Early Sepsis Detection with Machine Learning

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Introduction

Sepsis

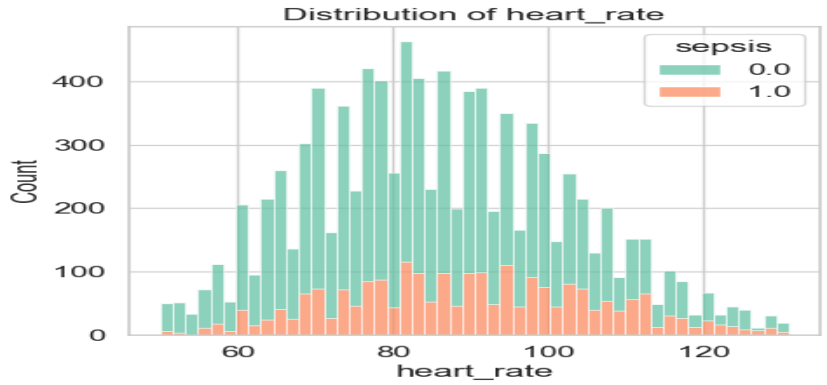
- Mortality >30%, early detection critical.

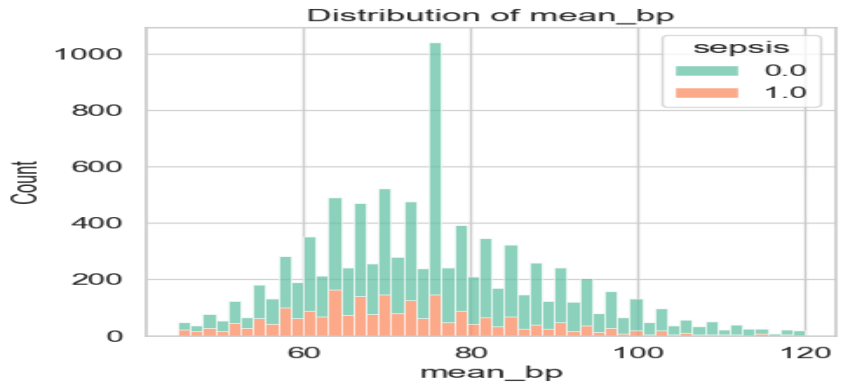
Data

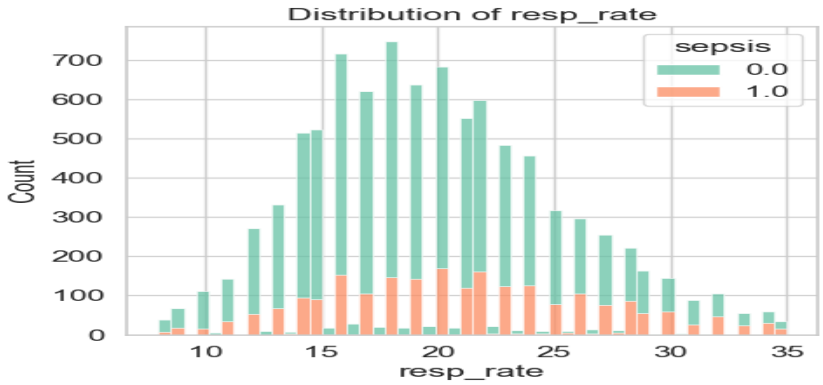
- MIMIC-III (vitals + notes)

Graph Result

- Sepsis patients have higher heart rates (100-120 bpm vs. 80-100 bpm) and lower mean blood pressure (some <80 mmHg vs. 80-100 mmHg







