



Wearable-Detected Atrial Fibrillation in Asymptomatic Adults: Managing the Referrals a Consumer Device Generates

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Received: 24 January 2025; Accepted: 21 June 2025; Published: 04 November 2025

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Abstract

Three landmark studies -- the Apple Heart Study (419,297 participants), the Huawei Heart Study (187,912 participants), and the Fitbit Heart Study (455,699 participants) -- have now shown that consumer smartwatches can flag possible atrial fibrillation (AF) in asymptomatic adults with a positive predictive value of 84%, 91.6%, and 98.2% respectively against ambulatory ECG or clinical confirmation. Applied across hundreds of thousands of otherwise healthy users, even a low per-person alert rate (0.23-1.0%) generates a large absolute stream of referrals: in the Apple Heart Study, 2,161 people were notified, but only 153 (34% of the 450 who returned an analyzable ECG patch) were ultimately confirmed to have AF, and a notified user under 40 had only an 18% chance of confirmed AF versus 34.8% across all ages. A separate study of established AF patients found that wearable ownership itself is associated with more AF-related clinic visits, more ECGs and ablations, and more messages to providers, and that 20% of wearable users report intense fear or anxiety after an irregular-rhythm notification. Meanwhile, ownership of the devices generating these referrals skews toward younger, wealthier, more educated, urban, and privately insured adults, while older, lower-income, and rural adults -- who carry the higher baseline AF risk that makes a true-positive alert more likely -- consistently lag in ownership. This review sets these findings side by side to characterize the referral surge wearable-detected AF is generating for cardiology, and the system-capacity and equity tensions it exposes that neither device accuracy alone, nor a one-sided promotional reading of these trials, resolves.

Keywords: Atrial fibrillation; Wearable devices; Smartwatch; Photoplethysmography; Screening; Health equity

Introduction

Three large prospective studies -- the Apple Heart Study, the Huawei Heart Study, and the Fitbit Heart Study -- have each enrolled several hundred thousand consumer smartwatch or fitness-tracker users and asked the same basic question: can a photoplethysmography (PPG) or pulse-tachogram algorithm, running passively on a device people already wear, flag atrial fibrillation (AF) in people who have no symptoms and no reason to suspect it? All three found that when the algorithm

does flag a possible irregular rhythm, that alert is usually right: positive predictive values against ambulatory ECG or clinical confirmation ranged from 84% to 98.2% across the three studies [1-3].

What none of the three headline positive-predictive-value numbers communicates on its own is scale. A rare per-person alert rate, multiplied across a cohort of hundreds of thousands of otherwise healthy people, still produces thousands of individual alerts, each of which now needs some form of clinical response -- typically a visit, an ECG, and often a

period of ambulatory monitoring before a diagnosis can actually be confirmed or excluded. This review sets the accuracy data from these three studies side by side with what is known about the downstream consequences of that accuracy at population scale: the confirmatory-testing pathway a positive alert triggers, the anxiety and health-care utilization documented in patients who already own these devices, and the uneven pattern of who owns a wearable in the first place.

Cardiology has not lacked reasons to be skeptical of consumer health technology before, but the specific tension this review focuses on is not whether these algorithms work -- on the evidence assembled here, they clearly do, more often than not -- but whether the referral stream they generate, and the population in whom they generate it, is the one a health system built confirmatory testing capacity to manage.

The reason AF detection matters enough to build a consumer product around it in the first place is that AF is a treatable driver of ischemic stroke, and a substantial share of it is genuinely asymptomatic: a person can carry the arrhythmia, and its associated stroke risk, for a long time with no symptom that would prompt them to see a clinician. That is precisely the gap a wearable worn during ordinary daily life is positioned to close, in principle, in a way an opportunistic pulse check at an occasional clinic visit cannot: continuous passive monitoring rather than a single point-in-time check. Whether that theoretical advantage survives contact with how a positive alert is actually confirmed, triaged, and acted on once it reaches a health system -- and who is and is not carrying the device that could generate it -- is the question this review examines using the studies that have actually measured each part of that pathway.

Material and Methods

This is a narrative review drawing on the Apple Heart Study, Huawei Heart Study, and Fitbit Heart Study primary publications, a cohort study of health-care utilization and psychological well-being in established AF patients who do or do not use a wearable device, a national survey of wearable-device ownership patterns in the United States, and a systematic review and diagnostic meta-analysis of smartwatch AF-detection accuracy, identified through the sources cited above and citation tracking between them, without a pre-registered protocol or systematic search string. All counts, percentages, and confidence intervals reported here are taken directly from the cited sources; none has been invented, estimated, or extrapolated.

