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Clinical Case

Reliability of Wearable Technology in Atrial Fibrillation Detection: A Clinical Review

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Abstract

Atrial fibrillation (AF) continues to remain one of the leading causes of stroke. Its asymptomatic and paroxysmal nature often makes it evade the traditional 24-hour monitoring procedures that are classic in clinical settings. As consumers rapidly adopt wearable technology, it offers a potential opportunity for non-invasive monitoring and detection. This especially applies to situations where the wearable technology uses single-lead electrocardiography (ECG) and photoplethysmography (PPG).

In this review, the goal is to evaluate the diagnostic reliability and the clinical utility of FDA-cleared wearable devices. The focus is on finding how reliable these technologies are in detecting AF. We synthesize pivotal studies as well as randomized trials published from 2018 up until 2025.

An analysis reveals that leading devices provide a high level of sensitivity (>95%) in controlled settings. In real-world settings, there are still challenges. False positives, inconclusive tracings, and motion artifacts are problems that need to be addressed by manufacturers. Current evidence suggests that wearables can serve as an adjunct screening tool but require 12-lead ECG confirmation for better diagnostic accuracy.

Keywords: *Atrial Fibrillation, Wearable Technology, Photoplethysmography, Smartwatch, Stroke Prevention, Digital Health.*

Introduction

Right now, AF is considered one of the most common heart rhythm disorders globally. It poses a significant challenge to healthcare systems worldwide. AF is characterized by chaotic electrical signals in the upper chambers of the patient's heart. This causes the heart muscle to quiver instead of contracting effectively.

The irregularity is not only considered a mechanical issue. It causes an increase in the risk of blood clots, which can become a medical emergency. AF has been linked to a significant increase in the risk of stroke [1] and heart failure.

The real danger of AF lies in its silence. Many patients experience what we call "silent AF". The condition develops, but the patient does not experience any noticeable symptoms, such as shortness of breath or palpitations. Unfortunately, for about one-quarter of these patients, the first sign is a stroke. This essentially means the window for preventive treatment was completely missed.

For the last few decades, the standard way to identify AF has relied on the use of the 12-lead electrocardiogram (ECG). It's an accurate tool, but it only offers a clinician a 10-second snapshot of the patient's heart activity. If there's no episode of AF during that 10-second period, the ECG appears normal.

This has created an opening for opportunistic screening. Wearables that consumers already use on a daily basis are becoming smarter. With the embedding of new technologies, smartwatches and fitness trackers give consumers a way to monitor their heart rate. It takes the heart rate monitor out of the hospital and puts it onto the consumer's wrist. In turn, individuals are now able to gather data over the course of months or even years, instead of just a few minutes or a couple of days.

Companies like Apple, Fitbit, and Samsung are leading the industry. They have recently introduced a combination of optical sensors and a medical-grade ECG that can be done on the spot. The shift has created an opportunity for millions to become part of their own cardiac care program.

While the technology is beneficial, the rapid adoption and advancement are growing faster than clinical guidelines can keep up. The devices are highly sensitive, which means they can spot problems effectively, but specificity has also risen as a potential barrier. Stress, skin tone, and even everyday movement have been found to potentially confuse these sensors. This can lead to false alarms, which contribute to the rise of digital hypochondria. Healthy people become anxious about false alarms, which can lead to the flooding of clinics regarding concerns that are just false positives.

This review aims to provide an evidence-based look at the reliability of these wearable technologies. We focused on modern randomized trials and other major clinical studies, published between 2018 and 2025. We evaluate whether these devices can truly be considered effective clinical tools or if they are creating more burden than benefit. The goal is to provide an analysis of the net clinical benefit. We answer the question: *"If a watch can detect AF, does treating that detection actually lead to better health outcomes for the patient?"*

Methodology

The goal of this review paper is to provide a comprehensive view of current evidence. This would ensure we do not rely on older technologies but rather analyze modern wearables to determine the accuracy, sensitivity, and reliability of wearable devices over the last few years.

