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PERCEPTION AND UTILIZATION OF AI-BASED DIAGNOSTIC TOOLS AMONG PRACTICING CARDIOLOGISTS: A CROSS-SECTIONAL STUDY

Original Article

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ABSTRACT

Background: Artificial intelligence (AI) is rapidly transforming cardiovascular diagnostics through enhanced precision, speed, and pattern recognition. Despite the growing presence of AI tools, their real-world adoption among practicing cardiologists remains unclear, particularly in high-volume tertiary care environments.

Objective: To assess the awareness, acceptance, and clinical utilization of AI-based diagnostic tools among cardiologists working in a tertiary care hospital setting.

Methods: A cross-sectional study was conducted over eight months at a tertiary care hospital in Lahore. A structured, pre-validated questionnaire was administered to 150 board-certified cardiologists. The instrument captured data on demographics, awareness, attitudes, and real-world application of AI tools. Data were analyzed using SPSS version 26. Descriptive statistics, chi-square tests, and ANOVA were used, with p-values <0.05 considered significant.

Results: Of the 150 respondents, 74.7% were male with a mean age of 42.6 ± 6.9 years. High awareness was observed for AI-enabled ECG (82.0%), echocardiography tools (73.3%), and risk prediction models (78.7%). Acceptance levels were also favorable, with 74.7% supporting routine AI integration and 72.0% agreeing AI improves diagnostic accuracy. Despite this, only 58.0% used AI-enabled ECGs, 49.3% used risk stratification tools, and 43.3% used AI in echocardiography; 24.0% reported not using any AI tool. The main barriers included lack of training and workflow integration.

Conclusion: Cardiologists in tertiary care demonstrate substantial awareness and positive perceptions of AI diagnostics, though practical adoption lags. Focused training and institutional strategies are needed to bridge this implementation gap and maximize clinical benefit.

Keywords: Artificial Intelligence, Cardiology, Clinical Decision Support Systems, Diagnostic Imaging, Echocardiography, Electrocardiography, Health Knowledge, Practice Patterns, Physicians, Surveys and Questionnaires.

INTRODUCTION

The integration of artificial intelligence (AI) into healthcare has emerged as a transformative force, with diagnostic tools at the forefront of this evolution. Among the medical specialties, cardiology stands out as a field particularly receptive to the potential of AI, owing to its heavy reliance on data interpretation, imaging, and pattern recognition. From early detection of arrhythmias using wearable devices to automated interpretation of echocardiograms and risk stratification models for heart failure, AI-based technologies are reshaping the diagnostic landscape (1). Despite this technological progress, the extent to which practicing cardiologists are aware of, accept, and utilize these tools in their daily clinical practice remains uncertain. This ambiguity underscores the need for a closer examination of the practical realities surrounding AI integration in cardiology (2). The past decade has witnessed an explosion of AI applications in cardiovascular medicine. Machine learning algorithms are being developed to enhance diagnostic precision, reduce interpretation errors, and improve clinical outcomes. For instance, studies have demonstrated that deep learning models can rival expert cardiologists in interpreting electrocardiograms (ECGs), with notable accuracy in detecting conditions such as atrial fibrillation, myocardial infarction, and left ventricular dysfunction (3). Moreover, AI-driven platforms can analyze large datasets rapidly, identifying subtle clinical patterns that may be missed by human clinicians. This capability has led to heightened interest in AI's potential to support clinical decision-making, improve diagnostic turnaround times, and reduce physician workload (4,5).

However, while the technological promise of AI is well documented, its clinical adoption is influenced by more than just performance metrics. The successful implementation of AI in cardiology depends on the perceptions, trust, and readiness of clinicians to incorporate these tools into their practice (6). Existing literature reveals a mixed response. Some cardiologists report enthusiasm and optimism regarding AI's capabilities, while others express skepticism, citing concerns over algorithm transparency, medicolegal responsibility, data privacy, and the potential erosion of clinical intuition (7,8). These concerns are particularly pronounced in tertiary care settings, where complex decision-making and multidisciplinary collaboration are the norm. Without a clear understanding of clinicians' perspectives, the healthcare system risks a misalignment between technological capabilities and clinical realities. Moreover, there appears to be a gap between AI development and frontline clinical application (9). While academic and commercial interest in AI for cardiology is accelerating, evidence suggests that the penetration of these tools into everyday clinical workflows remains limited. A key reason may be the lack of clinician-centered design in many AI tools, resulting in solutions that are technologically sound but practically cumbersome or misaligned with user needs. Additionally, variability in institutional resources, training opportunities, and leadership support can lead to disparities in adoption rates across healthcare systems. Despite numerous pilot projects and proof-of-concept studies, the true breadth of AI utilization by cardiologists, particularly those in tertiary care hospitals, is still under-characterized in the literature (10,11).

