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EVALUATION OF CLINICAL PRACTICES AND PROCEDURES FOR PEDIATRIC CARDIAC CATHETERIZATION BY NURSES

Original Research

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ABSTRACT

Background: Pediatric cardiac catheterization is a critical diagnostic and therapeutic intervention used to manage congenital and acquired cardiac conditions in children. The quality of nursing care before, during, and after the procedure significantly influences patient safety, procedural outcomes, and recovery. Despite its clinical importance, limited data exist regarding the practical performance of nurses in pediatric catheterization settings in developing countries. This study aimed to assess nurses' adherence to standard clinical practices during pediatric cardiac catheterization.

Objective: To evaluate the clinical practices and procedural adherence of nurses involved in pediatric cardiac catheterization.

Methods: A descriptive cross-sectional study was conducted at Al-Razi Institute, Lahore, from January to April 2025. The study included 120 registered nurses with valid PNMC licenses, aged over 20 years, and with a minimum of six months of experience caring for pediatric cardiac patients. Participants were selected using convenience sampling. A structured checklist comprising pre-, intra-, and post-catheterization practices was used to assess performance. Practices scoring ≥75% were deemed acceptable, while those scoring <75% were considered poor. Data were analyzed using SPSS Version 24.

Results: Among the 120 nurses, 53.33% were aged 33–38 years, 66.67% were married, and 50.0% held a Post-RN BSN degree. Regarding experience, 69.17% had between 6–10 years. Pre-catheterization practices were notably deficient: 85.0% did not ensure consent completion, 87.5% failed to check echocardiograms, and 55.83% omitted vital sign monitoring. Intra-procedural performance was stronger, with 95.83% assisting physicians and 95.0% flushing lines correctly. However, 80.83% failed to recommend limb positioning post-procedure, 79.17% did not monitor vitals adequately, and 96.67% did not assess dressing sites. Composite scoring revealed 100% of nurses scored below the 75% threshold.

Conclusion: The study highlighted critical gaps in pediatric cardiac catheterization nursing practices, particularly in pre- and post-procedural care. Strengthening training and standardizing protocols is essential to improve nursing outcomes.

Keywords: Cardiac Catheterization, Clinical Competence, Nursing Assessment, Nursing Education, Nursing Practice, Pediatric Nursing, Postoperative Care.

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INTRODUCTION

Pediatric cardiac catheterization has emerged as a vital diagnostic and therapeutic tool in managing congenital heart defects and other cardiovascular anomalies in children. This minimally invasive procedure provides detailed information about the anatomical and functional status of the pediatric heart, enabling clinicians to make accurate diagnoses, determine the severity of abnormalities, and implement appropriate treatment strategies (1,2). Cardiac catheterization is often preferred over open-heart surgery for complex congenital defects due to its reduced morbidity, shorter hospitalization, and lower risk of complications (3). Beyond structural abnormalities, this technique is instrumental in managing various conditions such as valvular disease, pulmonary hypertension, and arrhythmias, thereby improving both survival and quality of life in the pediatric population. Although pediatric and adult cardiac catheterization share procedural similarities, children present unique clinical profiles that demand specialized techniques, indications, and therapeutic approaches (4). In pediatric settings, catheterization procedures such as valvuloplasty, angioplasty, embolization, and septal defect repair are routinely performed. The choice and depth of sedation are carefully tailored based on the child's age, cardiac condition, and procedure complexity to ensure safety and cooperation during the intervention (5). The role of nurses is particularly critical in this context, as they are responsible for pre-procedural assessments, intra-procedural monitoring, and post-procedural care. Their duties include reviewing the child's medical history, interpreting diagnostic investigations such as chest radiographs, ECGs, and echocardiograms, and preparing both the child and parents with essential preoperative instructions, including informed consent and fasting guidelines (6,7).

