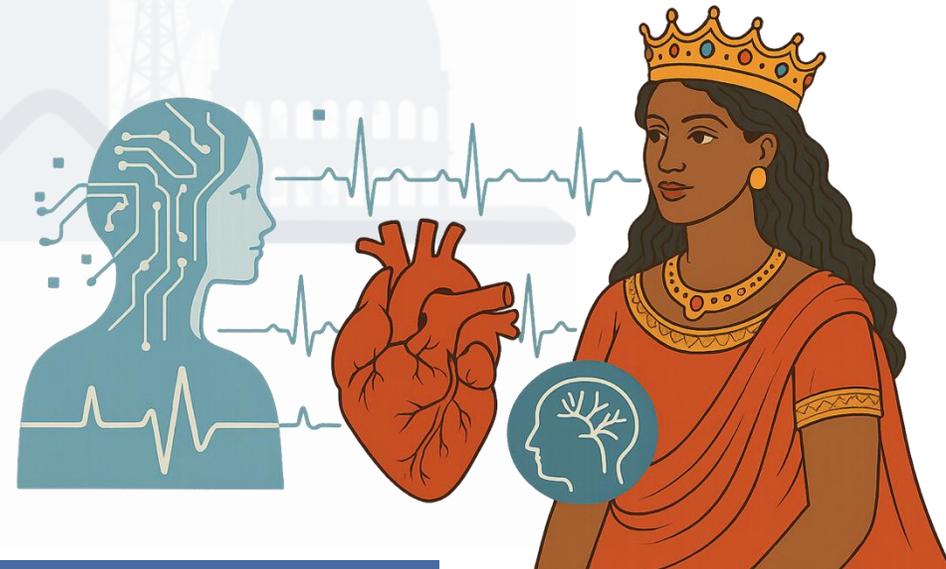


# Analyse de l'ECG par l'IA :

la reine de Saba de la prédiction de la cardiopathie,  
FA et possiblement des événements cardio-neuro  
emboliques ?

Pr Charles Guenancia

Cardiologie CHU DIJON

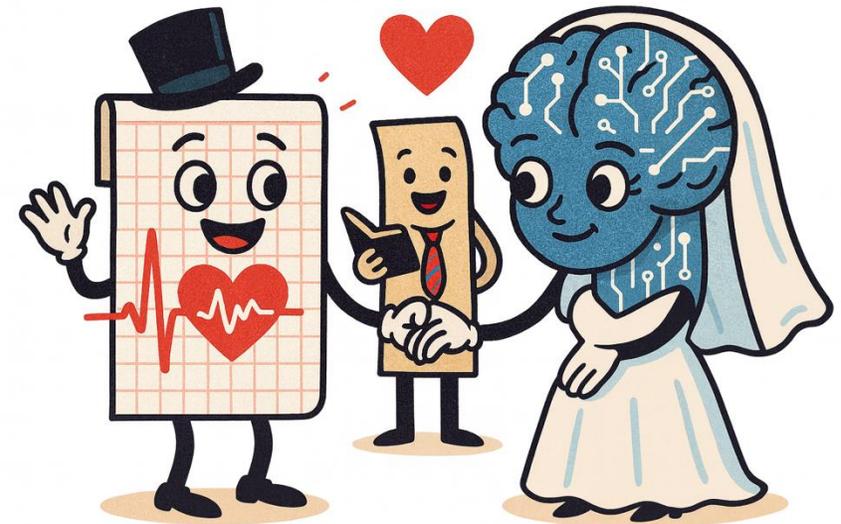


# Liens d'intérêt

- Bourses de Recherche : MicroPort CRM
- Consultant : Abbott, Medtronic, Pfizer
- Honoraires : Astra-Zeneca, BMS-Pfizer, AOP Pharma

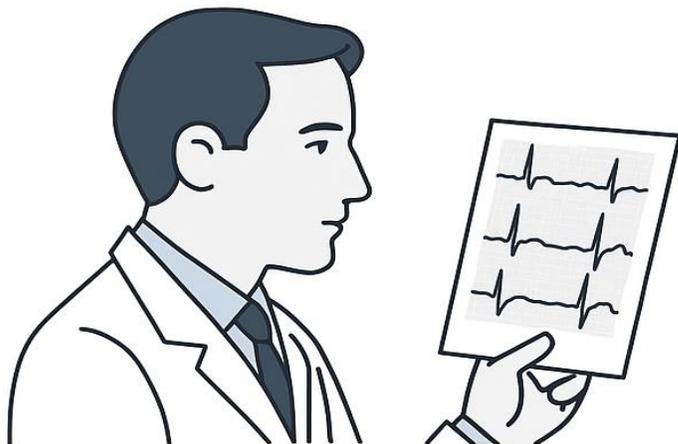
# ECG & IA : **le mariage parfait !**

- Ubiquitaire (millions de tracés existants) et depuis longtemps
- Rapport signal /bruit élevé
- Nombreux éléments à prédire
- Facile à diffuser à grande échelle



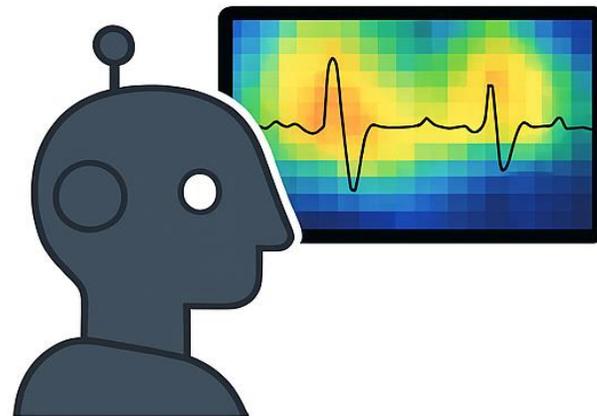
# Pourquoi j'aurais besoin de l'IA, je sais lire un ECG !

## Humain



- mesure des intervalles
- dépend de l'expérience
- interprétation physiologique
- sensible au bruit

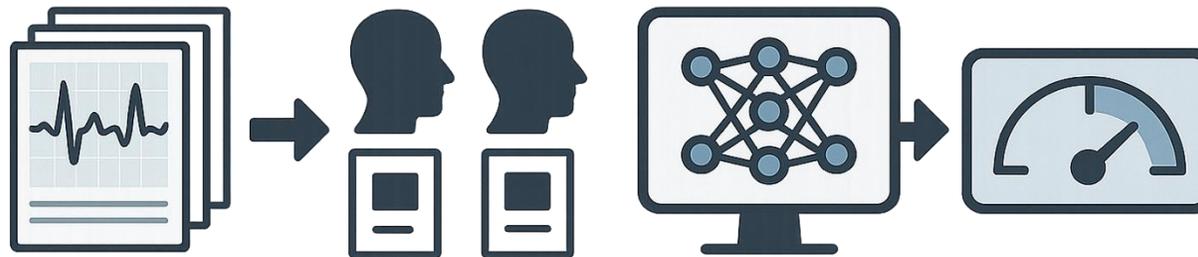
## IA



- analyse de motifs temporels très fins
- dépend de la qualité des labels
- boîte noire
- robuste si dataset massif

