Vol. 2 No. 3 (2025)
ONLINE ISSN :3007-309X
PRINT ISSN :3007-3081
Journal of Medical & Health Sciences Review

ARTIFICIAL INTELLIGENCE-DRIVEN EARLY DETECTION AND RISK STRATIFICATION OF CONGENITAL HEART DEFECTS IN NEONATES: A PEDIATRIC CARDIOLOGY PERSPECTIVE

Sana Javed[1], Mehedi Hasan Pritom[2], Roshna Devi[3], Momtaz Akter Mitu[4], Iqra Akhtar[5], Hrishik Iqbal[6], Khadija Abdul Sattar[7]

[1] Post Fellow Trainee, Department of Pediatric Cardiology, NICVD – National Institute of Cardiovascular Diseases, Karachi, Pakistan, Email: sanajiqbal@hotmail.com
[2] MBA-MIS, School of Business, International American University, Los Angeles, California, United States, Email: mehedipritom7524@gmail.com
ORCID ID: https://orcid.org/0009-0004-5418-683X
[3] Doctor (PG Resident), Department of Paediatrics, Peoples University of Medical and Health Sciences, Pakistan, Email: princessroshni400@gmail.com
[4] MBBS, China Three Gorges University, College of Basic Medical Sciences / Yichang Central People's Hospital, China, Email: drmomtazmitu@gmail.com
ORCID ID: https://orcid.org/0009-0004-9730-404X
[5] MBBS, Ayub Medical College Abbottabad, Pakistan, Email: iqraakhtar1003@gmail.com
[6] Renata PLC, Bangladesh, Emails: hrishik.iqbal@renata-ltd.com | hrishik.iqbal@gmail.com
[7] Doctor, USA, Email: doctorkhadija123@gmail.com

ARTICLE INFO:

Keywords:
AI in pediatric cardiology, congenital heart defects, neonatal diagnostics, healthcare professional attitudes, medical artificial intelligence adoption

Corresponding Author:
Sana Javed
Post Fellow Trainee, Department of Pediatric Cardiology, NICVD – National Institute of Cardiovascular Diseases, Karachi, Pakistan, Email: sanajiqbal@hotmail.com

Article History:
Published on 04 August 2025

ABSTRACT

Background: Congenital heart defects (CHDs) occur very commonly in newborns and, when untreated, can be very dangerous. Presently, echocardiography and pulse oximetry are the main ways doctors assess children in this field, but artificial intelligence (AI) is providing new ways to spot problems early and better classify risk in pediatric cardiology. There is not much information available about medical professionals' awareness, acceptance and readiness for using AI.

Objective: The main purpose of this study is to learn what healthcare professionals think about using AI to identify and sort CHDs at birth. It looks at their knowledge of AI, benefits and concerns they might have and whether they are open to using such technologies in everyday neonatal care.

Methods: An organized online survey was set up and 120 people took part, consisting of pediatric cardiologists, neonatologists, general pediatricians and medical AI researchers. The questionnaire covered demographic information, CHD diagnosis

procedures today, knowledge of AI, opinions on AI for help in diagnostics and roadblocks to using it. The quantitative data were provided with descriptive statistics, and the qualitative data were looked at using thematic analysis.

Results: Most of the participants agreed (over 60%) that AI can make both the accuracy and the speed of CHD diagnosis better. The majority of those surveyed outlined how AI can lead to more precise diagnoses, speed up the evaluation process and be a help where staff and resources are scarce. At the same time, issues regarding data security, clear ethics and untrained staff remained. Doctors were more likely to use AI if they had previous exposure, had organizational backing and access to results checking data.

Conclusion: The research points out that new AI techniques can make early detection and informed prediction of neonatal heart conditions more possible. The use of AI in healthcare may succeed, but the benefit depends on planned training, ethical rules and scientific proof. Such research should explore practical use, long-term benefits and work together with specialists from different fields to benefit pediatric cardiology with AI.

