






Improving Nurses' Knowledge about Prevention of Catheter Acquired Urinary Tract Infections in Intensive Care Units

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Abstract

Edited by: Sasho Stoleski
Citation: Abdelmoaty AM, Abdelghany EO, Soliman M, Kenawy AM, Saleh DA. Improving Nurses' Knowledge about Prevention of Catheter Acquired Urinary Tract Infections in Intensive Care Units. Open Access Maced J Med Sci. 2022 Feb 27; 10(E):638-642. https://doi.org/10.3889/oamjms.2022.8674
Keywords: Egypt; Urinary catheterization; Infection control; Nursing; Intensive care units; Education
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Received: 18-Jan-2022
Revised: 03-Feb-2022
Accepted: 17-Feb-2022
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Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist
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BACKGROUND: Lack of knowledge about causes and strategies to prevent catheter-acquired urinary tract infections (CAUTIs) requires an intervention that focuses on providing all evidence-based information to decrease the incidence of CAUTIs in admitted intensive care units (ICU) patients. Improving the nurses' knowledge will eventually help in the reduction of CAUTIs.

AIM: We aimed to investigate the improving nurses' knowledge about prevention of catheter acquired urinary tract infections in intensive care units.

METHODS: The present study is a health system-operational research, pre-test–post-test design with a control arm study. The study was conducted in two ICU units in one of the University hospitals, Cairo, Egypt, involving a total sample of 42 nurses. Self-administered questionnaires were used to assess nurses' knowledge about CAUTIs. The intervention was implemented through on job educational training sessions to nursing staff. Cochran Q was used to test the effect of the intervention on a satisfactory level of knowledge.

RESULTS: Knowledge score improved from 61.4 ± 14.1 in pre-test to 90.5 in the early post-test (EP) test done after 1 week to 91.3 in late post-test (LP) done after 1 month among nurses of the intervention ICU ($p < 0.001$). The percentage of nurses reporting a satisfactory level of knowledge significantly increased from 13.3% in the pre-test to 90% and 93.3% in follow-up (EP and LP, respectively) in the intervention ICU ($p < 0.05$)

CONCLUSION: The implemented training and education strategy used were effectively improved ICU nurses' knowledge concerning CAUTI.

Introduction

Healthcare-associated infections (HAIs) are fundamental causes of morbidity and mortality in developing countries. A hospital environment encourages certain infections to develop as contaminated medical instruments, untrained healthcare professionals, unclean hospital environment, and lack of clear infection control guidelines contribute to developing the HAIs. The prevalence of HAIs is 10–30% in developing countries and 5–10% in developed countries [1].

Indwelling devices, such as urinary catheters, raise the risk of critically ill patients. Catheter-associated urinary tract infection (CAUTI) is one of the most widespread device-related HAIs, accounting for more than 30% of hospital infections [2]. During hospitalization, from 10% to 25% of patients may receive indwelling urinary catheters, of whom 20% suffer from urinary tract infection. The daily risk of acquisition of urinary infection varies from 3% to 7% when an indwelling urinary catheter remains in place. Around 50% of patients are infected after 15 days of installation of the catheter, and almost 100% of them are infected after 1 month [3].

UTIs account for more than 12% of reported infections in US acute care facilities. More than 67% of these identified UTIs were linked with indwelling urinary catheters [4], [5].

The incidence of CAUTI varies significantly according to the type of hospital setting and ICU [6]. In Egypt, prospective surveillance was conducted from April 2011 to March 2012 in 46 ICUs from 11 hospitals. Of 472 HAIs identified, 47% were pneumonia, 22% were bloodstream infections, and 15% were urinary tract infections [5].

HAIs reflect a multifaceted problem that requires a multifaceted approach to solve [7]. According to evidence-based studies, incorporating care bundles are critical to preventing HAIs in intensive care units and reducing mortality and morbidity rates [8]. Evidence-based interventions focus on adapting the best practices using patient safety improvement programs as an approach to increased awareness and compliance [9].

Infection control practices are essential for nurses. Nurses have a unique opportunity to reduce the likelihood of HAIs [10].

Nurses are the primary providers of infection control-related patient education [11]. Recent studies have identified the knowledge gap between nurses, particularly in monitoring the need for infection control-related patient education, and their reluctance to remove the catheter as soon as it is no longer required in some healthcare facilities [12].

