

EDITORIAL

Wearable devices: monitoring the future?

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WEARABLE DEVICES: MONITORING THE FUTURE?

Wearable devices are becoming increasingly utilized in our contemporary world, and the Apple Watch is a popular tool for monitoring the heart rate and more recently, heart rhythm. The Apple Watch Series 4 was the first one granted clearance by the Food and Drug Administration (FDA), allowing rhythm detection and identification of Atrial Fibrillation (AF), on 11 September 2018; outlying however that the definitive diagnosis should not be made before a doctor confirms the validity of the possible alarm signal transmitted by the watch [1]. Nonetheless, Apple watches have been used to inform patients about other rhythm abnormalities as well. In this issue of Oxford Medical Case Reports, Goldstein and Wells present the case of a previously asymptomatic 56-year-old man diagnosed with Atrial Flutter after he noticed a high rate on his watch, which coincided with palpitations. He contacted the medical services 4 days later and an electrocardiogram (ECG) confirmed Atrial Flutter with a 2:1 AV block (Fig. 1). He proceeded to receive anticoagulation and a transoesophageal echocardiogram-guided electrical cardioversion [2]. In this case of an individual with a high thromboembolic risk score, it was clear that the Apple Watch had an instrumental role in identifying the abnormal rhythm and subsequent confirmation of the Atrial Flutter thus allowing further appropriate medical intervention and pharmacotherapy.

However, concerns have been raised about the accuracy of the watch with regards to rhythm abnormality detection, the need for perhaps unnecessary downstream testing in some individuals and ultimately whether it will benefit patients or simply increase the level of anxiety in those noticing abnormal heart rates or receiving notifications for abnormal findings. Only large

population-based registries will allow us to place the exact role of the Apple Watch.

The Apple Watch is a commercially available device, which can be found in stores and online, thus being more commonly used by healthy individuals. It is effective for measuring heart rate [3], and moreover, as it can detect abnormal cardiac rhythm, it may prove helpful to people who occasionally have symptoms such as palpitations. Newer versions of the device can record the ECG for subsequent reading by a physician, but this function was not available in the country where the patient was present [4].

To support the potentially beneficial role of the Apple Watch, the large Apple Heart observational study of 419 297 participants using an Apple Watch over a period of 8 months has been recently published, the 'Large-Scale Assessment of a Smart-watch to Identify Atrial Fibrillation'. This showed that detection of possible AF for more than 30 seconds was seen in 0.5% of the participants (who were generally younger) but for those over the age of 65, this rose to 3.2%. When the device recording was compared to an ECG patch, the positive predictive value was 0.84, which is very encouraging for potential clinical use [5].

However, there are certain limitations, which need to be considered. Firstly, there is a concern over the possible over-diagnosis of AF and the unnecessary anxiety that this could bring. Smart watches demonstrate high sensitivity but generally speaking, lower specificity, although with improving technology this is likely to also increase. Therefore, episodes of an otherwise benign dysrhythmia, may be misinterpreted as abnormal, resulting in patient stress, downward testing and even unnecessary anticoagulation treatment [6].

Linked with this is the fact that such wearable devices are utilized mainly by young healthy individuals who have a very

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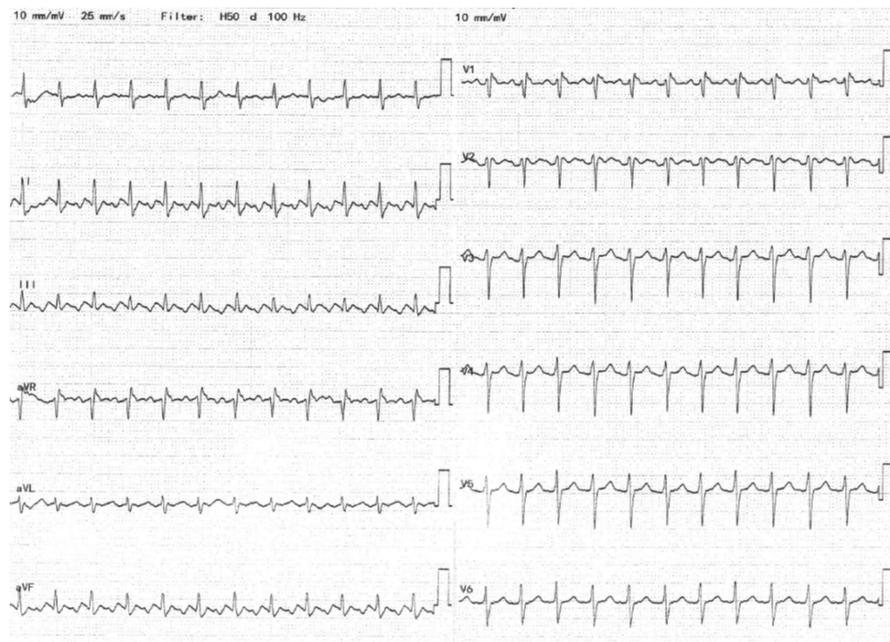