Results

Three landmark studies, three different devices, a consistent accuracy signal

The Apple Heart Study enrolled 419,297 participants and used a PPG-based irregular-pulse algorithm; 2,161 (0.52%) received an irregular pulse notification during the study [1]. The Huawei Heart Study enrolled 187,912 participants; 424 (0.23%) were flagged with a suspected-AF notification, and among 262 of these effectively followed up clinically, the notification's positive predictive value for confirmed AF was 91.6% (95% CI 91.5-91.8) [2]. The Fitbit Heart Study, the largest of the three at 455,699 participants, recorded 4,728 irregular heart rhythm notifications (1.0%); among 225 participants with a concurrent notification during ECG-patch monitoring, the positive predictive value was 98.2% (95% CI 95.5-99.5), and 97.0% (95% CI 91.4-99.4) specifically among participants aged 65 years or older [3]. Figure 1 sets the scale of enrollment and the per-person alert rate of all three studies out together, and Figure 2 sets their positive predictive values out directly. A more recent systematic review and diagnostic meta-analysis pooling 26 studies and 17,349 patients found broadly consistent results across smartwatch platforms, with pooled sensitivity of approximately 95% and specificity of approximately 97% for AF detection [6].

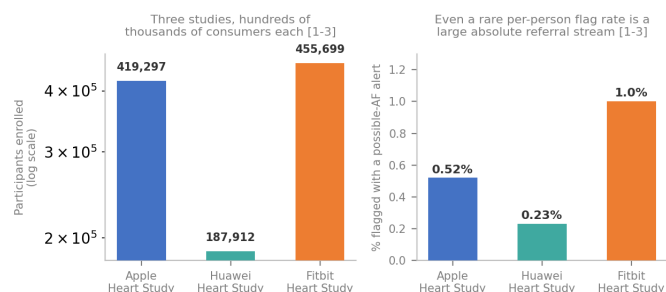


Figure 1: Enrollment size (log scale) and percentage of participants flagged with a possible-AF alert, three landmark consumer-device screening studies [1-3].

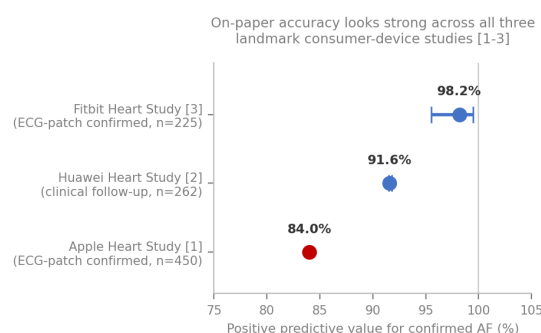


Figure 2: Positive predictive value for confirmed AF, with 95% confidence interval where reported, across the three landmark studies [1-3].

Even a low alert rate becomes a large absolute referral stream

The Apple Heart Study's own cascade illustrates what a 0.52% notification rate means in practice. Of the 2,161 participants notified, only 658 were sent an ambulatory ECG patch as part of the study's confirmatory pathway, and of those, 450 returned a patch with analyzable data; 153 of those 450 (34%) showed AF on the patch [1]. Figure 3 traces this full cascade. The 84% positive predictive value most often quoted from this study describes the notification's accuracy specifically among the subset who completed confirmatory monitoring, not the proportion of everyone notified who was ultimately confirmed to have AF -- a distinction that matters directly for how large a true referral and confirmatory-testing burden a health system should expect a wearable-detection program to generate. Notification rates and diagnostic yield also both varied sharply by age: participants under 40 had a notification rate of just 0.16%, versus 3.2% in participants 65 and older, and a notified participant under 40 had only an 18% chance of confirmed AF on the patch, versus 34.8% across all notified participants [1]. Figure 4 sets both age-stratified findings out together: alerts cluster in older users, but a young, notified user is specifically the one least likely to actually have AF -- and therefore the one most likely to undergo confirmatory testing that finds nothing.

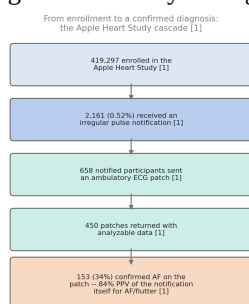


Figure 3: Referral cascade from enrollment to a confirmed AF diagnosis, Apple Heart Study [1].