The importance of education is that it is the key to quality patient care. Nurses who have continuous training in best practice become the forming backbone of quality patient care and the health care organizations. Frontline nursing staff plays a key role in positive outcomes related to an indwelling urinary catheter. Evidence-based education plays a significant role in patient outcomes and decreased CAUTI rates [13]. We aimed to investigate the improving nurses' knowledge about prevention of catheter acquired urinary tract infections in intensive care units.

Methods

Study hypothesis

The introduction of educational training to intensive care units would improve nurses' knowledge about urinary catheterization and daily care.

Study design

The present study is a health system-operational research, an intervention study pre-test, and post-test design with a control arm. This study was conducted in two selected intensive care units that reported the highest CAUTI rates in one of the University Hospitals in Cairo, Egypt. The highest priority unit was selected as the intervention ICU, and the second-highest priority unit was selected as the control ICU. These two units were selected conveniently according to the hospital's administration approval. This study was conducted for 20 months, from July 2018 to March 2020. In health-system operational research, routinely collected data are used to determine methods of delivering more effective, efficient, and equitable health services [12].

Study sample

A total sample of nurses was collected. All nurses working force in both ICUs were included in the study: 30 nurses in the intervention ICU and 12 nurses in the control ICU.

Study tools/instruments

Assessment of knowledge among nurses was done using a standardized self-administered questionnaire. The knowledge questions were summarized into six domains adopted and modified from CDC CAUTI guidelines and Abdelmoaty *et al.* questionnaire after the authors' permission [14], [15], [16]. The questionnaire consisted of 46 MCQs, true or false, and enumerated questions (46 questions). It included these six domains:

- a) General knowledge about IC activities (five questions)
- b) Specific knowledge about urinary catheter infections (seven questions)
- c) Knowledge about urinary catheter insertion (12 questions)
- d) Knowledge about daily catheter care (maintenance) (nine questions)
- e) Knowledge about urinary bag care (ten questions)
- f) Knowledge about components of CAUTI bundle and documentation (three questions).

Study phases and data collection

The study was conducted over three phases:

- Phase 1: Baseline pre-intervention assessment
- Phase 2: Study intervention
- Phase 3: Follow-up post-intervention assessment

The selected ICUs were visited four times per week, and all nurses were approached during the morning and afternoon shifts, where the purpose and nature of the study were explained. The researcher was available at the study ICUs when filling the data collection sheet to answer any questions and provide the needed explanations. Filling this sheet required about 15–20 min from each nurse. Nurses' knowledge was assessed using a standardized self-administered questionnaire to test knowledge about infection control policies focusing on urinary catheter insertion steps and daily care and provide baseline data to tailor the intervention package accordingly.

The intervention package included in the study:

1. Four educational face-to-face sessions were conducted to train nurses (around ten nurses in each session, each lasting for 45 min) on principles of infection control regarding urinary catheter insertion and daily care through a PowerPoint presentation and educational videos followed by an early post-test assessment (EP test) using the same questionnaire.
2. There were ten job training sessions, with support and monitoring conducted in small groups (2–3 nurses).

Both ICUs were assessed at recruitment (pre-test) immediately after recruitment (early post-test [EP test]), then assessed 1 month after recruitment (late post-test [LP test]).

Statistical analysis

All collected questionnaires were revised for completeness and consistency. Pre-coded data were entered into the Statistical Package of the Social Science Software program, version 23 (SPSS), to be statistically analyzed.

Quantitative data were examined for normality distribution using the Kolmogorov–Smirnov test. Data were summarized using mean and standard deviation (SD) for normally distributed quantitative variables and median and interquartile ranges (IQR) for non-normally distributed quantitative variables. In contrast, numbers and percentages were used to summarize qualitative variables. Cochran Q test was used to test the effects of the intervention on qualitative variables. If a statistically significant difference was detected, *post hoc* analysis (with the McNemar test) was conducted with a Bonferroni correction applied.

Scoring system of knowledge

Total scores < 70% were considered unsatisfactory, and scores of 70%–100% were considered satisfactory.

