AI may accurately detect heart valve disease and predict cardiovascular risk

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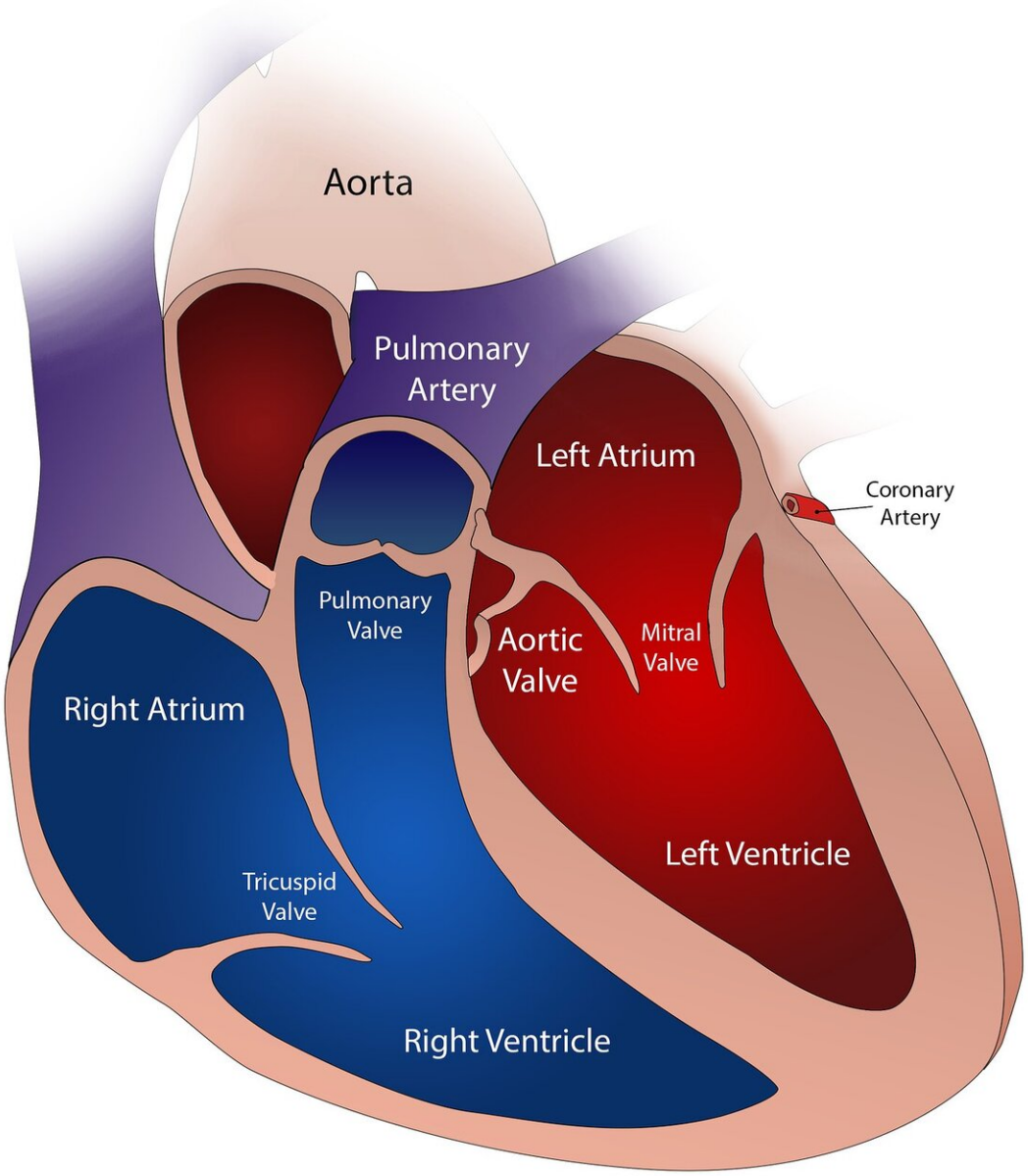

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Advances in artificial intelligence have enabled the development and application of AI tools that may be effective at detecting heart valvular disease and predicting the risk of cardiovascular disease events, according to preliminary research in two studies to be presented at the American Heart Association's Scientific Sessions 2023, held Nov. 11–13, in Philadelphia.

