Jurnal Ners

Volume 21 Issue 2, May 2026, p. 162-171
http://dx.doi.org/10.20473/jn.v21i2.78167

Original Article Open Access

Effect of nursing guidelines on clinical outcomes among patients undergoing cardiac catheterization

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Responsible Editor: Laily Hidayati

Received: 13 September 2025○ Revised: 27 October 2025 ○ Accepted: 5 May 2026

ABSTRACT

Introduction: Cardiac catheterization is considered the gold standard for the diagnosis and management of cardiac diseases; however, post-procedural complications pose a significant clinical challenge affecting patient outcomes. A notable gap exists in the availability of locally adapted nursing guidelines within the Egyptian healthcare context. Therefore, this study aimed to evaluate the effectiveness of structured, evidence-based nursing guidelines in improving patient knowledge and reducing complications among patients undergoing cardiac catheterization.

Methods: A quasi-experimental pretest–posttest design was conducted at Beni-Suef University Hospital, Egypt, involving 130 patients (65 per group) selected through purposive sampling. Eligibility criteria included patients aged 20–60 years, hemodynamically stable, and undergoing diagnostic or therapeutic cardiac catheterization. The study group received structured nursing guideline sessions, while the control group received standard hospital care. Data were analyzed using descriptive and inferential statistics, with significance set at $p < 0.05$.

Results: Regarding the primary outcome, there was a statistically significant reduction ($p < 0.01$) in post-catheterization complications — both early (within 24 hours) and late (after 24 hours) in the study group compared to the control group, immediately and at two weeks post-procedure. Regarding the secondary outcome, a statistically significant improvement ($p < 0.01$) was observed in patients' total level of knowledge and self-care practices related to cardiac catheterization care in the study group compared to the control group following nursing guidelines implementation.

Conclusions: The implementation of evidence-based nursing guidelines significantly enhanced patients' knowledge, reduced post-procedural complications, and promoted faster recovery after cardiac catheterization.

Keywords: cardiac catheterization, clinical outcomes, evidence-based nursing, nursing guidelines, nursing intervention, patient safety

Introduction

Coronary Artery Disease (CAD) is a serious and life-threatening condition that affects both men and women, accounting for an estimated 18.2 million deaths among adults worldwide, representing approximately 6.7% of the global population. Mortality from CAD is nearly five times higher in men than in women; however, this gender gap in mortality decreases with advancing age (Bill and Lakshmi, 2024). In Egypt, a marked increase in the incidence and mortality rates of CAD has been documented. The National Hypertension Project demonstrated an adjusted overall prevalence of 8.3%. Moreover, data from the World Health Organization (WHO) indicated that CAD accounted for 23% of total mortality, with an age-adjusted death rate of 186.36 per 100,000 population, positioning Egypt 23rd in the global ranking (Abd El-Gawad *et al.*, 2022).

Cardiac catheterization (CC) is an invasive diagnostic and interventional procedure that involves the insertion of fine-bore tubes (catheters) into a blood vessel and threading them to the heart to examine its structure and function, detect blockages, or treat conditions such

as narrow arteries and heart valves (Shoaib *et al.*, 2022). Cardiac catheterization allows for various assessments, including measuring blood pressure, blood flow to the heart, and oxygen levels in the blood. It is also used for obtaining blood samples, heart muscle biopsies, and hemodynamic evaluations, helping to determine the need for further treatment (Shaik et al., 2020).

Post-Coronary Care (Post-CC) patients may experience a range of complications, varying in severity and potentially contributing to morbidity and mortality. The most significant risks include cerebrovascular accidents (strokes), myocardial infarction, cardiac arrhythmias, vessel injury, and renal failure. Minor complications such as contrast allergies, hemorrhage, hematoma, transient pain, nausea, and vomiting can also affect patient outcomes (Yaqoob et al., 2022). Clinical outcomes are measurable or observable responses to an intervention that are documented at precise points during or after treatment. This indicates the maintenance or stability of the patients' health state (Van Veghel et al., 2020). Successful clinical results for patients undergoing CC include faster recovery, earlier ambulation, fewer postoperative complications, and lower hospital expenditures. These results can boost patient happiness, comfort, and quality of life (Chen et al., 2025).

Nurses play an important role in patients undergoing CC, as they require continuous monitoring and care coordination. Nurses can help reduce CC difficulties by adhering to recognized infection control recommendations and maintaining aseptic procedures through the procedure (Patel et al., 2024).During CC, safety protocols must be followed to enable early discovery and treatment of problems. Nurses who can identify problems early are more likely to take decisive action and improve patient outcomes. As a result, nurses with expertise in providing patient care during CC may be able to reduce the rates of morbidity and mortality in patients with CC (Niknam Sarabi et al., 2021).

