Operation Manual for Prognostic Prediction System After Mechanical Thrombectomy in Patients with Posterior Circulation Large Vessel Occlusion

2024. 09

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1 System Introduction

The incidence of stroke is rising annually, with approximately 33 million individuals affected globally each year. Ischemic stroke comprises about 70-80% of all stroke cases. Among these, acute posterior circulation large vessel occlusion represents a rare yet devastating condition, accounting for approximately 1% of all strokes. Alarmingly, nearly 80% of patients with this condition face either death or severe disability shortly after symptom onset.

To address this critical issue, we have developed a prognostic prediction system tailored for patients with posterior circulation large vessel occlusion who undergo mechanical thrombectomy. This system utilizes advanced machine learning ensemble algorithms to analyze demographic data, laboratory results, and imaging indicators. It automatically generates individualized predictions of functional outcomes for patients undergoing mechanical thrombectomy within 24 hours of symptom onset, focusing specifically on the three-month period following the procedure. The system is designed to aid clinical decision-making and to provide crucial prognostic information to both patients and their families.

This prognostic prediction system is implemented as a web-based application that is user-friendly, efficient, and accessible, allowing users to process relevant data and generate prognostic predictions anytime and anywhere. By facilitating timely and informed decisions in clinical settings, this tool aims to improve patient care and outcomes for those affected by posterior circulation large vessel occlusion.

2 Function Introduction

2.1 Homepage Interface

After logging in, users will be taken to the homepage, which offers a brief introduction to the system, its features, usage instructions, and contact information. Users can download the user manual by clicking the "User Manual" button, and they can access relevant webpages by clicking the links under "Useful Links."

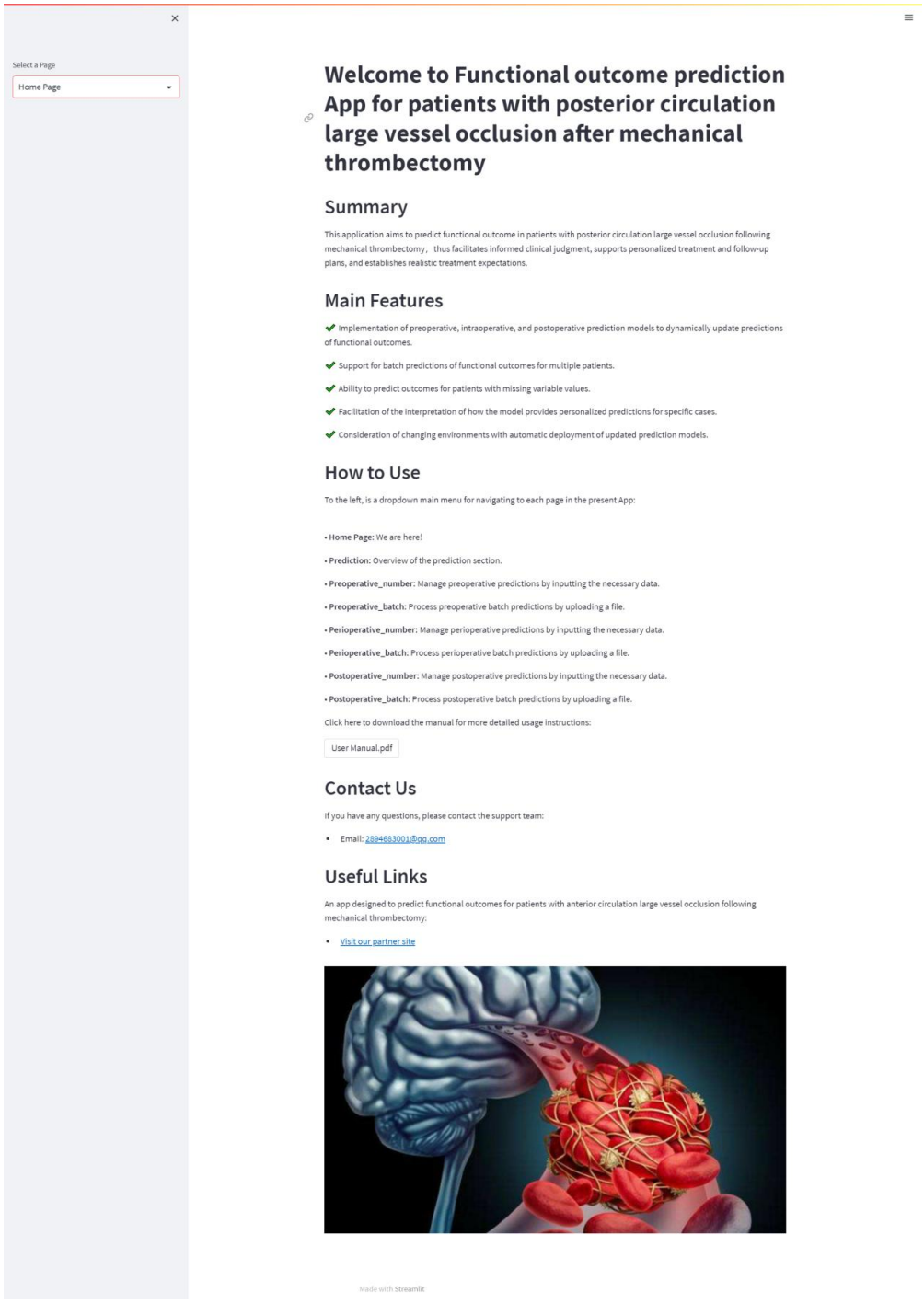

Figure 1

2. 2 Select Data Input Method

Users can access the prediction interface by selecting the option from the left sidebar and clicking the "Prediction" button. This system provides three predictive models — preoperative, intraoperative, and postoperative — to assess the prognosis of patients with occlusion of the large vessels in the posterior circulation who are undergoing thrombectomy. Each model offers two different methods for data input, allowing users to select their preferred format. For example, "Preoperative_number" is for single input, while "Preoperative_batch" allows for batch input, and so forth. This is illustrated in the image below:

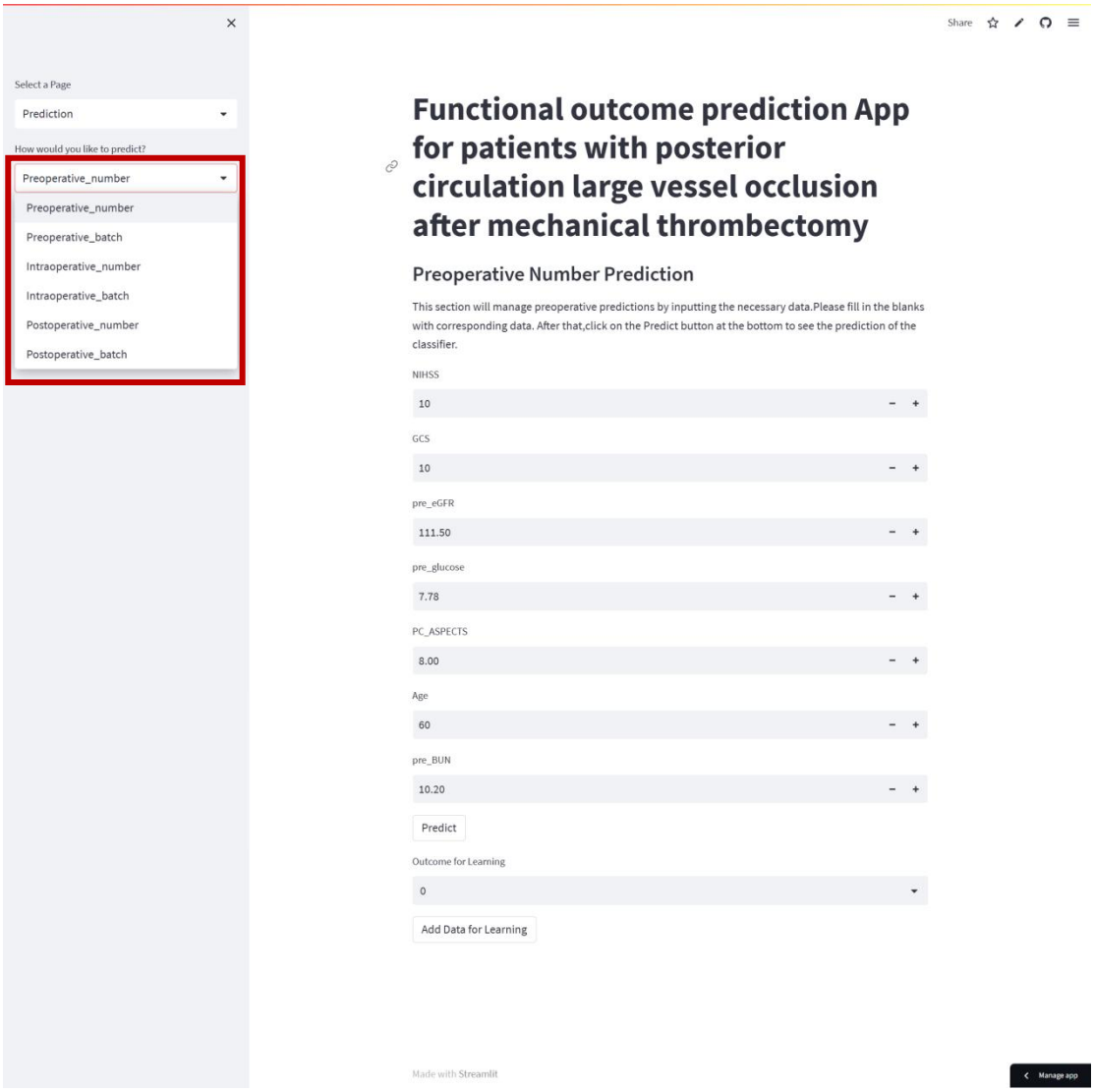

Figure 2

2.3 Manual Data Input Prediction

2.3.1 Data input

By clicking the "Number" button in the left selection bar, users will access the prediction interface for manually entering single data points. In the variable fields, users can input the relevant data and then press the "Predict" button. This will display the predicted probability of a favorable postoperative prognosis for the patient, along with the corresponding SHAP force plot and SHAP values for each variable. A positive SHAP value indicates that the feature contributes positively to the model's prediction, increasing the predicted output. In contrast, a negative SHAP value suggests that the feature has a detrimental effect, decreasing the predicted output. This is illustrated using the preoperative prediction model, as shown in the image below:

