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Application of Artificial Intelligence (AI) as the Assisting Strategy in the Cardiology Department

Manju Baby[1*], Sam Emmanuel Sabu[2], Sanjob Sabu[3]
[1]*School of Nursing, Texila American University, Guyana*
[2]*Jubilee Mission Medical College and Research Institute Thrissur, India*
[3]*Dr. Somervell Memorial CSI Medical College Hospital, Karakonam, Thiruvananthapuram, India*

Abstract

This manuscript explores the application of artificial intelligence (AI) in the cardiology department, highlighting its transformative impact on diagnostics, treatment, and patient management. AI encompasses various methods, including machine learning and deep learning, which enable the analysis of extensive data sets for improved decision-making in clinical practice. The paper discusses how the development of AI technologies that enhance the identification and prediction of cardiovascular diseases, through innovative analytical solutions that offer superior accuracy and speed compared to traditional methods. A significant focus is placed on AI's capability to swiftly interpret complex ECG patterns, facilitating early diagnosis of life-threatening arrhythmias. Furthermore, the manuscript emphasizes the importance of personalized medicine, wherein AI-driven insights contribute to tailored care plans for individual patients. The strategic integration of AI within cardiology not only enhances the quality of care but also streamlines clinical workflows. By addressing ethical considerations and potential biases, this paper aims to provide a comprehensive overview of the current state and future potential of AI in cardiology, ultimately advocating for its wider implementation to advance patient outcomes in cardiovascular health.

Keywords*: AI Advantages and Disadvantages, AI and Cardiology Department, Artificial Intelligence [AI], Artificial Intelligence [AI] in Cardiology, Artificial Intelligence and Cardiology Nurses, Cardiology Department.*

Introduction

Concept of AI

AI can be defined as the synthesis of activities that typically humans perform in day-to-day operations by computer prescriptions. It constitutes a variety of methods and tools that make it possible to create models of human thought processes, perceiving, learning, decision-making, etc. The concept of AI can be broken down into two broad categories: narrow AI, which is programmed to do specific functions such as face recognition or disease detection, and general AI, which aims to possess the ability to do anything that a man can do [1]. In its simplest form, AI incorporates a set of norms or standards, known as, algorithms, and a vast pool of data to identify and define relationships. Artificial intelligence comprises machine learning, which encourages systems to develop new knowledge from data and improve their performances without codification [2]. The other class is called Deep learning which uses neural networks to process data at multiple layers to perform sophisticated tasks like voice recognition and picture recognition. Of course, everyone knows that AI is used in various spheres of human life, starting from the healthcare system and ending with the financial industry and entertainment industry.

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****Corresponding Author: sabumm@yahoo.com***

For example, the field of healthcare is prepared to change diagnostics, treatment, and patient services with the help of predictive analytics and, therefore, an individualized approach.

Artificial intelligence needs massive data to learn from, and its quick processing offers healthcare practitioners actionable information beneficial to patients. Increasingly more companies and governments integrate artificial intelligence into everyday tasks, which has led to important ethical and practical concerns about privacy, agency, and the potential for bias of systems [3]. With the advancement of AI realizing its definition and what it is in terms of capability besides its effects will be significant in shaping the future use of AI and also the risks that come with it.

Application and Role of AI in Healthcare

There's been progress over the last few years in increased adoption of artificial intelligence (AI) within healthcare systems ranging from diagnosis, and patient observation to treatment management. According to [4], machine learning and deep learning may improve the chances of identification or prediction of cardiovascular diseases in women from clinical history, ECG, and other imaging tests. These new analytical solutions are more effective in terms of accuracy and speed compared to methods that were previously used in clinical practice; a win-win for the patient, and cost-effective for the healthcare system [4].

