

EFFECT OF A STRUCTURED NURSING PATIENT SAFETY EDUCATION PROGRAM ON CLINICAL OUTCOMES AND PATIENT SATISFACTION FOLLOWING CARDIAC CATHETERIZATION: A QUASI EXPERIMENTAL STUDY

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ABSTRACT

Background: Nursing practice and inconsistent implementation of patient safety protocols in cardiac catheterization settings contribute to preventable post-procedural complications and reduced patient satisfaction, particularly in low- and middle-income countries such as Pakistan.

Objective: To evaluate the effect of a structured nursing educational intervention on clinical practice, post-procedural complication rates, and patient satisfaction in a cardiac catheterization setting.

Methods: A quantitative quasi-experimental design was conducted at the Cardiac Catheterization Laboratory and Coronary Care Unit of a tertiary care hospital in Pakistan. 30 nurses were recruited through purposive sampling, and 88 patients through convenience sampling. A structured three-module educational intervention based on National Health Service cardiac catheterization safety guidelines was delivered to nursing staff. Three validated tools measured nursing clinical practice, patient clinical outcomes, and satisfaction before and after the intervention. Data were analyzed using the paired-sample t-test at $p \leq 0.05$ for nurses practice and Independent t-test for patient outcomes and patient satisfaction at $p \leq 0.05$.

Results: Very poor nursing practice was entirely eliminated following the intervention. Good and very good clinical practice increased to 43.3% and 10.0%, respectively. Severe post-procedural complications decreased from 25.0% to 0% ($p = 0.004$), patients with no complications increased from 6.8% to 38.6% ($p = 0.003$), and patient satisfaction improved from 20.4% to 93.2% ($p < 0.001$).

Conclusions: Structured nursing education grounded in standard patient safety guidelines significantly improved clinical practice, reduced post-procedural complications, and enhanced patient satisfaction, highlighting the urgent need for mandatory protocol-based training in cardiac catheterization nursing care.

Keywords: cardiac catheterization; patient safety guidelines; nursing practice; clinical outcomes; patient satisfaction

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1. INTRODUCTION

Cardiovascular disease (CVD) remains the foremost cause of morbidity and premature mortality worldwide, accounting for approximately 19.2 million deaths in 2023 alone, a figure that represents a near-50% increase since 1990 [1]. Ischemic heart disease (IHD) is the single most prevalent cardiovascular condition, affecting an estimated 240 million individuals globally, with coronary artery disease (CAD) constituting the primary driver of this burden [2]. The epidemiological transition across low- and middle-income countries has compounded

this challenge substantially; in the Indo-Pakistan subcontinent, CAD has emerged as the leading cause of death, with the incidence in urban Pakistan having nearly doubled over the past five decades [3]. As the global burden of CVD continues its upward trajectory, driven by population ageing, rising rates of obesity, diabetes, and hypertension, demand for advanced diagnostic and interventional procedures has intensified in parallel. Cardiac catheterization, encompassing both diagnostic coronary angiography and percutaneous coronary intervention (PCI), stands as the cornerstone modality for the evaluation and

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management of CAD, with more than one million procedures performed annually in the United States alone [4].

Despite its well-established clinical value, the procedure is inherently invasive and carries an overall complication rate ranging from 1.5% to 9%, depending on patient characteristics, procedural complexity, access site, and the anticoagulation strategy employed [4-6]. Vascular access site complications alone represent the most frequent category of post-procedural adverse events; a 2024 scoping review identified that such complications, including bleeding and pseudoaneurysm formation, are most often first detected through direct bedside nursing assessment rather than through routine hemodynamic monitoring [6].

Nurses are responsible for pre-procedural assessment and patient preparation, intraoperative monitoring, hemostatic management, post-procedural surveillance, and patient education prior to discharge [7]. The 2021 Society for Cardiovascular Angiography and Interventions (SCAI) Expert Consensus Statement, endorsed by the American College of Cardiology (ACC) [8], current American Heart Association and ACC guidelines specifically recommend that registered nurses conduct vital sign assessments every 15 minutes for the first two hours post-catheterization, a practice whose adherence was confirmed across 12 New England hospitals surveyed in 2023 [6]. Furthermore, the 2024 guidelines on best practices for vascular arterial access and closure provide contemporary nursing-relevant guidance on site management, closure device use, and early ambulation protocols [9]. Adherence to such standardized protocols has been demonstrated to reduce the incidence of access site complications and to shorten hospital length of stay, while non-adherence is consistently associated with preventable adverse events [5,8].

