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# Detection of Recurrent Atrial Fibrillation Utilizing Novel Technology

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**Abstract**

**The true prevalence of AF is likely underestimated because episodes are often sporadic and challenging to detect in a "real world" setting.**

**This case report will describe a 58-year-old atrial fibrillation patient with multiple cardiac risk factors. After two ablations and one cardioversion, the patient failed to remain in normal sinus rhythm. Shortly after AF returned, the decision was made to perform a second cardioversion. Post-procedure, the patient was given a novel FDA-approved, wireless ECG monitoring device compatible with the iPhone®. This device has the capability of recording and transmitting a single-channel ECG. Within days, the patient began feeling symptomatic again and used his device to transmit an ECG to his healthcare provider. Recurrent AF was detected and the patient was directed to seek further evaluation.**

**The success of this novel device to detect recurrent AF highlights the "real world" applicability of using mHealth technology more readily in patient care.**

## Case Presentation

A 58-year-old Caucasian male with a prior history of atrial fibrillation (AF), hypertension, obstructive sleep apnea, congestive heart failure (CHF), peripheral vascular disease, and moderate alcohol consumption was admitted to a local Emergency Room (ER). His primary complaints were intermittent palpitations and diaphoresis occurring over the course of the previous week. His medications were as follows: Metoprolol 50 mg twice daily, Lasix 80 mg daily, Pradaxa 150 mg twice daily, Aspirin 81 mg daily, Sotalol 120 mg twice daily. The patient's $CHADS_2$-VASc (Congestive heart failure, Hypertension, Age ≥75 years, Diabetes mellitus, Stroke/TIA, Vascular disease, Age 65-74, Sex) score for the development of AF was three.

The patient had previously undergone two ablations and one cardioversion all of which temporarily restored normal sinus rhythm until AF was later redetected. He subsequently underwent a second cardioversion procedure, which again resulted in the restoration of normal sinus rhythm, (confirmed by a post-cardioversion ECG). However, due to his history of not being able to maintain normal rhythm post-procedure, the patient was asked if he would be willing to use a novel, mobile device that would allow him to capture and automatically send ECGs to his healthcare providers for review.

## Device Description

The AliveCor™ Heart Monitor is an FDA-approved ECG device compatible with the Apple iPhone® (Figure 1). The device attaches to the iPhone®, much like a protective case. After the device is attached, the patient downloads and launches the free "AliveECG" application from the Apple iTunes® store. A picture then appears on the screen that demonstrates how to hold the device while recording. There are two different ways this can be done: either by placing the device on your fingertips or chest wall (Figure 2). Recording begins automatically when both electrodes make contact with the skin and takes approximately 10 seconds to complete. When the ECG is captured, it is automatically transmitted to a secure, online "cloud" via Wi-Fi and/or cellular service. Patients and healthcare providers can view previously recorded ECGs within the "AliveECG" application or by logging into the HIPAA-compliant cloud at www.alivecor.com.

## Remote ECG Review

Once ECGs have been transmitted to the cloud, a healthcare professional logs-in to review them. If an irregular ECG is present, such as AF, or another malignant rhythm disturbance, the healthcare provider calls the patient to collect further information such as additional symptoms and activity. Dependent on the healthcare

**Disclosures:**
None.

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**Figure 1:** The FDA approved AliveCor™ Heart Monitor and application.

provider's evaluation, the patient is directed to either follow-up with his or her primary care physician, or go to the nearest ER for immediate evaluation.

In the case of the 58-year-old male described above, the healthcare provider who reviewed the AliveCor™ ECGs noticed that one tracing looked irregular in comparison to previous transmissions (Figures 3 and 4). She called the patient to collect further information on symptoms and based on his responses, requested that he go to the closest ER. The patient informed the ER staff of his symptoms (intense palpitations and diaphoresis), and that his AliveCor™ device had possibly detected recurrent AF. Cardiac monitoring in the ER confirmed the results of the AliveCor™ device (Figure 5). AF was detected at a rate of 118 bpm and the patient was given 20 mg of Cardizem intravenously. Upon discharge, the patient was given a new prescription for a higher dose of Metoprolol as well as an additional prescription for a calcium channel blocker to maintain his ventricular rate control. The patient was also instructed to follow up with his primary cardiologist upon discharge.

## Discussionn

AF is a major public health problem and is the most common cardiac arrhythmia, affecting an estimated 2.7 million Americans.[1-3] By the year 2050, the number of Americans with AF will exceed 12 million.[1-3] This rise in AF is due to the advancing age of the population and the number of individuals living with multiple cardiovascular chronic conditions (e.g., heart failure, hypertension, heart disease, diabetes) that are known to be associated with the development of AF.[4-5] The true prevalence of AF is likely underestimated because episodes are often sporadic; therefore, it is challenging to detect and record an occurrence of AF in a "real world" setting. In fact, AF recurrence is estimated to be 50% in the first year after the initiation of treatments that restore a normal heart rhythm, highlighting the need for improved ECG methods for detecting AF.[6] Prior to 2012, mHealth technology for capturing and sending ECG rhythms to healthcare providers from a smartphone did not exist.[7] The AliveCor™ Heart Monitor offers rapid, real-world cardiac monitoring from virtually anywhere. Patients are able to utilize this technology when symptomatic to confirm AF and other rhythm abnormalities, allowing for more timely treatment and management.

AF that remains undetected or untreated could lead to devastating outcomes such as myocardial infarction or stroke. To help address this problem, the NIH formed an expert panel to identify gaps and recommend research strategies to prevent AF.[8] Easy-to-use, highly-accessible, and cost-effective devices such as the AliveCor™ Heart Monitor could be one solution to improving detection methods for AF. Furthermore, if patients use this type of technology to transmit a daily ECG, silent (asymptomatic) AF may be captured more readily.

