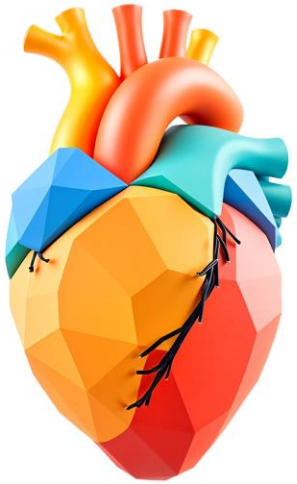

مرکز قلب تهران

دانشگاه علوم پزشکی و خدمات بهداشتی درمانی تهران

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7th CRITICAL CARDIOVASCULAR CARE

دوازدهمین کنگره سالیانه مرکز قلب تهران

2025

۲۵ و ۲۶ بهمن ماه ۱۴۰۳

13 & 14 February

Tehran Heart Center

Tehran, Iran

Rhythm detection in patients with AFib using AI

Cardiac arrhythmias affect a large population, with a total annual direct healthcare cost representing a significant economic burden. Arrhythmias can lead to morbidity and mortality.

AFib itself is not usually life threatening, but it is a serious condition that may increase a person's risk of mortality from cardiovascular conditions such as heart attack , and heart failure and stroke.

People with AFib may also have a higher chance of developing diseases such as dementiaTrusted Source and gastrointestinal and liver diseasesTrusted Source.

The earlier a person receives an AFib diagnosis the better their outcomesTrusted Source may be.

One important aspect is the detection and management of potentially thrombogenic arrhythmias such as atrial fibrillation. While atrial fibrillation is the most common arrhythmia with a lifetime risk of one in three persons and an increased risk of thromboembolic complications such as stroke, many atrial fibrillation episodes are asymptomatic and a first diagnosis is oftentimes only reached after an embolic event. Therefore, screening for atrial fibrillation represents an important part of clinical practice.

Due to its simplicity and low cost, analyzing an electrocardiogram (ECG) is the most common technique for detecting cardiac arrhythmia.

The massive amount of ECG data collected every day, in home and hospital, may preclude data review by human operators/technicians .

Therefore, deep learning approaches have gained interest in arrhythmia detection.


AI & technological advances in EP
ML in CIE
DL detects AF footprints in SR ECG
AI enabled handheld and wearable devices for real time AF detection
DL methodologies in cardiac MRI
Improved time efficiency
Aid in segmentation, TA, TC, Scar identification
Use of combined advanced modalities
BSM- MDCT-LGE MRI
VIVO
ADAS-VT
Non-invasive ablation (SBRT)
Computerised personalised virtual heart model
Virtual simulation of cardiac arrhythmias
VARP
VAAT
OPTIMA
Magnetic platform (Niobe,Stereotaxis)
Computer enhanced technique (Hansen and Amigo)
Acoustic energy-based system (Vytronus)
Rule based algorithms
Shock advise algorithms
Arrhythmia prediction
Better patient selection algorithms
ML methodologies & intra cardiac data to define arrhythmia mechanism
Holographic integrated visualisation of 3D imaging and real time catheter position

Table 3 Diagnostic accuracy of artificial intelligence-aided devices in identifying atrial fibrillation

Study	Device and AI algorithm	Signal analysed	AF detection
The iREAD Study William *et al.*[17]	Algorithm using smartphone (Kardia Mobile Cardiac Monitor) and handheld cardiac rhythm recorder vs. physician-interpreted ECG	ECG	96.6% sensitivity and 94.1% specificity for AF detection
HUAWEI Heart Study Guo *et al.*[18]	Wristband/wristwatch-based irregular pulse notification algorithm	PPG	Positive predictive value of PPG signals being 91.6% (95% CI 91.5–91.8%)
Apple Heart Study Perez *et al.*[19]	Smartwatch-based irregular pulse notification algorithm vs. subsequent monitoring with ECG patch	Initial PPG followed by simultaneous PPG and ECG	Smartwatch-based algorithm had a positive predictive value of 0.84 (95% CI 0.76–0.92) for observing AF during the simultaneous monitoring period
Chen *et al.*[20]	Smart wristband device enabled by AF-identifying AI algorithm vs. wristband ECG reviewed by physicians	PPG and ECG	Sensitivity, specificity, and accuracy were 88.00%, 96.41%, and 93.27%, respectively, for PPG and 87.33%, 99.20%, and 94.76% for ECG
Wasserlauf *et al.*[21]	Apple Watch with KardiaBand (enabled by convoluted neural network algorithm) vs. insertable cardiac monitor	ECG	97.5% and 97.7% for episode sensitivity and duration sensitivity, respectively
WATCH AF trial Dörr *et al.*[22]	Smartwatch-based algorithm vs. cardiologists' diagnosis by electrocardiography	PPG	Sensitivity of 93.7% (95% CI 89.8–96.4%), specificity of 98.2% (95% CI 95.8–99.4%), and 96.1% accuracy (95% CI 94.0–97.5%)

AF, atrial fibrillation; AI, artificial intelligence; CI, confidence interval; ECG, electrocardiogram; PPG, photo plethysmography.

