Multimodal, visually explainable AI prediction models to enhance the risk stratification of lethal ventricular arrhythmias

Contact

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Research project

Sudden cardiac death (SCA) is a major cause of mortality worldwide, accounting for 100,000 deaths per annum in the UK. Although it is generally considered a sudden and unexpected event, recent studies have demonstrated that more than half of the patients experience warning symptoms hours to days before the event [1,2]. Research has shown that early contact with emergency medical services may increase the likelihood of survival as much as fivefold [1]. SCA is a complex trait that can involve multiple underlying factors and triggers for ventricular arrhythmia. These can include inherited conditions, coronary artery disease (CAD), diabetes, as well as acute triggers such as ischemia, medications, and electrolyte imbalance [4]. Such diverse and complex pathophysiology makes it particularly challenging to find a linear relationship between multiple data domains to advance risk stratification of lethal ventricular arrhythmias and SCA [4]. Machine-Learning (ML) algorithms may provide the ability to identify novel patterns and clusters of SCA-defining variables in large datasets [3,4]. At the moment, AI models are deployed in single domain, for example electrocardiograms (ECGs) or echocardiogram datasets [3,4]. This interdisciplinary research project aims to explore, analyse and visualise large multimodal cardiac data that could potentially combine data, images and signals to advance ventricular arrhythmias risk stratification. The research will also investigate the broader aspect of combining human-machine vision approaches to develop and evaluate novel, visually explainable AI-based models that support the emerging field of human-machine collaboration (shared decision-making) in medical AI.

Applicant skills/background

This project requires a good theoretical and technical understanding of machine learning and data visualization approaches applied to complex data. Desirable skills include basic ECG interpretation knowledge and/or other cardiac/medical image processing methods.

References

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[2] Nishiyama C, Iwami T, Kawamura T et al. Prodromal symptoms of out-of-hospital cardiac arrests: a report from a large-scale population-based cohort study. Resuscitation. 2013;84:558–63. doi: 10.1016/j.resuscitation.2012.10.006.

[3] Acosta JN, Falcone GJ, Rajpurkar P, Topol EJ. Multimodal biomedical AI. Nat Med. 2022;28:1773–84. doi: 10.1038/s41591-022-01981-2.

[4] Holmström, Lauri, et al. "Artificial intelligence in ventricular arrhythmias and sudden death." *Arrhythmia & Electrophysiology Review* 12 (2023).