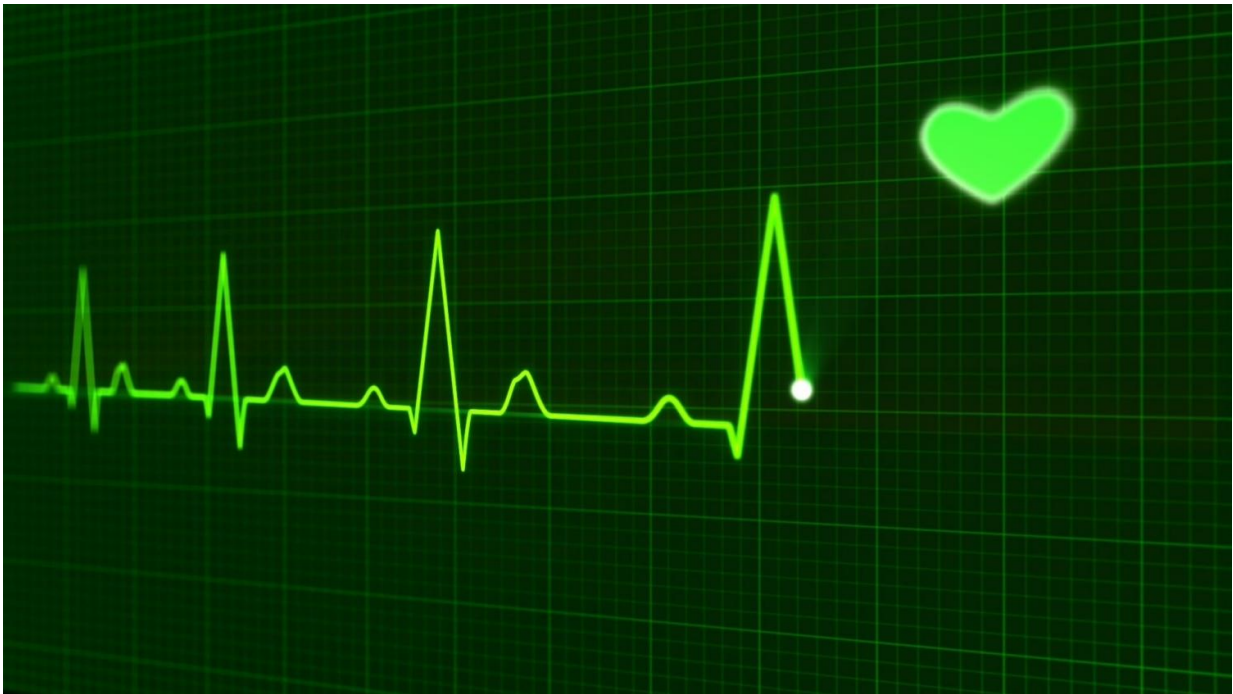# Spotlight on early detection of three heart diseases using ECG-AI

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Too often, the first sign of cardiovascular disease may be a major event like a heart attack, stroke or cardiac arrest. Now, researchers and clinicians at Mayo Clinic are using artificial intelligence (AI) technology to flag heart problems earlier, boosting the abilities of a diagnostic test that has been around for over a century—the electrocardiogram (ECG).

Early detection of heart disease can make a significant difference in a patient's quality of life and longevity, but a lack of defining symptoms adds complexity. The AI-enabled ECG provides a way to potentially detect heart disease earlier and track disease progression using a test that is relatively inexpensive, readily available and often already part of a patient's electronic health record.

Mayo Clinic has developed ECG-AI algorithms that are currently used in research to predict a patient's likelihood of having heart conditions like atrial fibrillation, amyloidosis, aortic stenosis, low ejection fraction, hypertrophic cardiomyopathy (HCM) and more. The AI can also predict a patient's biological age using traditional 12-lead and single-lead ECGs from smartwatches and portable devices.

One standout application is the use of ECG-AI to detect low ejection fraction, commonly called a weak heart pump. The 12-lead algorithm for detecting this condition is cleared for clinical use by the Food and Drug Administration (FDA) and licensed to Anumana. A single-lead algorithm for handheld devices externally applied to the chest is licensed to Eko Health for commercial development.