A recent study in the United States examined more than 100,000 echocardiograms of patients with paroxysmal atrial fibrillation. The program distinguished between echocardiograms that showed a heart in sinus rhythm (a period of normal heartbeat) and echocardiograms that showed a heart in an irregular rhythm. The program predicted which patients in sinus rhythm had or would have atrial fibrillation within 90 days.

Wearable Tech Uses AI to Detect Cardiac Arrhythmia 30 Minutes Before Onset

Researchers from the University of Luxembourg have developed a new AI-based model that can predict irregular heartbeat, or cardiac arrhythmia, about 30 minutes before its onset

Article

Early warning of atrial fibrillation using deep learning

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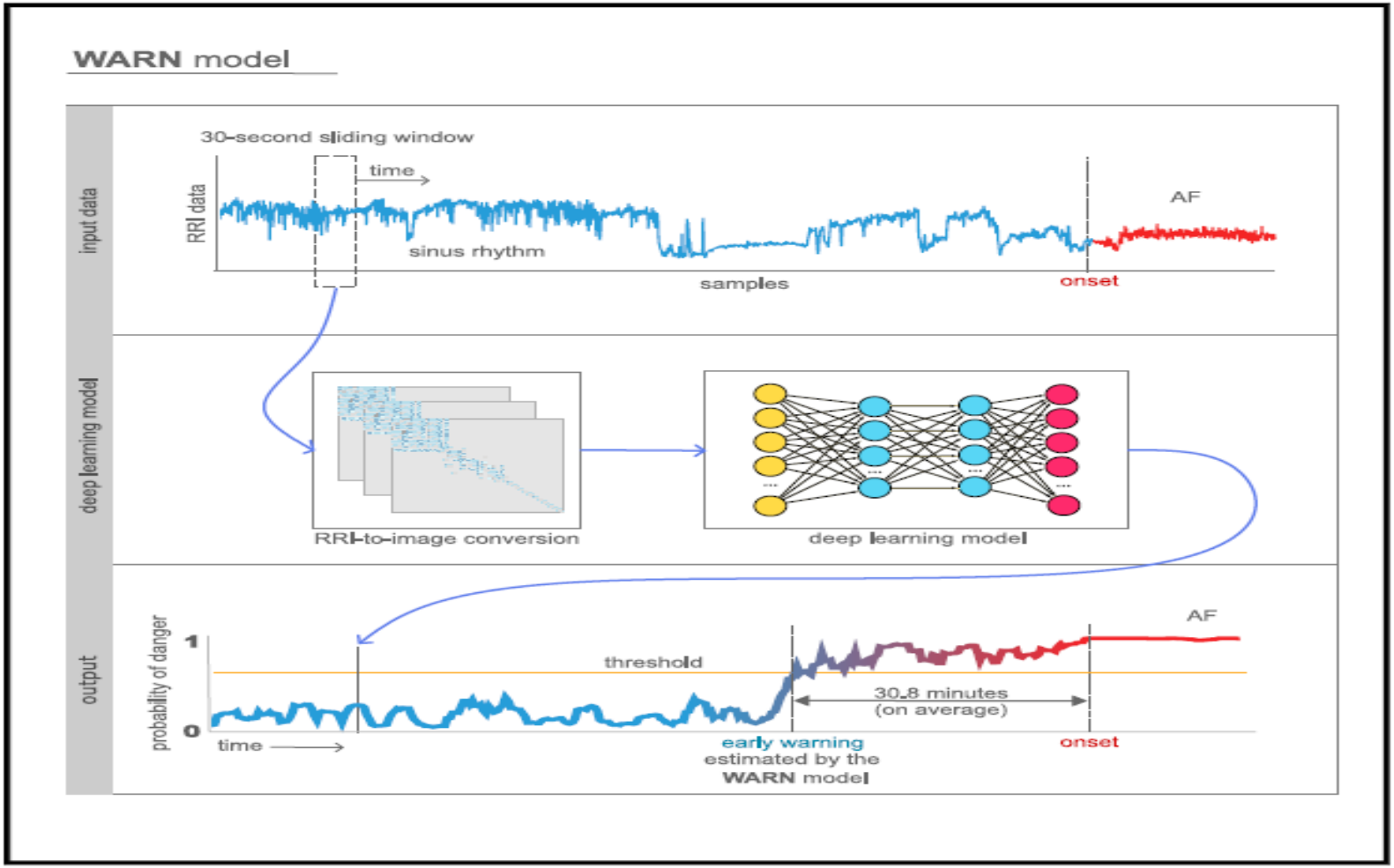
THE BIGGER PICTURE Atrial fibrillation (AF), the most prevalent heart rhythm disorder, affects millions globally, leading to significant increases in stroke risk, heart failure, and healthcare expenses. These challenges underscore the need for innovative monitoring solutions. Wearable technology, coupled with artificial intelligence, will eventually enable continuous, real-time tracking of heart health and warn users of imminent danger. This paper shows that such a future is not far. Our research introduces a model, WARN, that harnesses R-to-R intervals, the intervals between successive heartbeats, from readily available smartwatches to issue early warnings of AF onset. By leveraging extensive long-term data of individual patients, we expect that WARN can be personalized to significantly improve the prediction horizon, offering a future where many patients might manage AF proactively with as-needed medication rather than routine daily doses, thereby optimizing treatment regimens and improving quality of life.

