

# Unimodal versus Multimodal deep learning prediction of new onset postoperative atrial fibrillation using preoperative electrocardiograms

**Objective:** Although new-onset post operative atrial fibrillation (nPOAF) occurs in up to one third of cardiac surgery patients, efforts to reliably screen at-risk patients have been unsuccessful. Deep learning has been used to predict new onset atrial fibrillation in the general population using electrocardiograms (ECG). Thus, we examined whether a multimodal deep learning approach could predict nPOAF in cardiac surgical candidates using ECG data.

**Method:** Between 2004 and 2022, 4,108 patients without any history of atrial fibrillation (AF) underwent elective coronary bypass, mitral or aortic valve surgery at a single institution. Patients were selected based on a 12-lead ECG read as normal within 30-days of operation and no reported history of AF. Data were allocated to training, validation and testing sets in a 7:1:2 ratio. Multiple studies per patient was admissible for training but not for testing. We leveraged transfer learning using open-source ECG dataset PTB-XL in order to boost the performance of the ECG model. We then compared performance of unimodal tabular and ECG models with multimodal data fusion approaches.

## Results

Using STS data elements and preoperative electrocardiogram data, we developed a deep learning framework that fuses these data to predict nPOAF (figure). The incidence of nPOAF over this timeframe was 26.5%. On the hold-out set, a tabular approach demonstrated an AUC of 0.68 (Precision: 0.28, Recall: 0.63) and an ECG-only approach showed an AUC of 0.54 (Precision: 0.28, Recall: 0.72). When examining intermediate and late fusion techniques for multimodal model enhancement, the AUC was 0.64 and 0.63 respectively (Precision: 0.28, Recall: 0.72). All multimodal (NPV: 0.86, Specificity: 0.53), unimodal tabular (NPV: 0.85, Specificity: 0.53) and unimodal ECG (NPV: 0.82, Specificity: 0.56) models demonstrated fair discriminatory value for negative cases:

## Conclusions:

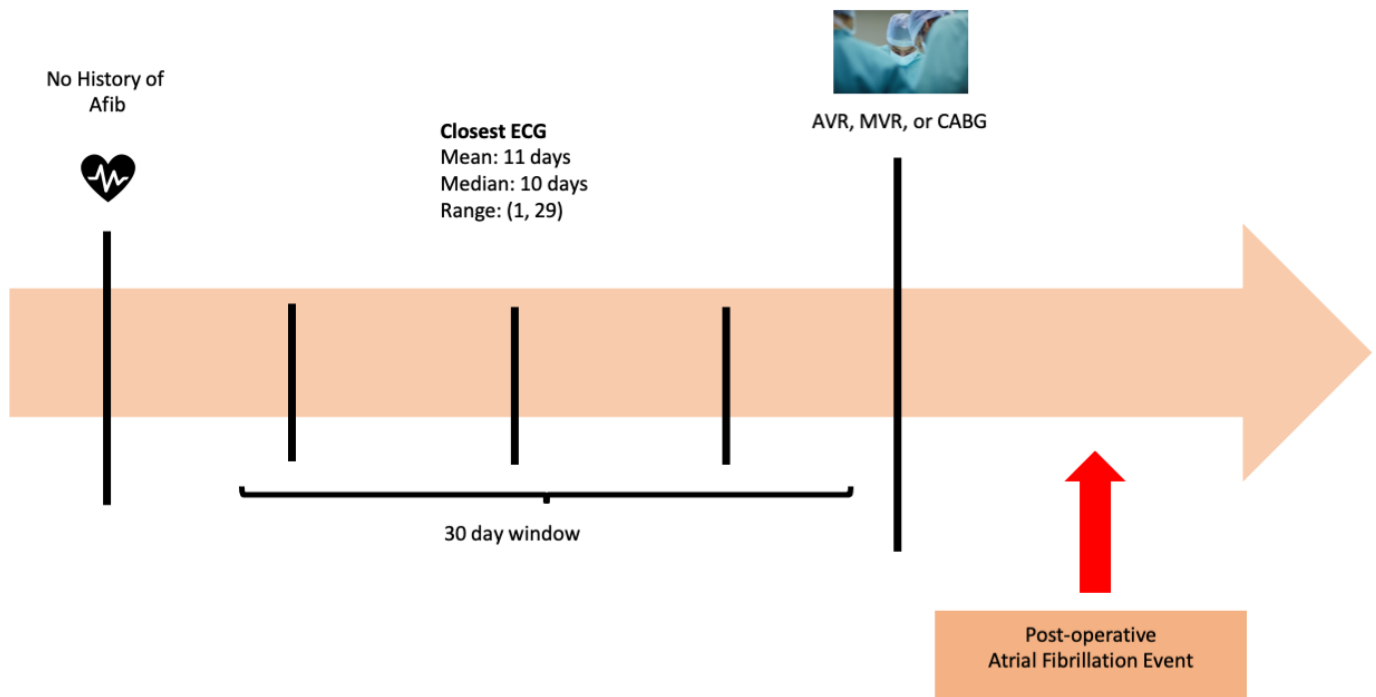
The accurate prediction of nPOAF remains challenging and these findings suggest that unstructured pre-operative variables such as rhythm data do not enrich current models. Data augmentation with variables that more accurately reflect pre-operative patient state are needed to improve prediction of this heterogeneous condition. Use of artificial intelligence models may have better clinical utility in screening out low-risk patients, which eliminates the need for medical prophylaxis and enables early discharge, thus optimizing healthcare resources.

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## Identified 4,108 patients with normal rhythms preoperatively



## Unimodal models compared to multimodal models for POAF prediction