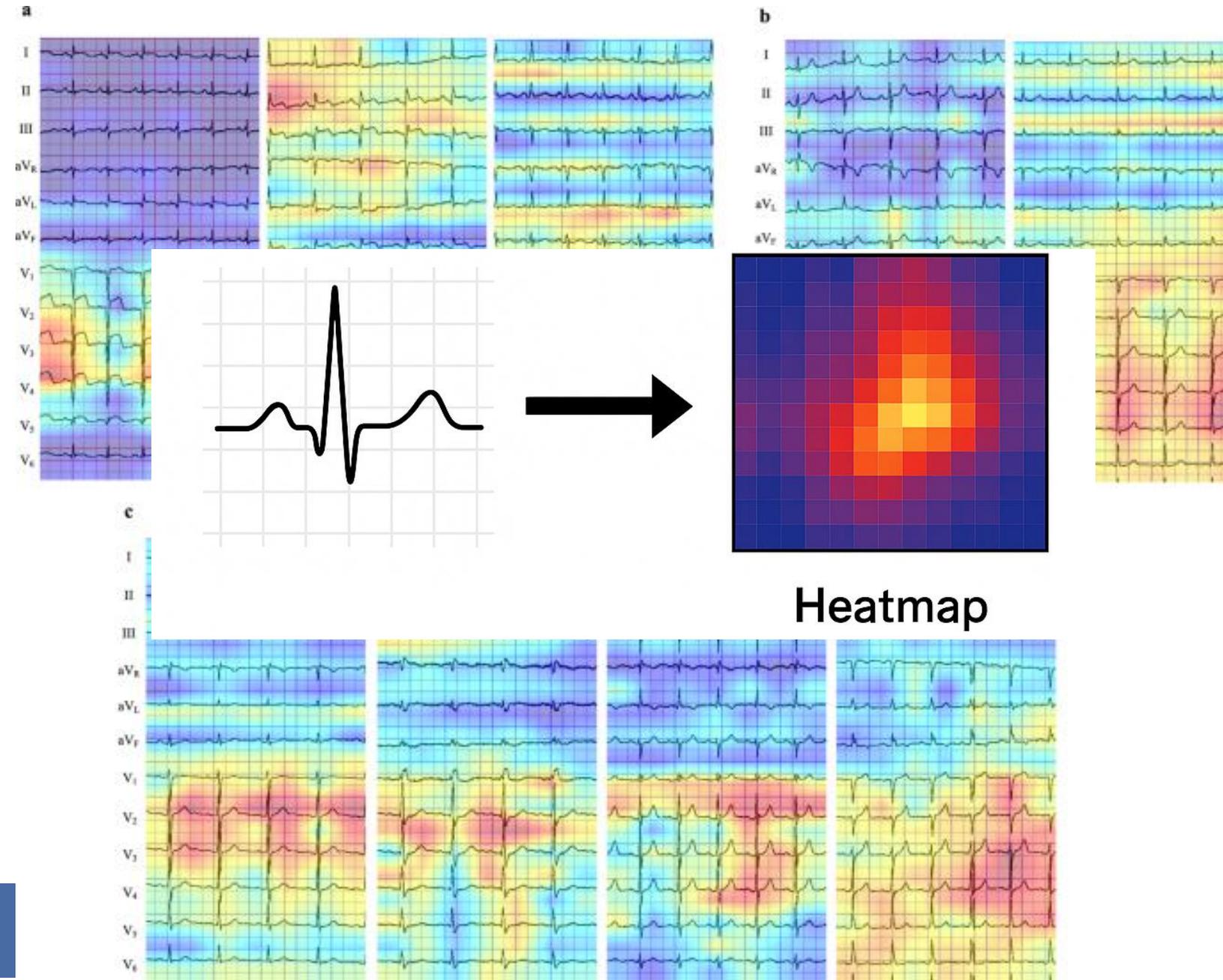
# L'IA ne lit pas, **elle prédit**

- Entraînement supervisé
- Milliers d'ECG labelisés par des experts (par exemple FA au suivi)
- Entraînement (CNN) = extraction automatique des motifs temporels
- Validation externe, ROC/AUC
- Sortie = probabilité



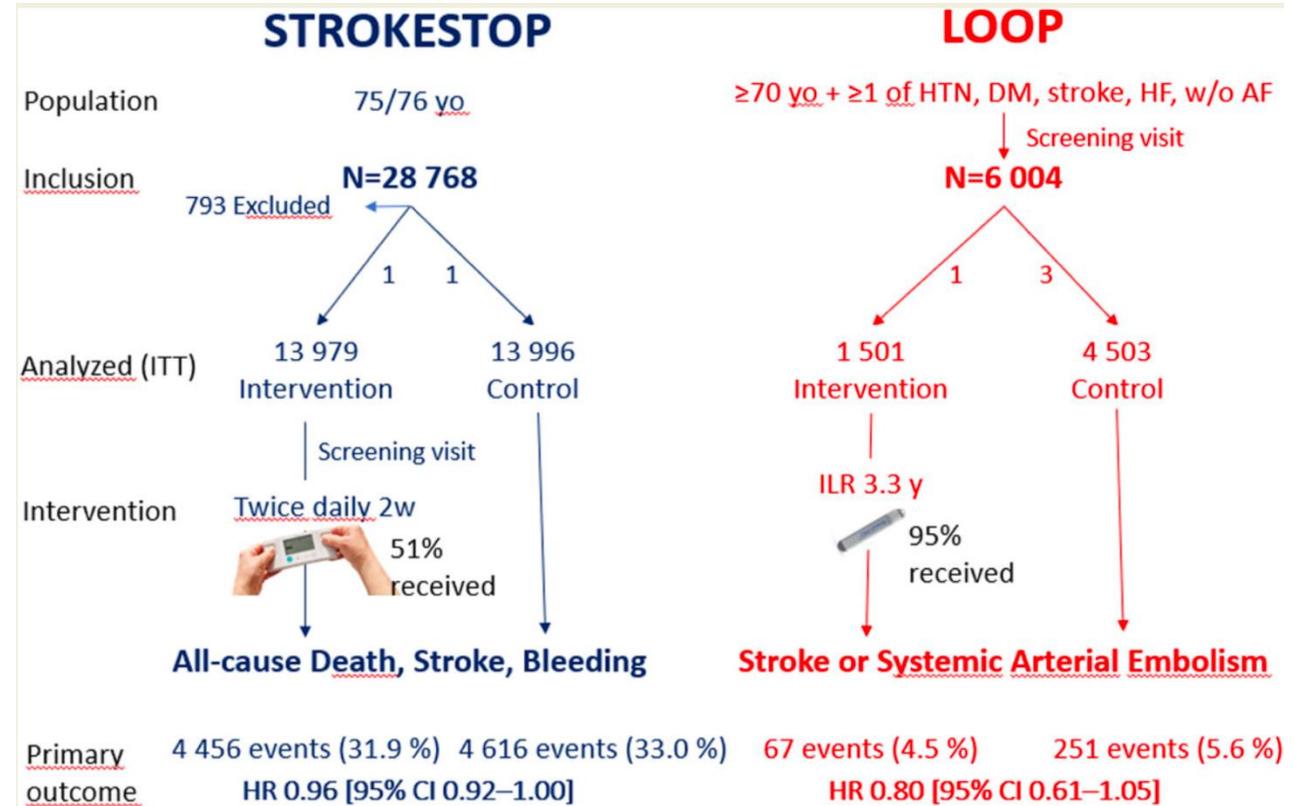
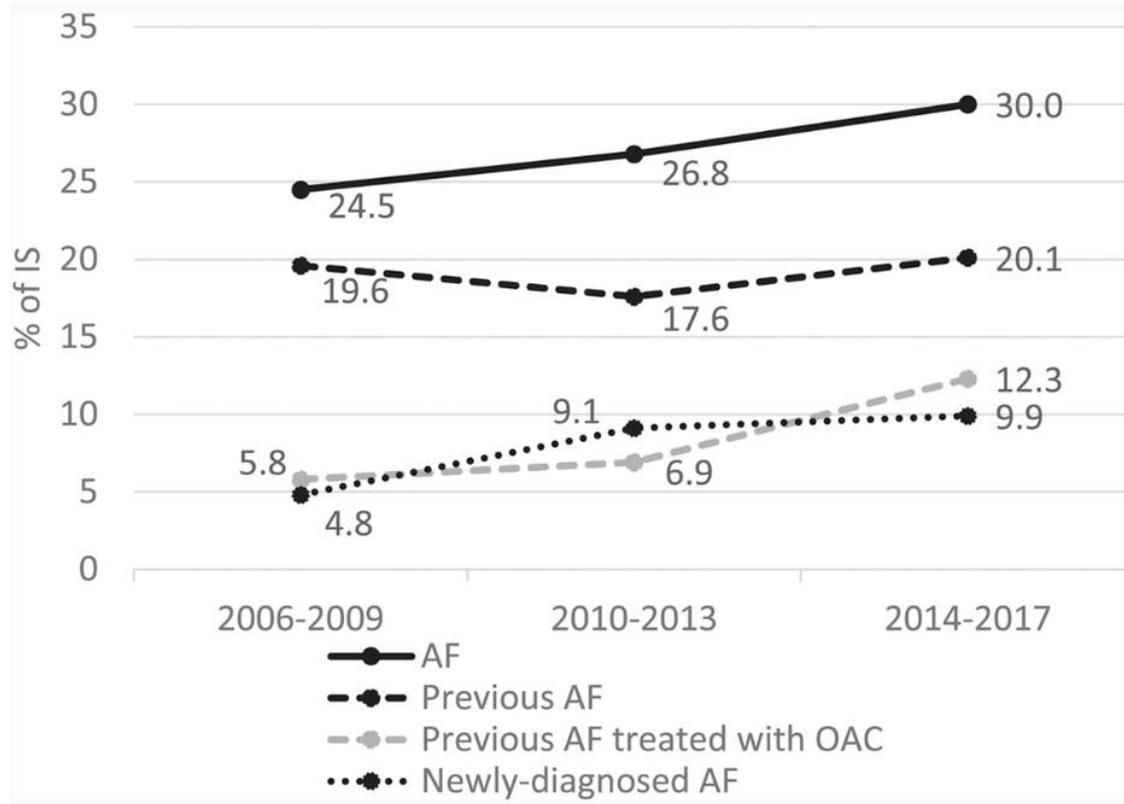
# Comment l'IA analyse l'ECG?