Method

Data

Vitals (12 time steps), notes via BioBERT

Models

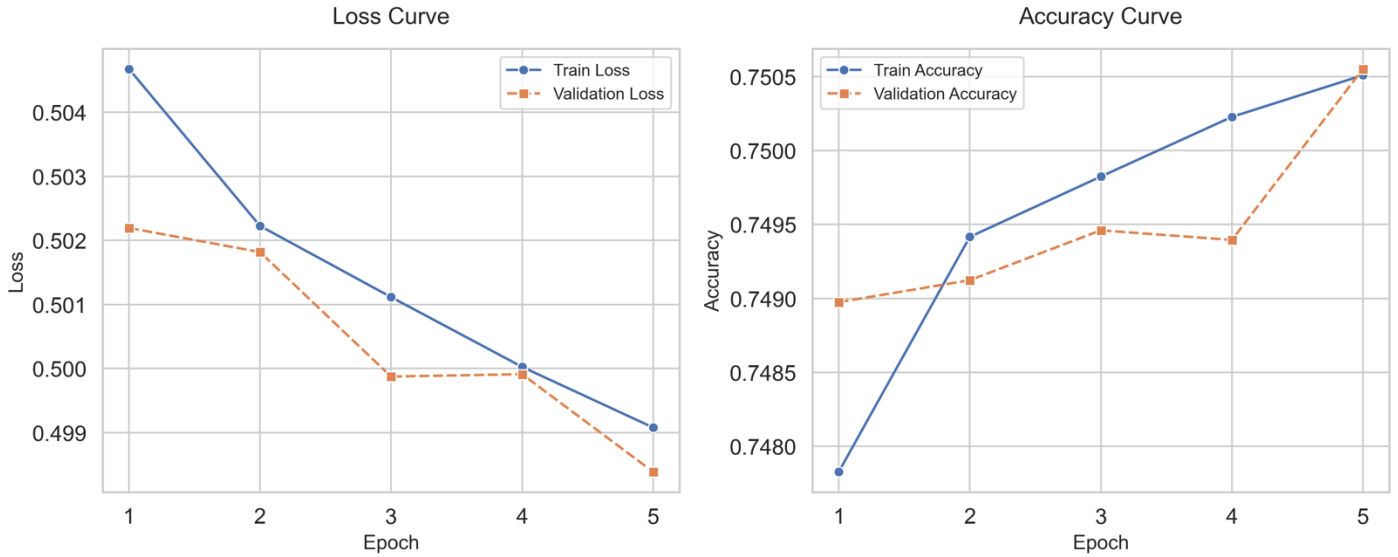
- Logistic Regression, LSTM (5 epochs).

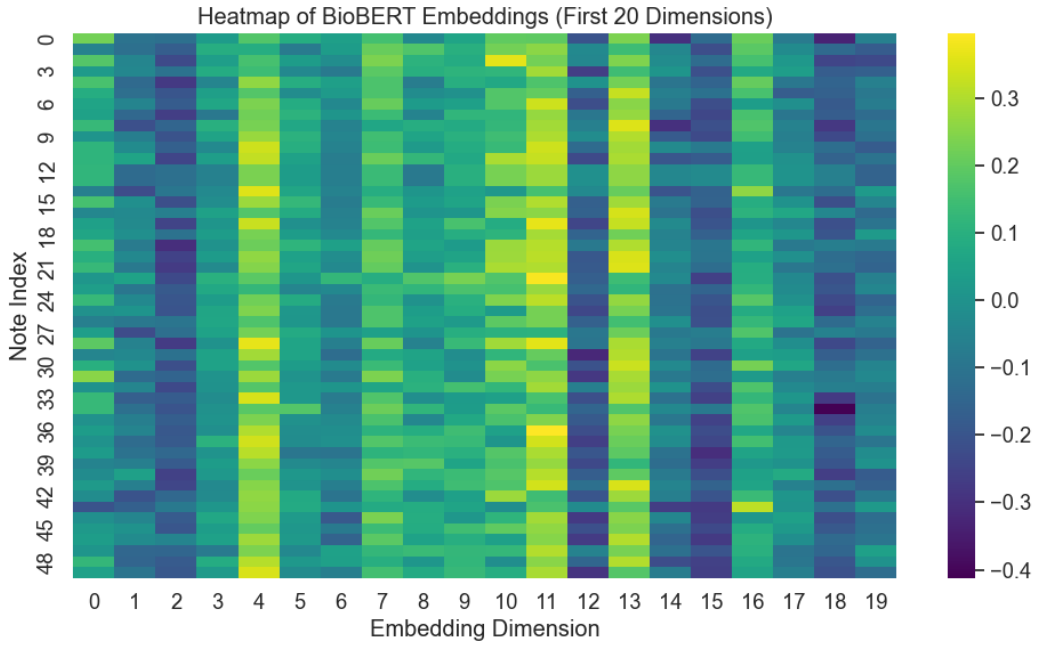
Graph Result (Heatmap)