A cross-sectional study conducted in Pakistan (2024) among 90 CCL and coronary care unit nurses at four tertiary care hospitals found that 68.9% had inadequate knowledge, while an alarming 90% demonstrated unsatisfactory clinical practice regarding post-catheterization patient safety [10]. Comparable deficits have been documented in Egypt, where a 2019 study of 40 cardiac nurses reported that 45% exhibited poor knowledge and 55% displayed poor practice, with performance positively correlated with years of clinical experience ($r = 0.960$, $p < 0.001$) and educational attainment [11]. Studies from Iraq and other regional settings have similarly concluded that nurses' knowledge of post-catheterization complications, including contrast-induced nephropathy, thrombus formation, and

delayed sheath removal sequelae, falls substantially below acceptable clinical thresholds [12,13]. A 2023 Egyptian study further demonstrated that the implementation of structured educational guidelines produced statistically significant improvements in nurses' performance and a concomitant reduction in vascular complications among patients undergoing cardiac catheterization [14]. These findings collectively point to an urgent and unresolved gap between established safety protocols and their consistent implementation in bedside nursing practice.

Patient satisfaction has emerged as a critical outcome measure in cardiovascular medicine, serving simultaneously as an indicator of care quality, a determinant of treatment adherence, and a mediator of recovery trajectories [15]. Within cardiac catheterization settings, patient satisfaction is shaped by multiple nursing-dependent variables, including the quality of pre-procedural education, adequacy of pain and anxiety management, timeliness of post-procedural monitoring, and the effectiveness of discharge instructions [16, 17]. These findings establish a bidirectional relationship between adherence to nursing guidelines and patient-centered outcomes, warranting systematic investigation.

Nursing trust has also been identified as a modifiable determinant of medication adherence in cardiac populations, further amplifying the downstream clinical significance of quality nursing interactions [18-20]. The majority of prior investigations have evaluated either knowledge and practice in isolation or patient outcomes without measuring the mediating role of guideline-concordant nursing behavior.

The study aims to: (a) assess the level of nurses' knowledge of and adherence to evidence-based safety guidelines pertaining to cardiac catheterization; (b) evaluate post-procedural clinical outcomes, including the incidence of vascular access site complications, hemodynamic instability, and contrast-induced nephropathy; (c) measure patient-centered satisfaction across the domains of pre-procedural preparation, intraoperative communication, and post-procedural nursing care. **MATERIALS AND METHOD**

1.1 Study Design

This study employed a quasi-experimental design to evaluate the effects of implementing standard patient safety guidelines on nurses' clinical practice, patients' clinical outcomes, and patient satisfaction during cardiac catheterization procedures.

2.2 Study Setting

The study was conducted at the Cardiac Catheterization Laboratory (Cath Lab) and Coronary Care Unit (CCU) of a tertiary care Hospital. This

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tertiary care facility was selected as the primary study site due to its active and high-volume cardiac catheterization services and the availability of a sufficient nursing and patient population relevant to the study objectives.

2.3 Study Sample

Two non-probability sampling techniques were employed to recruit two distinct groups of participants. A purposive sampling technique was used to recruit 30 registered nurses working in the Cardiac Catheterization Laboratory (Cath Lab) and Coronary Care Unit (CCU) at Tertiary Hospital, who were assessed at both pre- and post-intervention phases using the same validated tools; eligible nurses were those with a minimum of one year of clinical experience in cardiac care, who voluntarily provided informed consent. A convenient sampling technique was used on 88 patients undergoing elective cardiac catheterization, equally divided into 44 in the pre-intervention phase and 44 in the post-intervention phase; eligible patients were adults aged 20 to 60 years, fully conscious with a Glasgow Coma Scale (GCS) score of 15/15, and willing to provide written informed consent. Nurses already adhering to standardized patient safety guidelines or enrolled in concurrent studies were excluded, while patients undergoing emergency procedures or presenting with complex lesions, significant bleeding disorders, active infections, terminal illnesses, or severe psychiatric conditions were excluded to minimize confounding variables and ensure sample homogeneity.

