A Web-Based Application for Acute Coronary Syndrome Mortality Risk Prediction Using Explainable AI and Chatbot Integration in the Asian Population

Authors: *Sazzli Shahlan Kasim,[1] Lim Bing Feng,[2] Sorayya Malek,[2] Raja Ezman Faridz Raja Shariff,[3] Khairul Shafiq Ibrahim,[3] Ahmad Firdaus Zakaria,[3] Ahmad Bakhtiar Md Radzi[3]

1. Cardiovascular Advancement and Research Excellence (CARE) Institute, Universiti Teknologi MARA, Selangor, Malaysia
2. Faculty of Science, Bioinformatics Division, Institute of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia
3. Faculty of Medicine, Cardiology Department, Universiti Teknologi MARA (UiTM), Sungai Buloh Campus, Malaysia

*Correspondence to sazzlikasim@gmail.com

Disclosure: The authors have declared no conflicts of interest.

Acknowledgements: This work was supported by the Higher Institution Centre of Excellence (HICoE) research grant (600-RMC/MOHE HICoE CARE-I 5/3 [01/2025]) awarded to the Cardiovascular Advancement and Research Excellence Institute (CARE Institute), Universiti Teknologi MARA, Selangor, Malaysia.

Keywords: AI, cardiovascular disease, chatbot, machine learning, mortality risk prediction, ST-elevation myocardial infarction (STEMI).

Citation: EMJ Cardiol. 2025;13[1]:45-46. https://doi.org/10.33590/emjcardiol/FZLO3285

BACKGROUND AND AIMS

ST-elevation myocardial infarction (STEMI) is a leading cause of mortality, with significant variations in risk profiles among the Asian population. Traditional risk scores, such as the Thrombolysis in Myocardial Infarction (TIMI) score, were developed based on Western cohorts and have limited predictive accuracy for Asian patients. Machine learning models have shown superior performance but remain underutilised due to a lack of accessible and interpretable tools.

PURPOSE

This study aims to develop a web-based application that integrates ensemble learning, explainable AI, and a chatbot for STEMI mortality risk prediction.[1] The system provides transparent assessments, enhancing clinical decision-making for Asian healthcare providers.

METHODS

A dataset of 42,348 STEMI cases (2006–2019) from the National Cardiovascular Disease Database (NCVD) registry with 54 clinical features was used. Data preprocessing included handling missing values, outlier detection, and feature normalisation. Feature selection was performed using recursive feature elimination and expert input.

Ensemble models, including random forest, gradient boosting, XGBoost, and stack ensemble, were trained and validated using 10-fold cross-validation. SHapley Additive exPlanations (SHAP) provided interpretability of model predictions, with a user-friendly interface displaying summary plots and individual risk factor explanations.

A chatbot, powered by a fine-tuned large language model, was developed for real-time guidance. The chatbot was localised with region-specific clinical guidelines, terminology, and frequently asked questions to improve usability for Asian healthcare providers. The LangChain framework (LangChain, Inc., San Francisco, California, USA) facilitated seamless knowledge retrieval, enhancing chatbot interactions.

A prospective data collection feature enabled continuous model validation and refinement by incorporating new patient data over time.

RESULTS

The ensemble models outperformed traditional risk scoring methods, achieving an area under the curve score of 0.96, a recall score of 0.89, and a precision of 0.61 for in-hospital mortality prediction, compared to the TIMI risk score (area under the curve: 0.81). SHAP analysis identified key predictors, providing interpretable insights into risk stratification. The chatbot improved accessibility, offering real-time assistance for clinicians in risk assessment. The prospective data collection feature ensured ongoing model updates, maintaining predictive accuracy and clinical relevance.

CONCLUSION

This study presents a web-based STEMI risk prediction tool that integrates ensemble learning, explainable AI, and a chatbot, tailored for the Asian population. The system enhances predictive accuracy, interpretability, and usability, bridging the gap between advanced machine learning models and clinical practice. By combining AI-driven risk assessment with a user-friendly interface, this tool provides a scalable solution for improving STEMI outcomes in Asian healthcare settings.

Reference

1. Kasim SS et al. A web-based application for ACS mortality risk prediction using explainable AI and chatbot integration in the Asian population. Abstract. ESC Congress, 29 August-1 September, 2025.