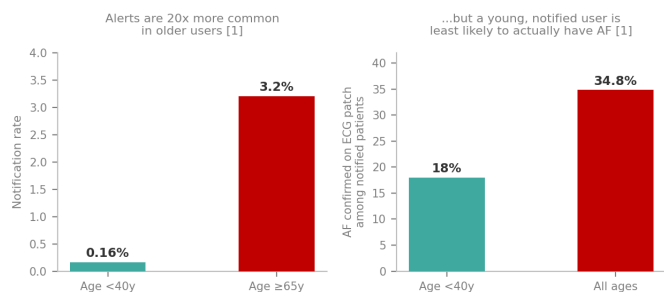


Figure 4: Notification rate and AF-confirmation rate on ECG patch, stratified by age, Apple Heart Study [1].

Ownership itself already changes health-care use and carries a psychological cost

A separate study of 172 patients already diagnosed with AF, comparing 83 who used a wearable device against 89 who did not, found that wearable use was associated with significantly more AF-related clinic visits (4.05 versus 2.70 per year), more messages sent to providers (3.59 versus 2.41 per year), and significantly more ECGs and ablation procedures [4]. This is a population already under cardiology follow-up, not an asymptomatic screening population, so it cannot be read as direct evidence of what wearable-detected AF does to referral volume in asymptomatic adults -- but it is direct evidence that owning and monitoring a wearable device changes how often a patient seeks care, independent of any new information the device provides. The same study found that 20% of wearable users reported intense fear or anxiety after receiving an irregular-rhythm notification [4]. Figure 5 sets both the utilization difference and the anxiety finding out together.

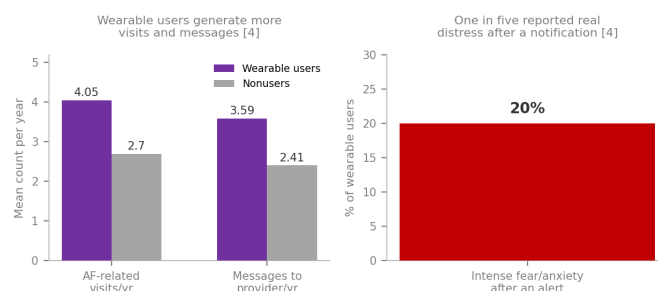


Figure 5: AF-related health-care utilization and reported anxiety, wearable users versus nonusers, among patients with established AF [4].

The device generating the referrals is not evenly distributed

A national survey analysis of approximately 24,000 respondents to the National Health Interview Survey (2020-2022) found that wearable-device ownership skews consistently toward younger, wealthier, more educated, urban, and privately insured adults who self-report excellent health, while adults aged 55 and older, lower-income adults, and rural adults consistently lag in ownership [5]. Figure 6 summarizes this pattern schematically. Since AF prevalence itself rises with age, this is not a neutral distributional fact: the demographic group in whom a wearable alert is most likely to represent a true positive -- older adults, per the Apple Heart Study's own age-stratified notification and confirmation rates [1] -- overlaps closely with the demographic group least likely to own the device that could generate that alert in the first place.

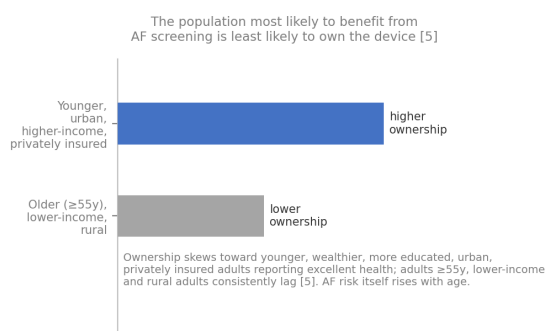


Figure 6: Schematic summary of wearable-device ownership patterns by demographic group, United States, 2020-2022 [5].

Study	N enrolled	% flagged	PPV for confirmed AF
Apple Heart Study [1]	419,297	0.52%	84% (ECG patch)
Huawei Heart Study [2]	187,912	0.23%	91.6% (95% CI 91.5-91.8)
Fitbit Heart Study [3]	455,699	1.0%	98.2% (95% CI 95.5-99.5)

Table 1: Enrollment, alert rate, and positive predictive value for confirmed AF across the three landmark consumer-device screening studies reviewed here [1-3].

Discussion

Read together, these findings do not support either a purely enthusiastic or a purely dismissive reading of consumer wearable AF detection. The accuracy signal across all three landmark studies, and the larger pooled meta-analysis, is genuinely strong: when one of these devices flags a possible irregular rhythm, it is right most of the time [1-3,6]. But strong per-alert accuracy and a manageable population-level referral burden are not the same claim. Applied across a screening population of hundreds of thousands, even the lowest observed alert rate in this review (0.23%, Huawei) still generates several hundred individual alerts requiring some clinical response, and the Apple Heart Study's own cascade shows that only a minority of notified participants completed confirmatory ambulatory monitoring at all [1]. A health system invited to absorb this referral stream is being asked to expand confirmatory-testing capacity -- ambulatory ECG patches, clinic visits, electrophysiology consultation -- for a population that self-selected into screening by already owning a smartwatch, not by clinical risk.

