Using smartphone enabled technologies for detection atrial fibrillation: is there a difference in signal quality between ECG and PPG?

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Objectives:
Guidelines indicate opportunistic screening for Atrial Fibrillation (AF) as a class I recommendation since it is proven to be important and effective in identifying cases of untreated, frequently asymptomatic AF. This work focuses on comparing the performance between photopletyshmography (PPG) and single lead ECG based smartphone applications during a national incentivized screening initiative and evaluate the quality related issues between these technologies.

Methods
Participants presented themselves voluntarily during the screening initiative. Screening was done using sequential measurements. First the circumference of the index finger and temperature of the finger was recorded. Next a single lead ECG device (Alivecor, 30 seconds) and a software only smartphone application based on photoplethysmography (FibriCheck, 60 seconds). Alivecor measurements were performed by placing both hands on two electrodes while the FibriCheck requires to place the finger on the smartphone camera. Additionally, demographic and background questionnaires were obtained. If one of the screening technologies indicated an irregular rhythm a 12-lead ECG was taken for verification by the cardiologist on site.

Results
In total 1056 participants were screened, 41% was male. The overall mean age was 59 ± 15 years with a mean BMI of 26 ± 10. In total 31% had no risk factors for AF, 34% had 1 risk factor, 19% had 2 risk factors and 16% had two or more risk factors. The screening resulted in the identification of 8 AF cases, 1026 regular sinus rhythms and 22 irregular rhythms (bigeminy, trigeminy, supraventricular arrhythmia). The AF cases had a $CHADS_2$-VASc score of 3 ± 1.18. The Alivecor had a sensitivity of 100% and specificity of 99.6% for the detection of AF, while the FibriCheck application had a sensitivity of 100% and a specificity of 97.2. The proprietary quality algorithms of Alivecor and FibriCheck indicated if the quality of the signal was insufficient for analysis. The quality was unreadable in 2.9% and 3.8% of the cases respectively. The main indicator were cold hands, tremor or callus formation at the hands of the users. Interestingly, no correlation was observed between both technologies. Only in 10% of the bad quality signals there was a correlation between both technologies. The other cases the majority of the findings favored normal recordings.

Conclusion
The obtained results indicate that detection of pulse intervals based on PPG is a sensitive and accurate screening tool for the detection of atrial fibrillation and has a high level of agreement with the results obtained using the single lead ECG. Despite the quality challenges of PPG signals, there is no correlation found in the cause nor the agreement between both technologies indicating that for the general population the quality parameters are properly tuned to prevent misdiagnosis as much as possible. These quality parameters will be a fundamental requirement further leverage PPG signals as a suitable signal for heart rhythm analysis.