

Effectiveness of a Nurse-Led Urinary Catheter Care Intervention on Catheter-Associated Urinary Tract Infection among Female Patients with Indwelling Urinary Catheters: A Pre-Experimental Study

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ABSTRACT

Background: Indwelling urinary catheters are frequently used in hospitalized patients for appropriate clinical indications but may increase the risk of catheter-associated urinary tract infection (CAUTI), particularly with prolonged catheterization. Nurses play an important role in maintaining urinary catheters and providing patients with education regarding safe catheter-care practices. **Objective:** This study aimed to evaluate the effectiveness of a nurse-led urinary catheter care intervention on catheter-care knowledge and CAUTI-related outcomes among female patients with indwelling urinary catheters. **Methods:** A quantitative research approach with a pre-experimental one-group pre-test-post-test design was adopted. The study was conducted among 100 adult female patients with indwelling urinary catheters in a selected hospital in Odisha, India, from February 01, 2026, to April 30, 2026. Participants were selected using a non-probability convenience sampling technique. Data were collected using a structured tool comprising sociodemographic and clinical characteristics, a structured questionnaire assessing knowledge regarding urinary catheter care, and a CAUTI assessment record. Participants received a structured nurse-led educational intervention covering hand hygiene, catheter and perineal hygiene, maintenance of the closed drainage system, drainage-bag positioning, prevention of kinking and obstruction, avoidance of unnecessary catheter manipulation, recognition of warning signs, and timely review of the continuing need for catheterization. Pre-test and post-test knowledge scores were compared using a paired *t*-test. **Results:** The mean catheter-care knowledge score increased from 12.36 ± 3.42 in the pre-test to 18.74 ± 2.61 in the post-test, with a mean improvement of 6.38 points. The paired *t*-test demonstrated a statistically significant improvement in knowledge ($t = 18.52, P < 0.001$). Regarding CAUTI status, 20 (20%) participants were classified as CAUTI-positive before the intervention, compared with 8 (8%) after the intervention. The proportion classified as CAUTI-negative increased from 80 (80%) to 92 (92%), representing a 12%-point reduction in the observed proportion of CAUTI-positive participants. **Conclusion:** The nurse-led urinary catheter care intervention was associated with a significant improvement in catheter-care knowledge and a reduction in the proportion of participants classified as having CAUTI after the intervention. The findings support structured nurse-led patient education as a component of comprehensive urinary catheter-care and infection-prevention practices. However, because the study used a one-group pre-experimental design without a control group, the observed change in CAUTI status cannot be attributed solely to the intervention.

Keywords: Catheter care, Catheter-associated urinary tract infection, Female patients, Infection prevention, Knowledge, Nurse-led intervention, Patient education, Urinary catheter

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INTRODUCTION

Indwelling urinary catheterization is a common intervention used in hospitalized patients for appropriate clinical indications such as urinary retention, selected perioperative conditions, accurate monitoring of urine output, and management of specific urinary problems. Although urinary catheters provide important clinical benefits, their use is associated with an increased risk of catheter-associated urinary tract infection (CAUTI), particularly when catheterization is unnecessary or prolonged.^[1-3]

CAUTI remains an important healthcare-associated infection and can result in additional discomfort, prolonged hospitalization, increased healthcare costs, and antimicrobial exposure. The risk of infection is influenced by the duration of catheterization and the quality of catheter insertion and maintenance practices.^[1,2]

Prevention of CAUTI requires a comprehensive approach that includes appropriate catheter indication, hand hygiene, aseptic technique, maintenance of a closed drainage system, unobstructed urine flow, correct positioning of the drainage bag, avoidance of unnecessary catheter manipulation, and prompt removal when the catheter is no longer required.^[1-3]

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Nurses have a central role in catheter maintenance because they frequently assess the catheter, monitor urinary drainage, provide hygiene care, identify complications, educate patients, and communicate concerns to the healthcare team. Nurse-led education can reinforce appropriate catheter-care practices and encourage patients to participate safely in their care.^[4,5]

Patient knowledge is particularly important when the catheter remains in place for several days. Patients may require simple and consistent information regarding hand hygiene, catheter handling, drainage-bag positioning, avoidance of pulling or unnecessary manipulation, and symptoms that should be reported promptly.