Diagnosing a weak heart pump

Approximately 3% of Americans have a treatable condition called low ejection fraction, where the heart is weakened and pumps less blood out to the body. The underlying causes and symptoms are often treatable, but people may not be aware of their condition until symptoms such as shortness of breath, fatigue and swelling in their legs start to get worse. Left untreated, low ejection fraction can progress to worsening heart failure, affecting quality of life and potentially become severe enough to require a heart transplant or lead to cardiac arrest.

Unfortunately, the symptoms of a weak heart pump can be confused

with those seen with normal pregnancy. At Mayo Clinic in Florida, Demilade Adedinsewo, M.B., Ch.B., a cardiologist, uses AI as a tool to detect a condition in women called peripartum cardiomyopathy, a weak heart pump that can develop during pregnancy or shortly after giving birth. Heart muscle weakness can be predicted with AI from a traditional 12-lead ECG and from an AI-enabled digital stethoscope that captures single-lead ECG and heart sound recordings.

"Our research with obstetric patients in Nigeria suggests that portable technology like the AI-enabled digital stethoscope has the potential to flag twice as many cases of peripartum cardiomyopathy as compared to routine care," says Dr. Adedinsewo.

"It may be a powerful tool to bring portable cardiomyopathy diagnostics to more women in underserved urban and rural populations around the world. Access is an important consideration in addressing health disparities in the U.S., because Black women have up to a sixteenfold greater risk of developing peripartum cardiomyopathy, compared to white women."

Amyloid buildup in the heart

Amyloidosis is a rare disease of misfolded proteins that go astray to form deposits of amyloid in organs, nerves and tissues. There are several different types, but when enough amyloid builds up in the heart, it causes heart failure and symptoms such as shortness of breath, fluid buildup and fainting. Patients also can have heart rhythm problems and might need a pacemaker. Early diagnosis is critical, because while amyloidosis is not curable, it is treatable with new medical therapies that can dramatically reduce the amount of amyloid produced and stop disease progression.

Using ECG-AI, clinicians at Mayo Clinic can potentially flag patients

who are in the early stages of cardiac amyloidosis. The technology is used in research and has FDA breakthrough device designation.

"We've done some research indicating that, if we apply [artificial intelligence](#) just to the electrocardiogram, we can suggest if the patient has the diagnosis, often before a clinician has even suspected it. So we believe that this is a way to make an [early diagnosis](#)," says Martha Grogan, M.D., a cardiologist at Mayo Clinic in Rochester, Minnesota. "Now, it has to be put in clinical context. It's not just that one AI ECG, but it can really help us suspect amyloidosis."

"It's a very powerful tool because it's inexpensive. It's available almost everywhere. Our research showed that even a single lead, which is something that you could do on a watch or a simple mobile device, can give us this prediction of amyloidosis," says Dr. Grogan. "So, one could imagine that, in underserved populations throughout the world, a simple ECG might help determine if a patient has amyloidosis, especially in those high-risk groups."

Hypertrophic cardiomyopathy

Hypertrophic cardiomyopathy is one of the most common genetic heart diseases, affecting 1 in 200 to 500 people. HCM happens when the heart's walls become thicker over time, which can disrupt the heart's electrical signals, increasing the risk of sudden cardiac death. Unfortunately, people often don't notice any symptoms until the disease progresses. It's like having a silent intruder in your heart.

Early detection is crucial but challenging. HCM does not always show up on basic tests, such as a 12-lead ECG. Most patients would not be referred to more resource-intensive tests, like an echocardiogram or MRI, unless a problem was suspected. But ECG-AI can spot HCM by recognizing subtle patterns that even expert clinicians might miss.

"Applying this AI algorithm to routine ECGs shows promise as a means to make early detection of HCM more practical, accurate and accessible as part of a heart health checkup," says Konstantinos Siontis, M.D., a cardiac electrophysiologist at Mayo Clinic in Rochester. "Athletes with yet undiagnosed HCM, who may be more at risk of dangerous arrhythmias during exercise, could benefit from early detection. And because HCM often runs in families, detecting it early in one person can lead to identifying other family members at risk."

Provided by Mayo Clinic