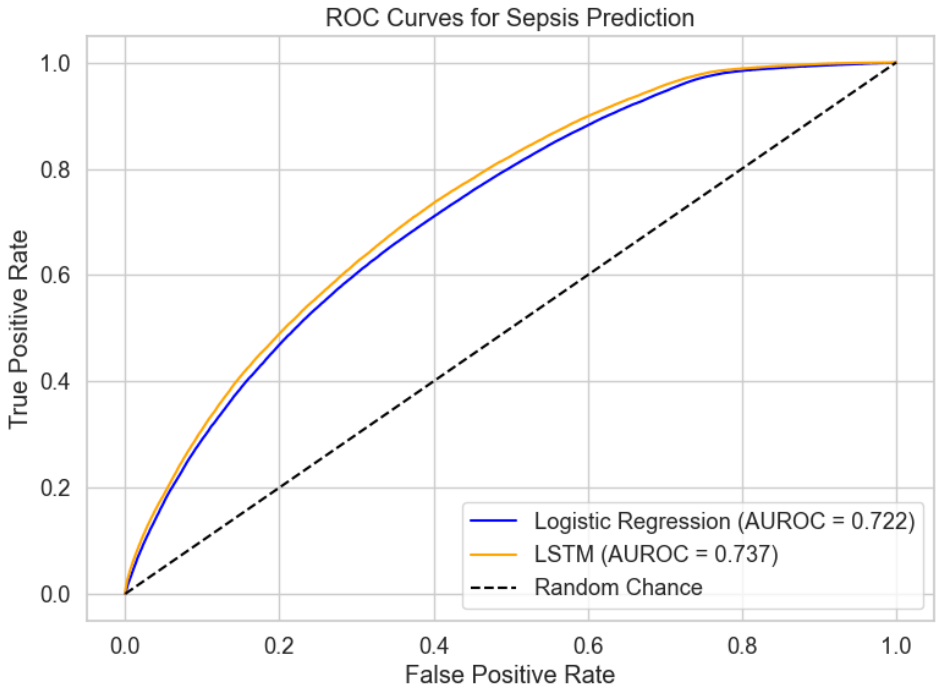
- Embeddings for 50 notes, values from -0.4 to 0.3.

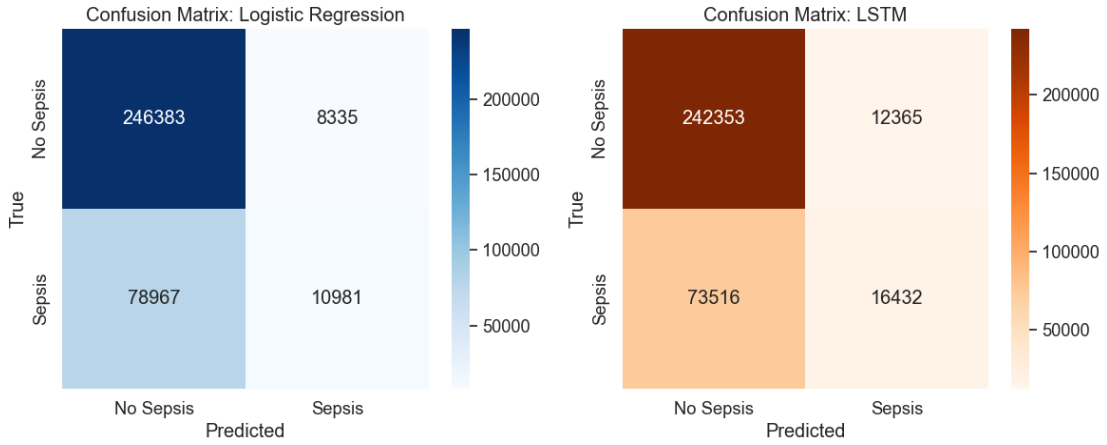
Graph Result (Loss Curve)

