A Clinical Tool for Predicting Post-Stroke Mortality and Evaluating Functional, Clinical, and Social Outcomes.

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Summary

We developed a prediction tool that features a user interface (**UI**) where clinicians can input patient data and access reliable predictions supporting informed decision-making. The tool integrates multiple outcomes and functional goals at different time points: 30-day mortality, fall risk during rehabilitation, and post-rehabilitation outcomes such as return to work and driving, pain, and depression. Machine learning models like XGBoost, Random Forest, and SVM were used for predictions, achieving fair accuracy for mortality (80%+), fall risk (88%+), and functional recovery (70%+).

Introduction

Clinical prediction tools have the potential to enhance the accuracy of prognoses and support personalized rehabilitation plans, while reducing variability in care and promoting equitable access to clinical services. We have used information from over 6,044 patients to develop a tool suitable for clinical settings, predicting mortality rate from stroke related to atrial fibrillation (AF), and post-stroke recovery outcomes, including functional, clinical and social scores at multiple timepoints after discharge.

Methods

The models were trained using datasets from four studies on stroke prediction and post-stroke function [1-4]. We subdivided the tool's prediction into three topics: 1) *pre-rehabilitation* prediction of mortality within 30 days in patients with AF-related stroke; 2) *during-rehabilitation* predictions of falls; and 3) *post-rehabilitation* functional predictions on return to work and driving, pain levels, depression, community participation and more. Input variables included age, gender, heart rate, side/type of stroke, days of hospitalization, medication intake, history and sum of comorbidities, BMI, and clinical scores (e.g., NIHSS).

Logistic Regression, Random Forest (RF), Support Vector Machine (SVM), XGBoost, Linear Discriminant Analysis (LDA), and k-nearest neighbors' classification were implemented. Data preprocessing included scaling and normalization of features. Datasets were partitioned into training (60%), validation (20%), and test sets (20%), with a k-fold cross-validation (k=5). Models were optimized independently through hyperparameter tuning with a grid test, with varying hidden layer sizes, regularization parameters, activation functions, and dropout rates. Model performance was evaluated using accuracy, precision, recall and F1-scores.

Results and Discussion

XGboost performed best for the prediction of death in patients presenting with stroke, number of falls, and depression level. Return to work and driving were predicted with RF models (**Table 1**). We have embedded the trained models into a simple and fast UI, with multiple tabs for each prediction topic, and an input panel for patient related data (**Figure 1**).

Table 1 Model performances

	Accuracy	Precision	Recall	F1
30-day mortality	.81	.55	.51	.50
Number of falls	.88	.73	.64	.66
Depression discharge	.79	.54	.52	.52
Return to work	.70	.70	.66	.67
Return to driving	.78	.80	.76	.76

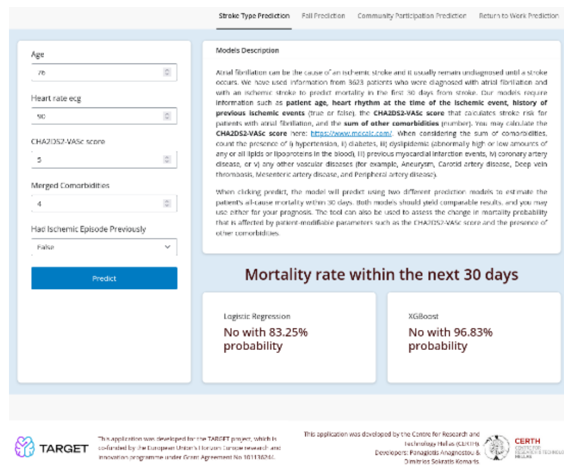

Figure 1 A tab of the UI for stroke-related clinical predictions.

Conclusions

The proposed tool integrates multiple predictions in a clear, user-friendly format, ensuring accessibility for clinicians while supporting informed decision-making. Since discharge is often tied to achieving specific milestones or a defined length of stay, we focused on estimating outcomes at multiple time points. Predictions are tailored to individual patients, incorporating modifiable factors such as BMI and medication intake. Additionally, outputs include functional goals, like the likelihood of returning to work, rather than clinical scores that may be less intuitive for patients and their families.

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