A systematic literature search was conducted across major medical databases. These consisted of PubMed, Scopus, and Google Scholar. The review focused solely on English-language studies that were published between 1 January 2018 and 1 January 2026.

Search terms included combinations of "Atrial Fibrillation", "Wearable Technology", "Photoplethysmography", "Smartwatch", and "Stroke Prevention".

A total of six studies were selected based on the criteria set out for inclusion. These studies primarily focused on identifying the precision, specificity, and overall performance of wearable devices in cases of AF.

Results

Research has shown that there is a definite benefit to turning to devices like the Apple Watch and similar wearables from major brands. These devices can provide continuous monitoring of heart rate and potentially enable early detection of AF.

The most popular study to show this is the Apple Heart & Movement Study. Initially conducted in 2019, several updates have been made. The study provides initial evidence of how a smartwatch, carried on the wrist, can provide valuable data to help users manage their health. While the study focused on several factors related to fitness and heart health, one section specifically looked at AF.

The study was able to gather data from 82,809 participants, and a total of 1,132,473 ECGs were taken in just the first year of the study period.

Watch Model - Cohort Description	
Number of participants in cohort	82,809
Number of participants without ECG-capable Watch (Series 1–3 or SE)	16,051
Number of participants with ECG-capable Watch (Series 4, 5, 6)	66,752
Number of participants with unknown Watch series	6
ECG data shared	
Number of participants with at least one ECG in first year post-enrollment, *N* (% with ECG-capable Watch)	55,740 (83.5)
Total ECGs taken within first year	1,132,473
Median number of ECGs, among participants with at least one ECG in the first year	8

Figure 1: ECG Summary Table for Year 1 of the Apple Heart & Movement Study (J. Truslow, et al.)

Among the 1,132,473 ECGs taken during the period, a total of 25,402 were classified as AF - accounting for 2.2% of all ECGs [2]. A total of 1,641 participants, which accounted for 2% of the cohort, had AF reported as part of their ECG monitoring.

The study did compare differences in AF detection between ECG version 1 and ECG version 2. The ECG version 2 is available on Watch OS 7.2 and later devices, which was released in December 2020. The expanded ECG classification abilities yielded significant improvements in the accuracy of AF detection among the cohort.

Another famous research paper is the Fitbit Heart Study [3]. Backed by Fitbit, this study looked at the capabilities of the Fitbit wearable devices in detecting problems with the heart, including signs of AF.

The study did not only focus on providing a comprehensive overview of how these devices can detect irregular heart rhythms. It also provided evidence of the accuracy presented by these devices.

There were 455,699 participants who enrolled in the study, with a median age of 47 years. Data were collected from 6 May 2020 up to 1 October 2020. During this period, a total of 4,728 participants, equalling 1% of the study pool, received an irregular heart rhythm detection notification.

From the participants who received these notifications, a total of 1057 had a subsequent analysis with an ECG patch monitor. AF was present in 32.2%, or 340, of these participants. When a different type of irregular heart rhythm detection (IHRD) was noted in 225 participants, concurrent AF was identified in 221. With only four not having this finding, it brought the positive predictive accuracy up to 98.2%.

The research also indicated a high accuracy of 97% among participants aged over 65 years.

Artificial intelligence (AI) has also made its way into the process of monitoring heart rates and potentially helping with the detection of AF.

Yu-Chiang Wang, et al. explore the possibility of integrating AI into current systems that detect AF [4]. The evidence shows that supervised learning in AI models with machine learning (ML) can significantly improve patient outcomes. These systems can be provided with labeled data and then use this to identify specific patterns in a person's heartbeat. This would, in turn, allow the system to detect AF more accurately compared to relying on standard methods alone.

Research into the use of supervised and unsupervised machine learning strategies remains limited - especially in relation to AF. But there are already some studies that have taken a look at the potential. This lays a foundation for future studies and trials.