- Réseaux de neurones convolutionnels (CNN) : motifs temporels / répétés
- Pas de mesure comme un humain
- Filtres glissants (Kernels)
- Pas d'interprétation visuelle (black box)
- Heatmaps



# Quel besoin clinique ?

## Le défi de la prédiction de l'AVC cardioembolique

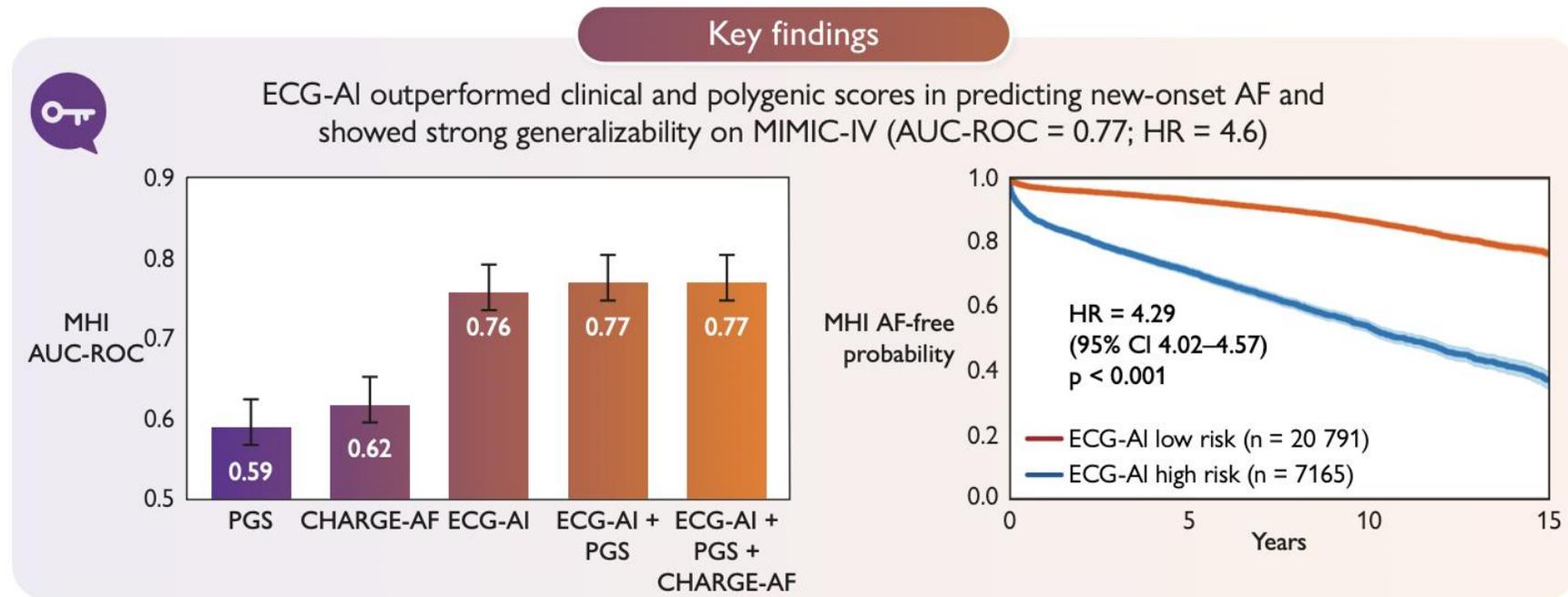
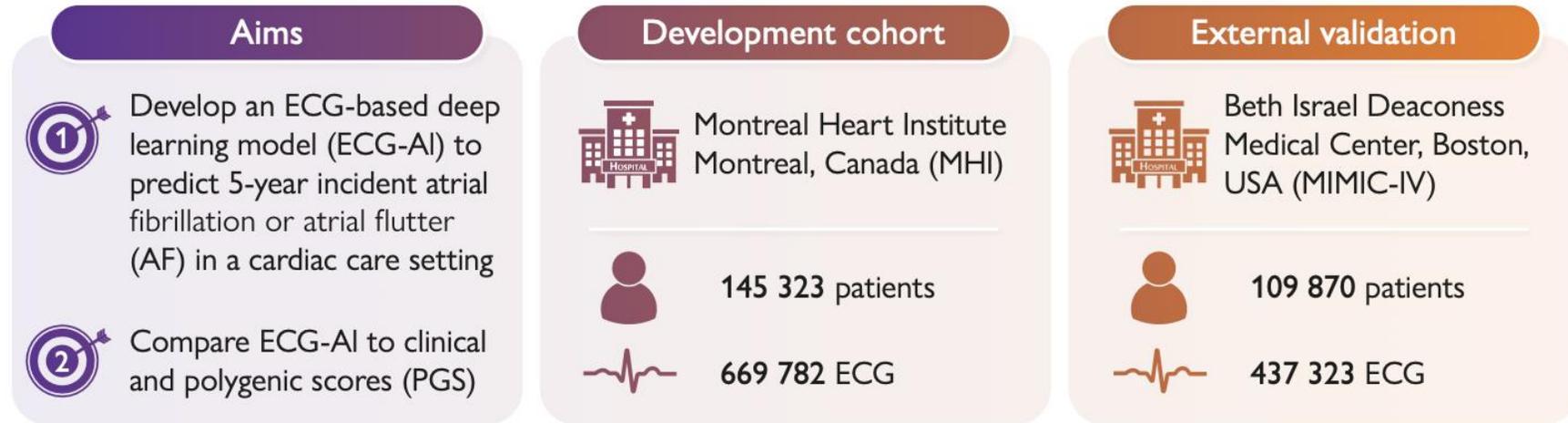