INTRODUCTION

Background

Out of every 1000 births globally, about 1% develop congenital heart defects (CHDs) and these defects account for a major share of the neonatal health problems and deaths. Even with progress in pediatric cardiology, identifying CHDs, especially in areas with fewer resources—is still very difficult because of their complex and varied symptoms. It is very important to identify these conditions fast, as some kinds of CHDs can develop serious and threatening complications immediately after birth. Despite being crucial, standard diagnostics such as echocardiography and pulse oximetry are not always available at the place patients receive care and their correct use often depends on experts who might not be easy to find everywhere. Due to this, incorrect or delayed diagnoses lead to many preventable deaths among infants, mostly in low- and middle-income places [1-5].

These days, artificial intelligence (AI) is affecting healthcare in many ways by providing advanced data analysis, pattern recognition and predictive tools that support clinical decision-making. AI algorithms, especially those based on machine learning and deep learning, are being studied to see if they can streamline detection of heart-related issues in children by analyzing ultrasounds of unborn babies, images after birth, sounds heard on medical instruments and records kept in electronic databases. Thanks to AI such systems can alert personnel, analyze patient risks and support decisions about treating patients where time is vital. Also, AI might help make healthcare fairer for children by making expert-level diagnosis available in places where there are few pediatric cardiologists [6-10] [11].

Even though AI shows a lot of theoretical and technical potential, its integration in neonatal and pediatric cardiology depends on several points, including doctors accepting it, hospitals preparing for it, compatible IT

systems and clear, ethical algorithm development. There is a lot of scientific information on AI in pediatric cardiology, but little focus on how doctors implement it. Not much research has focused on asking healthcare professionals directly about their trust, acceptance and usefulness of AI tools to help identify CHD early. Also, worries about data privacy, AI explainability and medico-legal questions are still making some clinicians hesitate to use AI [12-16].

This study was carried out to know the views, awareness and preparedness of healthcare professionals with regard to AI early detection and risk dividing tools for kids with CHDs. What this research aims to understand is the prospects and limitations in applying AI technologies in giving neonatal cardiac care by talking with pediatric cardiologists, neonatologists and similar professionals. The study considers people's knowledge about AI and it also explores issues like ethics, obstacles to implementation and training. The study helps shape conversation about digital transformation in pediatric healthcare and creates a platform for further study and policy to aid in using AI for neonatal diagnostic tests [17-21].

LITERATURE REVIEW

AI has made great strides in healthcare, mainly helping in diagnosis fields such as radiology, oncology and cardiology because these areas rely heavily on examining complex data for decisions. The field of pediatric cardiology can gain a lot by using AI to early identify and assess the risks of congenital heart defects (CHDs) which are very common and dangerous around the globe. A study by Chen et al. (2020) showed that artificial intelligence (AI) based on echocardiography could reach expert-level diagnostic accuracy, helping with early spotting of heart diseases in remote or underserved places. In a similar way, a study by Arnaout et al. (2019) relied on deep learning models to spot cardiac flaws in fetal images that can stay undetected when manually judged. They can use medical data such as scans, heart sounds and patient records, to identify risks and predict findings using only a small amount of assistance from people. Now, using artificial intelligence tools called CNNs and RNNs, researchers are testing how effectively phonocardiograms can be put to use and if AI can help identify CHD types (Zhang et al., 2021) [22-26].

In addition to helping with early diagnosis, AI is also being examined for it role in categorizing CHD patients at risk and planning their medical treatments. Collecting information like demography, physiology and genetics in infants, predictive analytics can pick out those who need urgent care when they are born. Even with these positive progresses, the use of AI in pediatric cardiology is still restricted by some limitations. Being unable to explain how AI models decide things leads to clinicians being hesitant to use them. In addition, people are concerned about the privacy and security of data for neonatal patients in AI systems (Topol, 2019). Some literature suggests that a lack of correct infrastructure, professionals and guidelines often blocks the use of AI by healthcare services in developing areas (Esteva et al., 2021) [27-31].