Patients undergoing cardiac catheterization have physical, psychological, educational, and social needs both before and after the procedure. These needs include proper preparation of the insertion site, establishing a trusting relationship with the nurse, alleviating anxiety in both patients and their families, and providing detailed information regarding their condition (Pazar & Iyigun, 2020). The nurse's major aim for patients following CC is to restore their ideal physiological, psychological, social, and occupational levels (Slicker et al., 2016).Nurses' responsibility after CC is to examine and assess the patient's condition from head to toe, noting general skin color and temperature. Pay close attention to the degree of consciousness was carefully considered. After the patients are transferred to the bed and connected to the monitor, the nurse listens intently to their breath and heart sounds, assessing peripheral circulation by observing the color and warmth of the dorsal pedals and posterior tibial pulses (Bangalore et al., 2021).

Therefore, this study aimed to evaluate the effect of implementing nursing guidelines on patient's clinical outcomes following cardiac catheterization.

Materials and Methods

It was hypothesized that such nursing guidelines would have a significant positive influence on the clinical outcomes of the study group of patients undergoing cardiac catheterization (who received nursing guidelines) compared to the controls who received standard hospital care.

Research design

A quasi-experimental design was used to achieve the study aim. According toKennedy-Shaffer (2024), this design provides an opportunity to evaluate the therapeutic impact on the population without the need to measure all possible confounding elements and identify population-level impacts. This design was suitable and helpful in determining the impact of structured nursing guidelines on clinical outcomes among patients who underwent cardiac catheterization. Patient responses were collected through surveys conducted before and after guideline implementation. The structured nursing guidelines booklet aimed to deliver information to improve patients' clinical outcomes and rehabilitation.

Research Setting and Participants

The study was conducted in the cardiac catheterization unit and outpatient clinics at Beni-Suef University Hospital. A purposive sample of 130 adult patients who met the eligibility criteria and agreed to participate was included in the study. Participants were equally divided into two groups: a study group (n = 65) who received the nursing guidelines intervention, and a control group (n = 65) who received standard hospital care.

Eligible participants were adult patients aged 20–60 years of both sexes, who were hemodynamically stable and undergoing diagnostic or therapeutic cardiac catheterization. They also had to agree to participate and be available for follow-up after discharge, either by telephone or during outpatient visits. These inclusion criteria ensured that the participants had similar clinical conditions relevant to the study objectives.

A purposive sampling approach was chosen because the study focused on a specific group of patients who met the defined clinical criteria, and random sampling was not feasible in this setting. This approach is consistent with the Joanna Briggs Institute (JBI) methodological guidance for quasi-experimental studies, where purposeful selection enhances the applicability of the results to similar clinical contexts.

Participants were allocated to the study and control groups using a time-based assignment method. Patients who met the inclusion criteria and were admitted during the first phase of data collection were placed in the control group, while those admitted during the subsequent phase after the implementation of the nursing guidelines were included in the study group. This method helped prevent cross-contamination between groups and aligned with the CONSORT recommendations for transparent reporting in non-randomized studies.

Matching was not performed because the allocation process relied on natural patient flow rather than random or case-matched selections. However, both groups were recruited using the same inclusion criteria, and standardized procedures were followed throughout the data collection to minimize potential selection bias and maintain group comparability.

Sample Size and Power Analysis

The sample size was calculated based on the estimated prevalence of the event of interest using a standard normal deviate corresponding to the desired confidence level, with a defined margin of error to ensure precision.

For this study, a confidence level of 95% (Z = 1.96) and a margin of error of 0.05 were applied. Because no previous prevalence data were available, P was conservatively assumed to be 0.5, providing the maximum sample size and ensuring adequate statistical power. The precision (E) was set to 10% of P, as recommended for estimating proportions in healthcare research. Based on these parameters, the calculated minimum sample size was approximately 130 participants, achieved by enrolling 65 participants in each group (study and control).

An official approval letter was obtained from the Faculty of Nursing, Ain Shams University to the director of Beni-Suef University Hospital, describing the nature of the study to obtain their acceptance. The researcher visited outpatient clinics repeatedly to find subjects who agreed to participate in the study. Oral and written consent was obtained from each participant in both groups after they were informed about the nature, objectives, and advantages of the study. Protecting participants' rights before filling out the survey, patients were informed that sharing was optional and that they could withdraw at any time without giving reasons. Confidentiality was maintained by using codes to identify participants instead of names or any other personal identifiers.

Instruments

Data were collected using two main questionnaires. The nursing guidelines booklet was first prepared by the researcher, guided by other team members. The content was reviewed and tested by a panel of five experts in critical care nursing from the Faculty of Nursing, Ain Shams University. The booklet was designed to enhance patients' knowledge, support self-care, and promote safe recovery before and after the procedure.