## Future Directions

It will become increasingly important to address the epidemic problem of AF with novel approaches utilizing advancements in mobile health (mHealth) ECG technology to empower patients to actively engage in their healthcare. Detection and treatment of AF may be improved through more rapid patient-provider communication.


**Figure 2:** Methods for recording an AliveCor™ ECG: either using fingertips (A) or chest wall (B).

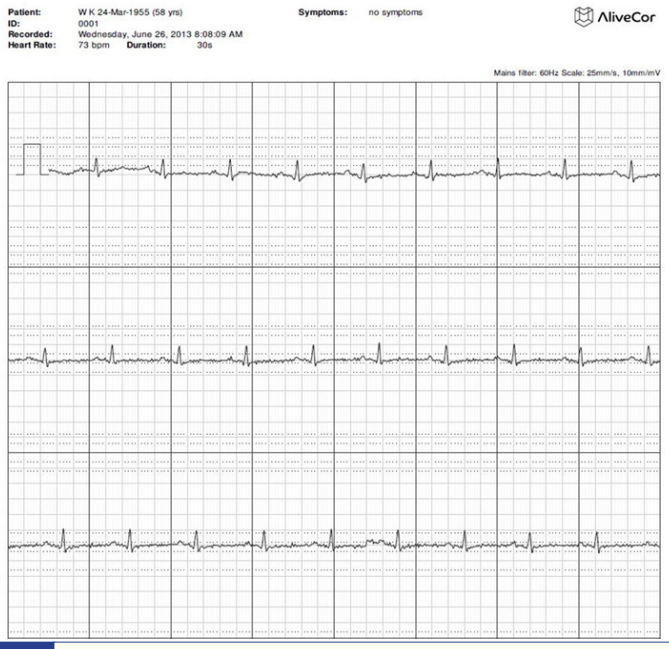


**Figure 3:** ECG captured with the AliveCor™ device showing the patient was in normal sinus rhythm post-cardioversion.

To date, mHealth tools that promote earlier detection and treatment of AF, adherence to cardiovascular treatments, improvement in self-management behaviors, and AF knowledge have not been evaluated. This case report demonstrates how this technology can be integrated into improving patient care.

## Conclusions:

In the case presented, novel technology led to more timely detection of recurrent AF. The patient provided positive feedback on device ease-of-use and monitoring. Since approximately one-third of patients with AF are asymptomatic, a daily ECG transmission in those who have undergone a prior cardioversion (such as the patient described in this report) or AF ablation may prove useful in detecting

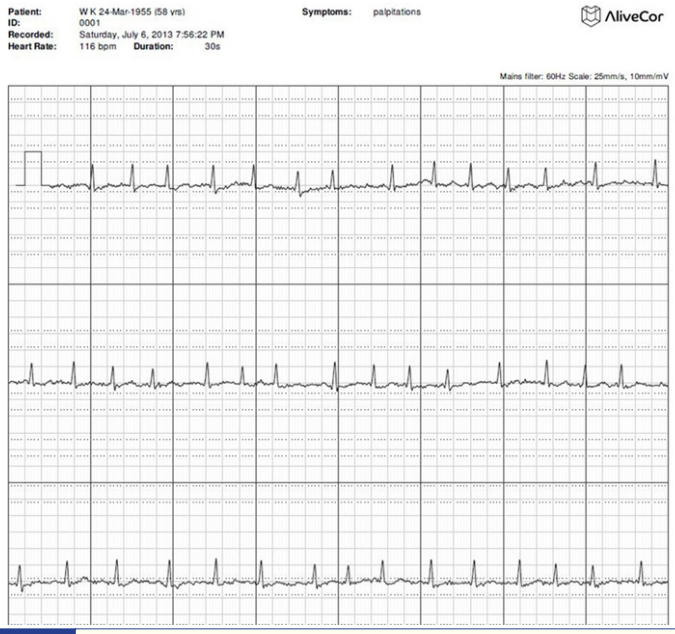


**Figure 4:** ECG captured with the AliveCor™ device showing the patient has returned to AF post-cardioversion.

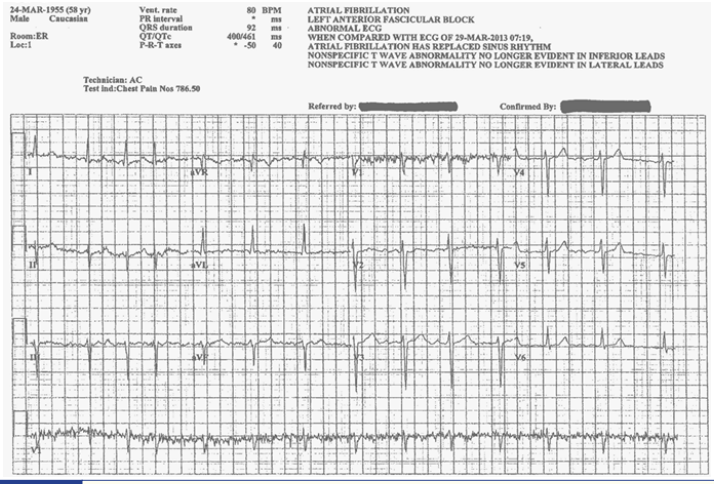


**Figure 5:** Emergency Room 12-lead ECG verifying the recurrence of AF.

silent AF. The real-world usability and non-cumbersome nature of ECG transmission via a smartphone could lead to enhanced arrhythmia detection and overall patient satisfaction.

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