Review and Analysis of Machine Learning Techniques for Heart Attack Prediction

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ABSTRACT
Heart attacks are one of the major drivers of death, and predicting them early can save many lives. The current research ensured that only relevant and recent studies were included, mostly from 2021 to 2025, to maintain updated information. Today, machine learning is widely used to analyze patient data and find methods that can help doctors/clinicians to identify individuals who may be at high risk. However, after reviewing a number of research papers in this area, it is clear that recent studies still have several important limitations.One major problem is that many models do not use explainable AI (XAI), so doctors cannot clearly understand why a model predicts a patient as safe or at risk. Many studies still depend mainly on basic machine-learning methods or even regression techniques, which are not ideal for heart-attack prediction. More advanced methods such as deep learning, boosting, transfer learning, or hybrid models are rarely used. In cases where neural networks are applied, they often give unstable results because the datasets are small or imbalanced, which increases the chance of overfitting. Some studies also use undersampling or PCA, which can remove useful information when the data is already limited. Another problem is the lack of well-labeled medical data. Some researchers try to fix this using semi-supervised learning, but this requires more computation and is still difficult. Overall, the existing research shows a need for more advanced, explainable, and reliable machine-learning approaches that can handle small, noisy, and imbalanced medical datasets. This review highlights these gaps and aims to support the development of better and more trustworthy heart-attack prediction models.

Keywords
Heart attack, prediction, myocardial infraction, machine learning, XG Boost, Random Forest

1. INTRODUCTION

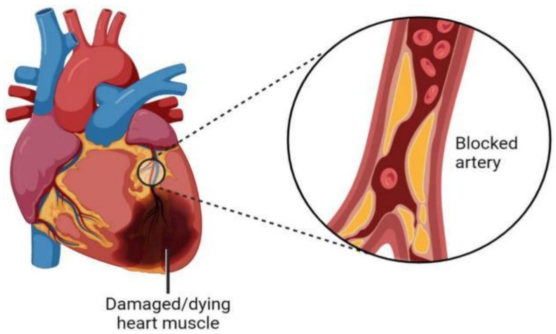

Fig. 1 Blockage in Heart

Source:https://microbenotes.com/wp-content/uploads/2023/04/Myocardial-Infarction-Heart-Attack.jpg

Heart attacks are still one of the predominant causes of death worldwide, and many studies put the stress on the serious need for early prediction to save patient lives. A heart attack generally occurs when blood passes to the heart is blocked because of high cholesterol, fat deposits inside the arteries as shown in Fig. 1, which leads to serious damage if not noticed in time. Since many individuals show mild or unclear symptoms before a heart attack, early identification becomes complicated and often results in delayed treatment.Due to traditional diagnosis depends heavily on doctor expertise, ECG readings and clinical tests, researchers are increasingly using machine learning to support faster and more accurate heart-attack prediction [1]. Machine learning algorithms can analyse large patient datasets, learn patterns related to risk factors, and then provide predictions as mentioned below in Fig. 2 that can be helped in early clinical decision-making.

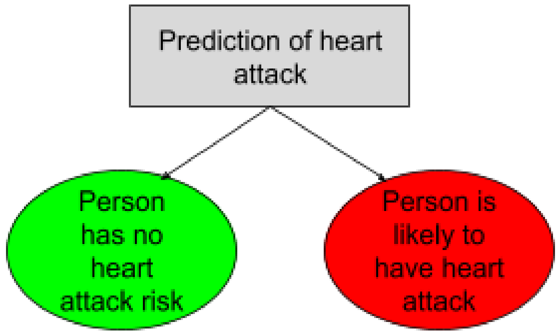

Fig. 2 Heart Attack Prediction [1]

Several studies show that classical ML algorithms - like Logistic Regression, Support Vector Machine, Decision Tree, Random Forest, and K-Nearest Neighbors perform well in predicting heart attack on various datasets. However, in spite of good results, several important research gaps have been found repeatedly across the 24 papers. Various studies mentioned that neural-network models usually become unstable when trained on small datasets, which leads to inconsistent predictions and poor generalization [2]. Some researchers used regression algorithms for tasks that behave more like classification, which limits accuracy and model performance.