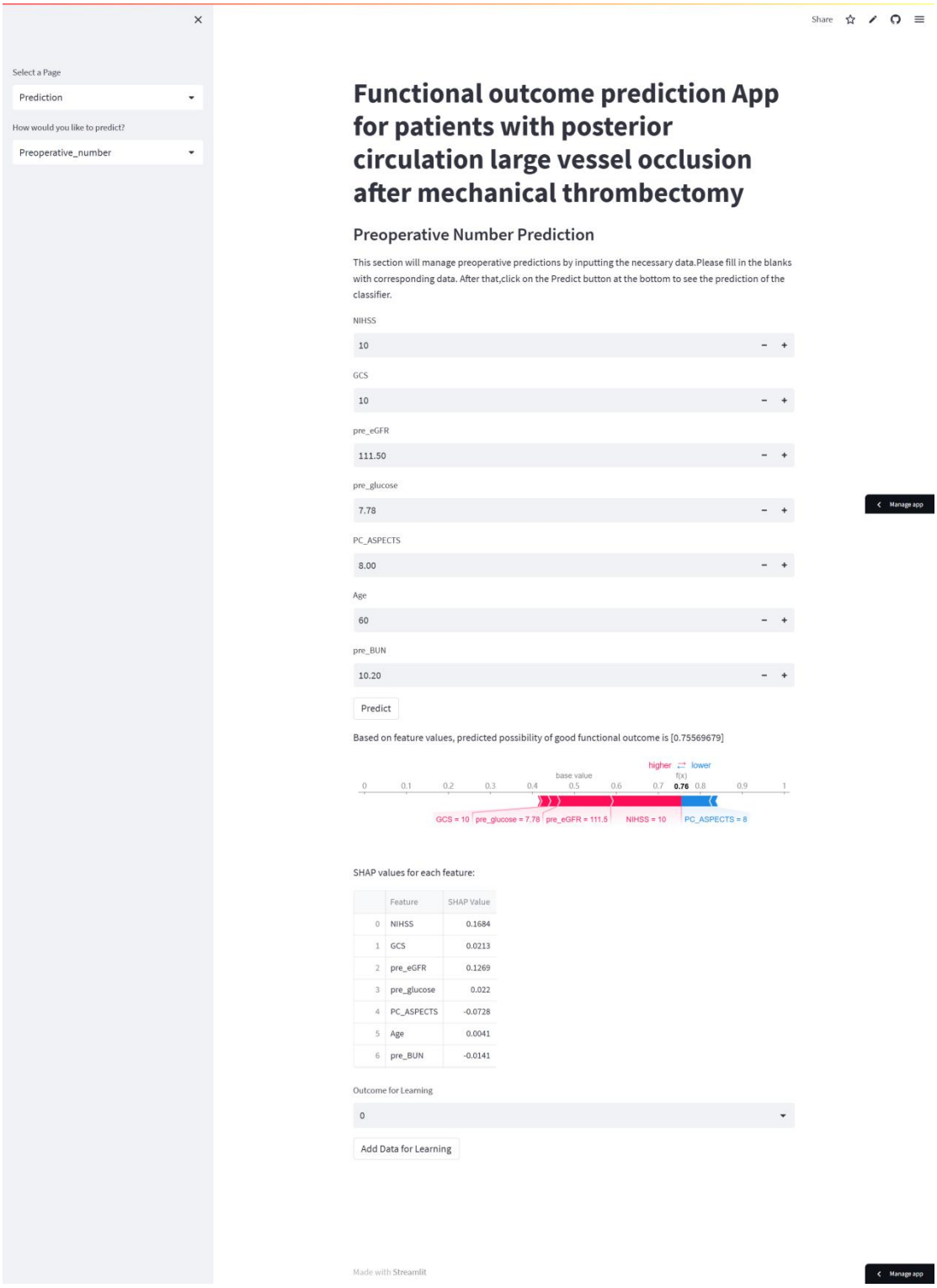
Select a Page
Prediction
How would you like to predict?
Preoperative_number
Share
Functional outcome prediction App for patients with posterior circulation large vessel occlusion after mechanical thrombectomy
Preoperative Number Prediction
This section will manage preoperative predictions by inputting the necessary data.Please fill in the blanks with corresponding data. After that,click on the Predict button at the bottom to see the prediction of the classifier.
NIHSS
10
GCS
10
pre_eGFR
111.50
pre_glucose
7.78
PC_ASPECTS
8.00
Age
60
pre_BUN
10.20
Predict
Based on feature values, predicted possibility of good functional outcome is [0.75569679]
higher
lower
base value
f(x)
0.76
GCS = 10
pre_glucose = 7.78
pre_eGFR = 111.5
NIHSS = 10
PC_ASPECTS = 8
SHAP values for each feature:
Feature
SHAP Value
0 NIHSS 0.1684
1 GCS 0.0213
2 pre_eGFR 0.1269
3 pre_glucose 0.022
4 PC_ASPECTS -0.0728
5 Age 0.0041
6 pre_BUN -0.0141
Outcome for Learning
0
Add Data for Learning
Made with Streamlit
Manage app

Figure 3

2.2.2 Model update

The system allows users to input the actual outcomes of patient follow-ups to assess and update the model's performance in real time. Users can click the "Outcome for Learning" button in the selection bar below to report the actual outcomes. They should input "1" when the actual outcome is favorable and "0" when it is unfavorable, as shown in the image below:

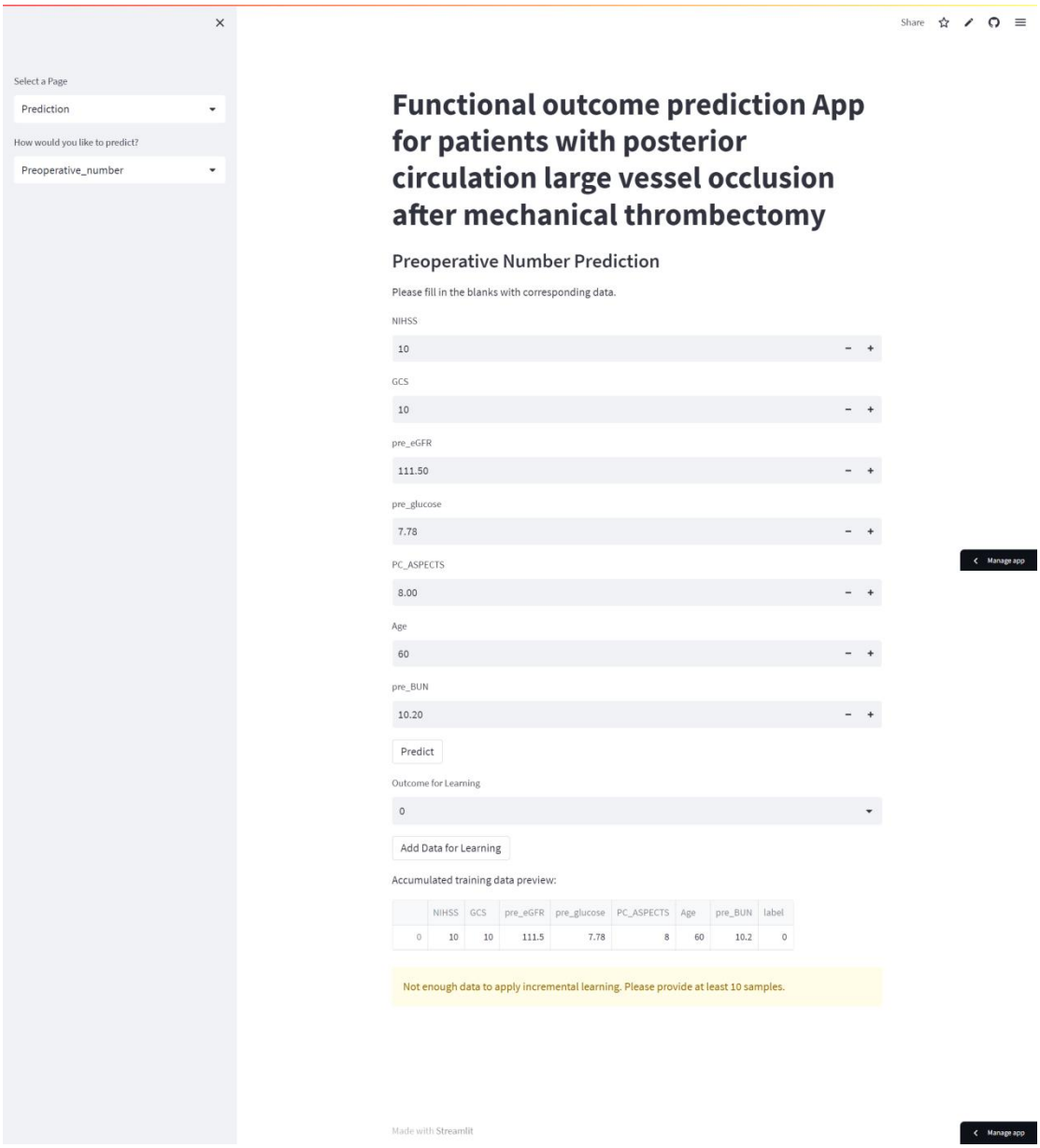

Figure 4

When the sample size added by the user is greater than 10 and the AUC of the model on that batch of patients is lower than the set threshold, the system will automatically update the model based on the data provided by the user.

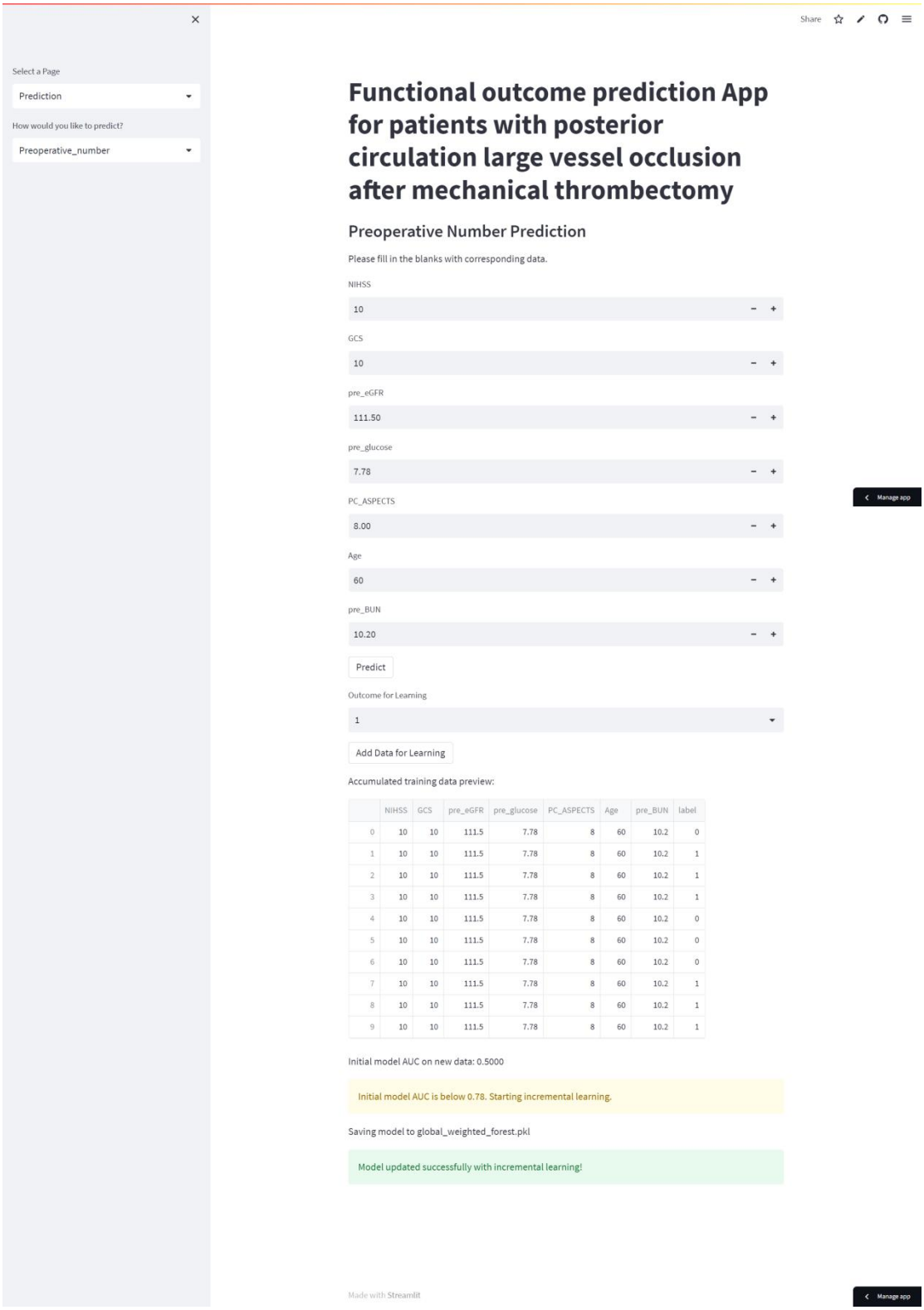

Figure 5

After the model is automatically updated, click the predict button again to enable the updated model for prediction. We can see that the predicted results have changed compared to Figure 3.

