

Role of Multidisciplinary Teams in Improving Diagnostic Accuracy for Congenital Heart Defects

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Abstract

This study evaluates the effectiveness of a multidisciplinary approach involving laboratory specialists, radiology technologists, and echocardiography technologists in diagnosing congenital heart defects (CHDs) at a tertiary hospital. By integrating data from laboratory tests, radiological imaging, and echocardiography, the multidisciplinary approach significantly improved diagnostic accuracy to 94% and reduced the average time to diagnosis to 12 hours, compared to individual modalities. Thematic analysis of qualitative data highlighted enhanced communication and teamwork as key benefits, while logistical challenges such as scheduling and the lack of standardized protocols were identified as barriers. These findings suggest that multidisciplinary collaboration can lead to better-informed treatment decisions and improved patient outcomes, provided that logistical challenges are addressed.

Keywords: Congenital Heart Defects, Multidisciplinary Collaboration, Diagnostic Accuracy, Echocardiography, Radiological Imaging, Laboratory Testing, Tertiary Hospital

Introduction

Congenital heart defects (CHDs) are among the most common types of birth defects, affecting approximately 1% of live births globally (van der Linde et al., 2011). Accurate and timely diagnosis is crucial for effective management and intervention, especially in infants and young children, to reduce the morbidity and mortality associated with these conditions (Hoffman, 2013). The complexity of CHDs often requires a multidisciplinary approach that integrates data from multiple diagnostic modalities, including laboratory tests, radiological imaging, and echocardiography, to ensure a comprehensive understanding of the patient's condition (Kim et al., 2019).

Collaboration between laboratory specialists, radiology technologists, and echocardiography technologists is essential in enhancing the accuracy of CHD diagnoses. Laboratory testing can provide important biochemical markers that indicate cardiac stress or other abnormalities, while imaging modalities such as echocardiography and radiology provide detailed anatomical and functional information about the heart (Reller et al., 2008). When these data are analyzed collectively, healthcare professionals can achieve a more holistic and nuanced understanding of the patient's cardiac anatomy and function, leading to better-informed treatment decisions.

In this context, the role of multidisciplinary collaboration becomes increasingly evident, particularly as healthcare systems become more integrated and reliant on various diagnostic specialties. By leveraging the unique strengths of laboratory, radiological, and echocardiographic data, diagnostic teams can improve both the accuracy and timeliness of CHD diagnosis. This paper aims to explore how a multidisciplinary approach involving laboratory specialists, radiology technologists, and echocardiography technologists can contribute to improved outcomes in diagnosing congenital heart defects, with a particular focus on the processes, benefits, and challenges of such collaborations.

Literature Review

The multidisciplinary approach to diagnosing congenital heart defects (CHDs) has garnered significant attention in recent years due to its potential to improve patient outcomes. Studies have demonstrated that a coordinated effort among healthcare professionals specializing in laboratory testing, radiological imaging, and echocardiography can lead to more accurate and timely diagnoses (Hoffman, 2013; Kim et al., 2019). This section will review the existing literature on the roles of laboratory, radiology, and echocardiography in CHD diagnosis, as well as the benefits and challenges of multidisciplinary collaboration.

Role of Laboratory Testing in CHD Diagnosis

Laboratory testing plays a crucial role in the diagnostic process for CHDs, providing important biochemical markers that can indicate cardiac abnormalities. Biomarkers such as brain natriuretic peptide (BNP) and troponin are often elevated in patients with heart defects, providing early indications of cardiac dysfunction (Rajpal et al., 2017). Laboratory tests can help guide further imaging studies by identifying patients who may be at higher risk for structural heart abnormalities. Pereira et al. (2019) found that incorporating laboratory markers into the diagnostic workflow improved the sensitivity of CHD detection, particularly in neonates.

Role of Radiological Imaging

Radiological imaging, particularly chest X-rays and computed tomography (CT) scans, provides detailed information about the structural anatomy of the heart and surrounding vessels. These imaging modalities are essential for identifying abnormalities such as enlarged cardiac chambers or abnormal vascular connections (Gaydos et al., 2017). Radiology technologists play a critical role in ensuring high-quality imaging, which is crucial for accurate diagnosis. Gaydos et al. (2017) emphasized the importance of radiological imaging in providing complementary information to echocardiography, particularly in complex cases where additional anatomical detail is needed.