Therefore, the present study was undertaken to evaluate the effectiveness of a structured nurse-led urinary catheter care intervention on catheter-care knowledge and CAUTI-related outcomes among female patients with indwelling urinary catheters.^[6,7]

Objectives

The objectives of the study were:

1. To assess the pre-test level of knowledge regarding urinary catheter care among female patients with indwelling urinary catheters
2. To assess the post-test level of knowledge regarding urinary catheter care after the nurse-led educational intervention
3. To determine the effectiveness of the nurse-led urinary catheter care intervention by comparing pre-test and post-test knowledge scores
4. To assess the occurrence of CAUTI before and after the intervention
5. To determine the association between pre-test catheter-care knowledge and selected sociodemographic and clinical variables.^[8,9]

METHODS

Research Design

A quantitative research approach with a pre-experimental one-group pre-test–post-test design was adopted.

Design: $O_1 \rightarrow X \rightarrow O_2$

Where O_1 represented the pre-test assessment, X represented the nurse-led urinary catheter care intervention, and O_2 represented the post-test assessment.

Setting and Period

The study was conducted among female patients admitted to a selected hospital in Odisha, India, from February 01, 2026, to April 30, 2026.

Participants and Sampling

The study included 100 adult female patients with indwelling urinary catheters. Participants were selected using a non-probability convenience sampling technique.

Inclusion criteria

Female patients who:

- Were aged 18 years or above;
- Had an indwelling urinary catheter;
- Were willing to participate;
- Were able to understand the language used for data collection;
- Provided written informed consent; and
- Were available for pre-test and post-test assessment.

Table 1: Sociodemographic and clinical characteristics of participants (n=100)

Variable	Category	n (%)
Age	18–30 years	21 (21)
	31–45 years	28 (28)
	46–60 years	29 (29)
	>60 years	22 (22)
	Marital status	
Marital status	Married	71 (71)
	Unmarried	15 (15)
	Widowed	11 (11)
	Divorced/separated	3 (3)
Education	Illiterate	19 (19)
	Primary	23 (23)
	Secondary	29 (29)
	Higher secondary	17 (17)
	Graduate and above	12 (12)
Residence	Rural	62 (62)
	Urban	38 (38)
Occupation	Homemaker	58 (58)
	Employed	18 (18)
	Self-employed	9 (9)
	Other	15 (15)
Catheter duration	<3 days	27 (27)
	3–7 days	48 (48)
	>7 days	25 (25)
Catheter indication	Perioperative/operative	39 (39)
	Urinary retention	27 (27)
	Urine-output monitoring	21 (21)
	Other	13 (13)
Previous UTI	Yes	31 (31)
	No	69 (69)

UTI: Urinary tract infection

Table 2: Comparison of catheter-care knowledge scores

Assessment	Mean±standard deviation	Mean difference	Paired t	P-value
Pre-test	12.36±3.42	6.38	18.52	<0.001
Post-test	18.74±2.61			

Table 3: CAUTI status before and after the intervention

CAUTI status	Pre-intervention (%)	Post-intervention (%)
CAUTI present	20 (20)	8 (8)
CAUTI absent	80 (80)	92 (92)
Total	100 (100)	100 (100)

CAUTI: Catheter-associated urinary tract infection

Exclusion criteria

Patients who were clinically unstable, had severe cognitive or communication difficulties, had previously participated in the same educational program, or were unavailable for post-test assessment were excluded.

Data Collection Instruments

A structured data-collection tool consisted of three sections.

- Section A: Sociodemographic and clinical characteristics, including age, marital status, education, residence, occupation, monthly income, admission type, duration and indication of catheterization, previous urinary tract infection, and recurrent urinary symptoms
- Section B: A structured questionnaire assessing knowledge regarding urinary catheter care, including hand hygiene, perineal care, maintenance of the closed drainage system,

drainage-bag positioning, prevention of obstruction and unnecessary manipulation, warning signs, and timely catheter review and removal

- Section C: A CAUTI assessment record containing relevant clinical, catheter-related, and microbiological information.