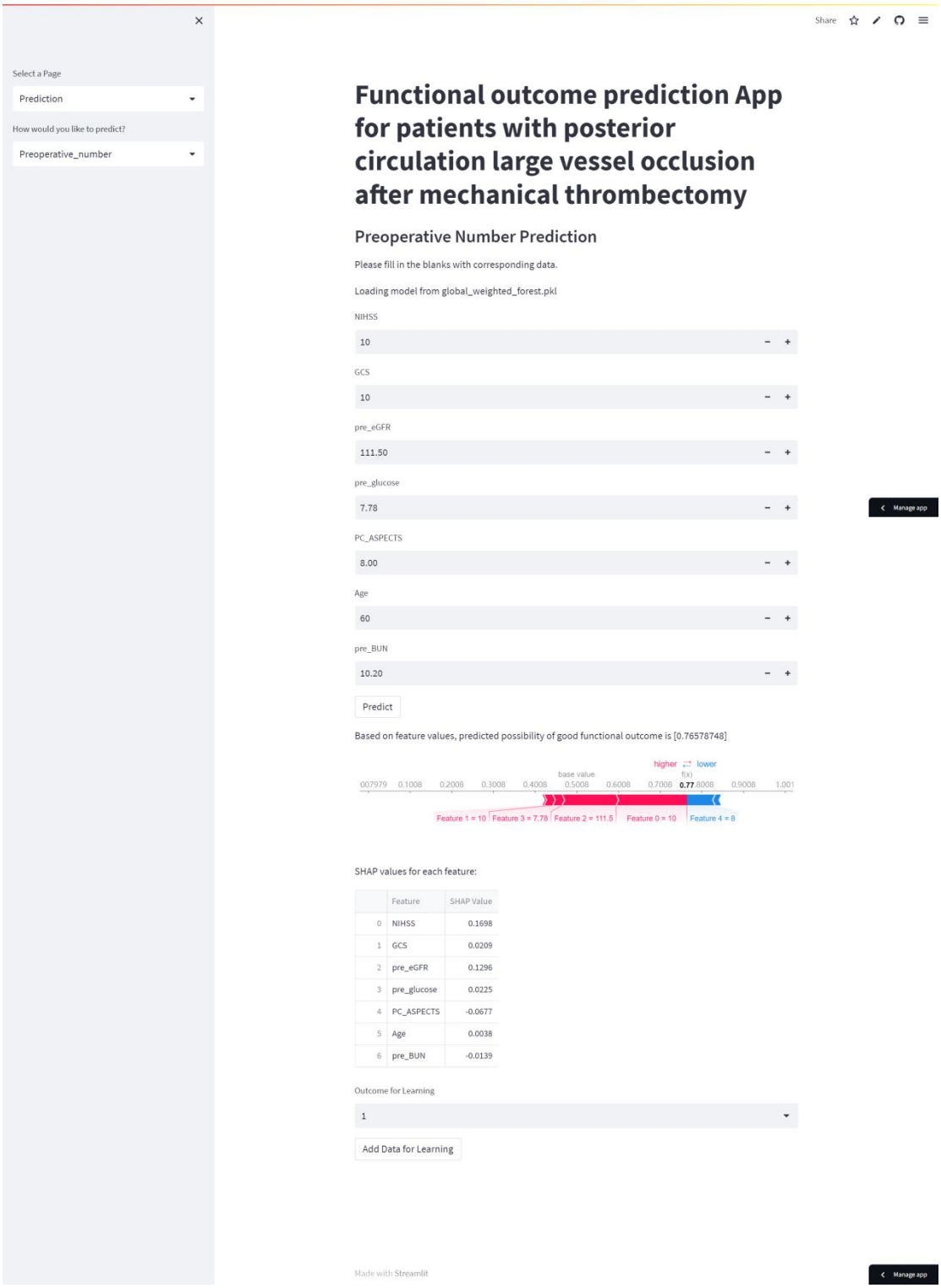

Figure 6

2.4 Table Upload Data Prediction

2.4.1 Download the form

By clicking the "Batch" button in the selection bar on the left, users will access the data upload prediction interface. To download a CSV format template for the postoperative model, simply click the link below the image, as illustrated in the following example:

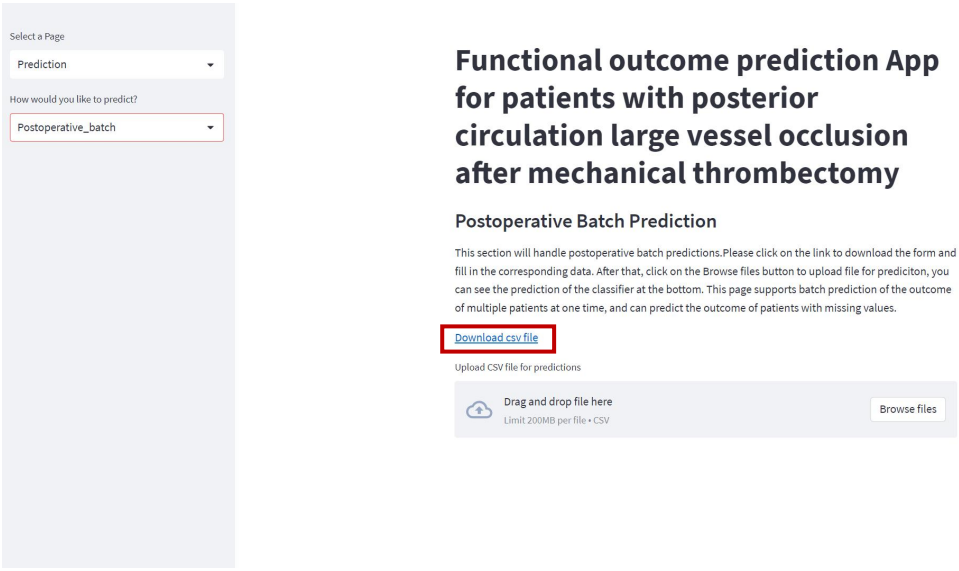

Figure 7

In the downloaded CSV template, fill in the required values for the corresponding indicators in order. This prediction system can perform prognostic assessments for patients with missing values; if any data is unavailable, simply leave the corresponding field blank. Furthermore, the system supports batch predictions for multiple patients, allowing you to enter data for each patient sequentially. Once you have completed all the entries, click "Save" and ensure the file is saved in CSV format, as illustrated in the image below:

	A	B	C	D	E	F	G
1	Age	GCS	PC_ASPECTS	procedural time	post_eGFR	post_NIHSS	
2	60	15	10	60	70	12	
3	70	10		110	69	10	
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
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20							
21							
22							
23							
24							
25							

Figure 8

2.4.2 Upload form

Return to the prediction system interface, click the "Browse files" button to upload the spreadsheet, or drag the CSV file below the image to import the data.

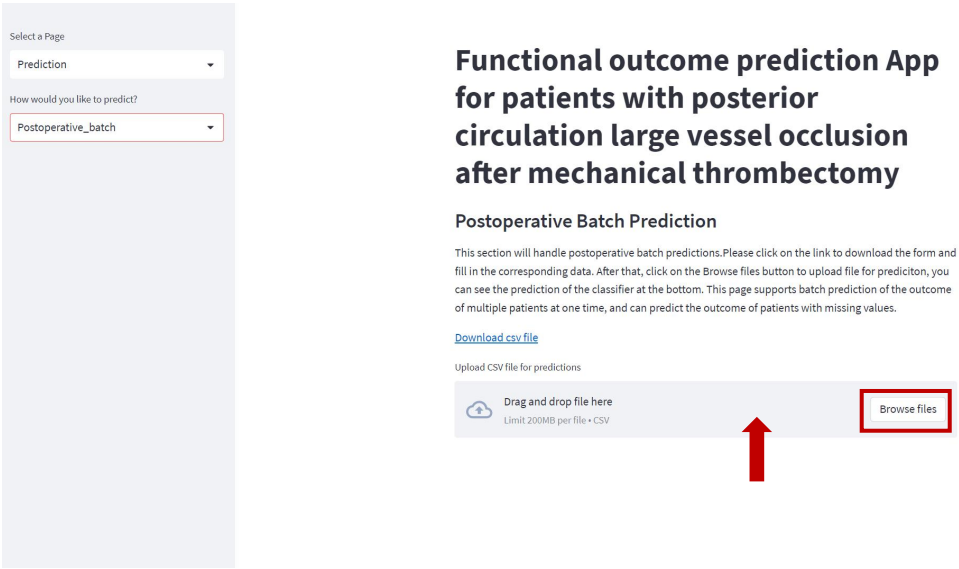

Figure 9

2.4.3 Output result

Once the data is imported, the prognosis prediction results will be displayed automatically. The left column of the output table lists the patient IDs, while the right column labeled "Predictions" indicates the probabilities of favorable outcomes for each patient. To download the CSV file containing the results, click on "Download predictions with results," as shown in the image below:

