Supplementary Online Content


**eFigure 1.** Three cohorts used to develop and validate a deep neural network for detecting atrial fibrillation  
**eFigure 2.** Geographical distribution of remote cohort participants  
**eFigure 3.** Deep neural network architecture  
**eReferences.**

This supplementary material has been provided by the authors to give readers additional information about their work.
Three cohorts used to develop and validate a deep neural network for detecting atrial fibrillation.

The Remote Cohort was used to develop and train the network, which was then validated in the Cardioversion Cohort and in a Second Validation Cohort as part of an exploratory analysis among ambulatory patients. (See text for details).

- **Remote Cohort**: 12,233 Cardiogram users consented for Health eHeart Study. 9,750 completed intake survey and linked Cardiogram account to Health eHeart. 6,682 Remote Development Cohort.
  - 6,499 no arrhythmia
  - 183 with arrhythmia and AliveCor
- **Cardioversion Cohort**: 51 Cardioversion Patients
  - Primary Validation: Identifying pre- and post-cardioversion segments.
  - Exploratory Analysis: Validation of AF detection from Ambulatory HR data.

**Sub-Cohort of the Remote Cohort: Exploratory Analysis**

- Hold-out sub-cohort: excluded those without full medical history, with pacemakers or implanted cardioverter/defibrillators and those with an average of <8hr/day of HR measurements (>66% HR data missing)
- Among those with AF, retained those who reported being in persistent AF “all the time.”
  - 1553 No AF
  - 64 with Persistent AF
eFigure 2. Geographical distribution of remote cohort participants

Blue dots indicate the number of participants that resided in the city and country corresponding to placement on the map. Black dots indicate areas of participants with AliveCor devices.
Deep neural networks are machine learning algorithms composed of multiple processing layers that can flexibly learn abstract representations of raw input data for a given task, such as detection of AF. Learning flexible representations from raw input data is well suited to overcome several challenges presented by the use of commercial heart rate sensors to detect AF: 1) they do not expose beat-to-beat intervals, instead only averaged heart rates; 2) sensor data is noisy; 3) the sensors themselves have significant error. In addition, supervised training of deep neural networks typically requires manual physician review of clinical data to identify “labels” upon which the network can train—which can be prohibitive at scale for clinical data. We used a purpose-built neural network consisting of 8 layers, each of which had 128 hidden units for a total of 564,227 parameters.
eReferences.


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