A crucial limitation in many studies is the lack of explainable AI (XAI). Most predictive models act like "black boxes," making it more challenging for clinicians or doctors to trust or understand the prediction outputs. Additionally, undersampling was used in many cases to deal with imbalance, dimensionality reduction techniques were used like PCA(Principle Component Analysis) which caught only limited variance but this eliminates useful information and may lower the model's learning ability. Some papers, meaning important medical features could be lost during reduction[3].

In overall study, the main challenges include lack of explainability, instability of models on small datasets, limited labeled medical data, minimal use of deep learning or transfer learning, weak handling of imbalance, and limited comparison with advanced ensemble methods. These above mentioned limitations show that existing models may have good accuracy but lack the robustness, generalization and transparency required for actual medical use[4].Therefore, the goal is to build a Heart Attack Prediction System using Machine Learning Techniques that manages these gaps by using hybrid ML algorithms, balanced-data techniques, efficient feature selection and explainable-AI methods. This approach will help to create a more accurate, reliable and interpretable model that can support timely prediction and improve patient healthcare results.

2. LITERATURE REVIEW

K.Tn, S. C. P, M. S, A. Kodipalli, T. Rao and S. Kamal (2023) did an important study using simple ML models like Logistic Regression, Decision Tree, and Random Forest to find early heart-attack risk. The researchers used basic medical details from patients to make the prediction easily. Their study is helpful, but the dataset was small and not balanced, which made the accuracy lower. Still, their work gives a good starting point for future research to improve heart-attack prediction [5].

The authors S. P. Sreeja, V. Asha, G. Kumar, S. Chandan, N. R. Divyashree and B. Nithya compared several ML algorithms on heart attack prediction. Random Forest and SVM surpassed Logistic Regression. The study can be more accurate if it uses advanced boosting algorithms and explainable AI. Imbalance dataset and small sample size affected results [6].

T. Kujani, P. Arivubrakan and B. R introduced Firework Optimization for feature selection, followed by ML classifiers. Feature optimization improved accuracy, but the technique was tested only on a single dataset, raising questions about its generalizability [7].

L. Chen (2024) carried out a study that utilized basic machine learning models to predict heart disease using clinical patient data. The method was straightforward, and the models gave average or moderate accuracy. The study faced issues because the dataset was unbalanced, and there is no comparison between deep learning or advanced ensemble models [8].

The author S. Kora et al. (2025) studied a semi-supervised learning method to predict heart attacks when there are not enough labeled medical records. This method improved the results, but it needed a lot of computing power and still had problems with noisy and unbalanced data. The study did not use explainable AI or multiple types of medical data, but it still provides a useful step toward better heart-attack prediction methods [9].

Y. Bonthu, S. Mannam, G. Kandikunta, V. G. Keshagani and G. Sarath carried out a study using advanced models like AdaBoost, Gradient Boosting, and Random Forest for heart-attack prediction. The use of these stronger ML techniques helped to achieve better accuracy compared to basic models. The work adds helpful progress in using advanced machine learning for medical prediction [10].

The authors M. S. Manoj, K. Madhuri, K. Anusha and K. U. Sree designed a heart-attack prediction system using machine-learning models like SVM, Naïve Bayes, and Decision Tree. The work followed a clear and systematic approach, showing how these algorithms can be used effectively for medical prediction. The study provides valuable insights and helps for further improvements in heart-attack prediction research [11].

J. S. Rose, P. Malin Bruntha, S. Selvadass, R. M. V, B. C. Mary M and M. J. D used ML classifiers on clinical datasets. Their study reported good accuracy but faced problems with small dataset size and noise. Regression was sometimes used for classification-like tasks [12].

M. G. Chitra and R. Govindaraj presented a prediction model using Naive Bayes and Decision Tree algorithms. Their study provided clear insights into how these classical ML methods could support heart-disease prediction and added meaningful value by showing that simple models were still utilized for medical data analysis and could guide future improvements in this field [13].

Imen Boudali, Sarra Chebaane, and Yassine Zitouni carried out a study using a large clinical dataset to identify myocardial infarction risk. Their research offered practical understanding of how traditional ML methods worked on extensive medical data and provided helpful knowledge [14].

The authors Mohammad Alshraideh, Najwan Alshraideh, Abedalrahman Alshraideh, Yara Alkayed, Yasmin Al Trabsheh, and Bahaaldeen Alshraideh conducted a clinical study that used machine-learning models .Their work highlighted the importance of making ML results understandable for healthcare use. Also, the study added useful knowledge by showing how clinical data and ML can work together to support medical decision-making [15].