Given the high-stakes environment in which cardiologists operate, their views and behaviors toward AI carry substantial weight in determining the trajectory of AI adoption. Cardiologists not only play a central role in diagnosing and managing cardiovascular diseases but also often guide broader institutional strategies for technology adoption. Thus, understanding their engagement with AI is essential to inform future policy, educational interventions, and technology development. Insight into their current level of awareness, their openness to integrating AI into practice, and the specific barriers they face can help bridge the divide between innovation and implementation. To address this critical knowledge gap, the present study aims to assess the perception and utilization of AI-based diagnostic tools among practicing cardiologists in tertiary care hospitals. By conducting a cross-sectional survey, the study seeks to generate empirical data on cardiologists' awareness, acceptance, and real-world application of AI technologies in their diagnostic workflows. This objective is rooted in the broader goal of ensuring that AI advancements in cardiology are not only technologically feasible but also clinically meaningful and practitioner-endorsed.

METHODS

This cross-sectional study was conducted over a period of eight months in a tertiary care hospital located in Lahore, Pakistan. The primary objective was to assess the current level of awareness, acceptance, and clinical usage of AI-based diagnostic tools among practicing cardiologists. The study was designed to capture real-world insights from physicians actively engaged in patient care, offering a representative understanding of the integration of artificial intelligence into contemporary cardiology practice. The study population comprised board-certified cardiologists currently employed in clinical departments of the selected tertiary care facility. Inclusion criteria were defined to allow participation of cardiologists with at least one year of post-fellowship clinical experience, regular involvement in diagnostic decision-making, and willingness to provide informed consent. Exclusion criteria included physicians on administrative duty with limited clinical engagement, cardiology trainees who had not yet attained full registration, and those who declined participation or returned incomplete responses.

A sample size of 150 participants was determined using a standard sample size calculation for proportions, with a 95% confidence level, 5% margin of error, and an assumed prevalence rate of 50% for AI tool usage, to maximize sample size and account for the exploratory nature of the study (12). A non-probability purposive sampling technique was employed to identify eligible participants, ensuring adequate representation from various subspecialties within cardiology, including interventional cardiology, electrophysiology, and echocardiography. Data collection was facilitated through a structured, pre-validated questionnaire developed based on previous literature and expert consensus (12,13). The questionnaire consisted of four sections: demographic and professional background, awareness of AI-based diagnostic tools, acceptance and attitudes toward AI integration in cardiology, and current patterns of utilization in clinical practice. Items were designed using a combination of Likert-scale responses, multiple-choice questions, and open-ended fields to allow for both quantitative analysis and qualitative insights. To ensure face and content validity, the questionnaire was reviewed by a panel of five senior cardiologists and a biostatistician. A pilot test involving 15 cardiologists, who were not included in the final analysis, was conducted to refine the language, assess internal consistency, and confirm feasibility of the tool in a busy clinical setting.

Participants were approached in person by the research team, and paper-based or digital versions of the questionnaire were provided based on individual preference. Informed written consent was obtained from all respondents prior to questionnaire administration. Confidentiality and anonymity of responses were ensured, and all data were coded and stored in encrypted files accessible only to the primary investigators. Ethical approval for the study was granted by the Institutional Review Board (IRB) of the tertiary care hospital. Data were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics were computed to summarize demographic variables, awareness levels, and utilization frequencies. Means and standard deviations were reported for continuous variables, while categorical variables were presented as frequencies and percentages. To assess associations between demographic/professional characteristics and levels of AI tool utilization, inferential statistics were applied. The Chi-square test was used for categorical comparisons, and independent samples t-tests or one-way ANOVA were used where appropriate for continuous variables. A p-value <0.05 was considered statistically significant throughout the analysis. Since data met the assumptions for normality, parametric tests were deemed appropriate.

Outcome measurement was focused on three primary domains aligned with the objective: awareness (measured through correct identification of AI-based tools and their functions), acceptance (assessed via Likert-scale ratings on perceived usefulness, trust, and readiness for adoption), and clinical usage (captured by self-reported frequency and types of AI tools used in diagnostic processes). Secondary outcomes included perceived barriers to AI integration, such as lack of training, concerns over accuracy, medicolegal implications, and institutional support. By adopting a rigorous methodology and validated assessment tools, the study was designed to provide a comprehensive understanding of the current state of AI adoption in cardiology at a major tertiary care hospital. The findings aim to inform targeted interventions that support the responsible and effective integration of AI in clinical cardiology settings.