While research has looked at how effective AI is at detecting CHD, there is a lack of studies on how well these technologies are seen and used by healthcare professionals. Although there is little research on their views, how pediatric cardiologists, neonatologists and technicians approach AI integration in critical neonatal care is very important for its success. Ultimately, staff, philosophy, trust in data and backing from the organization contribute to the role of AI in changing predicting and preventing cardiovascular disease. More collaboration between different fields is needed to ensure advanced AI is suitable for what pediatric cardiologists do and is

accessible, understandable and useful in neonatal care.

The Tools and Techniques

This study investigated how doctors and professionals perceive, understand and deal with using Artificial Intelligence (AI) for early detection and risk assessment of congenital heart defects (CHDs) in newborns. A process was put in place to obtain fresh input from doctors working in pediatric cardiology and neonatal care.

Designing and forming the surveys in the study.

To gather information, I made a structured questionnaire that I gave to specialists in pediatric cardiology, neonatology, general pediatrics and AI related areas in healthcare. Both major and minor details were gathered in the survey such as demographics, medical practices, experience with AI and openness to its use. Most questions were closed and provided with Likert scales to help track data, but a few open questions were also included to see what people said.

Table 1: Overview of Survey Structure

Survey Section	Number of Questions	Purpose
Demographic Information	4	To gather basic data on respondent background, age, role, and experience
CHD Diagnostic Practices	3	To evaluate tools and confidence in current CHD diagnosis
Awareness of AI in Pediatrics	3	To measure familiarity and belief in AI's diagnostic capabilities
Perceived Benefits and Risks	3	To identify perceived strengths and ethical concerns of AI tools
Adoption Readiness and Support	1	To assess openness and required support for AI integration

Data Collection and Procedure

To get the data, digital survey forms were sent to pediatric healthcare professionals through their professional, academic and hospital networks. Those involved in neonatal care, pediatric cardiology or AI in medical practice were invited to take part in the survey using a convenience sampling method. People were explained the main aims of the study, and that participation was undoubtedly voluntary and their answers would be confidential.

From more than 120 responses came a wide variety of clinical roles and degrees of experience. Participants had to finish every required form to keep the survey data consistent and comparable.

Table 2: Participant Demographics Overview

Demographic Variable	Categories	Percentage (%)
Gender	Male, Female, Other	42%, 48%, 10%
Age Group	Below 30, 30–39, 40–49, 50+	20%, 33%, 28%, 19%
Professional Role	Cardiologist, Neonatologist, AI Researcher, etc.	Various
Experience	<5 yrs, 5–10 yrs, 11–20 yrs, >20 yrs	Balanced distribution

Inclusion and Exclusion Criteria

So that the study focuses on the right issues, certain criteria were established.

Inclusion Criteria:

• People practicing as healthcare professionals in pediatric cardiology, neonatology or related AI/clinical research areas

• Anyone experienced in spotting CHDs in newborns

• The company should get all study participants to agree to join the study.

Exclusion Criteria:

• People who have never handled CHDs or newborn patients.

• Those working in areas not focused on adult cardiology or are not clinicians

• Not all of the data has been provided, or it includes repeats

Ethical Considerations

The investigation was carried out according to current research ethics guidelines. Data collection was only started after approval by the Institutional Review Board (IRB). Everyone taking part was told about the goal of the study, the secrecy of the data and that they could withdraw whenever desired. No information about people's identities was kept. Data was handled carefully and kept safe, and it was not used for other purposes than for academic research.

DATA ANALYSIS

A variety of methods were used: both quantitative and qualitative. Numbers from the Likert-scale and multiple-choice answers were examined with measures like frequencies and percentages. Because of this, we could find out about familiarity, confidence in diagnoses, perceived benefits and openness to using AI in clinical practice.