2.4 Instrument and Data Collection

Data were collected using three validated instruments. Nurses' adherence to patient safety guidelines was assessed through a stepwise observational checklist (Q1) developed in accordance with the National Health Service cardiac catheterization guidelines [20], comprising 26 items covering pre-procedure, intra-procedure, and post-procedure nursing practices, scored on a three-point scale (0 = not done, 1 = partially done, 2 = completely done), with a total possible score of 52. Clinical outcomes were evaluated using a checklist adopted from Ibrahim Shalaby et al. [21], consisting of 40 items assessing the presence or absence of minor local, major local, and systemic complications, categorized as no, mild, moderate, or severe.

Patient satisfaction was measured using a structured interview questionnaire, also adopted from Ibrahim Shalaby et al. [21], comprising 14 items rated on a seven-point Likert scale (0–6), with a total possible score of 84, categorized as unsatisfactory (below 50%) or satisfactory (50% and above); the reliability

of both adopted tools was confirmed by a Cronbach's alpha of 0.8 [21].

A demographic questionnaire was additionally administered to both nurses and patients to capture relevant socio-demographic and professional characteristics. Data collection was conducted across three sequential phases pre-intervention, intervention, and post-intervention over nine months following institutional ethical approval.

2.5 Statistical Methods

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 29 [22]. Descriptive statistics were applied to summarize the data, with mean and standard deviation reported for continuous quantitative variables, and frequencies and percentages calculated for categorical variables. Prior to inferential analysis, the normality of the data distribution was assessed using the Kolmogorov–Smirnov test, with a p-value > 0.05 indicating a statistically insignificant. Given the normal distribution of the data, the paired-samples t-test was employed to compare pre- and post-intervention practice scores among nurses and to evaluate changes in clinical outcomes and patient satisfaction following the implementation of standard patient safety guidelines. A p-value of ≤0.05 was set as the threshold for statistical significance across all inferential analyses.

3 RESULTS

The findings revealed a transformative and statistically significant improvement in nursing clinical practice, a reduction in post-procedural complications, and enhancement of patient satisfaction following protocol-based nursing education.

The Shapiro-Wilk test confirmed that nurses' clinical practice scores were normally distributed across all three procedural phases before procedure (W = 0.971, df = 30, p = 0.184), during procedure (W = 0.893, df = 30, p = 0.093), and after procedure (W = 0.965, df = 30, p = 0.106) as all p-values exceeded the 0.05 threshold, thereby justifying the application of parametric statistical tests, including the paired-sample t-test, for subsequent comparative analyses. The demographic and professional characteristics of the nursing sample are presented below.

Table 1. Normality test for nurses' clinical practice scores across pre-procedure, intra-procedure, and post-procedure phases of cardiac catheterization (n = 30)

Nurses' performance	Shapiro-Wilk			
	Item	Statistic	Df	P-value
Before Procedure	13	0.971	30	0.184

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During Procedure	06	0.893	30	0.093	1 year	4	13.3%
After Procedure	07	0.965	30	0.106	> 1-2 Years	8	26.7%
					2-5 Years	7	23.3%
					> 5 Years	11	36.7%
Working Experience in Cath-Lab							
					1 Year	10	33.3%
					> 1-2 Years	14	46.7%
					> 2-5 Years	6	20.0%