Table 1 Summary of previously used methodology in Heart Attack Prediction

Sr. No	Title	Year& platform	Author	Algorithm Used	Dataset Used	Limitation/Gaps
1.	Machine Learning based Chronic Disease (Heart Attack) Prediction	2023 , IEEE	V. Selvakumar, A. chanta and N. Sreeram	LR,KNN,SVM,Decision Tree ,Random Forest ,Bagging, AdaBoost, Gradient Boost,XGBoost,Neu ral Network (ANN) variants	UCI Cleveland heart dataset (303×14)	Limited rows/columns ,Dynamic data not used, Need for more diverse cohorts and real-world testing ,Neural network training unstable on small data; some architectures did not converge well

2.	Heart Attack Prediction Using Machine Learning Algorithms	2024 , IEEE	M. Kumar, et al.	LR ,Gaussian Naive Bayes,Bernoulli Naïve Bayes,SVM ,Gradient Boosting	UCI Heart Disease Dataset (303 samples)	Very small dataset, Only basic ML used - no deep learning , High risk of overfitting , Lack of external validation , No multi-center or real-time clinical testing
3.	Feature Optimized Hybrid Model for Prediction of Myocardial Infarction	2025 , F1000 Research	Sarita Mishra, Manjusha Pandey, Siddharth Routaray	Variance-based , Mutual Information ,Boruta,Recursive Feature Elimination ,LR,SVM,Decision Tree,AdaBoost	Myocardial Infarction dataset	AdaBoost improvement shown, but no comparison with deep learning, Dataset size small -limits generalization ,Only traditional ML algorithms used, Multiclass methods used but dataset may be binary, No real-time or clinical deployment tested.
4.	Prediction of Myocardial Infarction Based on Non-ECG Sleep Data Combined With Domain Knowledge	2025 , IEEE	C. Li, Y. Zhao, Q. Mo, Z. Wang and X. Xu	Domain-knowledge – based modeling , Machine learning classifiers ,Statistical analysis sleep-related biomarkers,Non-ECG multimodal input features	Non-ECG Sleep Data dataset	Lack of ECG or clinical parameters reduces model robustness, Domain knowledge may introduce human bias ,No comparison with DL sleep-signal models,Non-ECG sleep datasets may not generalize to clinical MI prediction.
5.	Prediction of Early Heart Attack Possibility Using Machine Learning	2023, IEEE	K. Tn, S. C. P, M. S, A. Kodipalli, T. Rao and S. Kamal	LR,KNN,RF,SVM, DT, Bagging / Boosting families,Naïve Bayes,Neural networks	UCI Heart Disease	Small dataset sizes limit generalizability, Potential overfitting when many algorithms are trained on small data, Need for explainability / XAI for clinical adoption.
6.	Comparative Analysis of Machine Learning Models for Heart Attack Prediction	2025, IEEE	S. P. Sreeja, V. Asha, G.Kumar, S.Chandan, N. R. Divyashree and B. Nithya	Logistic Regression, Decision Tree,CatBoost (gradient boosting tuned for categorical features)	Kaggle, combined UCI sets	CatBoost slightly outperforms others but margins are small,Limited feature diversity across datasets, Suggest addition of XAI and further hyperparameter tuning,Need to test on multi-center datasets for robustness.