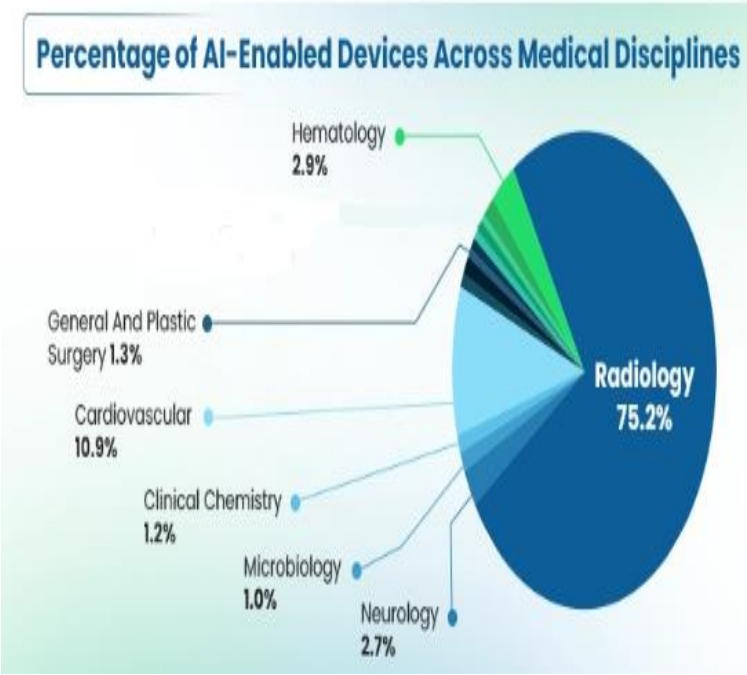

Figure 1. AI use in Major Healthcare Disciplines

(Source: Jasani, 2024)

Figure 1 indicates that while AI is being used majorly in the radiology area (75.2%), its role in cardiology has been significant with 10.9% adaptations. In addition, AI is increasingly being applied in the field of cardiology as pointed out by [5]. Sophisticated AI diagnostic techniques make predictions about possible heart disease, which will help cardiologists make more accurate decisions on the treatment necessary [5]. AI in cardiology has advanced even more as it can work through high volumes of data quickly to diagnose the early changes in patients' ECGs that signify life-threatening arrhythmias [6]. This would give the patient the ability to hold this so if she is sick, she may be able to be attended to sooner and she may have a better outlook.

A notable application of AI in cardiology includes the use of deep learning models to achieve accurate interpretation of more

complex ECG patterns to diagnose new atrial fibrillation besides saving a lot of time [6]. Technological enhancements like these form the basis of the concept of personalized medicine: the development of patient care plans that are unique to each patient's clinical profile and thus likely to give the best therapeutic results with the fewest side effects.

AI in Strategic Cardiology and Healthcare

AI has recently been adopted in the cardiology framework as a tool essential in strategic patient care. It has also contributed to improving the diagnosis, treatment, and management of cardiovascular disorders in clinical practice. Up-to-date AI applications in cardiology strategy have been primarily focused on its capacity to process extensive amounts of data, as well as to recognize patterns and carry out accurate predictions that support clinicians' decisions. One of the studies conducted [6] pinpointed the use of AI for ECG, and how the algorithms it uses can identify ECG irregularities and forecast cardiac incidents with reasonable accuracy. This has resulted in the creation of AI-supported decision-making tools that help cardiologists in arriving at the right decisions for the patients thus enhancing the effectiveness and efficiency of the systems. In the nursing profession, AI is used in the improvement of the quality of care as well as the use of advanced technology to carry out straightforward work. For instance, [7] showed how an ambient AI tool improves the accuracy of clinical documentation to reduce the workload of nurses involved in updating a patient's history.

Need of the Study

Cardiology is a field in which artificial intelligence plays a critical role in diagnosing increasingly complex cardiovascular diseases. The application of AI is the capability to increase the diagnostic rate, have better results of the treatments, and minimize the steps of treatments through better analysis of the huge volume of data available. With the advancement in health care delivery systems, the inclusion of AI will shape advancements such as precision medication dealing with specific patient issues adequately. Also, knowing the ethical concerns and possible bias in AI use in the health sector is significant to avoid unhealthy outcomes in the discovery of health solutions. The purpose of this study is to review these advancements and their application to cardiology practice.