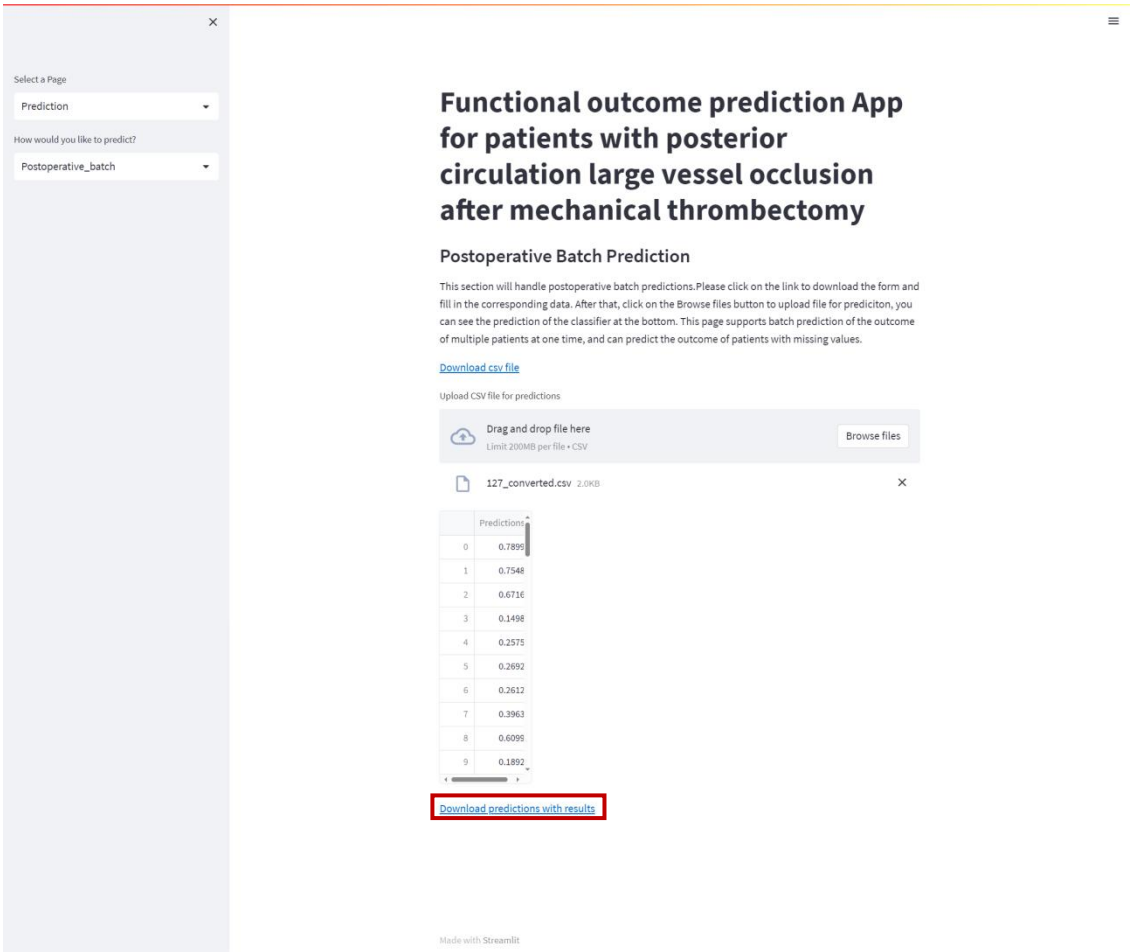

Figure 10

2.4.4 Model update

This prediction system enables users to evaluate model performance and automatically update the model. Users can add an "MRSI" column to the right of the feature column in the downloaded CSV file and input the actual prognosis of the patients. Enter "1" for favorable outcomes and "0" for unfavorable outcomes. After making these updates, simply import the modified CSV file back into the system as described earlier. When users provide more than 10 samples, the system will automatically assess the model's accuracy, recall, precision, F1 score, AUC, Brier score, and other performance metrics. It will also generate the corresponding ROC curve and calibration plot, as shown in the image below:

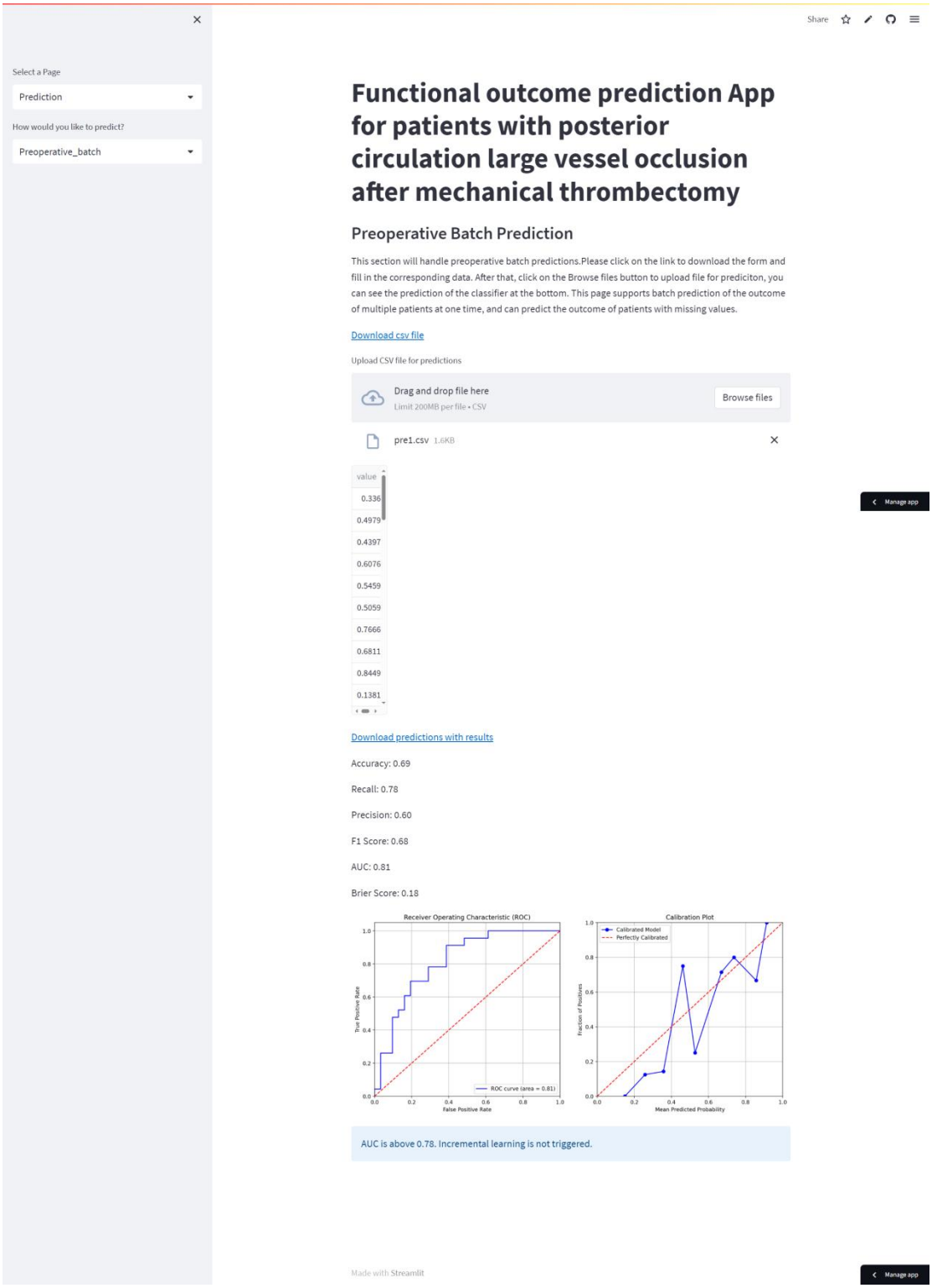

Figure 11

When the sample size added by the user is greater than 10 and the AUC of the model on that batch of patients is lower than the set threshold, the system will automatically update the model based on the data provided by the user.