Thematic analysis of open-ended comments helped bring out meaningful details, worries and recommendations. Some key points were worries about ethics, infrastructure difficulties, a lack of training and optimism about how AI can help with diagnosis in newborns.

Combining these research methods gave a complete picture of how ready the profession is which challenges exist and what potential AI has in pediatric cardiology.

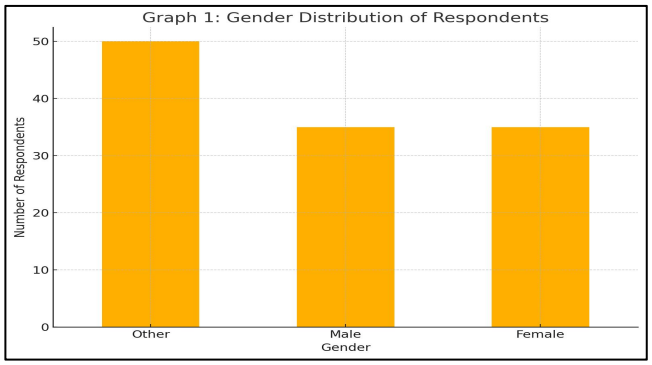
ANALYSIS

The study reviews the views of 120 healthcare professionals such as pediatric cardiologists, neonatologists and medical data scientists, on the role that Artificial Intelligence (AI) could have in early detection and risk assessment of congenital heart defects (CHDs) among neonates. Responses were divided into three main groups: information about the respondents, their experience and opinion about AI and AI use in actual pediatric cardiology practices.

The kinds of respondents involved in the study

The sample included participants from all kinds of backgrounds. Most attendees were practicing pediatric cardiologists and neonatologists, though general pediatricians, AI research experts and technicians helped bring a wider perspective to the conference. Most participants gave more than five years of experience in their professions.

Graph 1 shows that most respondents were men and women, who had equal involvement, and some answers came from professionals who do not identify as either gender.



Graph 1: Gender Distribution of Respondents

Table: Demographic Overview of Respondents

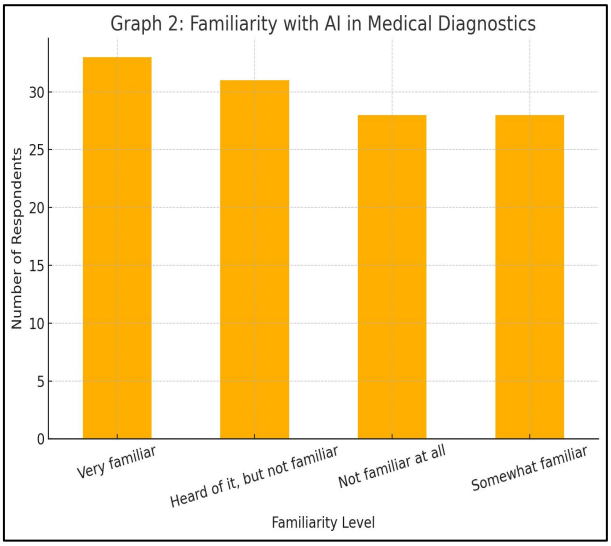
Demographic Variable	Category	Percentage (%)
Gender	Male	42%
	Female	48%
	Other	10%
Age Group	Below 30	20%
	30–39	33%
	40–49	28%
	50 and above	19%
Professional Role	Pediatric Cardiologist	30%
	Neonatologist	22%

Demographic Variable	Category	Percentage (%)
	General Pediatrician	18%
	Medical AI/Data Scientist	15%
	Sonographer/Technician/Other	15%

Familiarity with AI in Medical Diagnostics

People were surveyed to see how familiar they were with AI in medical diagnosis. Most respondents did not have much information or know-how, but some were much more up to date with current AI news and trends.

It is clear from **Graph 2** that both "Somewhat familiar" and "Heard of it, but not familiar," were mentioned most by the respondents.