The educational booklet was organized into four main parts, each representing a distinct phase of teaching. Each phase included specific learning topics, a defined duration, selected teaching materials, and clear learning outcomes.

Phase I: Overview of the heart and cardiac catheterization.

In this phase, patients were introduced to the basic structure and function of the heart, and the procedure of cardiac catheterization was explained. It covered both diagnostic and therapeutic types, reasons for performing the procedure, possible contraindications, and essential pre-procedure preparations, such as fasting, smoking cessation, and required medical tests.

- Duration: about 30 minutes.
- Teaching materials: illustrated PowerPoint slides, printed booklet pages and visual heart diagrams.
- Expected outcomes: Patients understand the purpose of the procedure, can distinguish between its types, and recognize how to prepare safely for it.

Phase II: Potential cardiac catheterization clinical outcomes.

This section focused on raising awareness of the risks that might occur after catheterization, such as bleeding, hematoma, irregular heart rhythms, allergic reactions, or kidney problems. It also emphasized the need to recognize warning signs such as chest pain, shortness of breath, or fever that require immediate medical attention.

- Duration: about 25 minutes.
- Teaching materials: printed booklet content, visual posters, and interactive discussions with the researcher.
- Expected outcomes: Patients will be able to identify potential complications and know when to seek prompt medical help.

Phase III: Post cardiac catheterization guidelines.

During this phase, patients received clear instructions for the immediate recovery period. The teaching covered wound care for the insertion site, bathing techniques, and activity restrictions, such as avoiding driving, lifting heavy objects, or engaging in strenuous exercise.

- Duration: about 20 minutes.
- Teaching materials: demonstrations, illustrations from the booklet, and verbal explanations.
- Expected outcomes: Patients will be able to perform appropriate site care, understand the importance of

rest, and follow activity precautions to prevent complications.

Phase IV: Nursing guidelines for safe discharge and rehabilitation.

The final phase focuses on long-term recovery and lifestyle adjustments. It includes guidance on maintaining a heart-healthy diet, following a gradual exercise plan, adhering to prescribed medications such as anticoagulants and beta-blockers, and attending follow-up appointments.

- Duration: about 25 minutes.
- Teaching materials: the printed booklet, discharge counseling.
- Expected outcomes: Patients understand how to maintain a healthy lifestyle after discharge, follow medication instructions, and attend scheduled medical reviews.

Overall, the total duration of the educational sessions was approximately one hour and 40 minutes, delivered individually in the cardiac unit according to each patient's readiness and condition. The booklet also served as a take-home reference, allowing patients to review the information after discharge. Content validity was confirmed through expert evaluation, and revisions were made to ensure clarity, accuracy, and cultural relevance.

Tool I: Patients' assessment questionnaire:

It was created by researchers using Arabic to align with the educational levels of the participants, who mostly use Arabic. It featured three primary components, which were divided as follows.

Section (A): Demographics questionnaire.

Demographics were investigated using a form that included several variables. This form was used to gather essential background information about the patients, which helped contextualize the outcomes of the nursing guidelines and assess the factors that may influence their outcomes.

Section (B): Patients' knowledge assessment questionnaire:

It was designed by Mohammed Hasballah et al. (2019) and Aly Mahgoub et al. (2022)to assess patients' knowledge of cardiac catheterization. It included five subsections and consisted of questions such as anatomy of the heart, coronary artery disease, and the definition, indications, and contraindications of cardiac catheterization.

Validity and Reliability:

The content validity of Tool I was reviewed by a panel of five experts in cardiovascular nursing and medicine, with an average Content Validity Index (CVI) of 0.91, confirming strong item relevance and clarity. Reliability analysis using Cronbach's alpha yielded a coefficient of 0.92 ($p < 0.01$), indicating the tool's excellent internal consistency.

Tool II: Patient's outcomes assessment questionnaire:

It focused on the clinical outcomes of patients undergoing cardiac catheterization through the following:

Section (A): complications evaluation sheet.

Adapted from,Abdel et al. (2022),this section comprised 18 items divided into two domains. The first domain assessed early complications (within 24 h) through 12 items covering local vascular complications, contrast agent complications, cardiac complications, and hemorrhagic or ischemic stroke. The second domain assessed late complications (after 24 h) through six items covering contrast-induced kidney injury.

Fever/chills, abnormal site discharge, arterial insufficiency, chest pain, and radial artery occlusion. Each item was scored as either present or absent.

Validity and Reliability:

The validity of the tool was confirmed by the same expert panel for content relevance and clinical applicability. Reliability testing produced a Cronbach's alpha coefficient of 0.764 ($p < 0.01$), indicating acceptable internal consistency.

Data collection

After obtaining institutional approval, the study spanned 11 months, from April 2023 to February 2024. The fieldwork consisted of four phases: the assessment phase lasted approximately two months, the planning phase took two months, the implementation phase extended for approximately five months, and the evaluation phase spanned two months.