- Training loss at 0.500, validation at 0.502, minimal overfitting.









Results

Performance

- LSTM AUROC = 0.737, Logistic Regression = 0.722,

Graph Result (ROC)

- LSTM outperforms Logistic Regression.

Graph Result (Confusion Matrices)

- LSTM: 24,233 correct non-sepsis, 16,432 missed sepsis; Logistic Regression: 10,981 missed sepsis, 8,335 false positives.

Results Cont.

Graph Result (Precision-Recall)

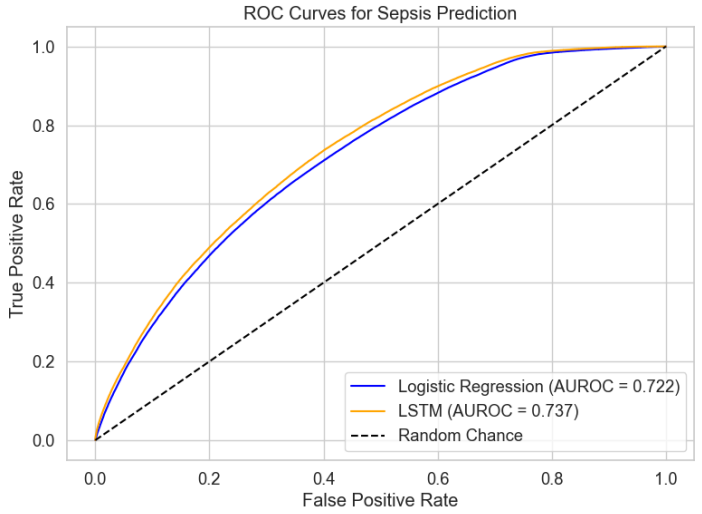
- Logistic Regression higher precision at low recall, LSTM better at higher recall.

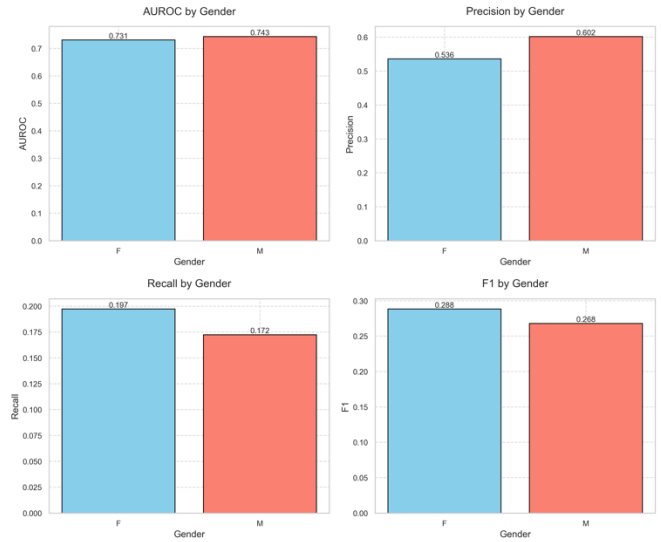
Graph Result (Fairness)