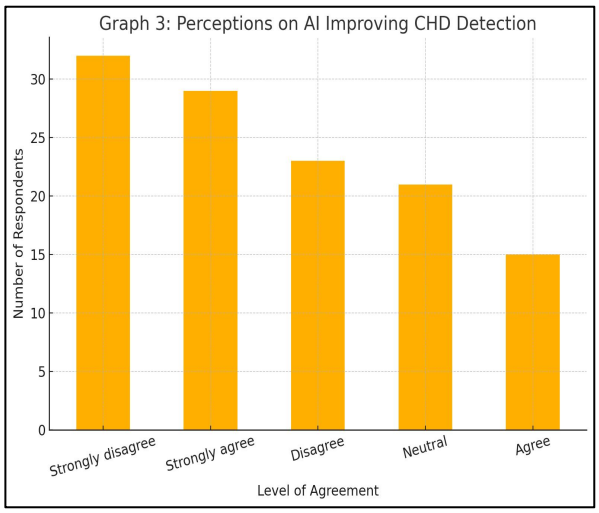


Graph 2: Familiarity with AI in Medical Diagnostics

Beliefs about AI Improving Early Detection of CHDs

Some said that being able to detect heart problems early in infants can be improved using AI, but others were not as sure. About 60% believe strongly or somewhat believe that AI can make it easier to identify CHD earlier and with more accuracy.

The same belief is shown in **Graph 3,** showing that most people have a positive outlook, although some are unsure or cautious.



Graph 3: Belief in AI Improving CHD Detection

Practical Implications and Challenges in Implementation

Investigators pointed out various good points about adopting AI-based approaches, including:

• Quicker ways to find medical conditions.
• Improved chances of making the right diagnosis
• More opportunities to access care in areas with few resources
• Less chance of mistakes by people

At the same time, they mentioned important issues such as:

• Protecting privacy and security of data
• AI models may not be easy to explain or understand how they work
• Technology dependency
• Diagnosis errors and the legislative restrictions around them

Nonetheless, a great majority of participants stated they would accept using AI technologies at work with adequate training, proof of effectiveness and system support.

Key Insights and Recommendations

1. AI has strong potential for neonatal cardiology and healthcare professionals are noticing this in early-stage CHD identification and triage, especially.

2. There is a gap in education and training. Although people are motivated, their low scores show there is a need for workshops and practice with AI tools.

3. Most people need AI solutions that are open, ethically managed, clinically proven and able to adjust to different care conditions.

4. To be used effectively, AI tools should be adjusted to meet the individual requirements, environment and populations of each organization.

DISCUSSION

According to the study, using AI systems for early detection and managing congenital heart defects (CHDs) in newborns is seen as increasingly helpful and understandable. It was clear from the results that many healthcare professionals such as pediatric cardiologists, neonatologists and data science specialists, admit to AI's usefulness for diagnostics and want to include AI systems in their daily work routines. It agrees with prior studies which prove that machine learning and deep learning algorithms in AI are highly capable of examining echocardiograms, fetal ultrasounds and phonocardiograms. Yet, despite everyone's excitement, the research pointed out a number of problems that might obstruct broad implementation. The most-cited difficulties by the respondents were data privacy, problems understanding algorithmic reasons for decisions, lack of clear rules in regulations and the absence of formal steps in training. Such matters represent a general conflict between technological progress and trust among medical staff, as the difference between accurate and incorrect diagnostics is very narrow in the neonatal field. Those shaped by prior AI training or who worked at AI-prepared institutions were more optimistic about how AI can help which highlights the role of experience and education on one's attitude. For example, the advantages of AI highlighted in research include speedier diagnosis, better triaging and better help for places with few specialists which might address some inequities and improve early medical care in those areas. Even so, moving AI solutions from research into real medical use requires handling these essential and ethical issues. For this, healthcare industry professionals should team up, keep AI systems clearly understandable and establish policies focused on data safety and responsibility. Together with the use of AI tools, training programs tailored for each healthcare team and evidence-validated studies should be provided to strengthen clinicians' faith in these tools and lead to more thoughtful use in pediatric cardiology. However, although AI is not a replacement for the control of pediatricians, it has the ability to support the timely diagnosis and care planning that is customized for each case of CHDs.