The primary outcome of this study was to evaluate the effect of structured nursing educational guidelines on reducing the incidence of post-cardiac catheterization complications — both early (within 24 hours) and late (after 24 hours)–in the study group compared to the control group receiving routine care. The secondary outcomes included improving patients' knowledge and self-care practices related to post-catheterization care and monitoring complication occurrence at the two-week follow-up.

The researcher started by interviewing the patients in both groups (study and control) who met the eligibility standards and illustrated the objective and nature of the study, as well as obtained their verbal approval for participation before data collection. Baseline data were obtained from the patients in both groups before the nursing guideline implementation using Tool I; this form was filled by the patients within the outpatient clinics. Each patient completed the questionnaire within 30-45

minutes. The researcher was accessible four days a week and visited around four patients each day.

The nursing guideline educational sessions were carried out in the cardiac catheterization unit and waiting area of outpatient clinics of the previously mentioned setting for the patients in the study group. It included four sessions, each lasting approximately 30 minutes to one hour. Each meeting began with a brief conclusion about the preceding session and the aim of the new topics, using simple Arabic to suit the patients' educational level.

The researcher evaluated the study and control groups immediately post cardiac catheterization using Tool II (Patients' Outcomes Assessment Tool). After 24 h, the researcher contacted either the patients or their relatives to investigate any clinical outcomes that had occurred. Furthermore, the patients were reassessed two weeks after discharge based on their readiness to participate.

Data analysis

Data were analyzed using (SPSS version 27). Quantitative variables are summarized as mean ± SD, whereas qualitative variables are presented as frequencies and percentages. The chi-square test was used for categorical variables when the assumptions were met; otherwise, Fisher's Exact Test was applied. The normality of quantitative variables was assessed before applying parametric tests, and an independent t-test was used for comparisons between the study and control groups. A multivariate binary logistic regression analysis was conducted to identify the predictors of early and late complications. Statistical significance was set at $p < 0.05$.

Trustworthiness

There are several ways to enhance the validity and applicability of this study. Validity was strengthened through pre- and post-tests to accurately detect changes in each group. Additionally, all patients in the study

Table 1. Demographic characteristics of patients (control & study) groups undergoing cardiac catheterization (n=130)

Items	Control (n=65)		Study (n=65)		X^2/t	p-value
	No.	%	No.	%		
Gender						
Male	57	87.6	53	81.5	0.945	0.331
Female	8	12.3	12	18.4		
Age (Years)					2.080	0.149
Less than 50 years	44	67.6	36	55.3		
50 years or more	21	32.3	29	44.6		
Mean ± SD	**49.75±7.32**		**48.77±7.38**			
Educational level						
Illiterate	27	41.5	21	32.3	2.604	0.457
Basic education	30	46.1	33	50.7		
Pre-university education	3	4.6	7	10.7		
University education	5	7.6	4	6.1		
Marital status						
Single	10	15.3	18	27.6	2.913	0.088
Married	55	84.6	47	72.3		
Work status						
Work	53	81.5	50	76.9	0.421	0.517
No work	12	18.4	15	23.0		
Nature of work						
Require muscular effort	28	43.08	35	53.8		
Require mental effort	9	13.80	8	12.3	4.275	0.118
Require mental /muscular effort	16	24.60	7	10.7		
Place of residence						
Rural	52	80.00	57	87.6	1.420	0.233
Urban	13	20.00	8	12.3		

X^2=chi-square, t=t-test, categorical age distribution and mean age were both compared to confirm baseline equivalence.