Age distribution: the majority of nurses (60.0%, n = 18) were aged between 30 and 40 years, while equal proportions (20.0%, n = 6 each) fell within the under-30 and over-40 age categories, indicating a predominantly mid-career workforce. With respect to gender, the sample was overwhelmingly female, with 93.3% (n = 28) of participants being female and only 6.7% (n = 2) being male, reflecting the predominant gender composition of the nursing profession in Pakistan. Concerning professional qualification, the largest proportion of nurses held a POST RN BS Nursing degree (63.3%, n = 19), followed by General Nursing (23.3%, n = 7), and BS Nursing (13.3%, n = 4). Regarding professional experience, the majority of nurses (36.7%, n = 11) reported more than five years of hospital working experience, followed by those with one to two years (26.7%, n = 8), two to five years (23.3%, n = 7), and one year or less (13.3%, n = 4), suggesting a relatively experienced nursing workforce. With respect to Cath Lab-specific experience, the largest proportion of nurses (46.7%, n = 14) had between one and two years of experience in the catheterization laboratory, followed by those with one year or less (33.3%, n = 10), and two to five years (20.0%, n = 6), indicating that the majority of nurses had limited specialized experience in the cardiac catheterization setting, which may have bearing on their baseline adherence to standard patient safety guidelines.

Table 2. Socio-demographic and Professional Characteristics of the Studied Nurses (n = 30)

Demographic Variable	Frequency(f)	Percentage(%)
Age		
< 30 Years	6	20.0%
30-40 years	18	60.0%
> 40 years	6	20.0%
Gender		
Male	2	6.7%
Female	28	93.3%
Profession Qualification		
General Nursing	7	23.3%
BS Nursing	4	13.3%
POST RN BS Nursing	19	63.3%
Working Experience in a Hospital		

In the pre-intervention phase, the majority of nurses demonstrated inadequate practice levels, with 33.3% categorized as poor and 26.6% as very poor, while none achieved very good practice at baseline. These findings were consistent with evidence from comparable settings; Korejo et al. reported that 90% of nurses working in cardiac catheterization units demonstrated unsatisfactory levels of clinical practice prior to any structured educational input [3], and Henedy and El-Sayad similarly documented that more than half of their studied cardiac nurses exhibited poor practice regarding patient safety post-cardiac catheterization [10]. The pervasive deficits observed at baseline further corroborate the findings of Sania et al., who identified a critical gap between expected and actual nursing practices in cardiac catheterization settings across Pakistani hospitals [23]. The implementation of the structured educational program resulted in statistically significant improvements across all practice categories ($p < 0.05$). Fair practice rose to 43.3%, good practice increased to 33.3%, and very good practice emerged at 10.0%, a level entirely absent prior to the intervention, while very poor practice was completely eliminated. These results aligned closely with the findings of Faried Abdelwanees Ali et al., who demonstrated that implementing educational guidelines produced significant improvements in cardiac nurses' performance regarding patient safety post-catheterization ($p \leq 0.05$) [13]. Similarly, Hamed et al. confirmed that a structured patient safety educational programme significantly enhanced nurses' performance scores in cardiac catheterization units [9], and Mohamed et al. reported that an intervention protocol focusing on safety measures produced highly significant improvements in nurses' knowledge and practices ($p \leq 0.001$) [17]. Collectively, these findings underscore that targeted, structured educational interventions represent an effective and evidence-based strategy for bridging the knowledge-to-practice gap in cardiac catheterization nursing care.

Table 3. Comparison of Nurses' Adherence to Standard Patient Safety Guidelines for Cardiac

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Catheterization Before and After Educational Intervention (n = 30)

Nurses Practices	Pre- Intervention Group			Post- Intervention Group			P- valu e
	f	%	Mean ± SD	f	%	Mean ± SD	
Very Poor Practice	8	26.6 %	0.38 9± 0.76 5	0	0%	1.18 ± 0.12 4	0.00 1*
Poor Practice	1	33.3 %	0.75 6± 0.64 5	4	13.4 %	1.31 ± 0.21 2	0.00 0*
Fair Practice	8	26.6 %	0.45 6± 0.42 1	1	43.3 %	1.45 ± 0.01 8	0.00 4*
Good Practice	4	13.5 %	0.61 7± 0.31 4	1	33.3 %	1.52 ± 0.11 6	0.00 3*
Very Good Practice	0	0%	0.51 7± 0.47 5	3	10.0 %	1.44 ± 0.04 9	0.00 0*

f = frequency; SD = standard deviation; * statistically significant at $p \leq 0.05$ (paired-samples t-test).