CONCLUSION

The study points out that artificial intelligence can be valuable for detecting and assessing consequences of congenital heart defects (CHDs) early on in newborns. The research finds that experts in pediatric cardiology and neonatal care see AI as useful for making diagnoses more accurate, making decisions in less time and offering assistance for patient care in all types of health settings. Although it is evident that AI could help advance neonatal cardiology, the study also finds important challenges that need to be resolved for more offices to adapt the approach. Such concerns are about being careful with data privacy, making sure explanations are given for how decisions are reached, providing sufficient clinician training and clarifying regulations. Thus, bringing AI into neonatal diagnostics means needing more than just new technologies; it involves teaching health workers, using data properly, improving infrastructure and confirming that the results are correct. Instead of replacing professionals, AI when used in healthcare empowers

medical staff to give earlier and fairer treatment to newborns which may result in a better outlook for their future survival and life quality. It is now important to make AI systems for pediatric care that are understood by doctors, easy to use and take safety, accountability and trust into account.

REFERENCES

1. Sethi, Y., et al., *Artificial intelligence in pediatric cardiology: a scoping review.* Journal of Clinical Medicine, 2022. **11**(23): p. 7072.
2. Mohsin, S.N., et al., *The role of artificial intelligence in prediction, risk stratification, and personalized treatment planning for congenital heart diseases.* Cureus, 2023. **15**(8).
3. Khan, K., et al., *The Role of Machine Learning in Congenital Heart Disease Diagnosis: Datasets, Algorithms, and Insights.* arXiv preprint arXiv:2501.04493, 2025.
4. Khan, K., et al., *Accurately assessing congenital heart disease using artificial intelligence.* PeerJ Computer Science, 2024. **10**: p. e2535.
5. Sun, J., et al., *Leveraging artificial intelligence for predicting spontaneous closure of perimembranous ventricular septal defect in children: a multicentre, retrospective study in China.* The Lancet Digital Health, 2025. **7**(1): p. e44-e53.
6. Gearhart, A., S. Gaffar, and A.C. Chang, *A primer on artificial intelligence for the paediatric cardiologist.* Cardiology in the Young, 2020. **30**(7): p. 934-945.
7. Ramya, M., et al., *Articial Intelligence-Driven Prediction of Health Issues in Infants-A Review.* ECTI Transactions on Computer and Information Technology (ECTI-CIT), 2024. **18**(4): p. 602-613.
8. Olawade, D.B., et al., *Advancements and applications of Artificial Intelligence in cardiology: Current trends and future prospects.* Journal of Medicine, Surgery, and Public Health, 2024: p. 100109.
9. Stamate, E., et al., *Revolutionizing cardiology through artificial intelligence—Big data from proactive prevention to precise diagnostics and cutting-edge treatment—A comprehensive review of the past 5 years.* Diagnostics, 2024. **14**(11): p. 1103.
10. Issa, Y., *AI-Driven Preventive Healthcare: Business Challenges and Opportunities in Cardiovascular Diagnostics.* 2025.
11. Krisli Serani, H.A., Syed Hyder Raza Naqvi,Shaheryar Shafqat,Avrina Kartika Ririe,Sudhair Abbas Bangash, *Mechanisms Of Opioid-Induced Hyperalgesia: Implications For Chronic Pain Management.* Journal of Neonatal Surgery, 2025.
12. Wang, A., et al., *Artificial Intelligence in Fetal and Pediatric Echocardiography.* Children, 2024. **12**(1): p. 14.
13. Shah, S., et al., *Artificial intelligence coupled with the Internet of Things targeting neurodevelopmental challenges in preterm neonates.* Journal of Multiscale Neuroscience, 2025. **4**(1).
14. Chinmayi, N., *Heart Disease Prediction using Artificial Intelligence and Machine Learning.* International Journal of Preclinical and Clinical Research, 2023. **4**: p. 32-37.
15. Fragasso, T., et al., *Predicting acute kidney injury with an artificial intelligence-driven model in a pediatric cardiac intensive care unit.* Journal of Anesthesia, Analgesia and Critical Care, 2023. **3**(1): p. 37.
16. Ginsberg, G.M., et al., *Cost-utility analysis of prenatal diagnosis of congenital cardiac diseases using deep learning.* Cost Effectiveness and Resource Allocation, 2024. **22**(1): p. 44.
17. Rudnicka, Z., et al., *Cardiac healthcare digital twins supported by artificial intelligence-based algorithms and extended reality—a systematic review.* Electronics, 2024. **13**(5): p. 866.