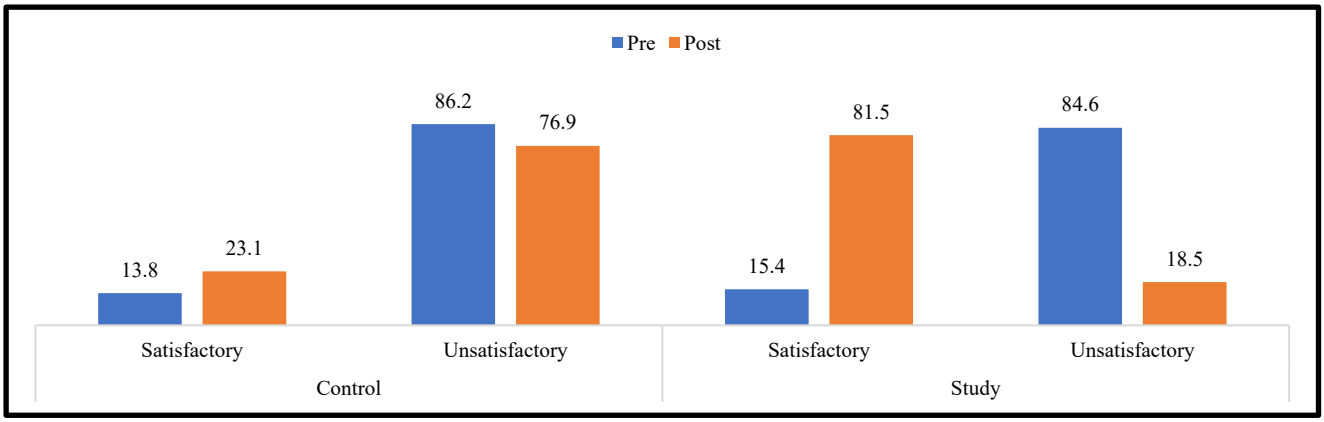

Figure 1. Total satisfactory level of knowledge among (control & study) group of patients' pre and post nursing guidelines implementation

group were exposed to the same learning experience, with each subcategory of the study group receiving the same content and using the same teaching modalities. Transferability was confirmed via a detailed explanation of the study through offering step-by-step data collection and analysis processes.

Objectivity was sustained via suitable analyses to check pre- and post-score variations. The study was conducted using rigorous procedures that reduced researcher bias in the interpretation of the findings. All steps of data collection and analysis were systematically documented to enhance transparency and reproducibility.

Ethical Considerations

Ethical approval for the study was obtained from the Ethical Committee of the Faculty of Nursing at Ain Shams University before the study initiation (approval number: 24.12.439). All participants were informed about the study's purpose, procedures, potential benefits, and their right to withdraw at any time without penalty. Written informed consent was obtained from each participant prior to their inclusion in the study. Participant confidentiality and anonymity were strictly maintained throughout the study period.

Results

Table 1 presents the demographic characteristics of the participants. The majority of patients in both groups were men, accounting for 81.5% in the study group and 87.6% in the control group. A notable proportion of participants were younger than 50 years, representing 55.3% and 67.6% of the study and control groups, respectively, which may influence recovery and adherence to post-procedure instructions. Regarding educational level, 50.7% of the study group and 46.1% of the control group had only basic education, a factor that could affect the comprehension of health education. Most participants were married (72.3% in the study group and 84.6% in the control group). Employment status was also similar, with 76.9% of the study group and 81.5% of the control group being employed, and approximately half of them engaged in physically demanding jobs, which may influence lifestyle-related outcomes. Finally, a large proportion of participants in both groups resided in rural areas (87.6% of the study group and 80% of the control group).

Figure 1 illustrates that prior to the implementation of the nursing guidelines, only a small proportion of patients demonstrated satisfactory knowledge regarding cardiac catheterization (13.8% in the control group and 15.4% in the study group). Following guideline implementation, a substantial improvement was observed in the study group, where 81.5% of patients achieved a satisfactory knowledge level compared with 23.1% in the control group. This marked increase reflects the positive impact of structured educational interventions on patients' understanding and preparedness for the procedure.

Table 2 presents the immediate outcomes of cardiac catheterization. The study group showed significantly fewer complications, including bleeding, hematoma, and cardiac arrhythmia, than the control group ($p = 0.029$, $p = 0.041$, and $p = 0.021$, respectively). These findings indicate that adherence to evidence-based nursing guidelines contributes to improved short-term safety and procedural outcomes. Furthermore, during the early follow-up period (two weeks post-procedure), the study group continued to demonstrate reduced bleeding events ($p = 0.023$), suggesting the sustained benefits of the implemented care protocol.

Table 3 Demonstrates significant differences in complications occurring 24 hours after cardiac catheterization. The study group experienced lower rates of contrast-induced kidney injury, fever or chills,

Table 2. Clinical outcomes (early complications) immediately and post two weeks of cardiac catheterization among studied patients (n=130).