The overwhelming majority of patients (79.5%, n = 35) reported dissatisfaction with nursing care (Mean $\pm$ SD = 3.191 $\pm$ 1.805), while only 20.4% (n = 9) reported satisfaction (Mean $\pm$ SD = 3.256 $\pm$ 1.645). Following the intervention, these proportions reversed dramatically, with 93.2% (n = 41) of patients reporting satisfactory satisfaction levels (Mean $\pm$ SD = 5.48 $\pm$ 1.212) and only 6.8% (n = 3) remaining unsatisfactory (Mean $\pm$ SD = 5.61 $\pm$ 1.114). Both differences were statistically significant ($p = 0.001$ and $p = 0.000$, respectively), confirming that adherence to standardized safety guidelines by nurses produced a substantial and measurable enhancement in the patient experience following cardiac catheterization. These findings are consistent with and supported by existing literature. Ibrahim Shalaby et al. reported that patients undergoing diagnostic cardiac catheterization who received structured nursing care demonstrated notably higher satisfaction scores, particularly in domains of communication, pain management, and procedural explanation [21]. Similarly, a study by Abd El-Rahman et al. found that improved adherence to

nursing guidelines was directly associated with higher patient satisfaction in catheterization settings, with patients expressing greater confidence in their care when nurses followed standardized protocols [14]. Thabet et al. further highlighted that patient dissatisfaction in cardiac catheterization units was largely attributable to inadequate nurse-patient communication and insufficient post-procedural guidance, both of which were directly addressed by the educational intervention implemented in the present study [24]. Collectively, these findings reinforce the well-established premise that patient satisfaction is not merely a subjective measure but a direct reflection of the quality and consistency of nursing care delivery [4].

Table 4. Comparison of Patient Satisfaction Levels Regarding Nursing Care Following Cardiac Catheterization Between Pre and Post-intervention Groups (n = 88)

Level of Satisfacti on	Pre- Intervention Group			Post- Intervention Group			P- val ue
	f	%	Mean ± SD	f	%	Mean ± SD	
Unsatisfactory Level	3	79.5 %	3.19 1± 1.80 5	3	6.8 %	5.6 1± 1.1 14	0.00 1*
Satisfactory Level	0	20.4 %	3.25 6± 1.64 5	4	93.2 %	5.4 8± 1.2 12	0.00 0*

f = frequency; SD = standard deviation; * statistically significant at $p \leq 0.05$ (paired-samples t-test).

Results revealed a significant reduction in post-procedural complication rates following the implementation of standard patient safety guidelines. Pre-intervention, severe complications accounted for 25.0% (n = 11), and only 6.8% (n = 3) experienced no complications. Post-intervention, severe complications were entirely eliminated (0%, $p = 0.004$), moderate complications declined from 47.7% to 15.9% ($p = 0.001$), and patients with no complications increased markedly to 38.6% (n = 17, $p = 0.003$), confirming that guideline-concordant nursing practice produced measurable improvements across all complication categories. These findings aligned with existing literature; Abdelwanees Ali et al. reported that educational guidelines for cardiac nurses significantly reduced vascular access site complications [13], Sania et al. confirmed that standardized post-catheterization nursing protocols reduced hematoma development [23], Mustafa and

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Hassan demonstrated that structured nursing interventions effectively managed early complications including vasovagal reactions [3], and Mohamed et al. reported highly significant reductions in complication rates following a safety-focused intervention protocol ($p \leq 0.001$) [17], collectively reinforcing that targeted nursing education represents an effective strategy for minimizing preventable complications in cardiac catheterization settings.

Table 5. Clinical Outcomes and Complication Rates in Patients Undergoing Cardiac Catheterization Pre- and Post-Intervention (n = 88)

Patients Clinical Outcome s	Pre- Intervention Group			Post- Intervention Group			P- valu e
	f	%	Sco re	f	%	Sco re	
Severe Complica tions	1	25.	34	0	0%	0	0.00
Moderat e Complica tions	1	0%					4*
Mild Complica tions	2	47.	22	7	15.	27	0.00
No Complica tions	1	7%			9%		1*
	9	20.	14	2	45.	17	0.00
		5%		0	5%		0*
	3	06.	0	1	38.	0	0.00
		8%		7	6%		3*

f = frequency; SD = standard deviation; * statistically significant at $p \leq 0.05$ (paired-samples t-test).

