaluation

Thank You