A well-coordinated multidisciplinary team—comprising cardiologists, pediatric anesthetists, cardiac technicians, and specially trained nurses—performs this delicate intervention in a fully equipped cardiac catheterization laboratory. The catheter is introduced via a peripheral vessel into the heart chambers, where contrast agents may be administered to visualize internal structures and assess hemodynamics (8). Nurses play a pivotal role in continuous monitoring of vital signs such as heart rate, oxygen saturation, and blood pressure throughout the procedure to detect early signs of complications. Though generally safe, cardiac catheterization carries potential risks such as bleeding, hematoma, arrhythmias, and rarely, more serious events like stroke or myocardial infarction (9). After the procedure, careful removal of the catheter, pressure application at the insertion site, and close observation in the recovery area are essential to manage post-anesthetic effects and prevent delayed complications (10). Parental involvement is crucial in post-procedural care, with nurses providing guidance on medication adherence, activity limitations, and signs of potential complications to monitor at home (11). In resource-limited settings, where the burden of pediatric cardiac disease is high, nurses often serve as the cornerstone of patient care—delivering continuous monitoring, initiating emergency responses, and administering medications with precision and empathy (6,7). Their expertise is comparable to a "spider-in-the-web," orchestrating care seamlessly among various aspects of pediatric cardiac intervention (8). Given their indispensable role in ensuring procedural success and patient safety, evaluating nursing practices in pediatric cardiac catheterization is essential to identifying gaps, standardizing care, and enhancing patient outcomes. Therefore, the objective of this study is to assess and analyze nursing practices in pediatric cardiac catheterization, with the goal of improving clinical protocols and optimizing holistic pediatric cardiovascular care.

METHODS

A descriptive cross-sectional study design was employed to evaluate the nursing practices related to pediatric cardiac catheterization. The study was conducted at Al-Razi Institute, Lahore, Pakistan, from January to April 2025. The target population comprised registered nurses holding valid licenses from the Pakistan Nursing and Midwifery Council (PNMC), specifically those working in pediatric departments with direct experience in caring for pediatric cardiac patients. The inclusion criteria encompassed male and female nurses aged above 20 years who had a minimum of six months of practical experience managing pediatric cardiac cases. Conversely, nurses without relevant cardiac care experience or lacking PNMC registration were excluded from the study to maintain data relevance and accuracy. A sample size of 120 participants was determined using Slovin's formula, which is commonly applied for sample calculation when the total population is known and a margin of error is to be considered (12,13). Participants were recruited through a non-probability convenience sampling technique, which was deemed appropriate due to the availability of a defined yet limited pool of eligible nurses at the study site. Data were collected using a structured observational checklist specifically designed to capture nursing

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practices at three critical phases of pediatric cardiac catheterization: pre-procedural, intra-procedural, and post-procedural care. The checklist enabled a detailed assessment of the adherence to standard nursing protocols and was validated through expert review for content relevance.

Each participant's performance was scored based on the completeness and accuracy of the practices recorded. A cumulative score of 75% or higher was classified as indicative of acceptable nursing practice, whereas scores below this threshold were categorized as poor. All participants were fully informed about the purpose and procedures of the study, and written informed consent was obtained before inclusion. Participation was entirely voluntary, with the freedom to withdraw at any stage without any repercussions. Ethical clearance for the study was obtained from the institutional ethics review committee of Al-Razi Institute. The data were coded and entered into SPSS software version 24.0 for statistical analysis. Descriptive statistics such as frequencies and percentages were used to present the findings in tabular format, offering a clear overview of nursing practice distribution across different phases of the catheterization process.

RESULTS

A total of 120 registered nurses from the pediatric unit participated in the study. The demographic distribution revealed that the highest proportion of nurses belonged to the 33–38-year age group (53.33%), followed by 27–32 years (25.00%), 20–26 years (10.83%), 39–44 years (6.67%), and 45–51 years (4.20%). Most participants were married (66.67%). Regarding academic qualifications, 50.0% had completed a two-year post-RN BSN, 30.83% held a diploma in nursing, and 19.20% possessed a generic four-year BSN degree. Concerning clinical experience, 69.17% of nurses had 6–10 years of experience, while 30.83% had between 6 months and 5 years. Assessment of nursing practices showed marked variation across the three phases of pediatric cardiac catheterization. In the pre-procedural phase, adherence to standard protocols was considerably low. Only 16.67% of nurses assessed the child's and parents' understanding of the procedure, and just 15.00% verified that consent forms were correctly filled. A small proportion (12.50%) reviewed previous echocardiogram reports, and 44.17% recorded vital signs. Identity verification of patients was performed by 35.00% of nurses, while 78.33% ensured that patients adhered to fasting guidelines, and 75.00% confirmed cannula placement. Overall documentation of the procedure was updated by 73.33% of the nurses.