7.	Optimal Feature Selection and Classification with Firework Optimization for Heart Attack Prediction by Machine Learning Classifiers	2025, IEEE	T. Kujani, P. Arivubrakan and B. R	Firework Optimization,RF,Gaussian Naive Bayes,SVM,Decision Tree ,K-Nearest Neighbors (KNN)	UCI Heart dataset (303 samples, 13 features)	Approach is computationally heavier during training/feature selection for higher dimensional data ,Results need external validation on datasets,
8.	Heart disease prediction utilizing machine learning techniques	2024, IEEE	L. Chen	LR,RF,LightGBM ,DT ,Boruta algorithm for feature selection; Random Search / Bayesian optimization for HPO	heart_2020_cleaned.csv (Kaggle) — 319,795 records, 18 attributes	Undersampling reduces information , applies better imbalance handling and retains more samples, Need for interpretability and deployment pathways for clinical use.
9.	Optimized Semi-supervised Machine Learning Approach for Heart attack Prediction	2025, IEEE	S. Kora, V. Bijalwan, D. D and V. K. B	Random Forest,SVM, Gradient Boosting,LR,Neural network variations,Ensemble learning models	Cleveland,Switzerland,Hungarian, Long Beach VA heart-disease datasets	Small labeled data requires self-training assumptions , Performance depends on quality of pseudo-labels , Unbalanced and noisy datasets reduce accuracy , , Limited interpretability,requires more explainable AI methods
10.	Heart Attack Risk Prediction Using Advanced Machine Learning Techniques	2024, IEEE	Y. Bonthu, S. Mannam, G. Kandikunta, V. G.Keshagani and G. Sarath	Support Vector Machine (SVM),Random Forest,XGBoost,Stacking Classifier with Logistic Regression, Decision Tree, KNN	Mendeley Multispecialty Hospital Dataset,UCI dataset composite ,Kaggle dataset	SMOTE used, but real clinical imbalance remains unaddressed, Stacking model lacks interpretability , Dataset diversity may cause inconsistent generalization , No deep learning or transfer learning applied beyond ML models
11.	Design and Analysis of Heart Attack Prediction System Using ML	2023 , IEEE	M. S. Manoj, K. Madhuri, K. Anusha and K. U. Sree	Logistic Regression, Multi-Layer Perceptron (Neural Network),CatBoost Regression,Random Forest Regression	Clinical patient dataset with heart disease attributes	Dataset source unclear, reproducibility issues , Regression algorithms used for classification-like task , No external validation on real hospital data , No comparison with deep learning or hybrid ensemble methods

12.	Heart Attack Prediction Using Machine Learning Techniques	2023 , IEEE	J. S. Rose, P. Malin Bruntha, S. Selvadass, R. M. V, B. C. Mary M and M. J. D	Logistic Regression,Support Vector Machine (SVM),Decision Tree,Random Forest	Kaggle Heart Disease Dataset	Small dataset size reduces generalizability, No advanced models (Boosting, DL, ensembles) tested , Imbalanced dataset not addressed, No real-world data validation or clinical integration
13.	Effective Heart Attack Prediction method using Machine Learning Algorithm	2024 , IEEE	M. G. Chitra and R. Govindaraj	SVM,Logistic Regression ,Naïve Bayes ,(KNN ,Decision Tree ,Random Forest ,Extreme Gradient Boosting (XGBoot)	Cleveland UCI data set and Kaggle	Dependence on preexisting datasets , traditional ML models used, Performance highly dependent on dataset quality, outliers and noise may affect metrics , Population diversity missing - datasets limited to Cleveland/UCI may not generalize to all regions .
14.	A predictive approach for myocardial infarction risk assessment using machine learning and big clinical data	2024,Elsevier _ scopus indexed	Imen Boudali, Sarra Chebaane, Yassine Zitouni	Decision Tree (DT),Random Forest (RF),Logistic Regression ,Gradient Boosting (GBoost),XGBoost, LightGBM,CatBoost ,Convolutional Neural Network	BRFSS Clinical Dataset,Balanced dataset created using Random Undersampling	Dataset imbalance required undersampling ,Only structured EHR data used ,PCA explained limited variance, External validation missing, No explainable AI (XAI) techniques applied for clinical interpretability , Limited evaluation of deep learning vs. boosting algorithms
15.	Enhancing Heart Attack Prediction with Machine Learning: A Study at Jordan University Hospital	2024, Research Gate	Mohammad Alshraideh et al.	Machine learning classification models,RF, SVM,DT, Naïve Bayes, KNN,Feature Selection using PSO	Jordan University Hospital (486 patient records, 58 variables)	Study limited to one regional hospital dataset , PSO-based feature selection tested only on this specific dataset , External validation missing, Model performance comparison limited to classical ML algorithms only.