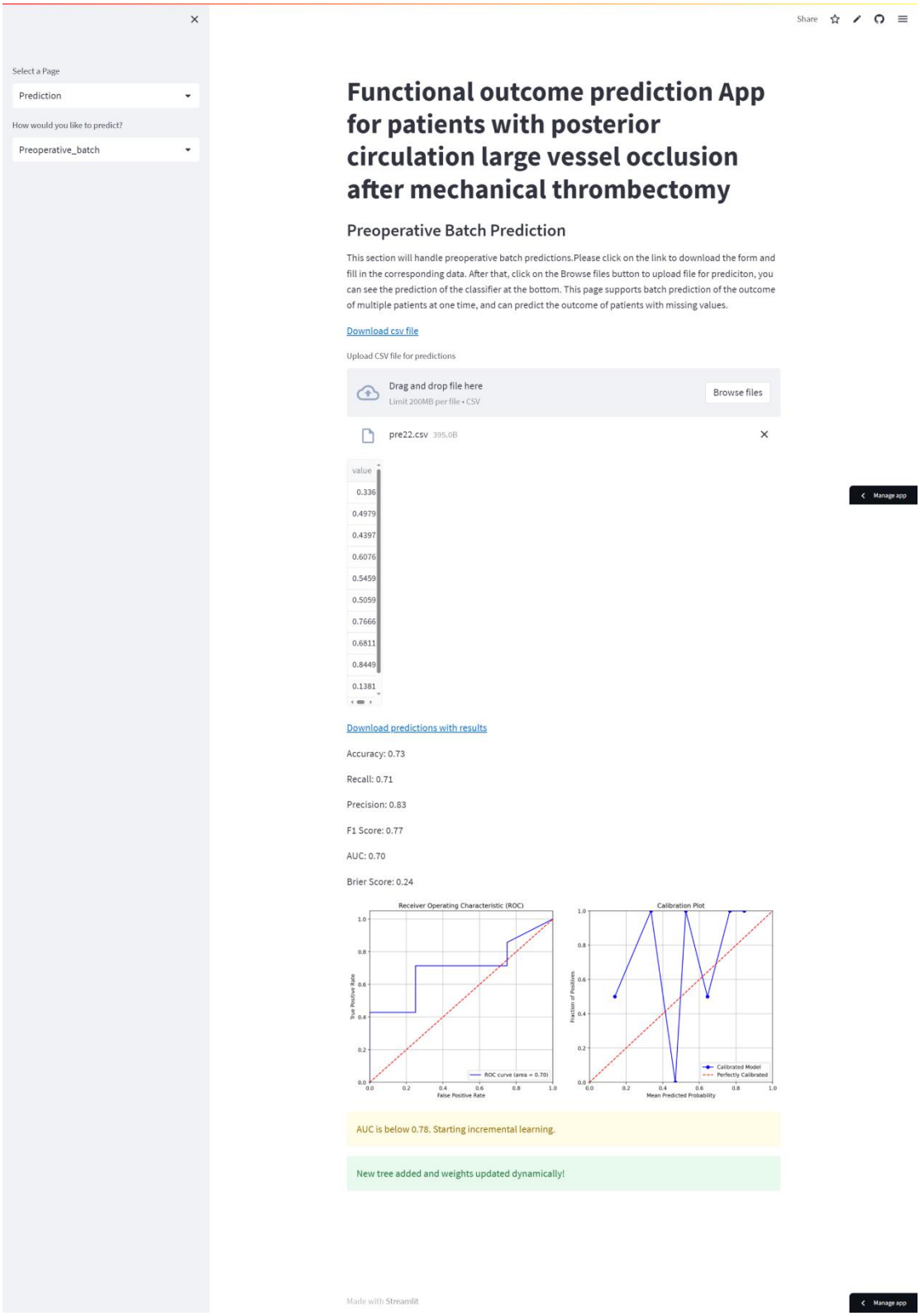
Share
Select a Page
Prediction
How would you like to predict?
Preoperative_batch
Functional outcome prediction App for patients with posterior circulation large vessel occlusion after mechanical thrombectomy
Preoperative Batch Prediction
This section will handle preoperative batch predictions.Please click on the link to download the form and fill in the corresponding data. After that, click on the Browse files button to upload file for prediciton, you can see the prediction of the classifier at the bottom. This page supports batch prediction of the outcome of multiple patients at one time, and can predict the outcome of patients with missing values.
Download csv file
Upload CSV file for predictions
Drag and drop file here
Limit 200MB per file • CSV
Browse files
pre22.csv 395.0B
value
0.336
0.4979
0.4397
0.6076
0.5459
0.5059
0.7666
0.6811
0.8449
0.1381
Download predictions with results
Accuracy: 0.73
Recall: 0.71
Precision: 0.83
F1 Score: 0.77
AUC: 0.70
Brier Score: 0.24
Receiver Operating Characteristic (ROC)
True Positive Rate
False Positive Rate
ROC curve (area = 0.70)
Calibration Plot
Fraction of Positives
Mean Predicted Probability
Calibrated Model
Perfectly Calibrated
AUC is below 0.78. Starting incremental learning.
New tree added and weights updated dynamically!
Made with Streamlit
Manage app

Figure 12