An artificial intelligence model for intensive care length of stay, neurological outcome and costs estimation after cardiopulmonary resuscitation: a cohort study.

NCT ID is not yet assigned

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Study Protocol:

In the planned study, we aim to create an artificial intelligence model to predict intensive care length of stay, expected neurological sequelae, and costs using data collected within the first hour of hospital admission and intensive care stay in patients with restored spontaneous circulation after cardiopulmonary resuscitation following cardiac arrest.

A key feature of this research is the ability to predict valuable outcomes early (within the first hour of admission) using easily obtainable data. Unlike many other studies, it combines both in-hospital and out-of-hospital cardiac arrest cases and, with a wide variety of data, aims not only to produce a single prediction model but also to estimate several intensive care outcomes.
The purpose of our study is to create an artificial intelligence model that can predict the length of intensive care stay, cost, patients' consciousness levels, and intensive care duration based on laboratory, demographic, and clinical data obtained during hospitalization in post-CPR (cardiopulmonary arrest) patients once their intensive care stay ends.

After obtaining ethics committee approval and hospital permission, all post-CPR patients admitted to the intensive care unit at Bezmialem Vakıf University Faculty of Medicine Hospital from its establishment date, October 24, 2010, until today (01.09.2025) will be retrospectively examined. Patients over 18 years old, admitted either from within the hospital or brought to the emergency department from outside, who respond to cardiopulmonary resuscitation, will be included in the study.
Demographic information of patients, resuscitation applications, methods and durations, laboratory results taken within the first hour after admission to intensive care, and treatment methods will form the database. A list of more than 70 data points will be filled out for each patient. Missing or incomplete data among these archival records will also be recorded. Patients with more than 80% missing or incomplete data will be excluded from the study.

Collected data will include interventions during resuscitation, drug doses and frequencies, durations, and treatments, interventions, and laboratory results performed in the first hour after achieving spontaneous circulation in the intensive care unit.

The created database will be analyzed using a Machine Learning (ML) artificial intelligence algorithm with the Python software program. Output parameters will be determined as intensive care length of stay,

cost, and neurological sequelae level. To determine the level of neurological sequelae, the Cerebral Performance Category (CPC) scale will be used. According to this scale: CPC 1 and 2 (1 - no or mild sequelae, 2 - moderate sequelae) will be considered positive outcomes; CPC 3-5 (3 - severe sequelae, 4 - vegetative state, 5 - brain death) will be evaluated as negative outcomes.
After processing missing and incomplete data by artificial intelligence, the database will be divided into two parts: model training (training part) and prediction model validation (validation part). Meaningful data will be selected through model training, and a prediction model will be built based on these data. To increase the interpretability of the prediction model and help users understand how and why certain predictions are made, the SHapley Additive exPlanations (SHAP) algorithm will be used. In machine learning, the SHAP technique is used to interpret the decision-making processes of complex machine learning models. Thanks to this model, using data obtained at the time of patient admission and within the first hour, we will be able to predict how many days the patient will stay in intensive care, whether or not they will have neurological sequelae upon discharge, the severity of such sequelae if present, and estimate the hospital's cost burden.

Variables:

- OHCA/IHCA
- Age
- Gender
- Comorbidities
- Circulatory Arrest etiology
- Witnessed/ non-witnessed arrest
- Bystander CPR education state (civilian/nurse/doctor)
- Patent airway at admission (intubated/not intubated)
- Time CA – ROSC
- Time CA-CPR
- Time CPR-ROSC
- Rhythm on arrival
- Time CA-defibrillation

- Number of defibrillations
- Calcium during CPR (yes/no)
- Amiodarone during CPR (yes/no)
- Bicarbonate during CPR (yes/no)
- Magnesium during CPR (yes/no)
- Adrenaline dose during CPR
- Pupillary reflex on arrival (yes/no)
- Ph on arrival
- Hco3 on arrival
- Lactate on arrival
- Pco2 on arrival
- Po2 on arrival
- Spo2 on arrival
- Hb on arrival
- Glucose on arrival
- Base excess on arrival
- Oxyhaemoglobin on arrival
- Carboxyhaemoglobin on arrival
- Initial heart rhythm at ROSC
- HR/ SBP/DBP/MAP at ICU admission
- APACHE/SOFA/ mGCS at ICU admission
- Circulatory shock (inotropes yes/no) at ICU admission
- Therapeutic hypothermia at ICU admission (yes/no)

- WBC
- PLT
- ALB
- CRE
- eGFR
- BUN
- INR
- Fib
- Na
- K
- Trop
- ALT
- AST
- CRP
- Proc
- D-dimer

} at ICU admission

Outcomes:

- Length of stay in ICU (LOS)
- CPC score at discharge
- Costs at discharge

Statistical analysis and Machine Learning Analysis plan:

DATA ANALYSIS METHOD

Independent samples t-test will be used for comparing demographic data, and logistic regression analysis and ROC analysis will be used for predicting significant data in the model.

DATA COLLECTION TOOLS AND FEATURES

The created database will be examined using a Machine Learning (ML) artificial intelligence algorithm with the Python software program. After processing missing and incomplete data by artificial intelligence, the database will be divided into two parts: model training (training part) and prediction model validation (validation part). Meaningful data will be selected through model training, and a prediction model will be built based on these data. To increase the interpretability of the prediction model and to help users understand how and why certain predictions are made, the SHapley Additive exPlanations (SHAP) algorithm will be used. In machine learning, the SHAP technique is used to interpret the decision-making processes of complex machine learning models.