Research conducted by Elias Ebrahimzadeh, et al. looked at the potential of ML and AI in predicting paroxysmal AF [5]. They focused on looking at how machine learning models would be able to use specific training data to improve detection accuracy.

What's interesting is how they decided to use the data available to them. The training data consisted of two 30-minute clips per event. The first 30-minute clip would end just before the onset of a paroxysmal atrial fibrillation (PAF) event. The second 30-minute clip is at least 45 minutes after the onset of the PAF event.

Sensitivity, specificity, and accuracy were tracked when these models were asked to identify and predict the possibility of PAF in the provided recordings. Sensitivity was recorded at 100%. The specificity was 95.55% and the accuracy was 98.21%.

This already shows the potential of integrating both ML and AI in situations where heart rhythms and similar metrics are used to identify the possibility of AF.

Another interesting thing here is the date of the publication. Published in 2018, this is one of the older studies to already show the potential of implementing modern-day tech in detection patterns for heart-related problems - with a focus on AF.

In a study by Mara S. Singeap, et al. researchers wanted to determine the current evidence for various devices in detecting AF [6]. The researchers included a total of five specific wearable devices. These consisted of the Apple Watch Series 4 to 6, FibriCheck, HUAMI Dynamic ECG, the Preventicus, and the KardiaMobile 6L.

While 2,234 records were initially identified from PubMed, Scopus, and SpringerLink, only five were included in the final review.