For this study, researchers developed an AI model called WARN (Warning of Atrial fibRillatioN) to help predict AFib.

The WARN system was trained and tested on 24-hour recordings of electrocardiogram data gathered through Holter devicesTrusted Source worn by 350 people at Tongji Hospital in Wuhan, China.

Graphical abstract



First, the ECG data were pre-processed with a zH-40–0.5 eht yb dewollof ,esion ecuder ot retlfi ssap-dnab mhtirogla snikpmoT-naP eht gnisu skaep R fo notiacfitinedi
The data were labeled with three classes: AF, pre-AF, and SR. AF was labeled by cardiologists, while pre-AF was defined as the period just before AF onset with high RRI variability .
The remaining segments were labeled as SR. Then, the RRI data were used to train a deep convolutional neural network (CNN) with 479 layers that classifies between SR, pre-AF, and AF segments.

Gonçalves said this same model could one day be used through everyday smartwatchesTrusted Source.

Current smartwatch technologies claiming to detect irregular heartbeat can be helpful for people with AFib. However, these technologies do not yet offer early detection and may not always provide accurate results. Early detection of AFib before it occurs could, therefore, improve preventive measures.

“Today, smartwatches can already tell usTrusted Source if we have AFib. However, for many people, when AFib sets in, it can be difficult to reverse it back to a regular sinus rhythm, ”he explained.

“An early warning allows patients to take preventive measures such as taking anti-arrhythmia and anticoagulant medication at an early time point”.

A not-so-distant future is conceivable in which simple wearables monitor our cardiovascular system 24/7, alerting us to subtle changes in its dynamics. These changes could then be linked to specific diseases like AFib or even life-threatening events like heart attacks. In many cases, even a few minutes before the alert could allow patients to seek immediate medical attention and perhaps prevent the onset of the disease, thus avoiding its associated complications.

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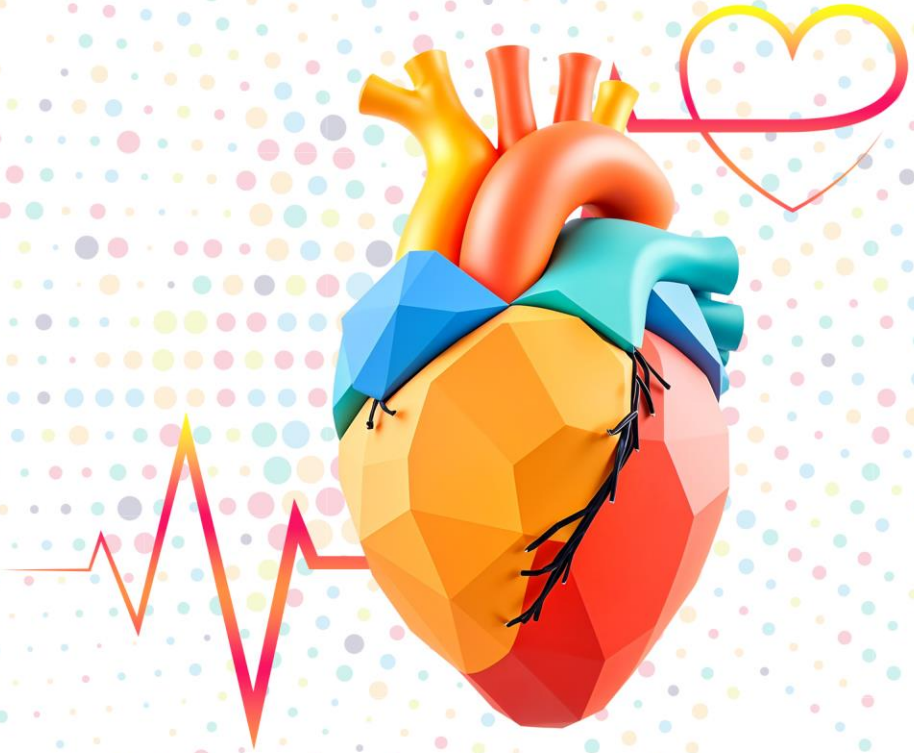

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