Artificial Intelligence approach helps identify patients with heart failure that respond to beta-blocker treatment

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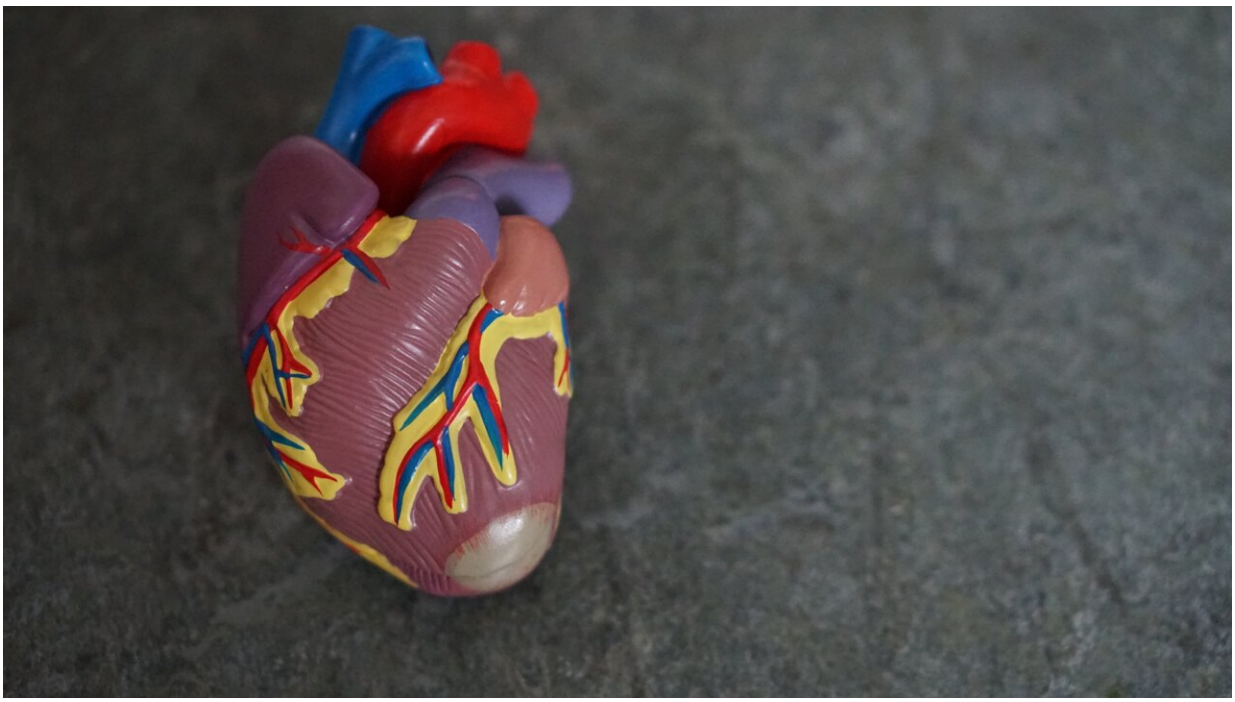

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Researchers at the University of Birmingham have developed a new way to identify patients with heart failure who will benefit from treatment with beta-blockers.

Their study involved 15,669 patients with heart failure and reduced left ventricular ejection fraction (low function of the heart's main pumping chamber), 12,823 of which were in normal heart rhythm and 2,837 of which had atrial fibrillation (AF)—a heart rhythm condition commonly associated with heart failure that leads to worse outcomes. Heart failure is one of the most common heart conditions, with substantial impact on patient quality of life, and a major driver of hospital admissions and healthcare cost.

Published today in *The Lancet*, the study used a series of artificial intelligence (AI) techniques to deeply interrogate data from clinical trials . The research showed that the AI approach could take account of different underlying health conditions for each patient as well as the interactions of these conditions, to isolate response to beta-blocker therapy. This worked in patients with normal heart rhythm, where doctors would normally expect beta-blockers to reduce the risk of death, as well as in patients with AF where previous work has found a lack of effectiveness. In normal heart rhythm, a cluster of patients (who had a combination of older age, less severe symptoms and lower heart rate than average) was identified with reduced benefit from beta-blockers. Conversely, in patients with AF, the research found a cluster of younger patients with lower rates of prior heart attack but similar heart function to the average AF patient who had a substantial reduction in death with beta-blockers (from 15% to 9%).

The research was led by the card*AI*c group, a multi-disciplinary team of clinical and data scientists at the University of Birmingham and the University Hospitals Birmingham NHS Foundation Trust, aiming to integrate AI techniques to improve the care of cardiovascular patients. The study used data collated and harmonized by the Beta-blockers in Heart Failure Collaborative Group, a global consortium dedicated to enhancing treatment for patients with heart failure. The research used individual patient data from nine landmark trials in heart failure that

randomly assigned patients to either beta-blockers or a placebo. The average age of study participants was 65 years, and 24% were women. The AI-based approach combined neural network-based variational autoencoders and hierarchical clustering within an objective framework, and with detailed assessment of robustness and validation across all the trials.

Corresponding author Georgios Gkoutos, Professor of Clinical Bioinformatics at the University of Birmingham, Associate Director of Health Data Research Midlands and co-lead for the card*AI*c group, says that "although tested in our research in trials of beta-blockers, these novel AI approaches have clear potential across the spectrum of therapies in heart failure, and across other cardiovascular and non-cardiovascular conditions."

Corresponding author Dipak Kotecha, Professor and Consultant in Cardiology at the University of Birmingham, international lead for the Beta-blockers in Heart Failure Collaborative Group, and co-lead for the card*AI*c group, added that "development of these new AI approaches is vital to improving the care we can give to our patients; in the future this could lead to personalized treatment for each individual patient, taking account of their particular health circumstances to improve their well-being."

First Author Dr. Andreas Karwath, Rutherford Research Fellow at the University of Birmingham and member of the card*AI*c group, added that they "hope these important research findings will be used to shape healthcare policy and improve treatment and outcomes for patients with heart failure."

The research is being presented today at the ESC Congress 2021, hosted by the European Society of Cardiology—a non-profit knowledge-based professional association that facilitates the improvement and

harmonization of standards of diagnosis and treatment of cardiovascular diseases.

More information: Andreas Karwath et al, Redefining β-blocker response in heart failure patients with sinus rhythm and atrial fibrillation: a machine learning cluster analysis, *The Lancet* (2021). DOI: 10.1016/S0140-6736(21)01638-X

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