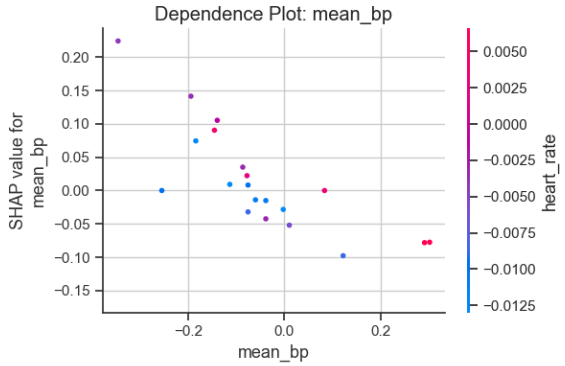
- AUROC balanced (F: 0.731, M: 0.743), recall higher for females (0.197 vs. 0.172).

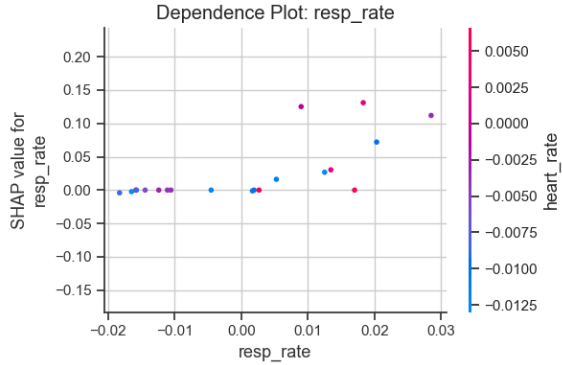
Graph Result (SHAP)

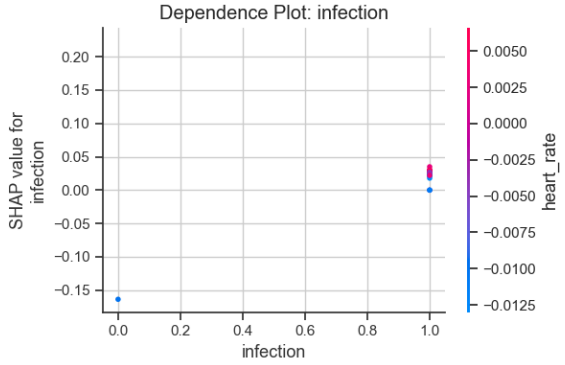
- Higher heart rates increase sepsis prediction (SHAP values up to 0.2).