Early complications (within 24 hours)	Control								Study								X^2			
	Immediately				post two weeks				Immediately				post two weeks							
	Yes		No		Yes		No		Yes		No		Yes		No		P1		P2	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	X^2	P-value	X^2	P-value
A-Local vascular complications:																				
1-Bleeding.	7	10.8	58	89.2	5	7.7	60	92.3	1	1.5	64	98.5	0	0.0	65	100.0	4.795	**0.029***	5.200	**0.023***
2-Hematoma.	10	15.4	55	84.6	2	3.1	63	96.9	3	4.6	62	95.4	4	6.2	61	93.8	4.188	**0.041***	0.699	0.403
3-Arteriovenous (AV) fistula.	0	0.0	65	100.0	0	0.0	65	100.0	0	0.0	65	100.0	0	0.0	65	100.0	0.000	1.000	0.000	1.000
4-Limb ischemia.	12	18.5	53	81.5	8	12.3	57	87.7	6	9.2	59	90.8	3	4.6	62	95.4	2.321	0.128	2.483	0.115
B-Contrast agent complications.																				
Allergic- contrast reactions.	4	6.2	61	93.8	0	0.0	65	100.0	2	3.1	63	96.9	0	0.0	65	100.0	0.699	0.403	0.000	1.000
C-Cardiac complications:																				
1-Chest pain /Recurrent MI.	11	16.9	54	83.1	7	10.8	58	89.2	6	9.2	59	90.8	4	6.2	61	93.8	1.692	0.193	0.894	0.344
2-Cardiac arrhythmia	25	38.5	40	61.5	10	15.4	55	84.6	13	20.0	52	80.0	7	10.8	58	89.2	5.355	**0.021***	0.609	0.435
3-Cardiac Perforation.	0	0.0	65	100.0	0	0.0	65	100.0	0	0.0	65	100.0	0	0.0	65	100.0	0.000	1.000	0.000	1.000
D- Hemorrhagic or ischemic stroke.	0	0.0	65	100.0	0	0.0	65	100.0	0	0.0	65	100.0	0	0.0	65	100.0	0.000	1.000	0.000	1.000

P1: comparison between study and control groups at 24 hours post-procedure.
P2: comparison between study and control groups at two weeks post-procedure.
Chi-square test was used when assumptions were met; otherwise, Fisher's Exact Test was applied for cells with expected counts <5, NA= Not applicable, Non-significant P >0.05. significant <0.05* Highly significant P < 0.01**.

Table 3. Clinical outcomes (late complications) after 24 hours and post two weeks of cardiac catheterization among studied patients (n=130).

Late complications (after 24 hours)	Control								Study								X^2			
	After 24 hours				Post two weeks				After 24 hours				post two weeks				P_1		P_2	
	Yes		No		Yes		No		Yes		No		Yes		No					
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	X^2	P-value	X^2	P-value
1-Contrast-induced kidney injury.	8	12.3	57	87.7	4	6.2	61	93.8	1	1.5	61	93.8	0	0.0	62	95.4	5.512	**0.019***	3.939	**0.047***
2-Fever /chills.	12	18.5	53	81.5	3	4.6	62	95.4	2	3.1	63	96.9	0	0.0	65	100.0	8.005	**0.005***	3.071	0.080
3- Abnormal discharge from the insertion site	6	9.2	59	90.8	2	3.1	63	96.9	0	0.0	65	100.0	0	0.0	65	100.0	6.290	**0.012***	2.031	0.154
4-Arterial insufficiency	7	10.8	58	89.2	2	3.1	63	96.9	3	4.6	62	95.4	1	1.5	64	98.5	1.733	0.188	0.341	0.559
5-Chest pain	14	21.5	51	78.5	10	15.4	55	84.6	5	7.7	60	92.3	4	6.2	61	93.8	4.993	**0.025***	2.882	0.090
6-Radial artery occlusion.	1	1.5	64	98.5	0	0.0	65	100.0	0	0.0	65	100.0	0	0.0	65	100.0	1.008	0.315	0.000	1.000

P1: comparison between study and control groups after 24 hours after cardiac catheterization
P2: comparison between study and control groups two weeks post-procedure
Chi-square test was used when assumptions were met; otherwise, Fisher's Exact Test was applied for cells with expected counts <5, NA= Not applicable, Non-significant P >0.05. significant <0.05* Highly significant P < 0.01**.

abnormal discharge from the insertion site, and chest pain (p = 0.019, p = 0.005, p = 0.012, and p = 0.025, respectively). Late complications observed two weeks after the procedure also showed improvement, with a notable reduction in contrast-induced kidney injury (p = 0.047). These results collectively highlight the effectiveness of the nursing guidelines in reducing both immediate and delayed post-catheterization complications.

Table 4 Demonstrates the multivariate logistic regression analysis for predictors of early complications following cardiac catheterization. The findings revealed statistically significant negative associations with bleeding (B = −1.521, p = 0.029, OR = 0.221, 95% CI = .065–0.880) and hematoma (B = −1.433, p = 0.041, OR = 0.243, 95% CI= 0.062–0.917). Similarly, cardiac arrhythmia or vasovagal attack showed a significant reduction (B = −1.572, p = 0.021, OR = 0.215, 95% CI= 0.062–0.825). In contrast, other early complications such as limb ischemia (p = 0.128), allergic contrast reaction (p = 0.403), and chest pain or recurrent myocardial infarction (p = 0.193) did not show statistically significant associations.