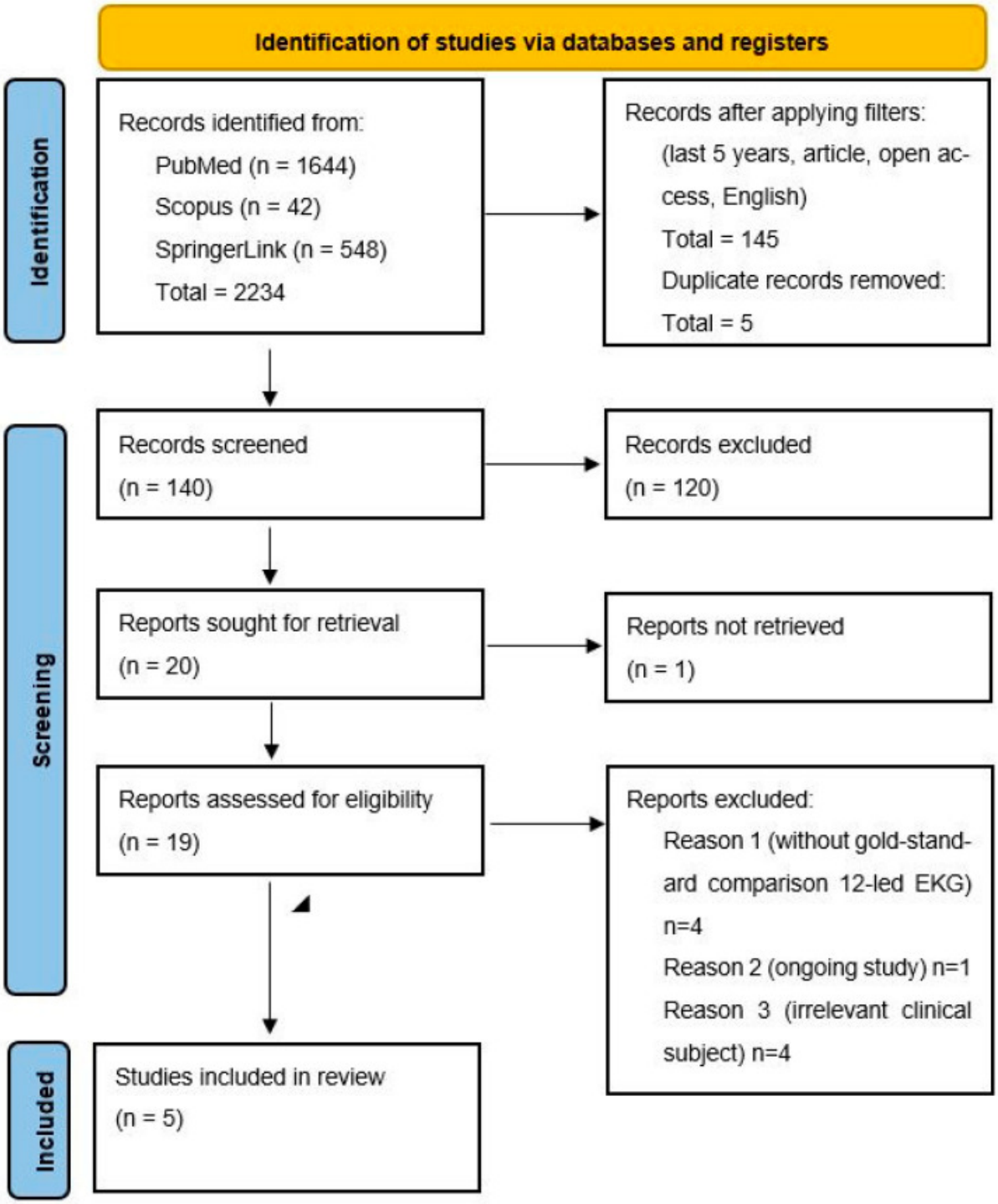


Figure 2: PRISMA Flow Diagram detailing inclusion criteria for AI / ML studies to determine the efficiency of AF detection by smart wearable devices (R. Vyas et al.)

There were a total of 1133 individuals who participated in the study.

Researchers were able to record a sensitivity between 83% and 100% among these devices. Specificity also ranged from 79% to 100%, depending on the device used.

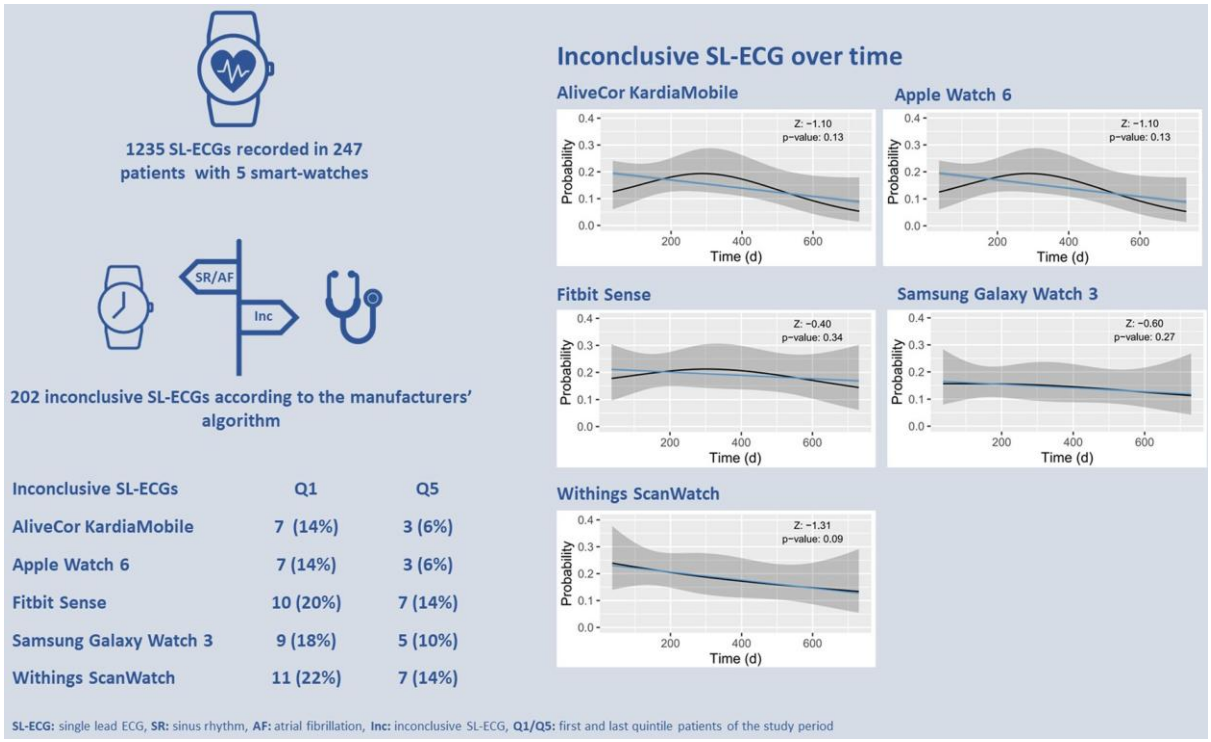
The researchers concluded that the multichannel ECG technologies used in certain smartwatches yield a high level of agreement with the use of a 12-lead ECG in the detection of ST-elevation myocardial infarction. This was a significant piece of evidence as it provides details not only on the detection of AF, but also the potential to identify complications.