"Computational methods to develop novel predictors of health and disease—'artificial intelligence"—are becoming increasingly sophisticated," said Dan Roden, M.D., FAHA, professor of medicine, pharmacology and biomedical informatics and senior vice-president for personalized medicine at Vanderbilt University Medical Center, as well as chair of the Association's Council on Genomic and Precision Medicine. "Both of these studies take a measurement that is easy to understand and easy to acquire and ask what that measurement predicts in the wider world."

Real world evaluation of an artificial intelligence enabled digital stethoscope for detecting undiagnosed valvular heart disease in primary care

A study conducted at three different primary care clinics in the U.S. compared the ability of a medical professional using a standard stethoscope to detect potential heart valve disease vs. the ability of an artificial intelligence program using sound data from a digital stethoscope to do the same.

Each study participant had a physical exam that included a primary care professional, either a physician or nurse practitioner, listening to their heart and lungs with a traditional stethoscope for unusual sounds or murmurs plus an exam with a digital stethoscope that recorded heart sounds. All participants also received an echocardiogram at a follow-up

appointment one to two weeks later to determine if heart valve disease was present, though the results were not shared with the clinician or the patient.

The analysis found:

- The AI method with the digital stethoscope detected 94.1% of cases of valvular heart disease compared to the standard stethoscope used by primary care professionals, which detected only 41.2% of cases.
- The AI method identified 22 people with previously undiagnosed moderate-or-greater heart valve disease, and the professionals using the standard stethoscopes identified eight previously undiagnosed people with heart valve disease.

"The implications of undiagnosed or late diagnosis of valvular heart disease are dire and pose a significant cost to our health care system," said lead author Moshe Rancier, M.D., senior medical director of Mass General Brigham Community Physicians in Lawrence, Massachusetts.

"This study demonstrates that health care professionals can screen patients for valvular heart disease more effectively and quickly using a digital stethoscope paired with high-performing AI that could detect cardiac murmurs associated with significant valvular heart disease."

The study's limitations include the small sample size of the study group, which prevents analyses of differences between subsets of participants (based on characteristics such as gender, race, ethnicity and age).

Additionally, while the AI method had greater sensitivity to sounds detected with the digital stethoscope, medical professionals using a standard stethoscope were able to be more specific in their diagnosis, 95.5% versus 84.5% for the AI method, which may reduce the potential

for false positives and/or additional tests or screenings for valvular heart disease.

However, this study only evaluated the accuracy of the digital stethoscope in comparison to a traditional stethoscope. Rancier noted researchers plan to evaluate six-month patient follow-up data to review more closely the clinical outcomes and additional diagnostic tests and treatments.

Study background and details:

- The study included 369 adults, all ages 50 and older, and 61% of participants identified as female.
- None of the participants had a prior diagnosis of heart valve disease or a history of a heart murmur.
- The health care professionals who performed their standard exam on their patients were not aware of the AI results or the echocardiogram results, making it a blind study.
- Participants were enrolled from June 2021 through May 2023. Data collection and analysis are ongoing.
- The health care clinics where patients received care were located in Queens, New York, and Lawrence and Haverhill, Massachusetts.
- The study participants self-identified their race or ethnicity: 70% identified as white adults, 18% were Hispanic or Latino adults, 9% were Black adults and 2% identified as Asian adults; with 1% of participants identified as other.