Gabet A, Guenancia C, ... Béjot Y Stroke. 2021;52:2077-2085

# Prédire la FA sur l'ECG en rythme sinusal

Jabbour et al European Heart Journal (2024) 45, 4920–4934

- Prédiction à 5 ans
- Développement 145 000 patients / 670 000 ECG
- Validation 110 000 patients / 437 000 ECG
- Comparaison a scores cliniques (CHARGE-AF) et polygéniques



# Prédire la cardiopathie sous-jacente ?

Oikonomou *European Heart Journal*, 2025

## Amylose 3 ans avant le diagnostic

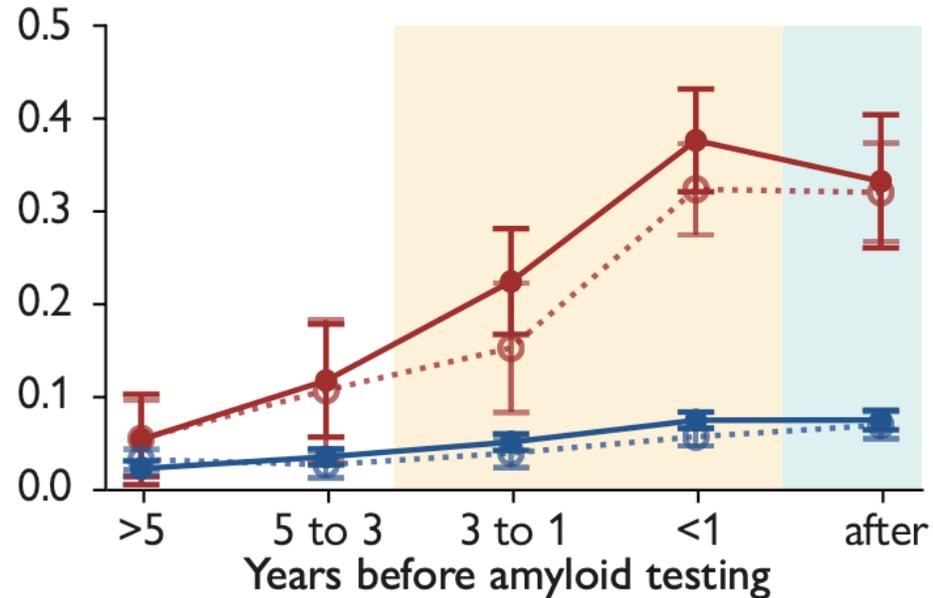


AI-Echo

YNHHS (cases)

HMH (cases)

AI-defined probability of ATTR-CM

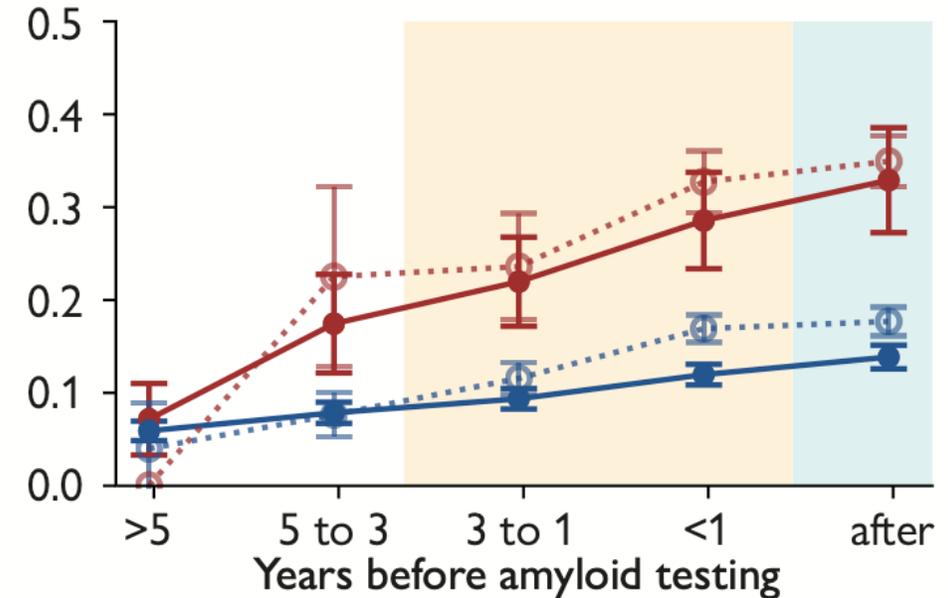


AI-ECG

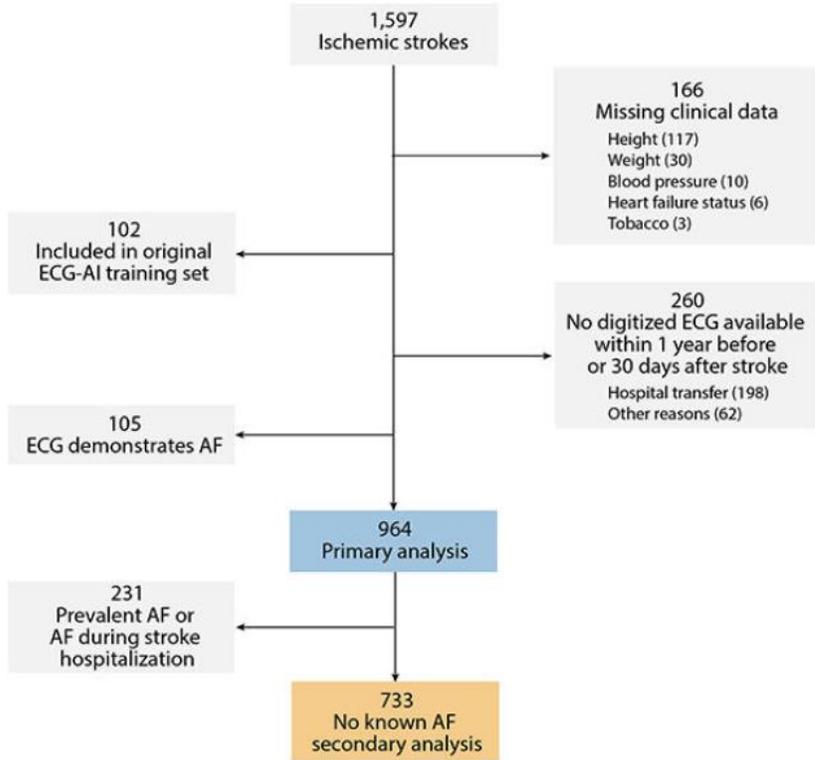
YNHHS (control)