Intervention

The nurse-led intervention consisted of structured education regarding:

- Appropriate urinary catheter care;
- Hand hygiene;
- Perineal and catheter hygiene;
- Maintaining a closed drainage system;
- Avoiding unnecessary disconnection and manipulation;
- Maintaining unobstructed urine flow;
- Keeping the drainage bag below bladder level;
- Avoiding kinking and dependent loops;
- Recognizing warning signs and urinary symptoms; and
- Timely reporting and review of the continuing need for catheterization.

Data Collection Procedure

After obtaining ethical and administrative permission, eligible participants were identified and informed consent was obtained. Baseline sociodemographic and clinical information and pre-test knowledge were assessed. The structured nurse-led catheter-care intervention was then provided. Post-test knowledge and CAUTI-related outcomes were subsequently assessed according to the study protocol.

Ethical Considerations

Ethical approval was obtained from the concerned authority. Written informed consent was obtained from all participants. Participation was voluntary, confidentiality was maintained, and participants were informed of their right to withdraw without affecting their treatment.

Statistical Analysis

Data were analyzed using frequency, percentage, mean, and standard deviation. A paired *t*-test was planned for comparison of pre-test and post-test knowledge scores where appropriate. Chi-square testing was used to examine associations between baseline knowledge and selected variables when assumptions were satisfied. A $P < 0.05$ was considered statistically significant.

RESULTS

Most participants were aged 31–60 years, were married, lived in rural areas, and were homemakers. Nearly half of the participants had an indwelling catheter for 3–7 days. Perioperative/operative indications represented the largest category of catheter use (Table 1).

Interpretation

The results showed an increase in the mean catheter-care knowledge score from 12.36 ± 3.42 in the pre-test to 18.74 ± 2.61 in the post-test, with a mean improvement of 6.38 points. The paired *t*-test value was 18.52 ($P < 0.001$) (Table 2).

The Table 3 shows that 20 (20%) participants were classified as having CAUTI before the intervention, whereas 8 (8%) participants were classified as having CAUTI after the nurse-led urinary catheter care intervention. The proportion of participants without CAUTI increased from 80 (80%) before the intervention to 92 (92%) after the intervention. Overall, the findings indicate a 12%-point reduction in the proportion of participants classified as CAUTI-positive following the intervention.

DISCUSSION

The present study evaluated the effectiveness of a nurse-led urinary catheter care intervention among 100 female patients with indwelling urinary catheters. The study focused on catheter-care knowledge and CAUTI status before and after the intervention.

The findings demonstrated an improvement in participants' catheter-care knowledge following the nurse-led intervention. The mean knowledge score increased from 12.36 ± 3.42 in the pre-test to 18.74 ± 2.61 in the post-test, with a mean difference of 6.38 points. The paired *t*-test value of 18.52 with $P < 0.001$ indicates a statistically significant improvement in knowledge after the intervention. This finding suggests that structured and focused nursing education can improve patients' understanding of important catheter-care measures, including hand hygiene, catheter hygiene, drainage-bag positioning, prevention of obstruction, avoidance of unnecessary manipulation, and recognition of warning signs.

The improvement in knowledge may be related to the direct and structured nature of the nurse-led educational intervention. Nurses have regular contact with hospitalized patients and are therefore in a suitable position to provide repeated explanations, demonstrate appropriate catheter-care practices, clarify misconceptions, and encourage patients to report urinary symptoms promptly. Better patient understanding may also support greater participation in safe catheter maintenance.

A reduction in CAUTI status was also observed following the intervention. Before the intervention, 20 (20%) participants were classified as having CAUTI, whereas after the intervention, 8 (8%) participants were classified as having CAUTI. The proportion without CAUTI increased from 80 (80%) to 92 (92%). Thus, a 12%-point reduction in the proportion classified as CAUTI-positive was observed after the intervention.

The observed reduction in CAUTI was consistent with the principle that appropriate catheter maintenance and prevention practices are important components of CAUTI prevention. Measures such as maintaining a closed drainage system, preventing obstruction and kinking, keeping the drainage bag below bladder level, avoiding unnecessary manipulation, maintaining hygiene, and reviewing the continued need for catheterization are important elements of safe urinary catheter management.

However, the reduction in CAUTI should be interpreted cautiously because the present study used a pre-experimental one-group pre-test-post-test design without a control group. Therefore, the observed change cannot be attributed exclusively to the nurse-led intervention. Other factors, including duration of catheterization, underlying illness, catheter indication, antimicrobial treatment, institutional infection-control practices, and changes in patient condition, may also have contributed to the observed outcome.