In contrast, intra-procedural care demonstrated higher adherence to clinical standards. A significant proportion of nurses assisted physicians during the procedure (95.83%), flushed lines to remove air (95.00%), applied dressings to the puncture site (90.83%), and transferred the child safely post-procedure (98.33%). Additionally, 89.17% utilized sterile towels to maintain asepsis, and 76.67% sterilized the puncture site. However, lower performance was noted in preparatory tasks, such as handwashing (17.50%), temperature checks in the operating room (6.67%), and pre-procedure discussions with physicians (8.33%). The post-procedural phase revealed substantial deficiencies in nursing practices. While 94.17% administered medications appropriately, only 20.83% monitored vital signs every 15 to 30 minutes post-procedure, and a mere 9.17% assessed distal pulses in the affected limb. Most nurses (90.00%) resumed fluid and diet intake upon patient arousal and 84.17% instructed parents to remain with the child. However, only 33.33% provided information about maintaining optimal bed rest, and just 19.17% ensured that the affected extremity remained straight. Dressing site assessment was conducted by 76.67% of nurses, yet only 3.33% educated parents on removing the pressure dressing at home. In addition, 85.00% failed to assess the extremity's color, temperature, and capillary refill, and 78.33% did not provide warmth to the patient.

These findings indicate that while intra-procedural practices were generally satisfactory, significant gaps were evident in the pre- and post-procedural phases, particularly in parental education, monitoring of vital signs, and assessment of the catheterized limb. Such lapses suggest the need for targeted training and standardization of nursing care protocols across all stages of pediatric cardiac catheterization. Based on the composite scoring analysis, it was found that none of the nurses achieved an overall score meeting or exceeding the acceptable threshold of 75% across all 34 evaluated practice items. The estimated average number of procedures correctly performed per nurse was substantially below the required benchmark for acceptable practice. Consequently, 100% (n=120) of the participating nurses were categorized as demonstrating poor practice. This finding highlights a significant gap in adherence to standardized nursing protocols in pediatric cardiac catheterization care. These results directly align with the study objective, emphasizing the urgent need for targeted training, continuous professional development, and implementation of evidence-based clinical guidelines to enhance nursing performance across all stages of pediatric cardiac catheterization.

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Table 1: Demographic features of Participants(n=120)

Age of participants	
20-26 years	13(10.83%)
27-32 years	30(25.0%)
33-38 years	64(53.33%)
39-44 years	8(6.67%)
45-51 years	5(4.20%)
Marital Status	
Married	80(66.67%)
Un-married	40(33.33%)
Education	
Diploma in General Nursing	37(30.83%)
4 years BSN	23(19.20%)
2 years BSN (Post-RN)	60(50.0%)
Experience	
6 months-5 years	37(30.83%)
6 months-10 years	83(69.17%)

Table 2: Score of pediatric cardiac catheterization practices among nurse

Sr. No	Items	Done F (%)	Not Done F (%)
A	Pre-cardiac catheterization Practices		
1	Catheterization procedure understanding	20(16.67%)	100(83.33%)
2	Children not eat/drink	94(78.33%)	26(21.67%)
3	Checking of cannula of child	90(75.00%)	30(25.00%)
4	Ensure consent paperwork is accreted completely	18(15.00%)	102(85.00%)
5	Check documents of lab tests	80(66.67%)	40(33.33%)
6	Vital sign monitoring	53(44.17%)	67(55.83%)
7	Check previous reports of echocardiogram	15(12.50%)	105(87.50%)
8	Check patient name and date of birth	42(35.00%)	78(65.00%)
9	Charts and update the documents of whole procedure	88(73.33%)	32(26.67%)
B	Intra-cardiac catheterization procedure		
1	Discussion of procedure with doctor	10(8.33%)	110(91.67%)
2	Preparation of equipment	35(29.17%)	85(70.83%)
3	Washing of hands before procedure	21(17.50%)	99(82.50%)
4	Checking operating room temperature	8(6.67%)	112(93.33%)
5	Sterilizing the puncture site by nurse	92(76.67%)	28(23.33%)
6	Connecting the child with cardiac monitor	86(71.67%)	34(28.33%)
7	Sterile towel used to cover the child	107(89.17%)	13(10.83%)
8	Nurse starts flushing all the lines to remove air	114(95.00%)	6(5.00%)
9	Assisting the physician during cardiac catheterization procedure by nurses	115(95.83%)	5(4.17%)
10	Observing puncture site for any bleeding	100(83.33%)	20(16.67%)
11	Application of dressing on site of puncture by nurse	109(90.83%)	11(9.17%)
12	Transfer of child to ward and handed over another nurse	118(98.33%)	2(1.67%)
C	Post-cardiac catheterization practice		
1	Nurse should make sure availability of equipment before return patient to ward	12(10.00%)	108(90.00%)
2	Provide information to parents to hold children on bed for optimal level of rest	40(33.33%)	80(66.67%)