HMH (control)

AI-defined probability of ATTR-CM

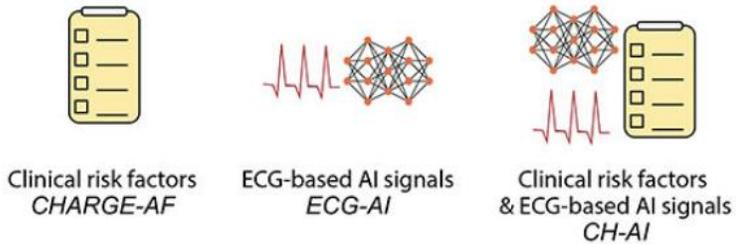
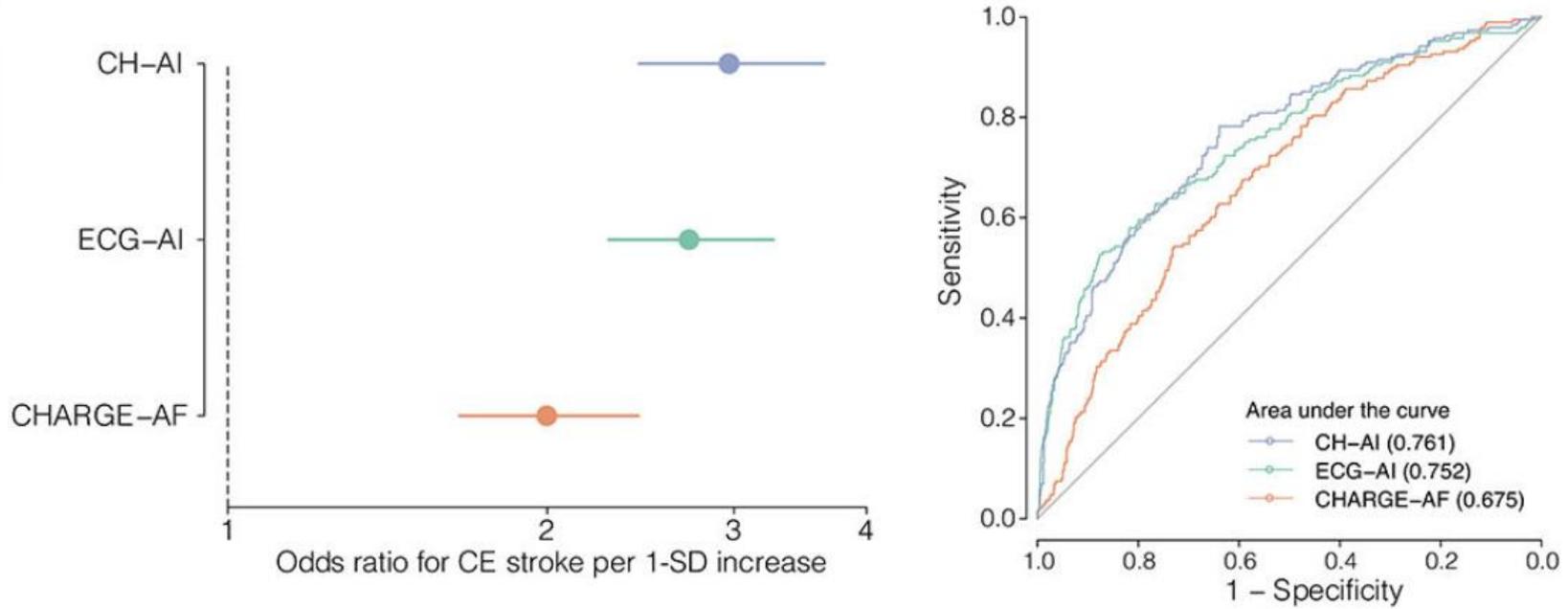