16.	Linking Electrocardiogram and Echocardiogram: Comparing Classical Machine Learning and Deep Learning Neural Networks for the Detection of Regional Wall Motion Abnormalities [16]	2025, IEEE	S. M. Joshi et al.	Classical ML models,Deep Neural Networks,ECG + Echo multimodal fusion,Feature engineering and preprocessing	ECG + Echocardiogram paired dataset	Combining ECG + Echo increases complexity , Requires high-quality multi-modal labeled data, Limited dataset size may affect DL performance , Not tested across different hospitals/devices.
17.	Multimodal Deep Learning for Cardiovascular Risk Stratification: Integrating Retinal Biomarkers and Cardiovascular Signals for Enhanced Heart Attack Prediction [17]	2025 , IEEE	K. Sathya and G. Magesh	Semi-supervised machine learning,Deep Neural Networks,Multimodal fusion (ECG + clinical data), Ensemble approaches , Data mining	Labeled + Unlabeled cardiac datasets (semi-supervised)	Limited availability of labeled medical data , Semi-supervised approach requires high compute , No external dataset validation ,Multimodal noise and imbalance still challenging.
18.	Explainable Prediction of Acute Myocardial Infarction Using Machine Learning and Shapley Values [18]	2020,IEEE	Lujain Ibrahim, Munib Mesinovic, Kai-Wen Yang, Mohamad A. Eid	CNN,RNN,XGBoost classifier,SMOTE for class imbalance handling,SHAP (Shapley Values) for explainability	ECG signal dataset Clinical cardiac records related to acute myocardial infarction	Requires very large ECG datasets to work well, Deep learning models are computational ly expensive, Focuses mainly on ECG data and ignores lifestyle factors,
19.	Explainable AI-Driven Intelligent System for Precision Forecasting in Cardiovascular Disease [19]	2025 , Frontiers in Medicine	Anas Bilal, Abdulkareem Alzahrani, Khalid Almohammadi, Muhammad Saleem, Muhammad Sajid Farooq, Raheem Sarwar	Multiple machine-learning classifiers, SHAP for feature importance, LIME for model explanation, Statistical preprocessing techniques	Electronic Medical Records (EMR), Hospital-based cardiovascular patient data	Focuses on general cardiovascular disease, not only heart attack,No ECG or real-time signal data used,Deep learning models are limited,External clinical validation is missing
20.	Enhancing Heart Attack Prediction: Feature Identification from Multiparametric Cardiac Data Using Explainable AI [20]	2025,MDPI	Muhammad Waqar, Muhammad Bilal Shahnawaz, Sajid Saleem, Hassan Dawood, Usman Muhammad, Hussain Dawood	ANN,LR,SVM,Random Forest,KNN,Naive Bayes,SMOTE for data balancing,SHAP and LIME for explainability	UCI Heart Disease Dataset (303 samples)	Dataset is small and outdated,No wearable or IoT data used,Model tested only on one dataset,No real clinical decision-support system implemented
21.	Acute Myocardial Infarction: Prediction and Patient Assessment through different Machine Learning Techniques [21]	2024,International Journal of Intelligent Systems and Applications in Engineering	Nudrat Fatima, Sifatullah Siddiqi	Logistic Regression,Random Forest,Support Vector Machine (SVM),Ensemble classifiers	Heart disease clinical dataset (around 350 patient records)	Dataset size is very small,No deep learning methods applied,Possible gender and age bias,Limited generalization to real hospitals

22.	Predicting the Risk of Myocardial Infarction(MI) Using Machine Learning(ML) [22]	2024,Ahliya Journal of Allied Medico-Technology Science	Murad Zeer, Mutaz Abu Sara, Asma Sbeih, Khaled Sabarna	LR,DT,RF,Naive Bayes,KNN,Gradient Boosting,XGBoost,Support Vector Classifier (SVC)	Kaggle heart attack dataset	Uses only public dataset,No explainable AI techniques,No ECG or time-series data,Clinical usefulness not validated
23.	Heart Attack Prediction Using Machine Learning Models: A Comparative Study of Naive Bayes, Decision Tree, Random Forest, and K-Nearest Neighbors [23]	2025,MDPI	Makhdoma Haider, Manzoor Hussain, Gina Purnama Insany	Naive Bayes,Decision Tree,Random Forest,KNN	Standard heart disease dataset	Accuracy is relatively low,No advanced feature selection,No deep learning or hybrid models,Simple dataset limits performance
24.	Hybrid Machine Learning and Deep Learning Approach for Heart Attack Prediction Using Clinical, Lifestyle, and Time-Series Data with Enhanced Feature Selection and Classification [24]	2025,SEEJPH Journal	Manish Rana et al.	Random Forest,Gradient Boosting,LSTM,Federated Learning,IoT-based ECG processing	Real-time IoT sensor data, Clinical and lifestyle patient data	System complexity is very high,Requires IoT and cloud infrastructure,Deployment cost is high,Explainability still limited