The age-stratified findings sharpen this further: alerts cluster in older users who are more likely to have true AF, but a substantial share of any wearable-detection program's volume, particularly among younger users, will represent alerts that lead nowhere diagnostically -- an 18% confirmation rate under age 40, against 34.8% overall [1]. Meanwhile, the ownership data show that the population carrying the higher baseline AF risk that would make an alert more likely to be a true positive is precisely the population least likely to own the device that could generate one [5], while established AF

patients who already own a wearable use more health-care resources and report meaningful anxiety after notifications, independent of new diagnostic information [4]. Taken as a whole, wearable AF detection is neither a solved screening problem nor a technology to dismiss; it is a referral-generating system whose true-positive yield, downstream testing burden, psychological cost, and demographic reach do not currently move together, and clinical pathways for managing it have not caught up with the scale at which it is already operating.

Study limitations

This is a narrative review, not a systematic review with a pre-registered protocol, and it draws on studies with different designs, devices, and confirmatory-testing methods that are not directly comparable head-to-head [1-3]. The Apple Heart Study's cascade data on patch return and confirmation rates describe one study's specific confirmatory pathway and may not generalize to how other health systems or other devices' users are followed up [1]. The health-care utilization and anxiety findings come from a single, modestly sized cohort of patients already diagnosed with AF, not from an asymptomatic screening population, and cannot be assumed to quantify the burden a wearable-detected alert in a previously undiagnosed adult would generate [4]. The ownership-disparity data describe the United States specifically and may not generalize to health systems or populations elsewhere [5]. Finally, none of the sources reviewed here reports a formal cost-effectiveness or health-system-capacity analysis of wearable-triggered AF referral pathways, so this review's central claim -- that the referral burden is large relative to confirmed diagnostic yield in some subgroups -- is a description of the component numbers available, not a validated capacity model.

Conclusion

Consumer wearable devices can detect atrial fibrillation in asymptomatic adults with positive predictive values of 84% to 98.2% across three large prospective studies, a genuine and now well-replicated technical achievement. What this review adds is that this same accuracy, applied across populations of hundreds of thousands of screened users, generates a referral and confirmatory-testing stream whose diagnostic yield varies sharply by age, whose psychological cost is measurable even in patients who already have a diagnosis, and whose access is distributed away from the older, lower-income, and rural adults who carry the higher baseline risk that would make a positive alert most clinically meaningful. Managing wearable-detected AF well will require treating it as a referral-management and equity problem, not only a device-accuracy problem.

The component figures behind that conclusion are worth restating together in one place. On the accuracy side: 84%

(Apple), 91.6% (Huawei), and 98.2% (Fitbit) positive predictive value for confirmed AF, and a pooled sensitivity of approximately 95% and specificity of approximately 97% across the 26-study, 17,349-patient meta-analysis [1-3,6]. On the burden side: only 658 of 2,161 notified Apple Heart Study participants were sent confirmatory monitoring at all, and established AF patients who already own a wearable generate roughly 50% more AF-related clinic visits and messages to providers than nonusers, alongside a 20% rate of intense fear or anxiety after a single notification [1,4]. On the equity side, the same national survey that documented lagging ownership among adults 55 and older, lower-income adults, and rural adults also confirms these are exactly the groups AF prevalence rises fastest in [5]. Table 2 sets the burden and equity figures out side by side.

Metric	Finding	Source
AF-related clinic visits/yr, wearable users vs nonusers	4.05 vs 2.70	[4]
Messages to provider/yr, wearable users vs nonusers	3.59 vs 2.41	[4]
Intense fear/anxiety after an irregular-rhythm alert	20% of wearable users	[4]
Wearable ownership, younger/urban/higher-income/insured	Consistently higher	[5]
Wearable ownership, age ≥ 55 y/lower-income/rural	Consistently lower	[5]

Table 2: Downstream health-care burden and ownership-equity findings referenced throughout this review [4,5].

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Cite this article: Vandekerckhove J, Sjöstrand-Berg L, Liepkalns A. Wearable-Detected Atrial Fibrillation in Asymptomatic Adults: Managing the Referrals a Consumer Device Generates. *J Heart Cardiovasc Sci.* 2025; 6: 019-024.