"We saw here that the AI-based stethoscope did extraordinarily well, it predicted nearly 90% of the of the valve disease diagnoses that were ultimately there. I see that as an emerging technology—using an AI-enabled stethoscope and perhaps combining it with other imaging modalities, like an AI-enabled echocardiogram built into your

stethoscope," Roden said. "Use of these new tools to detect the presence of valvular disease as well as the extent of valvular disease and the extent of other kinds of heart disease will likely help to transform CVD care."

Deep learning-based retinal imaging for predicting cardiovascular disease events in prediabetic and diabetic patients: a study using the UK biobank

Using data from the UK Biobank, a second study by another research group evaluated the effectiveness of using pictures of the retina at the back of the eye that were analyzed by a deep-learning algorithm tool to predict the risk of cardiovascular disease events, defined as heart attack, ischemic stroke, transient ischemic attack or death due to heart attack or stroke.

Deep learning is a method of artificial intelligence that trains computers to analyze multiple layers of data and gives computers the ability to "learn" by evolving their model independent of human intervention based on new information presented to it—a process challenged by the requirement of both large amounts of computing power and data.

Previous research had successfully developed a deep learning algorithm to predict cardiovascular disease events by analysis of retinal images and coronary artery calcium scores.

Researchers used the deep-learning algorithm to categorize retinal images of 1,101 people with prediabetes or type 2 diabetes into low-risk, moderate-risk and high-risk groups for likelihood of cardiovascular disease. They then measured the number of cardiovascular disease events among participants over a median period of 11 years.

The analysis found:

- 8.2% of participants in the low-risk group, 15.2% of participants in the moderate-risk group and 18.5% of participants in the high-risk group had experienced cardiovascular disease events by the end of the study period of 11 years.
- After accounting for demographic and other potential CVD risk factors, such as age, gender, high blood pressure medication use, cholesterol medication use and smoking history, people in the moderate-risk group were 57% more likely to experience a cardiovascular event compared to people in the low-risk group; and people with high-risk scores were 88% more likely to experience a cardiovascular event compared to those in the low-risk group.

"These results show the potential of using AI analysis of retinal imaging as an early detection tool for heart disease in high-risk groups such as people who have prediabetes and type 2 diabetes," said study lead author Chan Joo Lee, M.D., Ph.D., an associate professor at Yonsei University in Seoul, Korea. "This could lead to early interventions and better management of these patient groups, ultimately reducing the incidence of heart disease-related complications."

Study background and details:

- The UK Biobank is a large biomedical database and research resource with health records of about 500,000 adults—enrolled from 2006 until 2010—who receive care through the United Kingdom's National Health Service. The researchers accessed the data in March 2023 and analyzed health records through June 2023.
- Participants were 59 years old, on average; 45.5% were female and predominantly identified as white race (85.5%).
- Of the 1,101 adults with prediabetes or Type 2 diabetes, 550 people were in the low-risk group, 276 were in the moderate-risk

group and 275 were in the high-risk group.
- At the end of the study period, 138 (12.5%) of the participants had experienced cardiovascular events: 45 were from the low-risk group; 42 were from the moderate-risk group; and 51 were from the high-risk group.

The researchers tested the ability of the imaging to predict cardiovascular disease using a large dataset of people, however, this population was noted as primarily white race, which means the researchers' findings may not be applicable to other populations. Additional follow-up studies among people from diverse races and ethnicities are needed.

"These systems learn from big data sets, and they only learn from the data we give them to learn from. In the UK Biobank, for example, 93% of the participants are of European ancestry, so we have no sense of whether the approaches derived in the UK Biobank are relevant or meaningful to people who are not of European ancestry," Roden said.

"Another question is: does the retinal scan do a better job of predicting coronary artery disease than the pooled risk equations, or a polygenic risk score for coronary artery disease, or coronary calcium measurements? Those are all questions that need to be answered because as we develop more tools to predict events like coronary artery disease, we want to make sure that we use the right ones and the right combinations, rather than complicating care with alternate tools that have not been validated."

Provided by American Heart Association

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