2.1 Analysis of Algorithms used for Heart Attack prediction

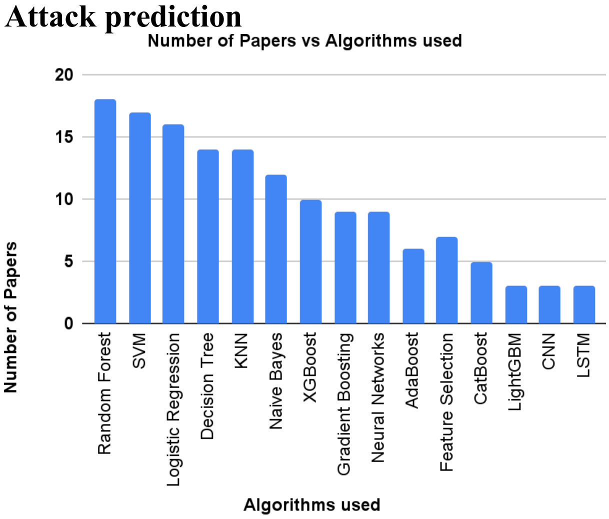

Fig. 3 Distribution of ML Algorithms Used for Heart Attack Prediction

As shown in Fig. 3, many researchers used traditional machine learning algorithms for heart attack prediction. Random Forest, Support Vector Machine, and Logistic Regression were the most commonly used models because they were easy to apply and performed well on small medical datasets. Also, Decision Tree and K-Nearest Neighbors were used widely due to their simplicity. Boosting methods like XGBoost and AdaBoost were used in fewer studies, while deep learning models such as CNN and LSTM were rarely applied.

2.2 Analysis of Datasets used for Heart Attack prediction

Many researchers utilized publicly available datasets for heart attack prediction, as shown below in Fig.4. The UCI Heart Disease dataset is the most commonly used, followed by Kaggle datasets. Fewer studies used real hospital clinical data or combined datasets from multiple sources. Only a very small number of papers used IoT, ECG time-series, sleep, or large clinical datasets.

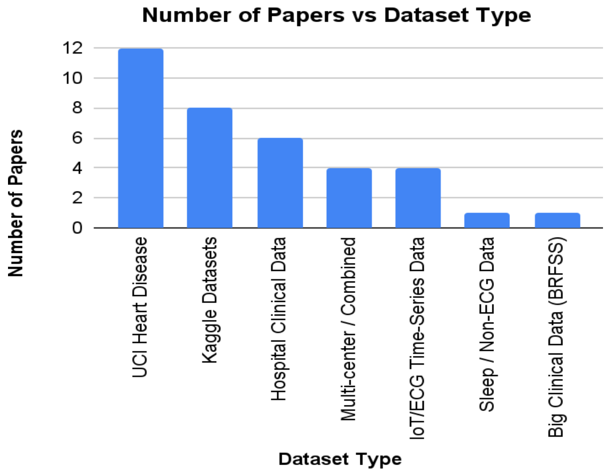

Fig. 4 Comparison of Dataset Utilized in Heart Attack Prediction

With analyzing the above papers as represented in Table 1, Fig. 3 and Fig. 4 we found there are some limitations that are listed below:

1) Requires more explainable AI methods,
2) Small dataset were used which reduces generalizability and high risk of overfitting,
3) Dataset imbalance required undersampling → loss of information,

4) Model performance comparison limited to classical ML algorithms only no comparison with hybrid ensemble methods
5) There is limited availability of labeled data which requires self-training assumptions and also there is limited interpretability.

3. PROPOSED METHODOLOGY

The aim of the proposed methodology shown below in Fig. 5, is to build a heart attack prediction system and to overcome most common gaps found in research, such as lack of explainability, unstable performance on small datasets, limited clinical features, data imbalance, and low generalization.This research combines advanced machine learning models, proper data preparation, hybrid sampling techniques, enhanced feature selection, and explainable AI tools like SHAP and LIME to address these problems.