Role of Echocardiography

Echocardiography is the cornerstone of CHD diagnosis, providing real-time, non-invasive assessment of cardiac structure and function. It is particularly valuable for visualizing intracardiac defects, valve abnormalities, and blood flow patterns (Reller et al., 2008). Echocardiography technologists are skilled in acquiring high-quality images that enable cardiologists to make precise diagnoses. Studies have shown that echocardiography, when combined with laboratory and radiological data, significantly enhances the diagnostic accuracy for CHDs (Kim et al., 2019).

Benefits of Multidisciplinary Collaboration

Multidisciplinary collaboration in CHD diagnosis offers numerous benefits, including improved diagnostic accuracy, reduced time to diagnosis, and enhanced patient outcomes. By integrating data from laboratory tests, radiological imaging, and echocardiography, healthcare teams can develop a more comprehensive understanding of a patient's condition (Hoffman, 2013). Kim et al. (2019) reported that multidisciplinary teams were able to diagnose CHDs more accurately compared to single-discipline approaches, leading to more timely interventions and better patient prognosis.

Challenges of Multidisciplinary Collaboration

Despite the benefits, multidisciplinary collaboration also presents challenges. Effective communication between different specialties is crucial, and a lack of standardized protocols can lead to delays in diagnosis or misinterpretation of data (Schwerzmann et al., 2017). Schwerzmann and others highlighted the need for clear communication pathways and shared electronic health records (EHRs) to facilitate seamless collaboration. Additionally, logistical challenges, such as coordinating the availability of different specialists, can hinder the effectiveness of a multidisciplinary approach.

Conclusion of Literature Review

The literature underscores the importance of a multidisciplinary approach in the diagnosis of congenital heart defects. Laboratory testing, radiological imaging, and echocardiography each provide unique and valuable information that, when combined, can lead to more accurate and timely diagnoses. However, successful implementation of this approach requires addressing the challenges of communication and coordination among different healthcare professionals. Future research should focus on developing standardized protocols and leveraging technology, such as EHRs, to enhance collaboration and improve patient outcomes.

Methodology

This study was conducted in a tertiary hospital setting to evaluate the effectiveness of a multidisciplinary approach in diagnosing congenital heart defects (CHDs). The study involved collaboration between laboratory specialists, radiology technologists, and echocardiography technologists, each contributing their unique expertise to the diagnostic process. The methodology comprised three main phases: patient selection, data collection, and data analysis.

Patient Selection

Patients included in this study were selected from the pediatric cardiology unit of the tertiary hospital. Inclusion criteria were children aged 0-18 years who presented with symptoms suggestive of CHDs, such as cyanosis, heart murmurs, or failure to thrive. A total of 150 patients were recruited between January 2022 and June 2022. Exclusion criteria included patients with previously confirmed non-cardiac conditions that could explain their symptoms and those who had undergone prior cardiac surgery.

Data Collection

Data collection involved three key diagnostic modalities: laboratory tests, radiological imaging, and echocardiography. Laboratory specialists performed blood tests, including BNP and troponin levels, to identify potential cardiac dysfunction. Radiology technologists conducted chest X-rays and CT scans to provide detailed images of cardiac anatomy, while echocardiography technologists performed transthoracic echocardiograms to assess cardiac structure and function in real-time.

All diagnostic data were documented in the hospital's electronic health record (EHR) system to facilitate seamless sharing among the different specialties. Each patient underwent the three diagnostic assessments within 48 hours of hospital admission, ensuring that the data were current and could be integrated effectively for analysis.

Data Analysis

Data analysis focused on evaluating the accuracy and timeliness of CHD diagnoses achieved through multidisciplinary collaboration. The diagnostic outcomes were compared to those from a historical control group of 100 patients who were diagnosed using a single-discipline approach (e.g., echocardiography alone). Sensitivity, specificity, and diagnostic accuracy were calculated for each modality individually and in combination.

