A Qualitative Study of Artificial Intelligence–Based Tools to Raise Suspicion for ATTR Cardiomyopathy

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INTRODUCTION

- Accurate diagnosis and appropriate treatment of rare cardiovascular (CV) diseases such as transthyretin amyloid cardiomyopathy (ATTR-CM) are often delayed until late in the disease course, potentially worsening patient outcomes.
- Artificial intelligence (AI)–enabled screening tools have been developed to help clinicians distinguish ATTR-CM from more common CV diseases with similar clinical manifestations.
- Despite the availability of these tools and their potential to improve patient care, they have not yet been adopted on a broad scale.[1]
- We used qualitative research methods to identify and understand the challenges and barriers related to the use of AI-enabled screening tools compared with standard risk scores.

METHODS

- Researchers (Hawk Partners, Fort Washington, PA) conducted 1:1 interviews with cardiologists and administrators of electronic health records/information technology (EHR/IT).
  - Format: a semi-structured interview guide used for interviews via telephone and live web platform.
  - Duration: 60 minutes.
  - Timing: June–July 2023.
- Eligible cardiologists and EHR/IT administrators satisfied the criteria listed in **Table 1**.

Table 1: Participant eligibility criteria

Cardiologists	EHR/IT administrators
• Board certified in cardiology • In practice for 3–32 years • Spent ≥50% of time on patient care • Provided care for ≥50 patients with heart failure in a typical month • Treated ≥1 patient with ATTR-CM in the past year • Influential within their organizations, as demonstrated by publications, committee membership, tenure, etc • Not employed as a consultant to a pharmaceutical company or in a setting affiliated with Kaiser/Kaiser Permanente	• Employed in current role for ≥1 year • Involved in EHR management and maintenance, including ≥3 of the following: – Transitioning to a new EHR system; monitoring EHR updates; implementing programmatic changes to EHR – Integrating EHR with other applications or patient management tools – Vetting EHR applications and use cases – Analyzing clinical data for research, process improvement, and reporting – Designing health information systems to comply with medical, legal, and ethical standards – Running queries on EHR data to support improved clinical outcomes – Implementing guideline-directed processes or pathways in support of patient care gaps • Not affiliated with a pharmaceutical company or healthcare manufacturer, and not employed by US federal or local government agency

ATTR-CM=transthyretin amyloid cardiomyopathy; EHR=electronic health records; IT=information technology

- Participants were asked to review and assess the following 3 existing ATTR-CM screening approaches:
  (1) Deep-learning–based automated electrocardiograph interpretation.[2]
  (2) Machine-learning–based interpretation of International Classification of Diseases, Tenth Revision (ICD-10) codes.[3]
  (3) Simple risk score derived from linear regression with known ATTR-CM predictors.[4]
- The order of exposure to these approaches was rotated across the interviews.
- Interviews were audio-recorded, transcribed, de-identified, and coded. Content was reviewed and analyzed for major patterns and themes using grounded theory.

RESULTS

- Characteristics of the cardiologists (n=20) and EHR/IT administrators (n=15) who were interviewed are summarized in **Table 2**.

Table 2: Participant characteristics

Characteristic	Cardiologist n=20	EHR/IT administrators n=15
Setting, n (%)		
Community	5 (25)	8 (54)
Academic	12 (60)	5 (33)
Standalone private practice	2 (10)	2 (13)
Specialized hospital/center of excellence	1 (5)	0
Practice/role		
Duration of employment, mean (range), y	12.3 (3–32)	11.5 (2–23)
Practice patient population		
Patients with heart failure, mean (range), n	192 (54–656)	N/A
Patients treated for ATTR-CM in past year, mean (range), n	37 (3–150)	N/A
Current EHR system, n (%)		
Epic	17 (85)	7 (47)
Cerner	–	2 (13)
Athena Health	2 (10)	–
Meditech	1 (5)	–
SOAPware	–	1 (7)
Quantum	–	1 (7)
Multiple EHR across network	–	4 (26)

ATTR-CM=transthyretin amyloid cardiomyopathy; EHR=electronic health records; IT=information technology; N/A=not applicable

- Participants shared their assessments of the strengths/opportunities and challenges/concerns of each ATTR-CM screening approach (**Figure 1A–C**).
- Participants also identified 5 critical features of the "ideal" ATTR-CM screening tool (**Figure 2**).

Figure 1: Summary of participant feedback on ATTR-CM screening approaches

A. Deep-learning–based automated echo interpretation

	Cardiologists	EHR/IT Administrators	Both
Perceived strengths and opportunities	Real-time use to confirm suspicion of ATTR-CM Sufficiently sensitive Runs in background and sends alerts via EHR	Integrates into existing diagnostic pathway (echo)	Potential to address care gap for systems without echo expertise
Perceived concerns and challenges	Potential to increase clinician workload Not an improvement over trained echo readers	Bandwidth required to transmit imaging data Interfacing with both echo software and EHR Keeping up to date with new imaging technology	Limited applicability (eg, due to need for multiple echos) False-positive rate may overwhelm follow-up testing capacity Cost ineffective

B. Machine-learning–based interpretation of ICD-10 codes

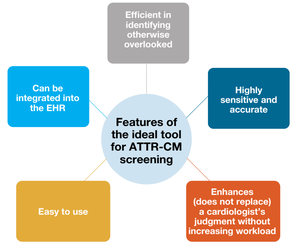
	Cardiologists	EHR/IT Administrators	Both
Perceived strengths and opportunities	Input data are available in all patients (widely applicable)	Low processing power requirement Easy to maintain	Easy integration with EHR Periodic "batch runs" can screen many patients at once for follow-up
Perceived concerns and challenges	Pop-up fatigue (flagging false-positives or known positives) Added staffing will be needed in smaller health systems More data needed on accuracy, specificity, and cost-effectiveness		Low quality of input data (ICD-10 code inaccuracies) may limit performance

C. Simple risk score

	Cardiologists	EHR/IT Administrators	Both
Perceived strengths and opportunities	Real-time use to confirm suspicion of ATTR-CM EHR integration for input Cost-effective due to simplicity	Easiest to implement and maintain Flexible to use with or without EHR integration	Low cost High level of familiarity
Perceived concerns and challenges	Must remember to use the tool if not automated Potential to increase clinical workflow Potential for overflagging (all patients aged ≥65 y with hypertension)	Challenging to automate if data not readily accessible from EHR	Performance may be limited by simplicity of the model

ATTR-CM=transthyretin amyloid cardiomyopathy; echo=echocardiogram; EHR=electronic health records; ICD-10=International Classification of Diseases, Tenth Revision; IT=information technology

Figure 2: Critical features of the ideal ATTR-CM screening tool identified by study participants



ATTR-CM=transthyretin amyloid cardiomyopathy; EHR=electronic health records

CONCLUSIONS

- Several important features were identified that warrant consideration when designing or selecting AI-based ATTR-CM screening tools to help facilitate broader use.
- These lessons may also apply to disease states beyond ATTR-CM and reflect the judgments, concerns, and hopes for the use of AI in clinical medicine reported by clinicians and EHR/IT administrators.

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DISCLOSURES

BC: Consultant: Caption Health, Viz.ai; advisory board: Novo Nordisk; advisor (equity interest): Healthspan, Zoe Biosciences. **LMB, RB, and AE:** Employees of Pfizer and hold stock/stock options. **FSA:** Consultant: Pfizer.

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