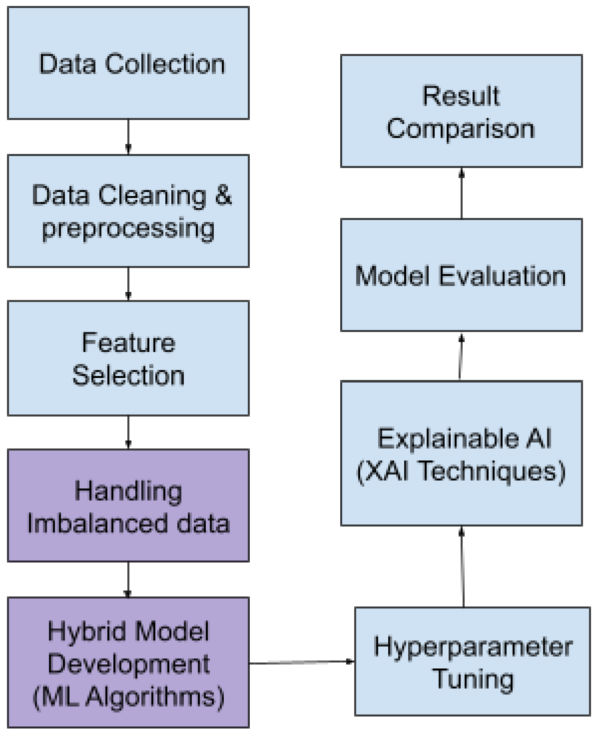

Fig. 5 Proposed Methodology of Heart Attack Prediction

The proposed method will begin with collecting heart-related medical data from reliable sources. After that, the data will be cleaned by fixing missing values, removing errors, and preparing it for analysis. The most important features will then be selected so that the model focuses only on useful information. To improve prediction quality, techniques for handling imbalanced data will be applied.

Next, a hybrid machine-learning model will be developed by combining multiple algorithms to get stronger and more accurate results. The model's settings will then be tuned to improve its performance. Explainable AI (XAI) methods will be used to show why the model makes certain predictions, helping doctors understand the output clearly. Finally, the model will be evaluated, and its results will be compared with other methods to show its overall effectiveness.

4. CONCLUSION

This review paper looked at many research studies on heart attack prediction using different machine learning techniques with different algorithms and available datasets. After carefully studying all the papers we found that several machine learning algorithms—such as Logistic Regression, Random Forest, SVM, Decision Trees, and KNN - have been utilized to predict heart attack risk. Many studies reported good accuracy, which shows that machine learning can be very helpful for early detection. However, it is observed that many studies used small or imbalanced datasets, limited medical features, or data from only one region or hospital. Some approaches also lack proper data balancing techniques and model explainability, which are important for clinical trust and decision-making. Overall, this review concludes although machine learning has shown promising results in heart attack prediction, there is still significant scope for improvement. Future research can focus on using larger and more diverse datasets, incorporating richer clinical and lifestyle features, applying advanced data balancing methods, and developing hybrid or ensemble models. Addressing these research gaps can lead to more accurate, reliable, and trustworthy heart attack prediction systems that can effectively support doctors and improve patient care.

5. REFERENCES

[1] V. Selvakumar, A. Achanta and N. Sreeram, "Machine Learning based Chronic Disease (Heart Attack) Prediction," 2023 International Conference on Innovative Data Communication Technologies and Application (ICIDCA), Uttarakhand, India, 2023.

[2] M. Kumar, D. P. Sekhar, K. N. Siddhartha, U. Pilania, K. S. Reddy and A. Shashank, "Heart Attack Prediction Using Machine Learning Algorithms," 2024 International Conference on Cybernation and Computation (CYBERCOM), Dehradun, India, 2024.

[3] Mishra S, Pandey M and Routaray SS. Feature optimized hybrid model for prediction of myocardial infarction [version 1; peer review: awaiting peer review]. F1000Research 2025.

[4] C. Li, Y. Zhao, Q. Mo, Z. Wang and X. Xu, "Prediction of Myocardial Infarction Based on Non-ECG Sleep Data Combined With Domain Knowledge," in IEEE Access, vol. 13,

[5] pp. 42262-42271, 2025.

[6] K. Tn, S. C. P, M. S, A. Kodipalli, T. Rao and S. Kamal, "Prediction of Early Heart Attack Possibility Using Machine Learning," 2023 2nd International Conference for Innovation in Technology (INOCON), Bangalore, India, 2023, pp. 1-5.

[7] S. P. Sreeja, V. Asha, G. Kumar, S. Chandan, N. R. Divyashree and B. Nithya, "Comparative Analysis of Machine Learning Models for Heart Attack Prediction," 2025 International Conference on Advances in Modern Age Technologies for Health and Engineering Science (AMATHE), Shivamogga, India, 2025, pp. 1-5.