Figure 1: ECG undertaken following the Apple watch notifications demonstrating atrial flutter.

low risk of AF, and therefore, the overall risk of a false positive notification of AF will be higher than the elderly population, who might be less likely to use an Apple Watch [7,8]. Even then, anticoagulation is unlikely to be indicated or beneficial in young, otherwise healthy individuals with very low thromboembolic risk.

Furthermore, another concern stems from the way the device operates. The watch, which is placed on the wrist, has an optical sensor detecting pulse waveform to passively measure heart rate [9]. Then, using an algorithm, each pulse peak is translated into an R wave in the ECG. Detection of this pulse irregularity is used to identify atrial fibrillation. It is evident that potential skin sensitivities could possibly interrupt this procedure and lead to inaccurate measurements [10].

However, despite its any possible disadvantages, the Apple Watch is here to stay. It is likely to help patients identify AF and also any other potential rhythm abnormalities in the future, but at the risk of necessitating significant downward testing in healthy individuals. In addition, many more companies are expected to produce similar wearables, thus leading to more people having access to home monitoring and then referring to physicians for further investigations [11]. Given that these devices can be easily purchased by healthy individuals, as physicians we need to expect and prepare for reviewing patients following Smart Watch notifications as they will become a more common feature of the daily clinical practice.

CONFLICT OF INTEREST

No conflicts declared.

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ETHICAL CONSIDERATIONS

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GUARANTOR

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REFERENCES

1. FDA. (2018). Apple Watch ECG and AF Approval. Retrieved from https://www.accessdata.fda.gov/cdrh_docs/pdf18/DEN180044.pdf
2. Goldstein L, Wells M. Oxf Med Case Reports OMCR 2019;258 (in press).
3. Koshy AN, Sajeev JK, Nerlekar N, Brown AJ, Rajakarier K, Zureik M, et al. Smart watches for heart rate assessment in atrial arrhythmias. Int J Cardiol 2018;266:124–7. doi: [10.1016/j.ijcard.2018.02.073](https://doi.org/10.1016/j.ijcard.2018.02.073).
4. Sanders D, Ungar L, Eskander MA, Seto AH. Ambulatory ECG monitoring in the age of smartphones. Cleveland Clin J Med 2019;86:483–92. doi: [10.3949/ccjm.86a.18123](https://doi.org/10.3949/ccjm.86a.18123).
5. Perez M, Mahaffey K, Hedlin H, et al. Large-scale assessment of a smartwatch to identify atrial fibrillation. New Eng J Med 2019;381:1909–17.
6. Cheung CC, Krahn AD, Andrade JG. The emerging role of wearable technologies in detection of arrhythmia. Can J Cardiol 2018;34:1083–7. doi: [10.1016/j.cjca.2018.05.003](https://doi.org/10.1016/j.cjca.2018.05.003).
7. Foster KR, Torous J. The opportunity and obstacles for smartwatches and wearable sensors. IEEE Pulse 2019;10:22–5. doi: [10.1109/MPULS.2018.2885832](https://doi.org/10.1109/MPULS.2018.2885832).
8. Turakhia MP, Desai M, Hedlin H, Rajmane A, Talati N, Ferris T, et al. Rationale and design of a large-scale, app-based study to identify cardiac arrhythmias using a smartwatch: the apple heart study. American Heart Journal 2019;207:66–75. doi: [10.1016/j.ahj.2018.09.002](https://doi.org/10.1016/j.ahj.2018.09.002).

9. Apple Inc. Using Apple Watch for Arrhythmia Detection, (December). Retrieved from Apple Inc. (2018). Using Apple Watch for Arrhythmia Detection, (December). 2018
10. Carpenter A, Frontera A. Smart-watches: a potential challenger to the implantable loop recorder? *Europace* 2016;18:791–3. doi: [10.1093/europace/euv427](https://doi.org/10.1093/europace/euv427).
11. Guo Y, Wang H, Zhang H, Liu T, Liang Z, Xia Y, et al. Mobile health technology for atrial fibrillation screening using photoplethysmography-based smart devices: the HUAWEI heart study. *J Am College Cardiol* 2019. doi: [10.1016/j.jacc.2019.08.019](https://doi.org/10.1016/j.jacc.2019.08.019).