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Author Affiliation:Independent research project
conducted by the study authors.**HOPE Score Performance for Survival Prediction in Hypothermic Cardiac Arrest patients After Extracorporeal Life Support: A Systematic Review and Individual Patient Data Analysis**

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ADMINISTRATIVE INFORMATION**Support** - None.**Review Stage at time of this submission** - Data analysis.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202690115**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 25 September 2026 and was last updated on 25 September 2026.**INTRODUCTION**

Review question / Objective The purpose of this study is to evaluate whether the existing HOPE score accurately predicts survival outcomes in patients with accidental hypothermic cardiac arrest undergoing extracorporeal life support (ECLS).

Rationale Accidental hypothermic cardiac arrest is associated with high mortality, although patients who undergo extracorporeal life support (ECLS) for rewarming may achieve meaningful survival despite prolonged cardiac arrest. The Hypothermia Outcome Prediction after Extracorporeal Life Support (HOPE) score was developed to estimate the probability of survival after ECLS rewarming using six clinical variables: age, sex, mechanism of hypothermia, serum potassium concentration, cardiopulmonary resuscitation duration, and core body temperature. The score has demonstrated good discrimination in its derivation and validation cohorts and has subsequently been evaluated in a literature-based cohort of published case reports.

However, additional cases have been reported since the previous literature-based assessment, and the performance of the HOPE score in this expanding body of published patient-level evidence warrants reassessment. Therefore, this updated systematic review aims to identify eligible published cases of accidental hypothermic cardiac arrest treated with ECLS and reassess the performance of the HOPE score by comparing predicted survival with observed outcomes. The primary outcome is survival to hospital discharge, with neurological outcome and additional measures of model discrimination, calibration, and classification performance evaluated as secondary outcomes. Accidental hypothermic cardiac arrest is associated with high mortality, but patients who undergo extracorporeal life support (ECLS) for rewarming may have meaningful survival despite prolonged cardiac arrest. The Hypothermia Outcome Prediction after Extracorporeal Life Support (HOPE) score was developed to estimate the probability of survival after ECLS rewarming using six clinical variables: age, sex, mechanism of hypothermia, serum potassium concentration,

cardiopulmonary resuscitation duration, and core body temperature. Although the HOPE score has been validated in clinical cohorts, its performance in individual cases reported in the literature has not been systematically assessed. Published case reports and case series provide detailed patient-level information that may allow evaluation of the score across a broader range of clinical presentations. Therefore, this systematic review will identify eligible published cases of accidental hypothermic cardiac arrest treated with ECLS and assess the performance of the HOPE score by comparing predicted survival with observed outcomes, with survival to hospital discharge as the primary outcome.

Condition being studied The health condition includes patients with accidental hypothermic cardiac arrest requiring rewarming with extracorporeal life support (ECLS), such as cardiopulmonary bypass (CPB) or extracorporeal membrane oxygenation (ECMO).

METHODS

Search strategy (Extracorporeal Membrane Oxygenation OR "ECMO" OR Extracorporeal Life Support* OR "ECLS" OR Extracorporeal Cardiopulmonary Resuscitation OR "ECPR" OR extracorporeal circulation OR extracorporeal rewarming) AND (Cardiac Arrest OR Heart Arrest OR Asystole* OR Cardiopulmonary Arrest OR Circulatory Arrest) AND (Hypothermia* OR Hypothermic OR "Cold Exposure" OR "Cold Injury").

Participant or population Patients with accidental hypothermic cardiac arrest (CA) who underwent rewarming with extracorporeal life support (ECLS/ECMO).

Intervention HOPE score (Hypothermia Outcome Prediction after Extracorporeal Life Support), calculated using the six predictor variables.

Comparator No separate intervention comparator; HOPE-predicted survival will be evaluated against observed survival outcomes.

Study designs to be included Case reports or case series.

Eligibility criteria Patients will be included if they:

Had accidental hypothermic cardiac arrest.
Received extracorporeal life support (ECLS), including extracorporeal membrane oxygenation

(ECMO) or cardiopulmonary bypass (CPB), for rewarming.

Had a core body temperature $\leq 32^{\circ}\text{C}$ at the time of cardiac arrest.

Had all six variables required to calculate the HOPE score: age, sex, mechanism of hypothermia (asphyxia-related or non-asphyxia-related), serum potassium, CPR duration, and core body temperature.

Had a survival outcome available.

Were reported in published case reports or case series.

Information sources Data will be obtained from patients reported in published case reports and case series. If relevant patient-level data are unavailable in the published reports, the corresponding authors will be contacted to request the missing information. data of the patients reported in the published case reports and case series

When relevant data were unavailable or unclear in the published reports, the corresponding authors were contacted to request additional or clarifying information. contact with authors if any data not available.

Main outcome(s) The primary outcome is survival to hospital discharge, used to assess the predictive performance of the HOPE score in patients with accidental hypothermic cardiac arrest undergoing ECLS rewarming.

Additional outcome(s) Neurological outcome at hospital discharge using the Cerebral Performance Category (CPC).

Data management Data were extracted by two reviewers using a standardized extraction sheet. Extracted data were checked for completeness and consistency, and discrepancies were resolved through discussion and, when necessary, consultation with a third reviewer. Duplicate or potentially overlapping cases were identified and assessed to avoid double counting. Missing or unclear data were recorded as not reported and were not claimed.

Quality assessment / Risk of bias analysis No formal risk-of-bias or methodological quality assessment will be performed because the study is based on individual patient-level data extracted from published case reports and case series.

Strategy of data synthesis Individual patient-level data extracted from eligible case reports and case series will be synthesized descriptively and quantitatively where appropriate. Patient

characteristics, HOPE score components, calculated HOPE scores, predicted survival probabilities, and observed outcomes will be summarized. The primary outcome will be survival to hospital discharge. The performance of the HOPE score will be assessed by comparing predicted survival probabilities with observed survival, including discrimination using the area under the receiver operating characteristic curve (AUC) with 95% confidence intervals. Sensitivity, specificity, positive predictive value, and negative predictive value will be calculated at clinically relevant HOPE-predicted survival thresholds, including the predefined 10% threshold. Continuous variables will be summarized using appropriate measures of central tendency and dispersion, while categorical variables will be summarized as frequencies and percentages. Where sufficient data are available, calibration of predicted versus observed survival will also be assessed. Heterogeneity in patient characteristics and reporting will be considered when interpreting pooled or comparative analyses.

Subgroup analysis No prespecified subgroup analyses are planned.

Sensitivity analysis Sensitivity analyses will be performed, where feasible, to assess the robustness of the findings by excluding cases with uncertain or estimated data and cases with suspected duplicate reporting.

Language restriction No language restrictions were applied.

Country(ies) involved Egypt, United States of America, and United Kingdom.

Other relevant information None.

Keywords Accidental hypothermia; extracorporeal life support; HOPE score; survival prediction.

Dissemination plans The findings will be submitted for publication in a peer-reviewed medical journal and may be presented at relevant scientific conferences. The results will also be shared with clinicians and researchers working in emergency medicine, critical care, cardiology, extracorporeal life support, and accidental hypothermia to support further research and clinical decision-making.

Contributions of each author

Author 1 - Ahmed Hamdi - Title/abstract and full-text screening; data extraction; data management; manuscript writing and revision.

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