The analysis also included qualitative assessments of team communication and coordination. Structured interviews were conducted with laboratory specialists, radiology technologists, and echocardiography technologists to gather insights into the challenges and benefits of multidisciplinary collaboration. Thematic analysis was used to identify key themes related to communication effectiveness, logistical challenges, and perceived improvements in diagnostic quality.

Ethical Considerations

The study was approved by the ethics committee, and informed consent was obtained from the parents or guardians of all pediatric patients. Confidentiality was maintained by de-identifying patient data, and all diagnostic procedures were conducted following established clinical guidelines to ensure patient safety.

Findings

Quantitative Findings

The quantitative analysis of the study revealed significant improvements in diagnostic accuracy and timeliness due to the multidisciplinary approach. The results are presented in the following tables.

Table 1. Diagnostic Accuracy Comparisons

Diagnostic Modality	Sensitivity (%)	Specificity (%)	Accuracy (%)
Laboratory Tests Alone	72	65	68
Radiological Imaging Alone	80	78	79
Echocardiography Alone	85	82	83

Diagnostic Modality	Sensitivity (%)	Specificity (%)	Accuracy (%)
Multidisciplinary Approach	95	92	94

Table 2. Time to Diagnosis

Diagnostic Modality	Average Time to Diagnosis (Hours)
Laboratory Tests Alone	24
Radiological Imaging Alone	20
Echocardiography Alone	18
Multidisciplinary Approach	12

The results indicate that the multidisciplinary approach significantly increased diagnostic accuracy (94%) compared to individual diagnostic modalities, and reduced the average time to diagnosis to 12 hours.

Qualitative Findings

The qualitative analysis focused on team communication, collaboration, and the perceived benefits of a multidisciplinary approach. The thematic analysis identified three major themes, each with sub-themes and participant responses.

Theme 1: Improved Diagnostic Accuracy

- Sub-theme 1.1: Comprehensive Data Integration

- Participant A (Laboratory Specialist): "Combining lab results with imaging findings allowed us to see the whole picture, which improved our confidence in the diagnosis."

- Participant B (Radiology Technologist): "Having access to lab markers while interpreting scans helped confirm our suspicions of certain defects."

- Sub-theme 1.2: Reduced Diagnostic Errors

- Participant C (Echocardiography Technologist): "We were able to cross-check each other's findings, which reduced the likelihood of missing subtle abnormalities."

Theme 2: Enhanced Communication and Teamwork

- Sub-theme 2.1: Effective Use of EHRs

- Participant D (Laboratory Specialist): "The electronic health records system made it easy to share results instantly, which improved our communication."

- Participant E (Radiology Technologist): "We could all see each other's findings in real time, which made discussions more productive."

- Sub-theme 2.2: Regular Interdisciplinary Meetings

- Participant F (Echocardiography Technologist): "Weekly meetings helped us stay on the same page and discuss complex cases in detail."

Theme 3: Logistical Challenges in Multidisciplinary Collaboration

- Sub-theme 3.1: Scheduling Difficulties

- Participant G (Radiology Technologist): "Coordinating the schedules of all specialists was sometimes challenging, which caused delays in getting the complete diagnosis."

- Sub-theme 3.2: Need for Standardized Protocols

- Participant H (Laboratory Specialist): "We need better protocols for when and how to involve each specialty to avoid duplication of tests and delays."

Conclusion of Qualitative Findings

The qualitative findings highlight the benefits of a multidisciplinary approach in terms of improved diagnostic accuracy and communication among team members. However, logistical challenges, such as scheduling and the lack of standardized protocols, were identified as barriers to optimal collaboration. Participants emphasized the importance of regular communication and effective use of EHRs in overcoming these challenges.

Discussion

The findings of this study demonstrate the significant benefits of a multidisciplinary approach to diagnosing congenital heart defects (CHDs) in a tertiary hospital setting. The quantitative results indicate that the combination of laboratory tests, radiological imaging, and echocardiography significantly improves diagnostic accuracy and reduces the time required for diagnosis compared to using any single modality alone. Specifically, the multidisciplinary approach achieved a diagnostic accuracy of 94%, which is markedly higher than the individual modalities, and reduced the average time to diagnosis to 12 hours. These findings align with existing literature that highlights the importance of integrating different diagnostic specialties to enhance patient outcomes (Kim et al., 2019).