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Sr. No	Items	Done F (%)	Not Done F (%)
3	Keeping the effected extremity straight	23(19.17%)	97(80.83%)
4	Give medications	113(94.17%)	7(5.83%)
5	Assess dressing site for bleeding	92(76.67%)	28(23.33%)
6	Monitor vitals 15 to 30 minutes before next hours	25(20.83%)	95(79.17%)
7	Assess the temperature of extremity	18(15.00%)	102(85.00%)
8	Provide warmth for the patients	26(21.67%)	94(78.33%)
9	Start fluid and diet after awaking	108(90.00%)	12(10.00%)
10	Instruct the parents to go together with patient	101(84.17%)	19(15.83%)
11	Instruct the parents to note bleeding if any	75(62.50%)	45(37.50%)
12	Educate the parents to remove pressure from infected site	4(3.33%)	116(96.67%)
13	Assess the extremity pulses distal to catheter insertion	11(9.17%)	109(90.83%)

Table 3: Composite Practice Score Summary

Practice Score Category	Number of Nurses	Percentage (%)
Acceptable (≥75%)	0	0.0%
Poor (<75%)	120	100.0%

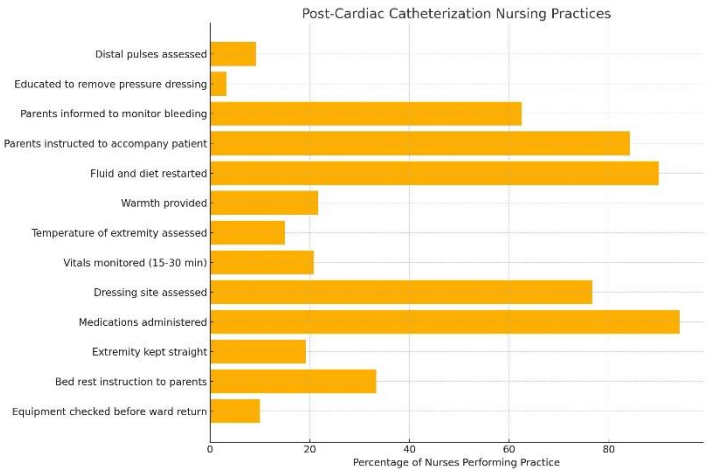


Figure 1 Post-Cardiac Catheterization Nursing Practice

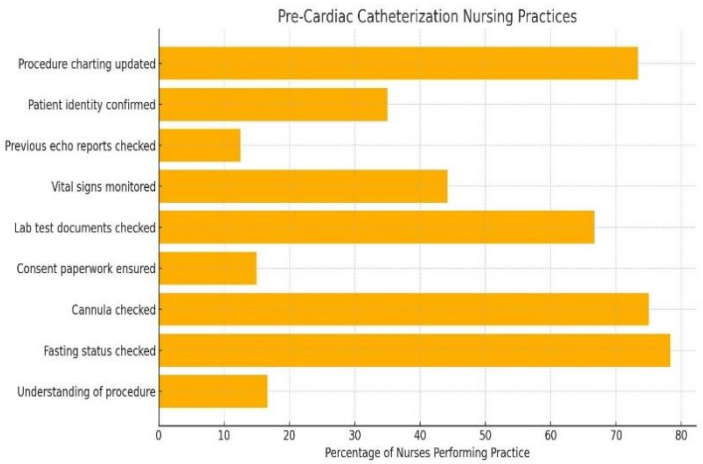


Figure 2 Pre-Cardiac Catheterization Nursing Practice

DISCUSSION

The present study assessed nursing practices related to pediatric cardiac catheterization and revealed considerable gaps in pre- and post-procedural care, despite relatively satisfactory performance during the intra-procedural phase. The majority of participants were within the age bracket of 33–38 years and held professional nursing degrees, aligning with previous findings where participants had a mean age of 34.26 years and nursing institute graduation as their educational background (14). This demographic consistency enhances the comparability of results across similar clinical populations. However, the findings underscored critical deficiencies in pre-catheterization practices, where most nurses failed to perform essential preparatory tasks, such as verifying consent, assessing the child's and parents' understanding of the procedure, reviewing diagnostic reports like echocardiograms, and recording vital signs. This is contrary to previously reported practices where nurses routinely ensured informed consent, conducted pre-assessment evaluations, and employed age-appropriate language to educate both the child and parents (15,16). The absence of structured pre-procedural preparation, including psychological readiness and medication administration for anxiety or sedation, raises concerns. Existing literature emphasizes that pre-procedural checklists and baseline assessments such as heart rate, oxygen saturation, and blood pressure are critical in minimizing

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perioperative complications and ensuring procedural success (17,18). The current findings suggest that such protocols are inconsistently followed, highlighting the need for institutional standardization. Despite these limitations in preparation, nurses demonstrated comparatively adequate competencies during the intra-procedural stage. Most assisted effectively during the catheterization, maintained aseptic technique, flushed lines appropriately, and applied pressure dressings—consistent with previous research documenting nurses' active roles in equipment handling, patient positioning, and sterile field maintenance (19,20). This area represents a strength of the study, reflecting that with appropriate supervision and structured environments like catheterization laboratories, nursing performance improves significantly.