Table 5 Demonstrates the multivariate logistic regression analysis for predictors of late complications following cardiac catheterization. The results revealed significant negative associations between the study group and the occurrence of contrast-induced kidney injury (B = −1.681, p = 0.019, OR = 0.195, 95% CI= 0.056–0.816), fever or chills (B = −2.116, p = 0.005, OR = 0.126, 95% CI= 0.039–0.572), abnormal discharge from the insertion site (B = −1.953, p = 0.012, OR = 0.147, 95% CI= 0.032–0.681), and chest pain or pressure (B = −1.487, p = 0.025, OR = 0.232, 95% CI= 0.061–0.880). Meanwhile, arterial insufficiency (p = 0.188) and radial artery occlusion (p = 0.315) did not show statistically significant associations

Discussions

The main findings of the current study revealed that the implementation of evidence-based nursing guidelines significantly improved patients' knowledge and post CC clinical outcomes. These results highlight the effectiveness of structured nursing interventions in enhancing patients' understanding and adherence to post-procedural instructions, which are essential for promoting recovery and preventing adverse events in the future.

The current study findings revealed that most patients were male. This may be due to hormonal

Table 4. Multivariate logistic regression analysis for predictors of early complications after cardiac catheterization among the studied patients (n=130).

Early complications	B	SE	Wald	P-value	OR	95% CI Lower	95% CI Upper
Bleeding	-1.52	0.690	4.81	0.029*	0.221	0.065	0.880
Hematoma	-1.43	0.701	4.18	0.041*	0.243	0.062	0.917
Limb ischemia	-0.8	0.520	2.32	0.128	0.450	0.153	1.396
Allergic contrast reaction	-0.88	0.759	0.69	0.403	0.425	0.097	2.080
Chest pain / Recurrent MI	-0.67	0.496	1.70	0.193	0.511	0.196	1.392
Cardiac arrhythmia / Vasovagal attack	-1.57	0.682	5.36	0.021*	0.215	0.062	0.825

Table 5. Multivariate logistic regression analysis for predictors of late complications after cardiac catheterization among the Studied Patients (n=130).

Late complications	B	SE	Wald	P-value	OR	95% CI Lower	95% CI Upper
Contrast-induced kidney injury	-1.68	0.726	5.52	0.019*	0.195	0.056	0.816
Fever / chills	-2.12	0.753	8.01	0.005*	0.126	0.039	0.572
Abnormal discharge (insertion site)	-1.95	0.797	6.30	0.012*	0.147	0.032	0.681
Arterial insufficiency	-0.78	0.572	1.73	0.188	0.461	0.147	1.498
Chest pain / pressure	-1.49	0.669	4.99	0.025*	0.232	0.061	0.880
Radial artery occlusion	-0.69	0.682	1.01	0.315	0.503	0.136	1.950

differences and lifestyle factors, such as smoking, stress, and activity levels, all of which can increase cardiac workload and participate in CAD progression, ultimately leading to the need for cardiac catheterization. According to the current study, approximately half of the participants in the study and control groups had a basic education. This may be due to people with low educational levels being more likely to smoke, have diabetes, hypertension, and hyperlipidemia as risk factors for CAD. This finding aligns with the study by (Hussein *et al.*, 2024) who reported that more than half of the cases in their study had a low educational level. Regarding work status, the study demonstrated that the majority of participants in both groups were working, with approximately half engaged in jobs requiring muscular effort. This finding may be attributed to the fact that nearly half of the participants had a low educational level." These results are aligned with those reported by, Hammad Ameen and Younis (2019)who found that more than 50 percent of cases had a low QoL, and one-fourth of them had poor QoL.

Regarding the total satisfactory level of knowledge of cardiac catheterization, there was a considerable difference between the two categories. More than three-quarters of the subjects in the study category displayed potential improvement in the post-test following guideline implementation in relation to the pretest. This may be due to the impact of providing nursing guidelines with clear, evidence-based instructions. Additionally, the researcher encouraged patients' involvement in their care (asking questions, practicing self-care skills), which promoted a deeper understanding. This finding was in correspondence with that of Nourali et al. (2023)which revealed that the average scores of patients' information, treatment adherence, and quality of life were significantly higher one month after the intervention than before in the study group for patients undergoing coronary artery bypass graft surgery.

The pronounced improvement in the total satisfactory level of knowledge observed in the study group can be interpreted through several complementary theoretical frameworks from health education and behavior change. First, adult learning theory (Kemple, 2000) helps explain why structured, evidence-based nursing guidelines are effective: adults are self-directed learners who benefit from learning that is problem-centered, relevant to their immediate needs, and builds on prior experience. By framing the guidelines around the practical tasks and decisions patients face before and after catheterization, the intervention likely increased intrinsic motivation and the perceived usefulness of the information, which facilitated deeper encoding and retention.

