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INPLASY

Prediction of postoperative mortality risk in patients with moderate to severe MR Undergoing transcatheter edge-to-edge mitral valve repair based on machine learning: a systematic review and meta-analysis

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 6 June 2026 and was last updated on 6 June 2026.

INTRODUCTION

Review question / Objective To systematically evaluate the predictive performance of machine learning (ML)-based models for predicting postoperative mortality risk in patients with moderate to severe mitral regurgitation (MR) undergoing transcatheter edge-to-edge repair (TEER).

Condition being studied Mitral regurgitation (MR) is one of the most common valvular heart diseases worldwide. Moderate to severe MR significantly reduces patient quality of life and survival time. For patients with multiple comorbidities, advanced age, or high surgical risk, TEER using devices such as MitraClip has become a standard treatment option. Despite the increasing use of TEER, predicting post-procedural mortality remains a major challenge, and there is currently a lack of precise, targeted risk assessment tools.

METHODS

Participant or population Patients diagnosed with moderate to severe MR by cardiac color Doppler echocardiography who underwent TEER were included. The outcomes predicted were in-hospital mortality and 1-year mortality after the procedure.

Intervention Exposure was defined as the development of predictive models using machine learning algorithms. Algorithms included but were not limited to naive Bayes, extreme gradient boosting (XGBoost), neural networks, least absolute shrinkage and selection operator (LASSO), logistic regression (LR), and Cox regression.

Comparator Models based on different algorithms or compared against traditional prediction models (if applicable).

Study designs to be included Only cohort studies—both prospective and retrospective—were included.

Eligibility criteria Literature screening and data extraction were independently performed by two researchers and cross-verified.

Inclusion criteria: (1) Study design was a cohort study; (2) Participants were patients diagnosed with moderate to severe MR by cardiac color Doppler echocardiography and treated with TEER; (3) At least one machine learning algorithm was used to build a model predicting postoperative mortality; (4) Primary outcome measure: model performance, assessed primarily by area under the receiver operating characteristic curve (AUC).

Exclusion criteria: (1) Studies focusing solely on risk factors without developing a predictive model; (2) Reviews, meta-analyses, case reports, conference abstracts; (3) Studies where full text could not be obtained; (4) Duplicates or previously published literature.

Information sources We searched PubMed, The Cochrane Library, Web of Science, and Embase databases up to April 2026. Search terms included: mitral regurgitation, edge-to-edge mitral valve repair, machine learning, predictive models, mortality, and related keywords.

Main outcome(s) Model predictive performance, expressed as AUC. Particular emphasis was placed on AUC values for training and test sets in predicting in-hospital mortality and 1-year mortality following TEER.

Quality assessment / Risk of bias analysis Two reviewers independently assessed the risk of bias in included studies using the Prediction Model Risk Of Bias ASsessment Tool (PROBAST). Disagreements were resolved through discussion or by consulting a third reviewer. The evaluation domains included participants, predictors, outcomes, and statistical analysis. The overall risk of bias for each study was determined based on these assessments.

Strategy of data synthesis Data analysis was conducted using R 4.5.2 software. Meta-analysis was performed on the AUC values of the best models reported in each study. Heterogeneity was assessed using the chi-square test (significance level $\alpha = 0.1$) combined with the I^2 statistic (with 50% as the threshold). Given differences among the included studies in model development methods and population characteristics, a random-effects model was primarily used for pooling. Funnel plots, Egger's test, and trim-and-fill method were employed to assess publication bias.

Subgroup analysis When substantial heterogeneity was observed, subgroup analyses—such as distinguishing between traditional prediction models and machine learning-based prediction models—were conducted to explore potential sources of heterogeneity.

Sensitivity analysis A leave-one-out sensitivity analysis was performed to evaluate the robustness of the meta-analysis results.

Country(ies) involved Cadre Ward, Department of Cardiology, Gansu Provincial People's Hospital, 730000, Lanzhou, Gansu, China.

Keywords Mitral regurgitation, Transcatheter mitral valve edge-to-edge repair, Machine learning, Mortality, Prediction model, Systematic review.

Contributions of each author

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