International Platform of Registered Systematic Review and Meta-analysis Protocols

INPLASY

Machine Learning Applications in Heart Failure: A Protocol for a Scoping Review of Systematic Reviews and Meta-Analyses

INPLASY2025120009
doi: 10.37766/inplasy2025.12.0009
Received: 2 December 2025
Published: 2 December 2025

Wu, HB; Wu, K; Ma, J; Wang, K; Shao, JM; Yu, J.

Corresponding author:
Jing Yu

ery_jyu@lzu.edu.cn

Author Affiliation:
Department of Cardiology, The Second Hospital and Clinical Medical School, Lanzhou University, Lanzhou, China.

ADMINISTRATIVE INFORMATION

Support - NSFC 81960086,82160089.

Review Stage at time of this submission - Data extraction.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY2025120009

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 9 December 2025 and was last updated on 9 December 2025.

INTRODUCTION

Review question / Objective This scoping review systematically synthesizes and compares evidence from existing systematic reviews and meta-analyses on machine learning (ML) applications in heart failure (HF). Its primary aim is to elucidate performance disparities among heterogeneous ML methods across diverse clinical settings in HF, identify optimal ML methods for developing accurate predictive models, and formulate evidence-based recommendations on the applicability, merits, and limitations of different ML methods in HF. The ultimate goal is to facilitate clinicians' risk stratification and evidence-based therapeutic decision-making for addressing complex clinical challenges in HF management.

Background HF is a heterogeneous clinical syndrome markedly characterized by high morbidity and mortality, whose symptoms and signs result from any structural or functional impairment affecting ventricular filling or ejection. Globally, the prevalence of HF is estimated to exceed 64 million cases. Currently, driven by ongoing population growth and aging, the burden of HF continues to rise. Clinically overt HF exacerbation is associated with deterioration in health-related quality of life (HRQoL), unplanned hospitalization, increased healthcare utilization, and elevated medical costs. Therefore, medical interventions must be user-friendly, efficient, automated, and highly accurate to improve patient outcomes, reduce healthcare costs, and decrease HF-related mortality.

ML, a subfield of artificial intelligence, integrates computer science, statistics, and mathematical decision theory to identify complex patterns from large-scale datasets. Its clinical applications include prediction, diagnosis, classification, and automated medical image analysis, among others.

Significant performance discrepancies exist among different ML methods across diverse clinical contexts. Selecting an appropriate ML method and developing more accurate predictive models thereon can provide clinicians with powerful tools to facilitate risk prediction and evidence-based therapeutic decision-making, thereby better

addressing the complex clinical challenges in HF management.

Rationale HF is a cardiovascular disease with high global morbidity and mortality, exerting a substantial burden on healthcare systems. In recent years, ML has been increasingly applied in HF-related research, with a gradual surge in relevant systematic reviews and meta-analyses. However, the application scenarios, model types, methodological characteristics, and existing limitations of these published reviews have not been systematically mapped or summarized. Therefore, it is imperative to systematically synthesize and compare ML applications in HF. This provides clinicians with evidence-based references to better manage HF and address complex clinical challenges.

METHODS

Strategy of data synthesis We conducted searches in Embase, Web of Science, and PubMed databases for published articles incorporating the terms "machine learning", "heart failure", "systematic review" or "meta-analysis". The final search date was October 10, 2025. Complete search strategies and database details will be included in the published review.

Eligibility criteria
Inclusion criteria:
– Studies concerning the application of ML in HF.
– Studies categorized as systematic reviews or meta – analyses.
Exclusion criteria
– Studies not published in the English language.
– Studies not peer – reviewed.
– Studies that did not involve models developed for human beings.
– Studies with no full text available.
– Conference abstracts.
– Studies that did not report outcomes of interest.

Source of evidence screening and selection Unique records were compared against the eligibility criteria using Rayyan, an online review tool. Study selection will be carried out by two independent reviewers (Haibin Wu and Kun Wu). For each article, if the two reviewers reach an agreement on the eligibility decision, the article will be included or excluded accordingly. In case of disagreement between the two reviewers, a third reviewer (Jie Ma) will be consulted, and a discussion focusing on the relevant article will be conducted until a consensus is achieved. The articles selected after the first round of screening will proceed to the full-text screening phase. The full-text review will be conducted by the same two independent reviewers (Haibin Wu and Kun Wu). In case of disagreement, a third reviewer (Jie Ma) will be consulted to make the final decision.

Data management Data will be independently extracted by Haibin Wu and Kun Wu, with any discrepancies resolved by Ke Wang and Jiming Shao. A pre-designed Excel spreadsheet will extract predetermined data. In case of additional modifications during extraction, a discussion among all six authors (Haibin Wu, Kun Wu, Jie Ma, Ke Wang, Jiming Shao, Jing Yu) will be held to reach a consensus. (details about data extraction items will be published with the review).

Language restriction English.

Country(ies) involved China.

Keywords Machine Learning; Heart Failure; systematic review and meta - analysis.

Contributions of each author
Author 1 - Hai Bin Wu - Haibin Wu led all aspects of the review: study selection, data extraction, data analysis and manuscript drafting.
Email: wuhb2025@lzu.edu.cn
Author 2 - Kun Wu - Kun Wu was involved in study selection, data extraction and data analysis.
Email: wukun2024@126.com
Author 3 - Jie Ma - Jie Ma was involved in study selection, data extraction and data analysis.
Email: maj2023@lzu.edu.cn
Author 4 - Ke Wang - Ke Wang was involved in data extraction and data analysis.
Email: wangke2612@163.com
Author 5 - Jiming Shao - Jiming Shao was involved in data extraction and data analysis.
Email: shaojm1999@163.com
Author 6 - Jing Yu - Jing Yu was involved in data extraction, data analysis and manuscript revision.
Email: ery_jyu@lzu.edu.cn