In a systematic review by Narut Prasitlumkum et al., researchers compared the overall usefulness of smartwatches to that of smartphones in detecting AF [7]. While smartwatches are becoming popular options for understanding cardiovascular health, many people continue to rely on smartphone apps. These apps often uses the mobile phone's camera in order to do specific scans. There are also special phone cases that connect to smartphone apps to provide similar functions.

The results are mixed as not all studies show the same level of accuracy.

Research done by C. Isenegger et al. tested the accuracy of multiple smartwatches [8]. Among 247 participants included in the study, and 1,235 single-lead ECGs performed, 16% of the results were labeled inconclusive. Individual smart watch inconsistencies range from 15% up to 19%.

The Apple Watch and the Kardia Mobile devices had the lowest overall inconclusive rates. The Withings Scan Watch and the Fitbit Sense had some of the highest rates.



Inconclusive SL-ECGs	Q1	Q5
AliveCor KardiaMobile	7 (14%)	3 (6%)
Apple Watch 6	7 (14%)	3 (6%)
Fitbit Sense	10 (20%)	7 (14%)
Samsung Galaxy Watch 3	9 (18%)	5 (10%)
Withings ScanWatch	11 (22%)	7 (14%)

Figure 3: Inconclusive SL-ECG over time reported in the Basel Wearable Study (C. Isenegger et al.)

These inconclusive findings can pose a significant problem. Specifically, they raise a concern for digital hypochondria - health anxiety.

Discussion

Our findings suggest that wearable devices can be exceptionally helpful in detecting signs of AF early. One of the major issues the public health system faces right now is silent AF. When AF doesn't cause noticeable symptoms, the first time a patient may know they have it is after a stroke. These events can be life-threatening or cause severe disabilities. When a stroke happens, it means the chance for early diagnosis of AF was missed.

Wearable devices that people already use on a daily basis are becoming tools to improve cardiac care. These devices have shown potential in identifying abnormalities with the consumer's heart rhythm. A notification ensures the individual is aware of it. Even when there were no physical symptoms, smart technology, especially when combined with AI and ML, is becoming a critical addition to current preventative interventions.

While useful, there are some limitations and barriers that we should not overlook. In particular, we need to understand the current rate of inconclusive alerts that these devices are showing. When a consumer sees an alert that they could have signs of AF, this could lead to a rush to a local clinic or even an emergency unit. If this happens to thousands of consumers in a real-world situation, clinics may become flooded with patients concerned about the alerts given on their smartwatches. At the end, many of these inconclusive findings could be false positives, which means adding more to the workload of busy clinics and worsening the existing burden.

Conclusion

There's no denying that smartwatches are useful. They not only allow consumers to track the time and read their messages, but they can also be valuable health assets. By wearing these devices, patients could potentially get notified if there are any abnormalities with their heart rate or rhythm. But right now, inconclusive findings can lead to health anxiety.

Future studies should ideally focus on finding ways in which we can build even smarter AI models and integrate them with the existing technologies used by these devices. This would help to increase the accuracy rate and reduce those inconclusive findings.

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