The study illustrates that there were statistically significant variations between the pre- and post-guideline implementation groups regarding early complications. In relation to vascular complications post-CC, the findings of this study demonstrated that after receiving nursing guidelines, the incidence of bleeding and hematoma varied significantly between the study and control groups. This may be due to the guideline's instructions, which included restricted mobility for–six hours after sheath removal, early signs of bleeding and hematoma, and avoiding unexpected movement, which contributed to the low incidence of vascular complications following cardiac catheterization. This finding is supported by Kaur & Singh (2024),who demonstrated that nurses play a vital role in preventing these complications through the implementation of nursing strategies. Additionally, patients in the experimental group experienced a lower potential for vascular complications than those in the control group. Concerning cardiac arrhythmia post-cardiac catheterization, the study group demonstrated significant improvement both immediately and at post-two weeks compared to the control group. This improvement may be due to the implementation of guidelines for the early recognition of symptoms of cardiac arrhythmia. These findings align with those of Rymer et al. (2024)**,** who concluded that arrhythmia guidelines were effective in improving outcomes in patients with myocardial infarction. Additionally, the study group experienced fewer complications and better overall outcomes.

Regarding late complications, there was a statistically significant difference between the study and control groups. As contrast-induced kidney injury (CIKI) was notably reduced in the study group, dropping to (0%) post- two weeks compared to 6.2% in the control group, with significant p-values of (0.019) after 24 h and (0.047) post- two weeks. In addition, fever, chills, and chest pain were significantly lower in the study group. This finding may be attributed to the impact of nursing guidelines, including daily living modifications and precautions to avoid expected negative outcomes. These findings are supported by Mustafa and Hassan (2020), who concluded that subjects in the experimental category had lower physiological parameters than the controls.

This study has several limitations that warrant consideration when interpreting the findings. The relatively modest sample size may limit the generalizability of the results to broader populations, whereas the single-center design restricts external validity across different healthcare settings and patient demographics. The absence of randomization represents a notable limitation, as a non-randomized design may introduce confounding variables that could affect the reliability and validity of the findings. Potential selection bias may have influenced the composition of the study participants, as patients undergoing cardiac catheterization may not fully represent the general population at risk for CAD. Additionally, the cross-

sectional nature of this study precludes long-term follow-up, limiting our understanding of how the identified risk factors influence patient outcomes.

Conclusion

The study concluded that evidence-based nursing guidelines based on clinical practice are effective in improving clinical outcomes in patients who have undergone cardiac catheterization. Educational programs for nurses offering the latest information and best practices to enhance patient care can help improve self-care practices for this group of patients.

Healthcare institutions should integrate evidence-based clinical practice guidelines into routine care protocols for patients undergoing cardiac catheterization. Continuous professional development programs should be implemented to ensure that nurses remain updated on current best practices, enabling them to deliver high-quality, patient-centered care that promotes optimal recovery and self-care adherence.

Future studies should explore the long-term effects of guideline implementation on patient outcomes and identify the specific components of nursing interventions that contribute most significantly to improved clinical results.

Acknowledgments

The corresponding author sincerely thanks the patients who willingly participated in this study. Their trust and cooperation were invaluable in making this study possible. Special appreciation is extended to the colleagues and mentors whose guidance, feedback, and technical insights greatly contributed to the preparation of this manuscript. The author also confirms that no financial support, grant, or external funding was received for this study.

Decleration Of Generative Artificial Intelligence (AI) Use

During the preparation of this manuscript, the authors used ChatGPT-5.5 only for the purpose of enhancing the language quality and readability of this manuscript. This tool was not used to generate scientific content, analyze data, interpret results, or formulate conclusions. All AI-assisted output was critically reviewed, edited, and verified by the authors. The authors retain full intellectual responsibility for the accuracy, originality, and integrity of this manuscript, in accordance with the ethical publishing standards of Jurnal Ners.

Funding source

The first author provided financial support for the study.

Availability of data and materials

All datasets used and produced in this study are restricted due to ethical requirements, confidentiality concerns, and institutional guidelines. Only de-identified information may be shared by the corresponding author based on a reasonable request accompanied by ethical approval to safeguard participant privacy.

Authors' contributions

Mai Mohamed Ali: Conceptualization, Data collection, data analysis, Resources, writing -original draft, writing- reviewing, Editing, Hanan Sobieh Sobieh: Conceptualization, Supervision, project administration, Methodology, writing- reviewing, editing. Sara Fathy Mahmoud: Supervision, Visualization, Data Analysis, methodology, reviewing . Dena Mohamed Maarouf: Data interpretation, writing and drafting, investigation, reviewing and editing.

Declaration of Interest

There are no conflicts of interest.

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How to cite this article: Ali, M. M, Sobieh, H. S., Mahmoud, S. F., and Maarouf, D. M. (2026) 'Effect of Nursing Guidelines on Clinical Outcomes among Patients Undergoing Cardiac Catheterization', *Jurnal Ners*, 21(2), pp. 162-171. doi: http://dx.doi.org/10.20473/jn.v21i2.78167