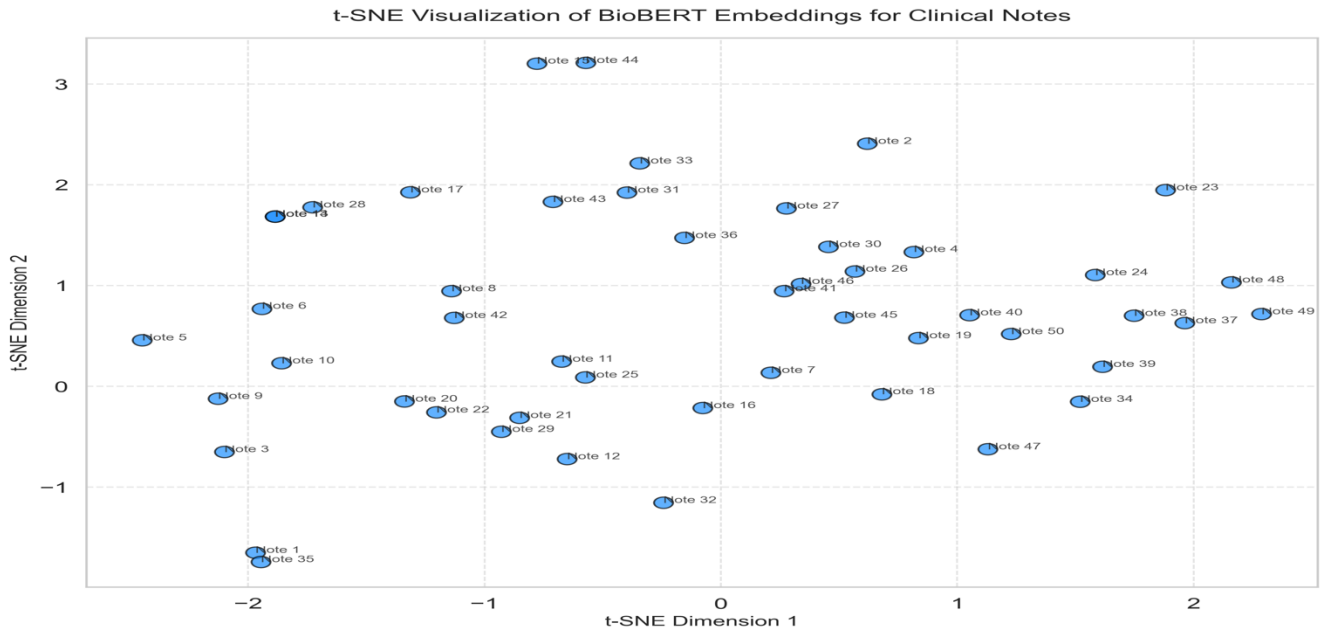
Future Directions

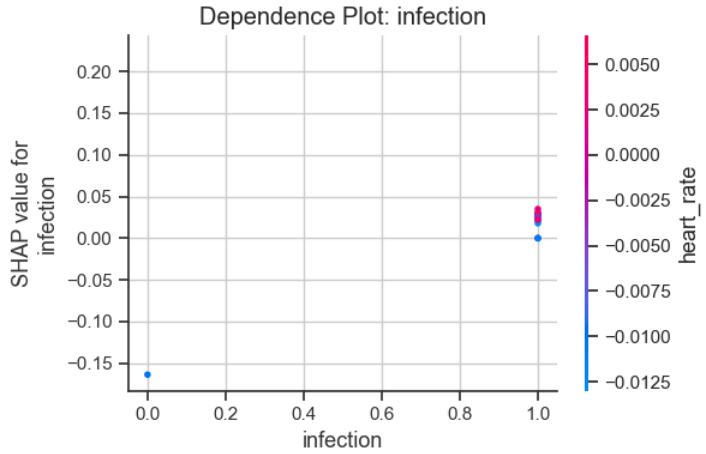
Improve text processing with larger samples or GPT-4, as t-SNE shows clustering (Notes 2, 23) but room for better pattern capture.

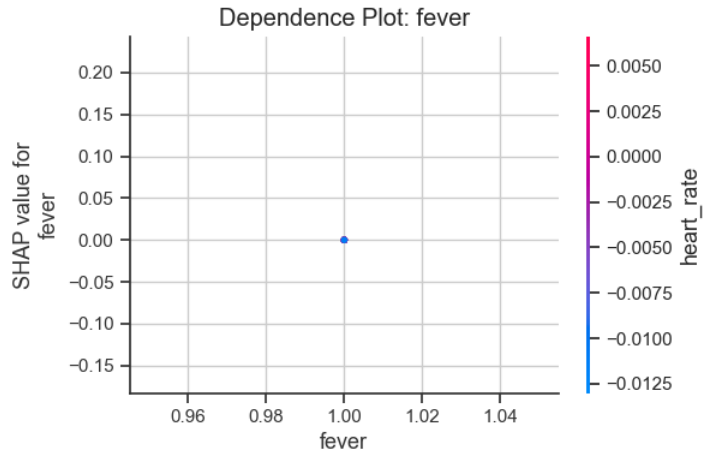
Enhance text feature extraction, as SHAP plots show infection (SHAP values up to 0.8) and fever (SHAP values up to 0.1) are key predictors.

Address fairness (recall: F 0.197, M 0.172) by analyzing age and ethnicity, plus use SMOTE for class imbalance.

Real-time ICU monitoring to save lives.







Conclusion

Summary

- AUROC 0.737, key predictors identified

Future

- Real-time, equitable detection