4 DISCUSSION AND CONCLUSIONS

The findings of the present study demonstrated that the implementation of standard patient safety guidelines through a structured educational intervention produced significant and measurable improvements in nurses' clinical practice, patient clinical outcomes, and patient satisfaction in cardiac catheterization settings. Prior to the intervention, the majority of nurses exhibited poor to very poor practice levels (59.9%), with none achieving very good practice, findings that closely mirror those reported by Korejo et al., documented that 90% of nurses in Pakistani cardiac catheterization units demonstrated unsatisfactory practice levels [3], and Henedy and El-Sayad, who found that over half of studied cardiac nurses exhibited poor post-catheterization safety practices [10]. The baseline knowledge and practice deficits identified in the present study were further consistent with Faisal, who attributed such gaps to the absence of post-catheterization care content in nursing curricula [3], and with Sania et al. reported that 77% of nurses in

Pakistani cardiac units demonstrated unsafe practices prior to any educational intervention [23]. Following the structured three-module educational programme, statistically significant improvements were recorded across all practice categories ($p < 0.05$), with very poor practice entirely eliminated and very good practice emerging at 10.0%, corroborating the conclusions of Hamed et al. and Mohamed et al., both of whom confirmed that structured educational protocols produced highly significant enhancements in cardiac nurses' performance and safety attitude scores [9,17].

The intervention equally produced substantial benefits in patient-centered outcomes. Post-procedural severe complications were entirely eliminated following the intervention (25.0% to 0%, $p = 0.004$), and the proportion of patients experiencing no complications increased from 6.8% to 38.6% ($p = 0.003$), findings consistent with Faried Abdelwanees Ali et al., who demonstrated that educational guidelines for nurses significantly reduced vascular access site complications including hematoma and bleeding [13], and with Mahmood H. et.al., confirmed the effectiveness of nursing interventions in managing early coronary catheterization complications [11]. Most strikingly, patient satisfaction levels underwent a dramatic transformation, with unsatisfactory satisfaction declining from 79.5% to 6.8% and satisfactory levels rising to 93.2% ($p = 0.000$). This finding resonates with Ibrahim Shalaby et al., who reported that structured nursing care was directly associated with higher patient satisfaction scores in catheterization settings [21], and with Naidu et al., established that nursing competence, communication, and technical proficiency are the principal determinants of patient satisfaction in cardiac care [7]. The demographic homogeneity observed between the pre- and post-intervention patient groups further strengthened the validity of these outcome comparisons, reducing the likelihood of confounding bias.

The present study concluded that the implementation of standard patient safety guidelines through a structured educational intervention significantly improved nurses' adherence to safe clinical practices, reduced post-procedural complication rates, and markedly enhanced patient satisfaction levels in cardiac catheterization settings. These findings underscore the critical importance of ongoing, protocol-based nursing education as a cornerstone strategy for advancing patient safety and quality of care in cardiovascular nursing practice. It is recommended that hospital administrations mandate regular competency-based training programmed for all nurses working in cardiac catheterization

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laboratories, that standardized safety guidelines be embedded within institutional nursing protocols and displayed in clinical areas for continuous reference, and that future research adopt randomized controlled trial designs with larger, multi-center samples to further establish the generalizability of these findings across diverse healthcare settings in Pakistan and beyond.

Supplementary Materials

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Author Contributions

Conceptualization, S.M. and M.M.; methodology, B.B., M.M. and S.M.; software, B.B., M.M.; validation, S.M.; formal analysis, S.M. and B.B.; investigation, B.B. and S.M.; resources, B.B.; writing original draft preparation, S.M. and B.B.; supervision, S.M., M.M. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Research and Ethics Committee of the University of Lahore [Protocol Number REC-UOL-1389]. Approval date: June 10, 2026.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The authors declare no conflict of interest.

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