Nevertheless, post-procedural care remained notably deficient. A majority of nurses did not adhere to standard monitoring protocols, failed to maintain the affected limb in the correct position, and inadequately assessed the puncture site and extremities for signs of bleeding, temperature changes, or pulse deficits. Such practices diverge sharply from evidence-based recommendations that emphasize frequent vital sign monitoring, thorough dressing inspection, and proper limb care to prevent complications such as bleeding, hematoma, or embolism (21). Furthermore, patient and family education post-procedure were largely neglected, with nurses failing to provide guidance on pressure dressing removal, signs of complications, or home care instructions—despite established literature underscoring the importance of comprehensive discharge counseling to reduce readmissions and improve long-term outcomes (21,22). Emotional support and recovery monitoring were also sub-optimally addressed, which could adversely affect the psychological well-being of both the child and their caregivers.

The study's strengths lie in its comprehensive evaluation of nursing practices across all three procedural phases and its identification of critical practice gaps, offering actionable insights for targeted interventions. However, limitations include the use of a convenience sampling technique, which may introduce selection bias, and reliance on observational checklists, which could be subject to reporting inaccuracies. Additionally, the lack of correlation analysis between nurses' educational background or experience and their performance restricts deeper inferential understanding. Future studies should employ randomized sampling across multiple institutions, incorporate direct observational audits alongside self-reports, and explore the impact of targeted training programs on nursing competencies in pediatric cardiac catheterization. Overall, the findings emphasize the necessity for structured training, adherence to standardized guidelines, and continuous professional development to improve nursing care quality. Addressing these shortcomings is essential for safeguarding pediatric patients and ensuring optimal outcomes during and after cardiac catheterization procedures.

CONCLUSION

This study concluded that nursing practices related to pediatric cardiac catheterization were largely inadequate, particularly in the pre- and post-procedural phases. While nurses demonstrated acceptable performance during the procedure itself, critical lapses were evident in essential areas such as pre-procedural preparation, vital sign monitoring, limb care, and post-procedure patient and parent education. These deficiencies highlight the urgent need for structured clinical guidelines, targeted training programs, and continuous professional development to ensure safer and more effective care for pediatric patients undergoing cardiac catheterization. Strengthening nursing competencies in these areas is essential for improving clinical outcomes and ensuring the overall well-being of children in cardiac care settings.

AUTHOR CONTRIBUTION

Author	Contribution
Sidra Hashim	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Ahmad Raza*	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
Sania Shabir	Substantial Contribution to acquisition and interpretation of Data

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Author	Contribution
	Has given Final Approval of the version to be published
Muhammad Kaleem Akhter	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sidra Ghazanfar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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