# Prédire l'origine cardioembolique de l'AVC

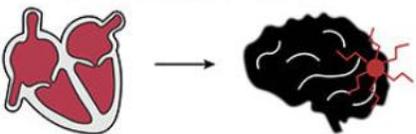


**B**

## ECG-based AI discriminates cardioembolic stroke



To discriminate cardioembolic stroke

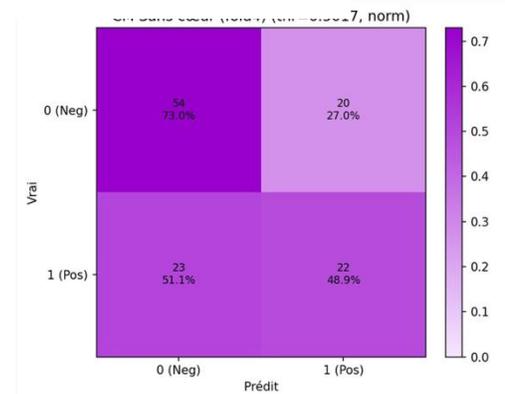
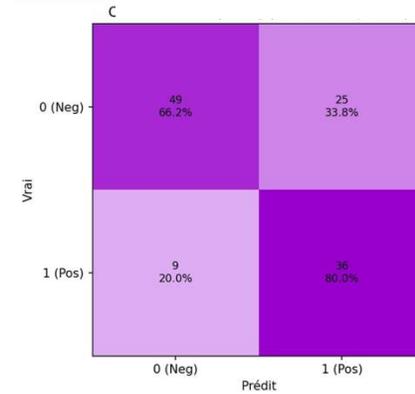
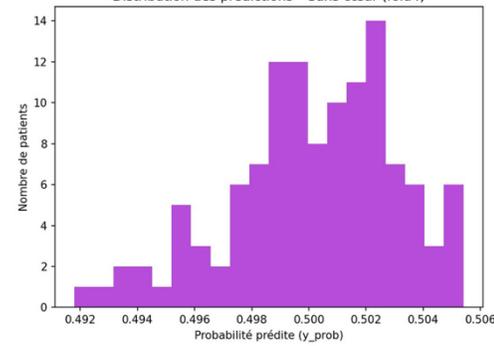
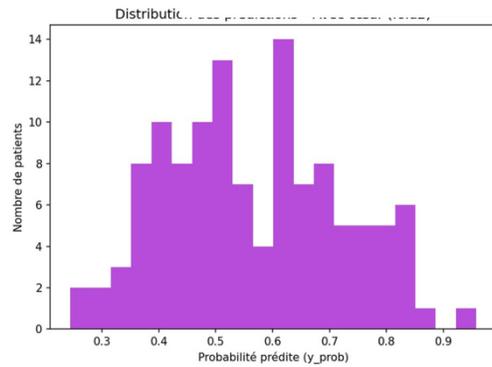
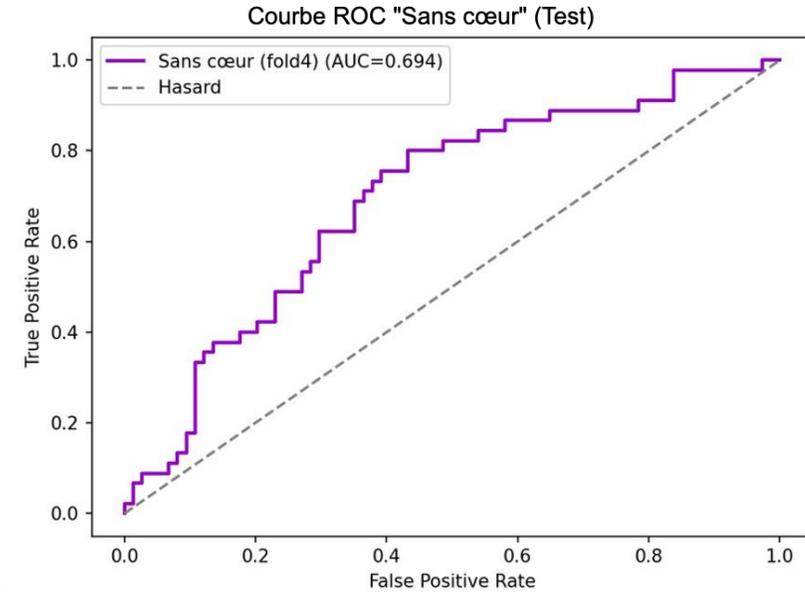
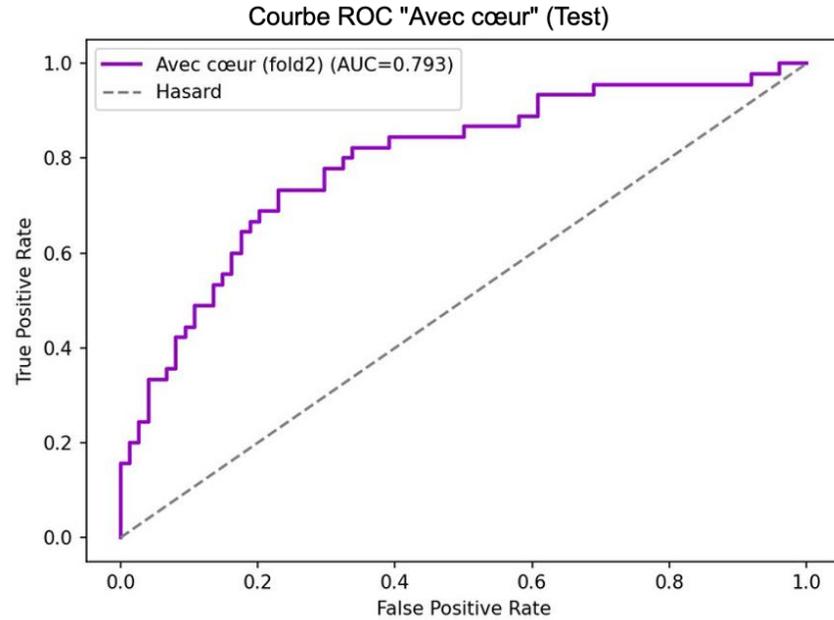


*Pas meilleur que les scores cliniques ?*

10.1161/CIRCEP.124.012959

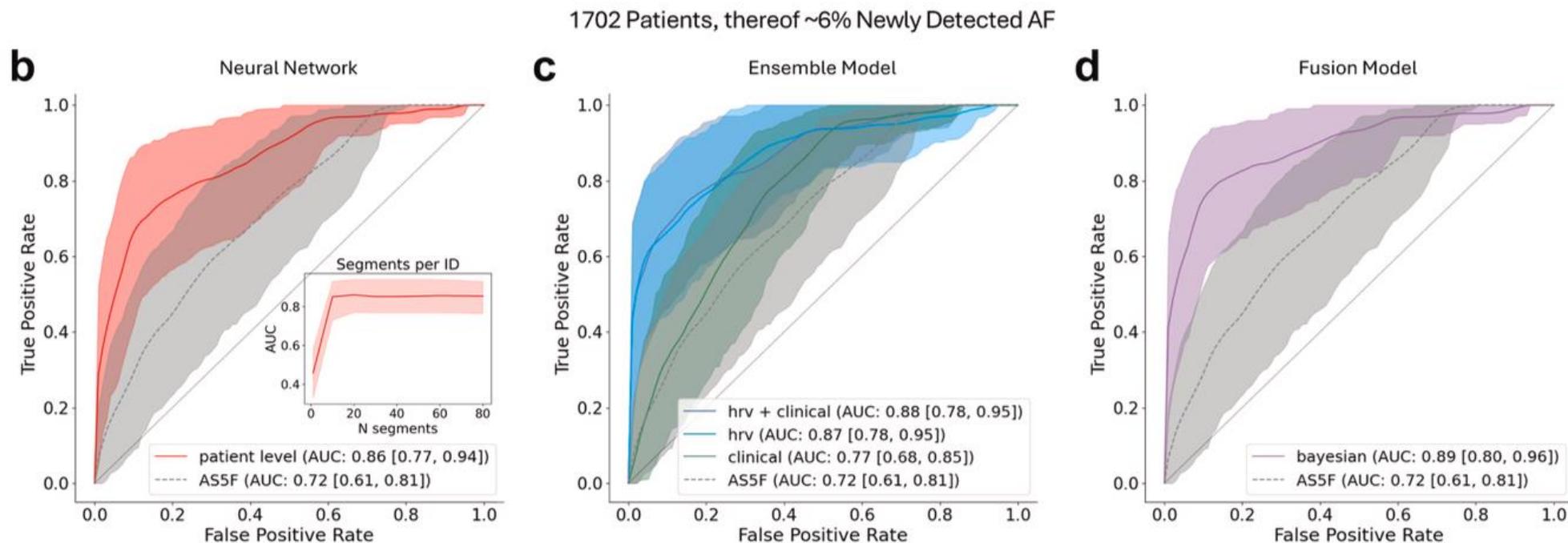
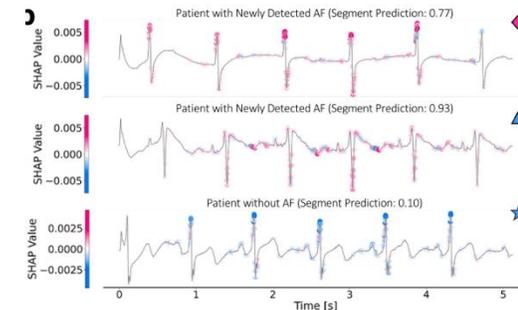
# Prédire l'origine cardioembolique de l'AVC