Ethical considerations

All the studied participants were treated according to the Helsinki Declaration of biomedical ethics. Consent was obtained after demonstrating the study's objectives, data confidentiality, and study impact. The study protocol and tools used in data collection were revised and approved by the ethical committee of Kasralainy Faculty of Medicine (D-2-2020).

Results

The mean age of nurses was 37.5 and 32.1 years in the intervention and control units, respectively (Table 1). Nurses and high nurses constituted the working force with 86.7% and 13.3% in the intervention unit, and 83.3% and 16.7% in the control unit. All nurses of the control ICU were previously employed in different ICUs before starting to work in the current ICU, and 91.7% of them had attended previous infection control courses with a statistically significant difference between them and those of the intervention ICU ($p = 0.04$ and

Table 1: Sociodemographic characteristics of nurses working in the selected intensive care units

Variables	Intervention ICU (n = 30)	Control ICU (n = 12)	p
Age			
Mean \pm SD	37.5 \pm 11	32.1 \pm 11.1	0.21
Median (IQR)	39 (25–48)	26 (23.5–43.5)	
Sex, n (%)			
Female	26 (86.7)	10 (83.3)	1
Male	4 (13.3)	2 (16.7)	
Qualifications, n (%)			
High nurse	4 (13.3)	2 (16.7)	1
Nurse	26 (86.7)	10 (83.3)	
Previous employment and IC background, n (%)			
Had previous employment	21 (70)	12 (100)	0.04
Attended IC courses	5 (16.7)	11 (91.7)	< 0.001
Studied IC during high education	20 (66.7)	11 (91.7)	0.13
Experience (years), n (%)			
<5	8 (42.1)	4 (33.3)	0.18
6–10	0	2 (16.7)	
11–15	0	0	
>15	11 (57.9)	6 (50)	

IC: Intensive care, ICU: IC units, SD: Standard deviation, IQR: Interquartile range

< 0.001, respectively). The percentage of nurses with experience of more than 15 years was higher in the intervention unit, 57.9%, compared to the control unit, 50% (Figure 1).

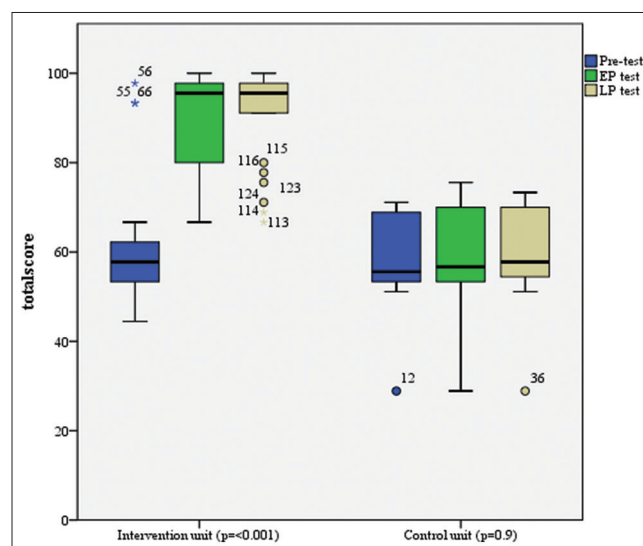


Figure 1: Total knowledge score at baseline, early and late follow-up among studied nurses in intervention and control ICUs

A significant improvement was observed in the total knowledge score and scores of the individual domains among nurses in the intervention ICU compared to the control ICU. In the intervention ICU, the total knowledge and individual domain scores showed a statistically significant improvement between the baseline and early and late follow-ups, while there was no significant improvement between the early and late follow-up scores. In the control ICU, there was no statistically significant improvement in the total knowledge scores of nurses ($p > 0.05$) (Table 2).