RESULTS

The final sample included 150 cardiologists, with a male predominance (74.7%) and a mean age of 42.6 ± 6.9 years. Participants had an average of 14.3 ± 5.1 years of professional experience. Subspecialty representation was broad, with interventional cardiology comprising the largest group (38.7%), followed by echocardiography (23.3%), electrophysiology (18.0%), and general cardiology (20.0%). In terms of awareness, 82.0% of participants correctly identified AI-enabled ECG analysis as an existing tool, followed closely by risk prediction models (78.7%) and AI in echocardiography (73.3%). Awareness of wearable AI-integrated devices was slightly lower, at 64.7%. These figures indicate a relatively high baseline awareness of major AI tools relevant to cardiology, though variations exist across subdomains. Regarding acceptance, a majority agreed that AI improves diagnostic accuracy (72.0%) and should be integrated into routine cardiology practice (74.7%). Additionally, 67.3% agreed that AI reduces clinical workload, while 59.3% expressed trust in AI-generated recommendations. Although acceptance was broadly favorable, a notable minority remained uncertain or unconvinced, particularly with regard to reliability and trust in AI decisions. Utilization patterns revealed that 58.0% of cardiologists reported using AI-enabled ECG systems in their practice, while 49.3% had employed AI tools for risk stratification, and 43.3% used AI-assisted echocardiography reporting systems. Notably, 24.0% of respondents reported not using any AI-based diagnostic tool in routine care. This discrepancy between awareness and actual usage highlights a possible gap in practical integration despite theoretical endorsement.

Table 1: Demographics

Variable	N (%) or Value
Gender	
Male	112 (74.7%)
Female	38 (25.3%)
Age (years)	
Mean ± SD	42.6 ± 6.9
Professional Experience (years)	
Mean ± SD	14.3 ± 5.1
Subspecialty	
Interventional Cardiology	58 (38.7%)
Electrophysiology	27 (18.0%)
Echocardiography	35 (23.3%)
General Cardiology	30 (20.0%)

Table 2: Awareness of AI Tools

AI Tool	Correctly Identified N (%)
AI-enabled ECG analysis	123 (82.0%)
AI in Echocardiography	110 (73.3%)
Risk prediction models	118 (78.7%)
Wearable AI devices	97 (64.7%)

Table 3: Acceptance of AI Tools

Statement	Agree/Strongly Agree N (%)
AI improves diagnostic accuracy	108 (72.0%)
AI reduces workload	101 (67.3%)
AI should be integrated into routine care	112 (74.7%)
I trust AI-based recommendations	89 (59.3%)

Table 4: Usage of AI Tools

Tool	Used in Practice N (%)
AI-enabled ECG	87 (58.0%)
AI in Echo Reporting	65 (43.3%)
AI for Risk Stratification	74 (49.3%)
None	36 (24.0%)