Research Aim and Objectives

The study aims to explore the influence of the application of Artificial intelligence (AI) as the assisting strategy in the cardiology department.

Research objectives are:

1. To identify the advantages of AI in assisting doctors, nurses, and staff in the cardiology department.
2. To analyze reasons for acceptance of AI as an assisting tool in the cardiology department.
3. To determine the factors responsible for the difficulty of the medical staff of the cardiology department in using AI.
4. To study the effect of AI on work efficiency, time management, and the decision-making process of the cardiology department.
5. To determine the efficacy of AI in training and educating the nurses of the cardiology department.

Methods

In the methods section of the systematic literature review approaches which were used in the research to finalize the literature and articles are specified in this section. This section will include details associated with study selection, inclusion criteria, and exclusion criteria, as specified below:

Study Selection

To identify the relevant and authentic sources databases PubMed and ScienceDirect were used. The following search string was used to narrow down the potential source of information.

1. Artificial Intelligence AND ("cardiology nurses" OR "health care facilities")
2. Artificial Intelligence AND cardiology department
3. Artificial Intelligence AND acceptance AND cardiology department.
4. AI AND Cardiology department AND ("Advantages" OR "disadvantages")
5. Artificial Intelligence AND cardiology nurses AND acceptance
6. AI AND work efficiency AND cardiology department
7. Cardiology department AND AI AND time management
8. AI AND Nurses AND feasibility
9. AI AND cardiology department AND Monitoring
10. Cardiology department AND Nurses AND Artificial Intelligence

Non-specific references or references not related to AI and AI in industries other than health care and cardiology, references that are not in the English language, and only Abstracts and book chapters were not considered. The inclusion and exclusion criteria below were used to further identify specific resources for the manuscript development using a Systematic literature review.

Inclusion Criteria

1. Peer-reviewed research articles, review articles, and case studies from reputable scientific databases.
2. Studies published between 2014 and 2024.
3. Studies published in English.
4. Studies focusing on the application of AI in health care, specifically in the cardiology department.
5. Studies related to the advantages and disadvantages of AI in the cardiology department.

Exclusion Criteria

1. Opinion pieces, editorial articles, and non-peer-reviewed content, news articles.
2. Studies published before 2014.
3. Studies published in languages except English.
4. Studies that do not focus on AI.
5. Studies not related to AI in healthcare departments.

Summary of Final Studies and the PRISMA Sheet

Search strings have been designed as mentioned above and used for searches in both PUB med and Science Direct databases. A total of 4,580 references from PubMed and 31,775 references from ScienceDirect were considered in Step I. Duplicate references were removed around 3750 references and 30560 references in which AI was not included were eliminated, Of the total 2054 references were selected from Step I. Further references were eliminated based on language criteria, only abstracts, references without open access, and those that were not relevant for study in step II. Only 1422 references were considered for step III. All references could be retrieved in this step. Thus, 1422 references were considered for step IV. Most of the references were not for open access and thus excluded from the selection. This resulted in the removal of 1270 references in the final step. Around 35 references were observed to be duplicates. Around 65 references were found to be Book chapters and encyclopedias. Thus, 52 references were considered for the final SLR writing.

A PRISMA sheet representing the finalization of references has been provided below:

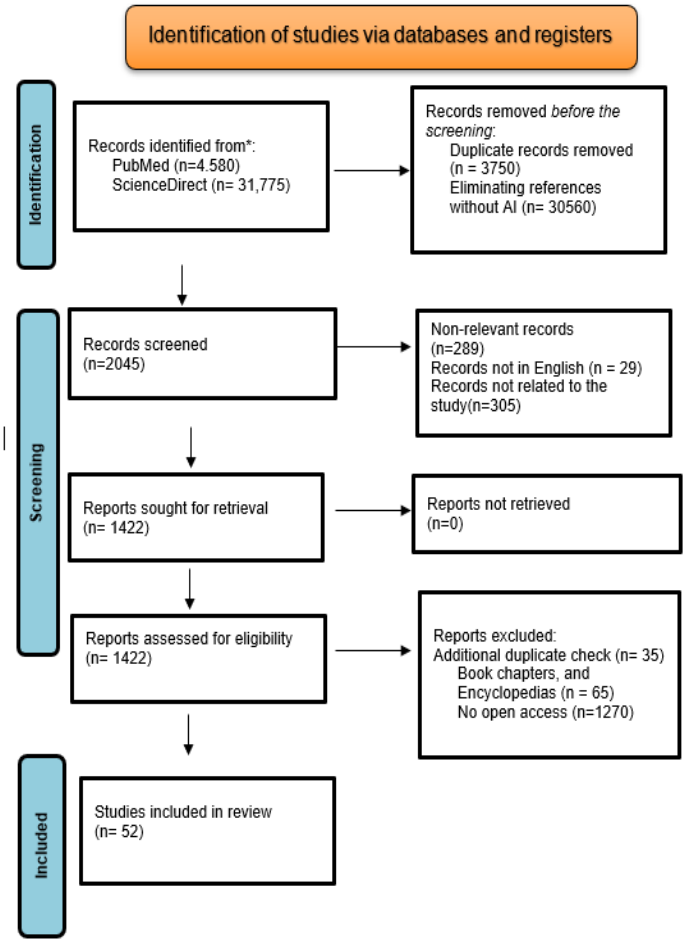

Figure 2. PRISMA Framework [53]

(Source: Self-Created**)**

Results

In this section of the study, the findings from the existing studies that would be finalized for reviewing would be presented by the researcher in a detailed manner.

Advantages of AI in Assisting Doctors, Nurses, and Staff in the Cardiology Department

The benefits of having AI to help the doctors, nurses, and staff in the cardiology department are immense. Solutions implemented for AI technology are rather obvious and will increase the effectiveness, accuracy, and quality of cardiology activity. However, as another case they must be discussed, a possibility of minimizing human mistakes in the cardiology department is also considered when using AI. Through analysis of large chunks of data that AI performs in a short time, doctors as well as nurses can be sure that AI has algorithms that can alert them to instances where mistakes or otherwise incorrect diagnoses have occurred and thereby, improve on the outcome of the health aspect of any patient. For instance, [8] pointed out the case where AI can identify fetal congenital heart defects making it easier to treat it early. On the same note, AI has been found to deliver positive outcomes in early diagnosis and enhance the management of cardiac patients. This is elaborated by [9] where they pointed out that photon-counting computed tomography, which is powered by artificial intelligence, can be used to assess coronary artery disease during work-up for transcatheter aortic valve replacement thus can result in improved decisions in interventions and overall results in patients.

Besides, one can make AI a means to bring about quality clinical documentation in turn, enhancing communication amongst the medical team towards better care [7] claims that the addition of ambient AI to organizations can ease clinical writing since medical professionals will have more information regarding such patients and make those decisions. In addition, AI can be employed in wearables for continuously supervising patients with heart disease and for identifying atrial fibrillation according to [10]. If a smart wristband is fitted with an AI algorithm, then the wristband monitor can give a real-time screen to the health care professionals who give the early warning signals of a shift in health status. Finally, AI application in identifying prehospital cardiac patients with Acute Coronary Syndrome is evidenced by [11]. This permits the healthcare personnel to administer care on time and the outcome of this means is very positive to the patients hence decreasing the potential for long-term effects. AI is therefore a valuable tool to transform the cardiology department; helps the patient outcomes observation and communication while reducing the role of the human factor. In diagnosis, handling and documentation can play a major role in improving the quality of health care that patients receive.

Reasons for Acceptance of AI as an Assisting Tool in the Cardiology Department

There are several reasons why cardiology departments embrace AI as an aiding tool. First, diagnosis is made accurate since AI evaluates immense medical data making a precise diagnosis for conditions like arrhythmias and coronary artery disorders at an early stage. Second, it helps in risk assessment to treat patients according to their risk characteristics [12]; [13]; [14]. Third, AI helps to optimize tasks, as well as taking routine work and entertaining it to free the cardiologists for further more time for their patients [15]; [16]. Also, the announced application of AI for data analysis advances research in cardiology thus enhancing patient results all around as well.