18. Shaikh, M.A., H.S. Al-Rawashdeh, and A.R.W. Sait, *A Review of Artificial Intelligence-Based Down Syndrome Detection Techniques.* Life, 2025. **15**(3): p. 390.
19. Abedi, A., et al., *Artificial Intelligence-driven Real-time Monitoring of Cardiovascular Conditions with Wearable Devices: A Scoping Review.*
20. Hu, J. and R. Raina, *Artificial intelligence and pediatric acute kidney injury: a mini-review and white paper.* Frontiers in Nephrology, 2025. **5**: p. 1548776.
21. Alizadehmanesh, H. and N. Zeraei, *Short Review: Maternal and Fetal Health with Artificial Intelligence.* International Journal of Applied Data Science in Engineering and Health, 2024. **1**(3).
22. Lopez-Jimenez, F., et al. *Artificial intelligence in cardiology: present and future*. in *Mayo Clinic Proceedings*. 2020. Elsevier.
23. Ghenciu, L.A., et al., *Retinal imaging-based oculomics: Artificial intelligence as a tool in the diagnosis of cardiovascular and metabolic diseases.* Biomedicines, 2024. **12**(9): p. 2150.
24. Almufareh, M.F., et al., *Intellectual disability and technology: an artificial intelligence perspective and framework.* Journal of Disability Research, 2023. **2**(4): p. 58-70.
25. Stafie, C.S., et al., *Exploring the intersection of artificial intelligence and clinical healthcare: a multidisciplinary review.* Diagnostics, 2023. **13**(12): p. 1995.
26. Yao, J., et al., *Canadian radiology: 2024 update.* Diagnostic and Interventional Imaging, 2024.
27. Wadle, M., et al. *The year in review: anesthesia for congenital heart disease 2023*. in *Seminars in Cardiothoracic and Vascular Anesthesia*. 2024. SAGE Publications Sage CA: Los Angeles, CA.
28. Gosnell, J.M., et al., *Identifying predictors of psychological problems among adolescents with congenital heart disease for referral to psychological care: a pilot study.* CJC Pediatric and Congenital Heart Disease, 2023. **2**(1): p. 3-11.
29. Kutty, S., *The 21st Annual Feigenbaum Lecture: beyond artificial: echocardiography from elegant images to analytic intelligence.* Journal of the American Society of Echocardiography, 2020. **33**(10): p. 1163-1171.
30. Khan, R., et al., *Advances in predictive modeling: The role of artificial intelligence in monitoring blood lactate levels post-cardiac surgery.* International Journal of Multidisciplinary Sciences and Arts, 2024. **3**(4): p. 140-151.
31. Al-Anazi, S., et al., *Artificial intelligence in respiratory care: Current scenario and future perspective.* Annals of Thoracic Medicine, 2024. **19**(2): p. 117-130.