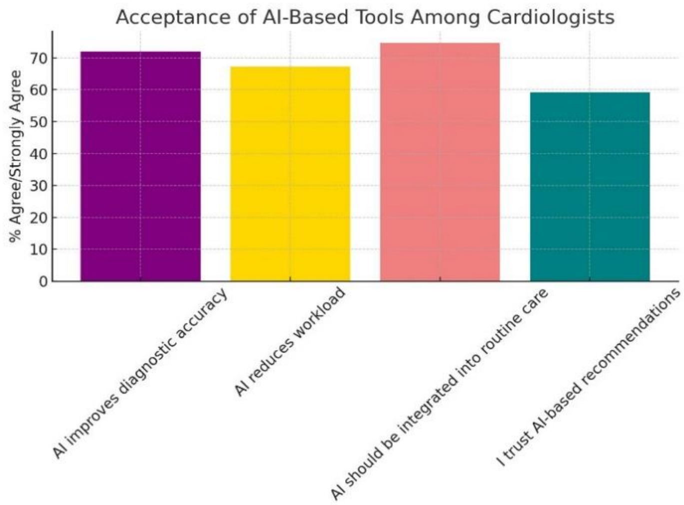

Figure 1 Acceptance of AI-Based Tools Among Cardiologists

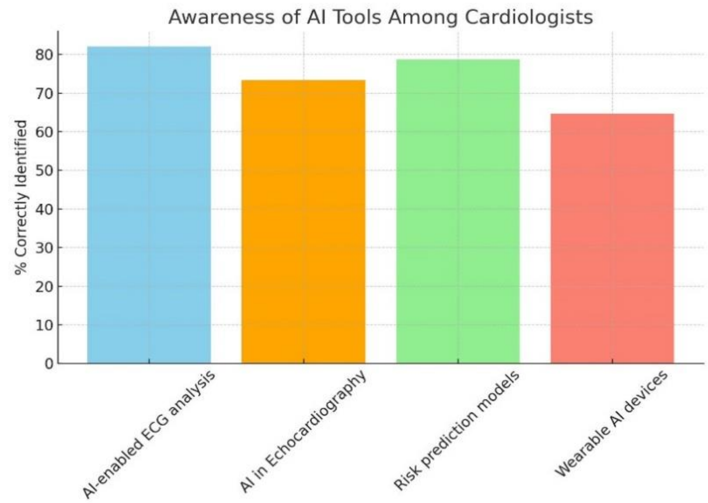

Figure 2 Awareness of AI Tools Among Cardiologists

DISCUSSION

The findings of this study reflect an evolving yet cautious engagement of practicing cardiologists with AI-based diagnostic tools in a tertiary care setting. High awareness and favorable attitudes toward AI were evident, although actual integration into daily clinical workflows remained limited. These results are aligned with existing literature indicating a persistent gap between conceptual acceptance and operational application of AI in clinical cardiology (14,15). The current level of awareness, where over 70% of participants correctly identified widely used AI tools such as AI-enabled ECG and risk prediction models, is consistent with international trends. For example, a recent study on interventional cardiologists found that while over 80% reported familiarity with AI, only about 22% were actively using it in practice, highlighting a disconnect between awareness and usage (16). Similar patterns were reported, where cardiologists acknowledged the potential of AI but cited usability, cost, and interoperability issues as key barriers to adoption (17) The relatively high acceptance rate of AI tools, as indicated by over 70% agreement on statements regarding diagnostic accuracy and clinical utility, is in line with broader healthcare trends. A multicenter survey across China suggested that training and institutional support significantly improve healthcare workers' confidence in AI tools (18,19). In the present study, despite positive attitudes, 24% of respondents had not incorporated any AI tool into practice, which aligns with global data showing low real-world usage despite rising enthusiasm.

The findings also reinforce that specialty-specific exposure and institutional infrastructure may play pivotal roles in determining AI uptake. Cardiologists in echocardiography and interventional domains reported higher use of AI tools—echoing research that suggests AI-assisted imaging is among the most mature areas in clinical AI adoption. AI tools such as AIEchoDx have demonstrated diagnostic accuracy comparable to senior cardiologists, bolstering clinical confidence in their utility (20). Nonetheless, the gap between awareness and practical adoption points to systemic barriers. These include a lack of formal training, ambiguity around medico-legal implications, and minimal integration of AI into institutional guidelines and workflows. Studies across multiple healthcare systems—including Saudi Arabia and India—have consistently shown that even well-informed physicians remain hesitant to adopt AI due to perceived risks, lack of clarity on data privacy, and fears of professional deskilling (21,22).

One of the strengths of this study is its focus on a tertiary care setting where exposure to complex diagnostic workflows is higher, making it an ideal context to assess real-world AI integration. The comprehensive tool used captured both quantitative and qualitative insights, ensuring a more nuanced understanding of physician behavior. However, the study has several limitations. Being single-center, it may not generalize to all healthcare settings or geographic regions. The reliance on self-reported data can introduce bias, and the cross-sectional design limits causal inference regarding trends in AI adoption. For future research, longitudinal studies tracking the evolution of AI perception over time would offer valuable insights into behavioral change and implementation dynamics. Furthermore, intervention-based studies assessing the impact of targeted training programs or institutional AI policy frameworks could help establish best practices for promoting effective AI integration (23). Comparative studies across different specialties and healthcare systems could also illuminate contextual factors influencing adoption. In conclusion, while cardiologists in this study demonstrated substantial awareness and acceptance of AI-based diagnostic tools, clinical usage remains modest. This disparity highlights the ongoing need for structural support, targeted education, and policy alignment to bridge the gap between promise and practice. AI holds immense potential to revolutionize cardiovascular diagnostics, but its success depends equally on technological refinement and human-centered implementation.

CONCLUSION

This study demonstrated that cardiologists in a tertiary care setting possess high awareness and generally favorable attitudes toward AI-based diagnostic tools, yet fewer than two-thirds have incorporated these technologies into routine practice. Bridging this awareness–utilization gap requires structured training, clearer medico-legal guidance, and seamless workflow integration. By identifying specific barriers and enablers, the findings offer actionable insights for hospital administrators, policymakers, and technology developers aiming to accelerate responsible AI adoption and ultimately enhance diagnostic accuracy and efficiency in cardiovascular care.

AUTHOR CONTRIBUTION

Author	Contribution
Muhammad Aizaz Mohsin Khan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Aftab Anwar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Faizan Mahmood	Substantial contribution to the acquisition and interpretation of data. And has given final approval of the version to be published.
Muhammad Mehmood	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sahil Ghouri	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Maryam Khalid	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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