## Apport du scanner combiné dans la prédiction de la cause cardioembolique : modèle IA



Royer T., Béjot Y, Guenancia C. unpublished data

# Prédire la FA grâce aux données du scope après un AVC

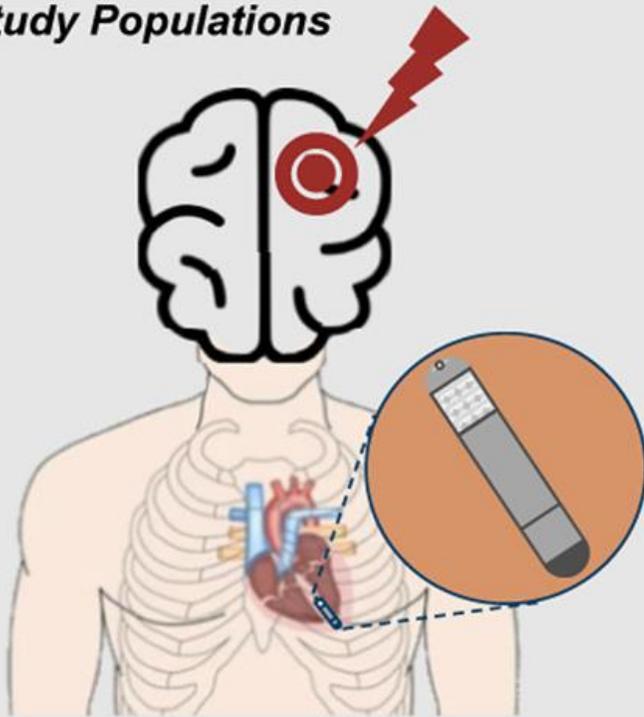


eBioMedicine 2025;118: 105869

# Prédire la FA sur l'ECG en rythme sinusal après un AVC cryptogénique

Choi et al Heart Rhythm 2024;21:1647–1655

## Study Populations

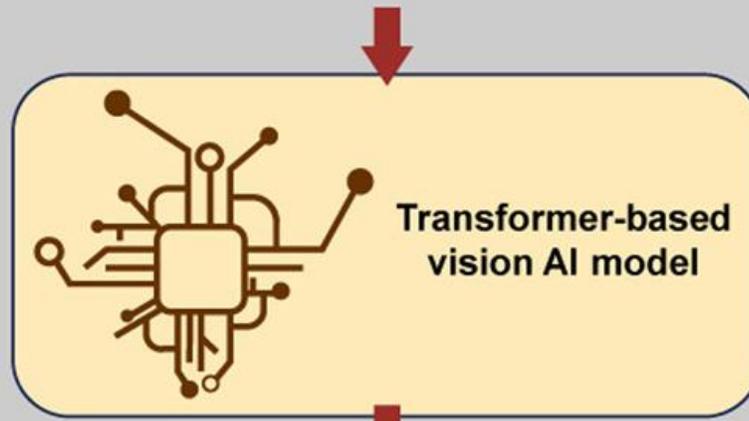


352 ESUS patients with insertable cardiac monitor from four tertiary hospitals

## Methods



12-lead sinus rhythm ECG

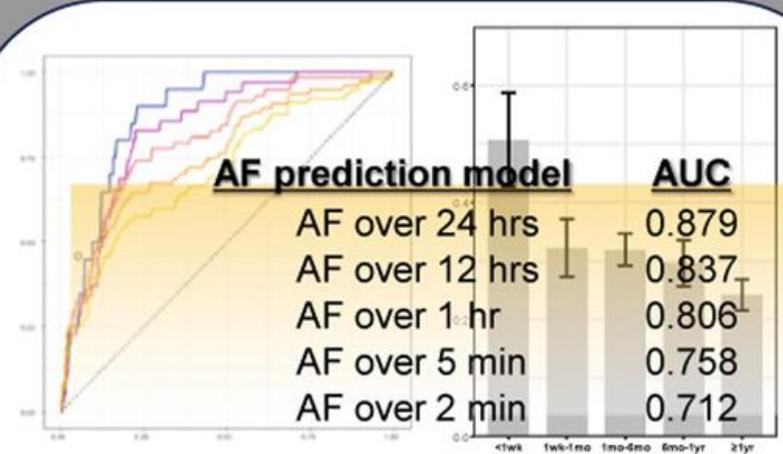


Transformer-based vision AI model

AI-AF risk score



## Results



Risk stratification

**CONCLUSION:** Our AI model demonstrated excellent diagnostic performance in predicting AF and AF risk stratification in patients with ESUS

# Quid de la **cardiomyopathie atriale** ?



## Deep Learning applied to 12-leads ECG for the identification of atrial cardiomyopathy risk and its correlation with incident AF: the A-CardioPT score

Soundous M'Rabet, MD<sup>1</sup>, Amine Kheldouni<sup>2</sup>, Pauline Porquet<sup>2</sup>, Ludovic Sibille<sup>3</sup>, John Fitzgerald, MD, PhD<sup>4</sup>, Pierre Jais, MD, PhD<sup>4</sup>, Charles Guenancia, MD, PhD<sup>1</sup>, Josselin Duchateau, MD, PhD<sup>4</sup>

<sup>1</sup>Cardiology Department, Dijon University Hospital, France; <sup>2</sup>Philips Cardiologs, Paris, France; <sup>3</sup>inHeart, Pessac, France; <sup>4</sup>Cardiology Department, Bordeaux Haut-Lévêque University Hospital, France

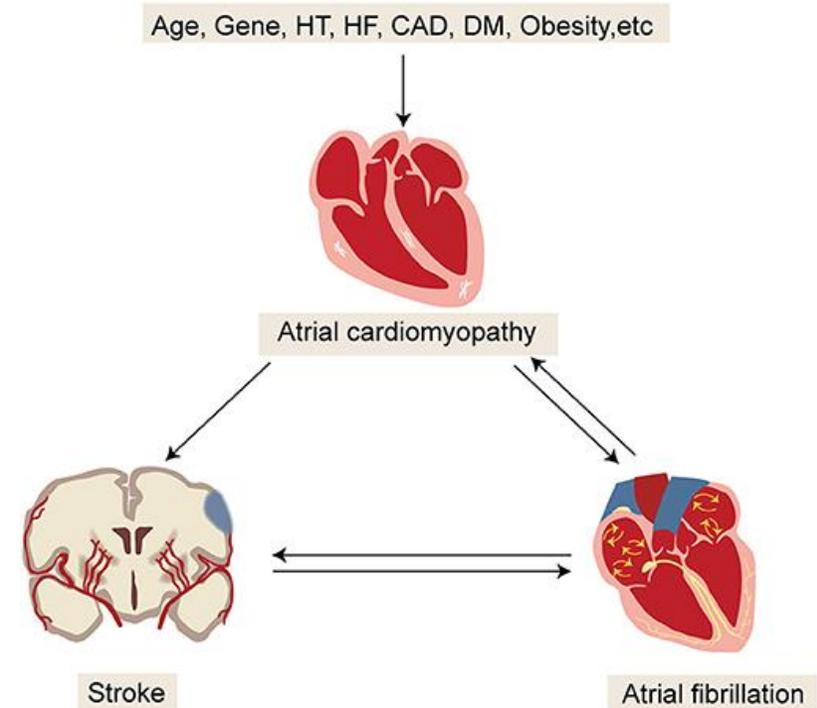
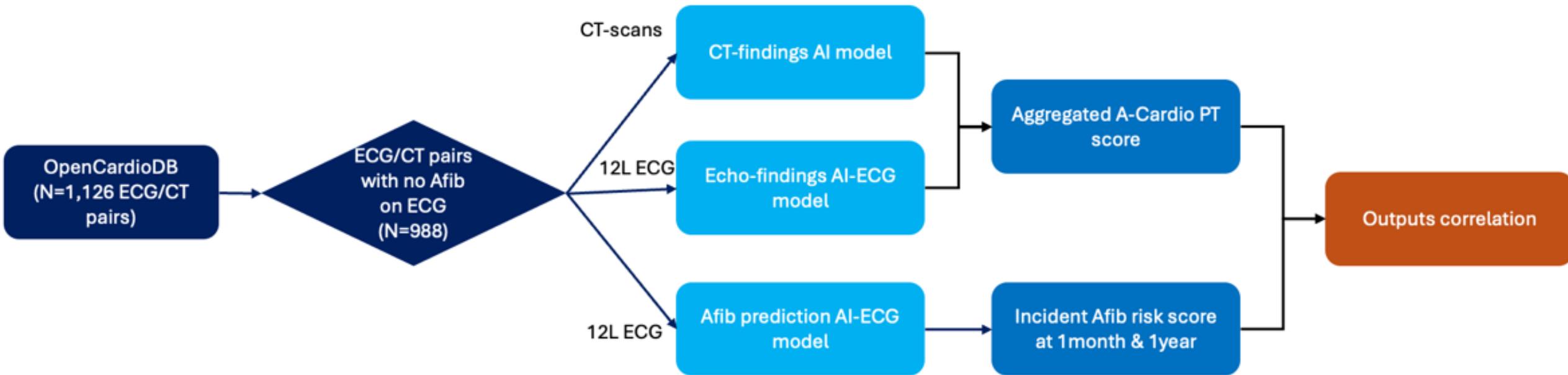