Factors Responsible for the Difficulty of the Medical Staff of the Cardiology Department in Using AI

There are several barriers for healthcare professionals in cardiology to implement AI technologies and for the most part, the lack of training and prior knowledge of the technology when compared to other industries [17]; [18]; [19]; [2]. Despite cardiology's early adopter status of AI systems, many cardiologists and other support staff are not aware of these principles when interpreting AI-derived results and may use these with hesitancy which may lead to errors in patient management. In addition, there is still limited access to training, especially for high-value AI uses and AI that are reliant on cardiology and analytics where there is a strong understanding of both [20], [21]; [22]; [23]. Another important factor is the high level of difficulty in the adoption of AI technologies in the working environment due to the necessity of expert knowledge for solving the problems of accuracy, interpretation, and immediacy in such a range [24]; [25]. These put a strain on the cardiology staff hence the high instance of struggle that calls for formal training on how to implement AI in the practice.

Effect of AI on Work Efficiency, Time Management, and the Decision-Making Process of the Cardiology Department

AI is known to enhance the working rates, time management, and decision-making within departments of cardiology. For example, AI-based diagnosis simplifies the diagnosis process and helps cardiologists spend more time with patients [26]; [27]. Due to the ability of machine learning algorithms to quickly analyze big data, diagnoses are made quickly along with better accuracy of the interventions consequently [28]; [29]; [30]. Awareness of seemingly small but essential data patterns such

as genes or rhythm distortion within hearts improves health care analysis and adds to decision-making sophistication where AI performs well [31]; [23]. Further, it offers decisions and suggestions supported by factual information in near real-time to serve as a roadmap for clinicians to take the right approach with the help of decision analytics [32]; [33]. From these AI developments, patient benefits increase, and efficiency in the cardiology department flow is enhanced, making the department more adaptive and functional [33]; [34]; [35]; [36].

Efficacy of AI in Training and Educating the Nurses of the Cardiology Department

AI has proven effective in training and educating cardiology nurses by enhancing accessibility to advanced knowledge and simulation tools. AI-driven platforms provide virtual training environments where nurses can develop skills, understand complex procedures, and engage with realistic clinical scenarios [37-40]. Additionally, AI can simplify sophisticated diagnostic data, making it easier for nurses to interpret complex imaging results and identify key indicators of cardiovascular issues [41-44]. AI also offers real-time guidance, which can be particularly helpful in improving nurses' responsiveness and decision-making capabilities [45]; [46]; [47]. Moreover, AI's data-driven insights help nurses understand patient trends and risk factors, thereby enhancing their clinical judgment [48, 49]. With AI's aid, cardiology nurses can participate in ongoing, personalized learning experiences that boost their proficiency and adaptability to evolving medical technologies.

Discussion and Conclusion

The studies suggest that crucial progress has been made within the cardiology department through the usage of AI – regarding diagnosis accuracy, risk assessment, clinical documentation, and most importantly, patient monitoring. Technological advancements like photon-counting computed tomography being powered by Artificial Intelligence seem to provide cardiologists with sound information needed to enhance the outcomes of their patients [9]. This is demonstrated in how AI helps reduce human inaccuracies in early diagnosis of conditions such as congenital heart defects or in wearable technology that tracks heart patients 24/7 [8]; [10]. Regulating factors that contribute to the optimal fulfilment of AI depend on time management and efficiency, there remain extraneous barriers that limit their use such as inadequate training implying the need to train the healthcare workforce on structured AI systems [17, 21]. Thirdly, the adoption of AI in training and actual technique provides skills and preparedness in a simulation and actual guidance of cardiologic nurses [37]. This has the potential to revolutionize cardiology duties as Al starts to fill gaps that have frustrated clinical improvement so far and which professionals in healthcare should be well-trained to apply. Moreover, according to the analysis by [50], it is clear that the contribution of AI in raising the quality and accuracy of left ventricular ejection fraction assessments can enhance the quality of cardiology work. In conclusion, AI is waiting for the transformation of cardiology and at the same time, the healthcare staff who need training and support

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