The improved diagnostic accuracy can be attributed to the complementary nature of the different diagnostic modalities. Laboratory tests provided biochemical markers that offered early indications of cardiac dysfunction, while radiological imaging and echocardiography provided detailed structural and functional assessments of the heart. The integration of these data points enabled healthcare professionals to form a more comprehensive understanding of each patient's condition, which in turn facilitated more accurate and timely decision-making. The results of this study are consistent with the findings of Rajpal et al. (2017) and Gaydos et al. (2017), who also reported that combining different diagnostic modalities leads to enhanced diagnostic precision.

The qualitative findings further underscore the benefits of multidisciplinary collaboration. Participants reported that the use of electronic health records (EHRs) facilitated effective communication between team members, allowing for real-time data sharing and reducing the risk of miscommunication. Regular interdisciplinary meetings also played a crucial role in ensuring that all team members were aligned in their understanding of each case. These findings are consistent with the work of Schwerzmann et al. (2017), who emphasized the importance of effective communication pathways in multidisciplinary care. However, the study also highlighted several challenges, including scheduling difficulties and the lack of standardized protocols for involving different specialties. These logistical challenges can hinder the efficiency of the diagnostic process and need to be addressed to optimize the benefits of multidisciplinary collaboration.

One of the key implications of this study is the need for healthcare systems to develop standardized protocols that define the roles and responsibilities of each specialty in the diagnostic workflow. Such protocols could help streamline the diagnostic process, reduce redundancy, and minimize delays. Additionally, investing in technologies such as integrated EHR systems can further enhance communication and collaboration among team members. Future research should focus on evaluating the impact of standardized protocols and technological interventions on the efficiency and effectiveness of multidisciplinary care in diagnosing CHDs.

Another important consideration is the scalability of the multidisciplinary approach. While the results of this study are promising, the implementation of a multidisciplinary approach in smaller healthcare settings with limited resources may present challenges. Future studies should explore how multidisciplinary diagnostic teams can be adapted to different healthcare contexts, particularly in low-resource settings, to ensure that the benefits of this approach are accessible to a broader population.

In conclusion, the findings of this study provide strong evidence that a multidisciplinary approach involving laboratory specialists, radiology technologists, and echocardiography technologists can significantly improve the accuracy and timeliness of CHD diagnosis. The integration of multiple diagnostic modalities allows for a more comprehensive understanding of the patient's condition, leading to better-informed treatment decisions and improved patient outcomes. However, addressing the logistical challenges of multidisciplinary collaboration, including scheduling and the need for standardized protocols, is essential to fully realize the potential benefits of this approach. Future research should focus on developing strategies to overcome these challenges and expand the implementation of multidisciplinary diagnostic teams across diverse healthcare settings.

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ملخص:

تقيم هذه الدراسة فعالية نهج متعدد التخصصات يشمل المتخصصين في المختبرات، وتقنيي الأشعة، وتقنيي تخطيط صدى القلب في تشخيص في المستشفى الثالث. ومن خلال دمج البيانات من الاختبارات المعملية، والتصوير الإشعاعي، وتخطيط صدى (CHDs) عيوب القلب الخلقية القلب، أدى النهج متعدد التخصصات إلى تحسين دقة التشخيص بشكل كبير إلى 94٪ وخفض متوسط الوقت اللازم للتشخيص إلى 12 ساعة، مقارنة بالطرائق الفردية. سلط التحليل المواضيعي للبيانات النوعية الضوء على تعزيز التواصل والعمل الجماعي كقوائد رئيسية، في حين تم تحديد التحديات اللوجستية مثل الجدولة والافتقار إلى البروتوكولات الموحدة كعوائق. وتشير هذه النتائج إلى أن التعاون متعدد التخصصات يمكن أن يؤدي إلى قرارات علاجية مستنيرة وتحسين نتائج المرضى، بشرط معالجة التحديات اللوجستية

الكلمات المفتاحية: عيوب القلب الخلقية، تعاون متعدد التخصصات، دقة التشخيص، تخطيط صدى القلب، التصوير الإشعاعي، الاختبارات المعملية، المستشفى الثالث