The value of AI for enhancing suspicion of cardiac amyloidosis using electrocardiography and echocardiography: A narrative review

Authors

Grogan, Martha;[1] Lopez-Jimenez, Francisco;[1] Guthrie, Spencer;[2] Kumar, Nisith;[3] Langevin, Reuben;[4] Witteles, Ronald ;[5] Royyuru, Ajay;[6] Rosenweig, Michael;[7] Cairns-Smith, Sarah;[4] Ouyang, David;[8]

Affiliations

[1]Mayo Clinic; [2]Attralus, [3]Pfizer; [4]Amyloidosis Research Consortium; [5]Stanford University; [6]IBM; [7]City of Hope; [8]Cedars-Sinai

Abstract

Background: Non-specific symptoms and other diagnostic challenges lead to underdiagnosis of cardiac amyloidosis (CA). Artificial intelligence (AI) could help address these challenges but a summary of the performance of these tools is lacking.

Methods: A narrative review of published literature describing (1) the performance of AI tools that use data from electrocardiograms (ECG) and echocardiography (ECHO) to improve identification of CA and (2) challenges that hinder adoption of these tools.

Results: Thirteen studies met inclusion criteria with sample sizes ranging from 50 to 2,451 patients. Four studies used ECG data, eight used ECHO data and one used both. Most patients were males over age 60. The CA gold standard was typically defined as a CA diagnosis in an institutional or other database but the requirements for these diagnoses were heterogenous across studies, and many did not distinguish among CA subtypes. AI model development varied considerably, and only four studies included external validation. The ability of models to predict CA ranged from 0.71 to 1.00, sensitivity ranged from 16%-100%, and specificity from 75%-100%. Only one study reported model performance across strata of gender, age, race, and CA type. Persistent challenges to AI adoption include knowledge, trust, usability, cost, EHR/IT interoperability, patient-related factors, workflow, and strategic partnerships (see table)

Conclusions: Published studies on AI for improved identification of CA show favorable performance measures but numerous methodologic and other challenges must be addressed before these tools should be widely adopted.

Figure. Non-technical barriers that may hinder adoption and implementation of AI in cardiovascular medicine*

Barrier	Detail	Potential Solutions
Knowledge	Limited understanding of which EHR-based and digital tools in clinical practices/systems use AI algorithms	Improve clinician education about current and potential AI use in patient care
Trust	Lack of trust in human–AI collaboration. Concerns about use of AI to dictate clinical decisions, validity of data, and data privacy. Lack of trust in tools developed by third-party vendors, who IT administrators perceive fail to deliver on promises of prescriptive AI	Work with professional societies to create and disseminate targeted education to mitigate clinician concerns about AI dictating decision-making
Usability	Concern about usability and integration of cardiovascular-focused AI tools into clinical workflows.	Promote research to drive and facilitate integration of AI tools into existing workflows
Cost	Hospitals and large clinical practices have constrained AI budgets regardless of potential benefits. Stakeholders (cardiologists and IT administrators) must justify cost to procurement and value assessment committees.	Promote research that informs on various aspects of return on investment of AI tools
EHR/IT Interoperability	Integration of AI tools into existing IT (Ex: EPID, Cerner, Allscripts) EHRs can be challenging and tools from different vendors are often incompatible with each other.	Identify and facilitate access to collaborative pathways between AI developers and EHR vendors
Patient-related factors	AI research may not have addressed patient preferences, fears, or cultural factors and biases that may impact acceptance of these technologies	Promote research that addresses patient perceptions about AI in cardiovascular care and address potential for racial, gender or other biases
Workflow	Products that are not tailored to organization-specific workflow and culture present challenges for adoption	Products need to support the right workflow sequencing for the right provider
Strategic partnerships	Niche products that are not viewed as foundational to organizational operations are unlikely to be adopted	Developers must be able to communicate that AI tools are integrated into, and run throughout the hospital or system in which they are implemented

*Adapted from Schepart et al., 2023,[49] Koulaouzidis et al., 2022,[50] Nicolosi et al, 2023,[47]