[8] T. Kujani, P. Arivubrakan and B. R, "Optimal Feature Selection and Classification with Firework Optimization for Heart Attack Prediction by Machine Learning Classifiers," 2025 5th International Conference on Pervasive Computing and Social Networking (ICPCSN), Salem, India, 2025, pp. 542-546.

[9] L. Chen, "Heart disease prediction utilizing machine learning techniques", TMBLS, vol. 3, pp. 35–50, Mar. 2024.

[10] S. Kora, V. Bijalwan, D. D and V. K. B, "Optimized Semi-Supervised Machine Learning Approach for Heart

Attack Prediction," 2025 IEEE 4th World Conference on Applied Intelligence and Computing (AIC), GB Nagar, Gwalior, India, 2025, pp. 797-802.

[11] Y. Bonthu, S. Mannam, G. Kandikunta, V. G. Keshagani and G. Sarath, "Heart Attack Risk Prediction Using Advanced Machine Learning Techniques," 2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT), Kamand, India, 2024, pp. 1-6.

[12] M. S. Manoj, K. Madhuri, K. Anusha and K. U. Sree, "Design and Analysis of Heart Attack Prediction System Using ML," 2023 IEEE International Conference on Integrated Circuits and Communication Systems (ICICACS), Raichur, India, 2023, pp. 01-06.

[13] J. S. Rose, P. Malin Bruntha, S. Selvadass, R. M. V, B. C. Mary M and M. J. D, "Heart Attack Prediction using Machine Learning Techniques," 2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2023, pp. 210-213.

[14] M. G. Chitra and R. Govindaraj, "Effective Heart Attack Prediction method using Machine Learning Algorithm," 2024 10th International Conference on Communication and Signal Processing (ICCSP), Melmaruvathur, India, 2024.

[15] Imen Boudali, Sarra Chebaane, Yassine Zitouni,"A predictive approach for myocardial infarction risk assessment using machine learning and big clinical data",Volume 5, June 2024, 100319 Elsevier _ scopus indexed.

[16] Mohammad Alshraideh, Najwan Alshraideh,Abedalrahman Alshraideh ,Yara Alkayed,Yasmin Al Trabsheh,and Bahaaldeen Alshraideh, 'Enhancing Heart Attack Prediction with Machine Learning: A Study at Jordan University Hospital',Hindawi

[17] Applied Computational Intelligence and Soft Computing Volume 2024, Article ID 5080332.

[18] S. M. Joshi et al., "Linking Electrocardiogram and Echocardiogram: Comparing Classical Machine Learning and Deep Learning Neural Networks for the Detection of Regional Wall Motion Abnormalities," in IEEE Access, vol. 13, pp. 134519-134528, 2025.

[19] K. Sathya and G. Magesh, "Multimodal Deep Learning for Cardiovascular Risk Stratification: Integrating Retinal Biomarkers and Cardiovascular Signals for Enhanced Heart Attack Prediction," in IEEE Access, vol. 13, pp. 99672-99689, 2025.

[20] Ibrahim et al., "Explainable Prediction of Acute Myocardial Infarction Using Machine Learning and Shapley Values",IEEE Access, 2020.

[21] Bilal et al., 'Explainable AI-Driven Intelligent System for Precision Forecasting in Cardiovascular Disease",Frontiers in Medicine, 2025.

[22] Waqar et al.,"Enhancing Heart Attack Prediction: Feature Identification from Multiparametric Cardiac Data Using Explainable AI", Algorithms (MDPI), 2025.

[23] Fatima & Siddiqi,"Acute Myocardial Infarction: Prediction and Patient Assessment through different Machine Learning Techniques", IJISAE, 2024.

[24] Zeer et al., "Predicting the Risk of Myocardial Infarction(MI) Using Machine Learning(ML)", AJAMTS, 2024.

[25] Haider et al.,"Heart Attack Prediction Using Machine Learning Models: A Comparative Study of Naive Bayes, Decision Tree, Random Forest, and K-Nearest Neighbors", Engineering Proceedings, 2024.

[26] Rana et al.,"Hybrid Machine Learning and Deep Learning Approach for Heart Attack Prediction Using Clinical, Lifestyle,and Time-Series Data with Enhanced Feature Selection and Classification", SEEJPH, 2025.