Figure 1: Methodology to compute A-CardioPT and Predict AF scores in order to evaluate their output correlations



# Cardiomyopathie atriale

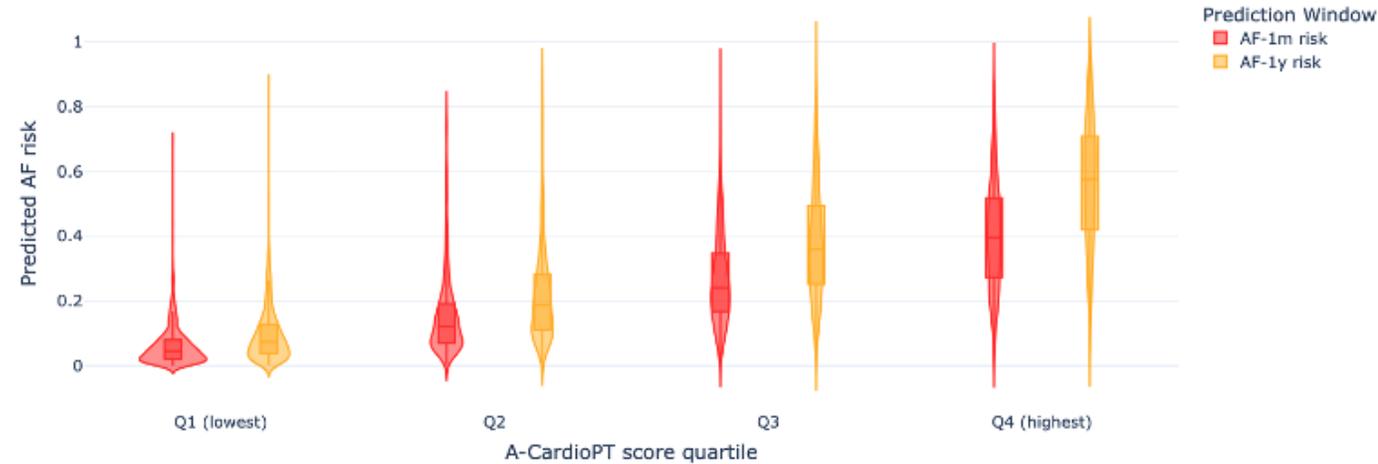
4 quartiles de patients

Les patients avec A-CardioPT score haut

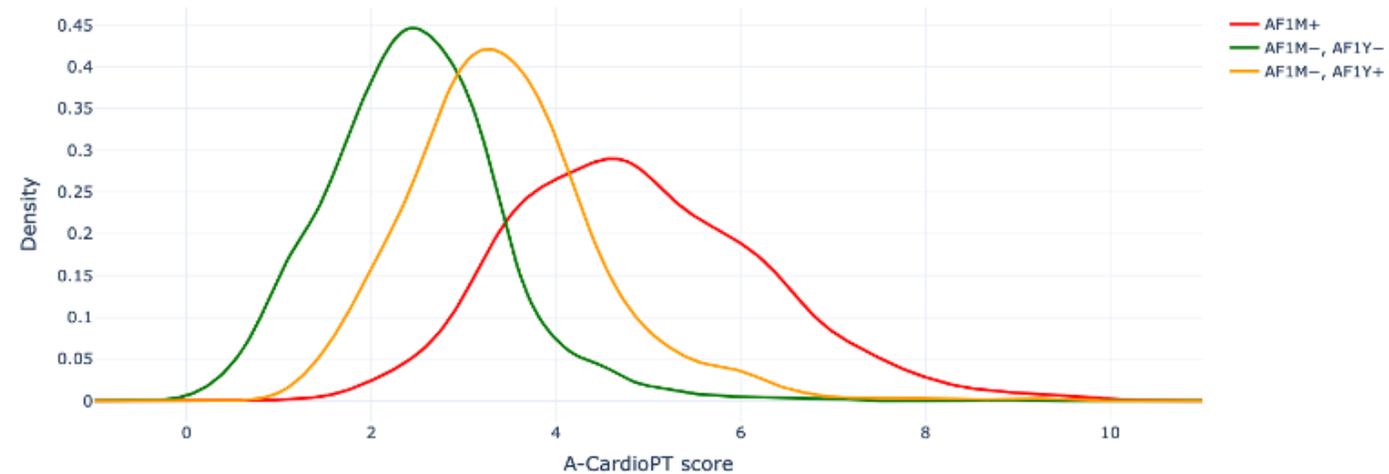
- Plus haut risque de FA
- Surtout sur FA à 1 mois

Figure 2: Correlation between incident AF risk and the A-CardioPT score

2.1. AF-risk probability across A-CardioPT score quartile bins



2.2. Distribution of A-CardioPT score per incident AF phenotype



M'Rabet et al. ESC Heart and Stroke Congress 2025

# RHU TALENT (CHU Bordeaux & Dijon, partenaires publics et privés)



TALENT

Building an opportunistic screening strategy

## PRIMARY PREVENTION

### CP1 12L ECG screening

ECG

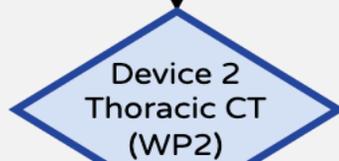


Low risk

Thoracic CT  
& Biology

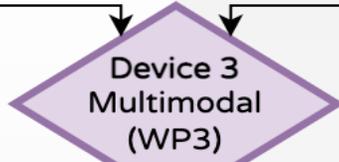
### CP2 Chest-CT screening

Thoracic CT



Low risk

ECG  
& Biology



Low-risk

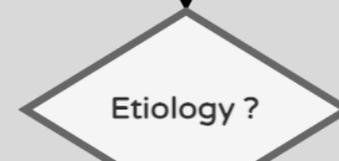
High risk

Preventive therapy  
(anticoagulation)

## SECONDARY PREVENTION

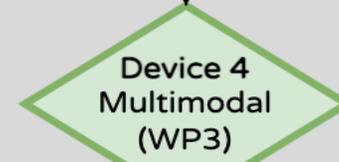
### CP3 After ischemic stroke

Ischemic  
Stroke event



Clear cause

ECG, Biology  
& Cardiac CT



High risk

Low risk



**PEC**  
EQUIPE D'ACCUEIL - EA 7443  
Psychiatrie & Soins de Santé Carcéraux

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