Overall, the findings indicate that the nurse-led urinary catheter care intervention was associated with improved

catheter-care knowledge and a lower proportion of participants classified as having CAUTI after the intervention. The findings support the importance of structured patient education as one component of comprehensive urinary catheter-care and infection-prevention practices.

CONCLUSION

The present study concluded that the nurse-led urinary catheter care intervention was associated with a significant improvement in catheter-care knowledge among female patients with indwelling urinary catheters. The mean knowledge score increased from 12.36 ± 3.42 in the pre-test to 18.74 ± 2.61 in the post-test, indicating improved understanding of essential catheter-care practices.

A reduction in the proportion of participants classified as having CAUTI was also observed, from 20% before the intervention to 8% after the intervention. These findings highlight the importance of structured nurse-led education and appropriate catheter-care practices in supporting safe urinary catheter management.

As the study used a one-group pre-experimental design without a control group, the observed reduction in CAUTI cannot be attributed solely to the intervention. Further controlled studies with larger and more diverse samples are recommended to establish the effectiveness of nurse-led catheter-care interventions more conclusively.

Limitations

1. The study used a one-group pre-experimental design without a control group
2. Convenience sampling may limit generalizability
3. The study was conducted in a single hospital
4. Only female patients were included
5. The study period was relatively short
6. CAUTI occurrence may have been affected by clinical and institutional factors other than the intervention
7. Knowledge improvement may not necessarily reflect actual catheter-care behavior.^[10,11]

Implications

Implications for nursing practice

The findings indicate that structured nurse-led education can improve patients' understanding of urinary catheter care. Nurses should provide clear and consistent education regarding hand hygiene, catheter and perineal hygiene, drainage-bag positioning, prevention of kinking and obstruction, avoidance of unnecessary catheter manipulation, and recognition of symptoms requiring medical attention. Regular assessment of the continuing need for catheterization and prompt communication with the healthcare team may further support safe catheter management and CAUTI prevention.

Implications for nursing education

Urinary catheter care and CAUTI prevention should be emphasized in nursing education through classroom teaching, demonstrations,

clinical practice, and skill-based learning. Nursing students may be provided with opportunities to develop competency in appropriate catheter maintenance, infection-prevention measures, patient education, and early recognition of catheter-related complications.

Implications for nursing research

The findings provide a basis for further nursing research on nurse-led catheter-care interventions. Future researchers may conduct studies using larger samples, control groups, randomized or quasi-experimental designs, longer follow-up periods, and standardized CAUTI surveillance measures. Research may also examine catheter-care practices in addition to knowledge outcomes.

Implications for nursing administration

Nursing administrators can support standardized urinary catheter-care practices by developing institutional protocols, conducting regular staff training, maintaining catheter-care checklists, and organizing periodic audits. Monitoring catheter utilization, duration of catheterization, and CAUTI indicators may help identify areas requiring improvement in infection-prevention practices.

Implications for patients and caregivers

Patients and caregivers should be provided with simple, understandable instructions regarding safe urinary catheter care. Education should emphasize hand hygiene, avoiding unnecessary handling or pulling of the catheter, maintaining proper drainage-bag position, preventing kinking of the tubing, and promptly reporting fever, pain, abnormal urine, leakage, or other concerning symptoms. Active patient and caregiver participation may support continuity of safe catheter-care practices during hospitalization and after discharge when applicable.

Recommendations

1. Similar studies may be conducted using a quasi-experimental or randomized controlled design
2. Future studies may include larger samples and multiple hospitals
3. Studies may include both male and female patients
4. Future research should assess catheter-care practices in addition to knowledge
5. CAUTI should be monitored using standardized surveillance definitions and catheter-day measures where feasible
6. Longer follow-up may be used to determine whether improvements are sustained
7. Future studies may evaluate the feasibility and cost-effectiveness of nurse-led catheter-care programs.^[12,13]

ETHICAL APPROVAL

Ethical approval was obtained from the concerned institutional authority before commencement of the study.

INFORMED CONSENT

Written informed consent was obtained from all participants.

AUTHOR CONTRIBUTION

The author contributed to the conception and design of the study, data collection, analysis, interpretation, manuscript preparation, and revision.

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