Baseline data showed that nurses had a high knowledge gap in steps and importance of urinary catheter daily care, urinary bag care, and urinary catheterization documentation. Following the intervention, the percentage of nurses reporting a satisfactory level of

Table 2: Nurses reporting satisfactory level of knowledge during the baseline and follow-up assessment in both units

Domains of knowledge	Intervention unit				p	Post hoc test	Control unit			
	Pre-test (n = 30), n (%)	EP test (n = 30), n (%)	LP test (n = 30), n (%)				Pre-test (n = 12), n (%)	EP test (n = 12), n (%)	LP test (n = 12), n (%)	p
A-infection control activities	12 (40)	25 (83.3)	24 (80)		0.001	P ¹ 0.004 P ² 0.08 P ³ 1	2 (16.7)	3 (25)	5 (41.7)	0.2
B-urinary catheter infections	10 (33.3)	29 (96.6)	29 (96.6)		< 0.001	P ¹ < 0.001 P ² < 0.001 P ³ 1	3 (25)	3 (25)	3 (25)	1
C-urinary catheter insertion	12 (40)	25 (83.3)	29 (96.6)		< 0.001	P ¹ 0.007 P ² < 0.001 P ³ 0.1	4 (33.3)	4 (33.3)	2 (16.7)	0.6
D-urinary catheter care	7 (23.3)	28 (93.3)	28 (93.3)		< 0.001	P ¹ < 0.001 P ² < 0.001 P ³ 1	5 (41.7)	3 (25)	6 (50)	0.3
E-urinary bag care	4 (13.3)	24 (80)	25 (83.3)		< 0.001	P ¹ < 0.001 P ² < 0.001 P ³ 1	0 (0)	1 (8.3)	0 (0)	0.3
F-CAUTI bundle and documentation	2 (6.6)	20 (66.6)	22 (73.3)		< 0.001	P ¹ < 0.001 P ² < 0.001 P ³ 1	0 (0)	0 (0)	1 (8.3)	0.3
Total	4 (13.3)	27 (90)	28 (93.3)		< 0.001	P ¹ < 0.001 P ² < 0.001 P ³ 0.6	2 (16.7)	3 (25)	3 (25)	0.1

P¹ between Pre-test and EP test, P² between pre-test and LP test, P³ between EP test and LP test. LP: Late post-test, EP: Early post-test, CAUTI: Catheter-acquired urinary tract infections

knowledge for all the knowledge domains increased significantly during follow-up (EP and LP) in comparison to the baseline assessment in the intervention ICU ($p < 0.05$). In contrast, there was no change in the percentage of nurses reporting a satisfactory level of knowledge in the control ICU ($p > 0.05$).

Discussion

Our study reported that knowledge among the nurses of the intervention unit improved after conducting CAUTI educational training. Consistent with our results, a study was done in a similar environment in one of Cairo University Hospitals by Abdelmoaty *et al.*, 2020, who reported that the nurses' median knowledge score had increased significantly after implementing CAUTI training [16]. Furthermore, in correspondence to our findings, a study performed by Yazici *et al.*, 2018, who reported that the baseline knowledge score of nurses improved after implementing educational training with a significant increase in knowledge ($p < 0.001$) [8]. This demonstrates the success of the planned adopted training strategy in the present study.

Our study comes in agreement with Mosbeh *et al.*; 2019, who reported that total knowledge scores improved after CAUTI bundle education in the ICUs of Beni-Suef University [17]. Another study performed by Mohammed and Hamza, 2019 in ICUs of a hospital in Iraq reported that nurses had a shallow satisfactory knowledge before intervention and significantly increased after educational sessions [18]. Another study in Egypt conducted by Abdel-Hakim and Hamza, 2018 implemented a urinary care bundle through teaching sessions for nurses at one of the Cairo University Hospitals. Knowledge level was significantly improved

by 80% [19].

Another study was carried out in the USA in 2018, where education sessions about proper urinary catheterization trained nurses improved their knowledge levels significantly [20].

As for nurses of the control unit, there was no statistically significant difference between Pre-test, EP test, and LP test in most domains of knowledge.

Study limitations

1. Nurses' resistance to being involved and educated at the beginning of the intervention. The rationale for compliance to the CAUTI bundle was emphasized, and the danger of non-compliance to themselves and patients was highlighted on several occasions.
2. The control ICU was followed up first for EP and LP tests to avoid exchanging information between staff if both ICUs followed up simultaneously. Then, the intervention started in the intervention ICU and was followed up sequentially for EP and LP tests, and it was very challenging as there was a fear of exchanging information in the control ICU.

Conclusion

Evidence-based training and education of nursing staff have succeeded in improving their knowledge level significantly. This highlights the significance of continuous training, supervision, and monitoring of nurses to ensure their compliance with urinary catheterization and daily care infection control guidelines.

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