

Effect of Implementing Indwelling Urinary Catheter Maintenance Care Nursing Guidelines on Catheter Associated Urinary Tract Infection Occurrence in Intensive Care Unit

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Abstract: Catheter Associated Urinary Tract Infection (CAUTI) is widespread Health Acquired Infection that influence patient's welfare and duration of hospitalization. **Aim:** Determine effect of implementing Indwelling Urinary Catheter (IUC) maintenance nursing care guidelines on CAUTI occurrence in intensive care unit (ICU). **Design:** A quasi-experimental design pretest and post-test phase was used. **Setting:** The study was conducted in ICU affiliated to Suez Canal University Hospital. **Tools:** Three tools utilized in this study; nurses' knowledge questionnaire regarding IUC maintenance nursing care guidelines, nurses' practice e observational checklist and patient observational assessment sheet. **Result:** The nurses total score for both knowledge and practice improved significantly after implementation of IUC maintenance nursing care guidelines (p-value= 000). Also, nurses' knowledge and practice founded to be correlated positively to each other during both pretest phase and post-test phase (p-value= .000, .006) respectively. Improving nurses' practice to more than one-fold result in decreasing CAUTI from decrease from 54.48 to 31.9 per 1000 catheter day. **Conclusion:** IUC maintenance nursing care guidelines enhance nurses' knowledge and practice and decrease CAUTI rate in Suez Canal University Hospital ICU.

Keywords: IUC maintenance nursing care guidelines, Nurses' knowledge and practice.

1. INTRODUCTION

Catheter Associated Urinary Tract Infection (CAUTI) is a widespread healthcare associated infection for both developed and developing countries with a great complication start from discomfort up to death. Moreover, CAUTIs result in significant cost escalation for individual hospitals as well as the healthcare system [1]. Centers for Disease Control and prevention (CDC) reported that CAUTI incidence resulting in 131 million dollars per year for treating uncomplicated cases with septicemia that would raise about \$2800 for every septic complicated case [2]. This cost become higher in the developing countries as a result of raising CAUTI rate 3-5 folds and development of multiple drug resistant bacteria [3], [4]. In Saudi Arabia, Oman, and Bahrain a survey study gathering this Arabian gulf nations reported that CAUTI incidence was 3.2 per 1,000 catheter days[5]. Regarding Egyptian hospitals, a national survey conducted through ninety-one ICUs CAUTI was reported to be 1.9/1000 urinary catheter day[6].

Fortunately, CAUTI is a preventable adverse outcome to Indwelling Urinary Catheterization (IUC). The first line and the most preventive method is avoidance of IUC insertion and early removal of unnecessary ones [7]. The second line is changing healthcare personal wrong beliefs and practices through enhancing perception of CAUTI preventive guidelines and patient safety culture. CAUTI guidelines are a set of precautions and steps to be used or a voided during IUC insertion, maintenance care and removal based on evidence-based practices.

Application of CAUTI preventive guidelines in developing countries are faced by many challenges differed according to many factors including socioeconomic status, shortage in some sterile medical supplies and non-availability of others, for example sterile catheterization kit, sample port, sterile gloves, and sterile single-use packet of lubricant jelly, availability of Infection Control (IC) qualifications, continuous educational programs and surveys and political accountability for negligence [3], [6], [8]–[10]. To overcome such challenges critical thinking and problem-solving management through ensuring frequent IC programs and guidelines education, proper use of the available supplies with avoidance of IUC insertion [3], [11].

Investigating effect of CAUTI preventive guidelines application in Egypt is recommended by a study affiliated to International Nosocomial Infection Control Consortium (INICC) [4]. According to that the current study was conducted

STUDY AIM:

The aim of the current study is to determine effect of implementing indwelling urinary catheter maintenance care nursing guidelines on catheter associated urinary tract infection occurrence in intensive care unit.

RESEARCH HYPOTHESIS:

The research hypothesis of the current study was supposed to raise total knowledge scores and practice of nurses who will be exposed to the IUC maintenance nursing care educational guidelines of than their pre total knowledge and practice score. And the post occurrence rates of CAUTI to ICU patient will be lower than the pre score

2. SUBJECT AND METHODS

STUDY DESIGN

A quasi-experimental was conducted in ICU at Suez Canal University Hospital (SCUH) in Ismailia Governorate through six-month period from October 2018 to March 2019..

SUBJECT

The study sample composed of nurses and ICU patient sample.

THE NURSES SAMPLE:

The nurses calculated through sample size to be 19 nurses, but we have to raise our sample to be 33 to suit the nature of the study and increase efficacy of the results (23 females and 10 males) had accepted to participate in the study and completed all study phases. The sample size for nurses was calculated according to the following equation: $N = (Z_{\alpha})^2 \times p \times q / d^2$ Where: n = sample size. Z_{α} = the value of standard normal distribution for type I error probability for the sided test and equals 1.96. p = Satisfactory knowledge to identify all the measures for prevention of CAUTI = 57%. $q = 1 - p$, d^2 = the accuracy of estimate = 0.05. So, according to the calculations the sample size = 19 nurses.

THE PATIENTS' SAMPLE

The patient's sample were a purposive sample of all eligible adult patients for the study criteria during study for two consecutive months for each period (assessment pretest phase and post-intervention phase). The including criteria were adult patients having the IUC from 2 days at least either present or have been removed from two days. The exclusion criteria were having signs and symptoms of Urinary Tract Infection (UTI) on ICU admission, suprapubic catheter and a childhood patient. The total number of patients during pretest group were 47 patients and post-test group 45 patients.

DATA COLLECTION:

Data collection was done through three phases; assessment pre-test phase, intervention phase and evaluation phase.

i. ASSESSMENT PRE-TEST PHASE:

The first phase (assessment pre-test phase) was concerned with evaluating current preintervention nurses knowledge and practice and CAUTI occurrence rate through three tools nurses' knowledge assessment questionnaire, nurses' practice checklists regarding IUC maintenance nursing care guidelines, and patient assessment sheet, that was developed by the researcher based on the relevant literatures.

TOOL I: NURSES' ASSESSMENT QUESTIONNAIRE SHEET

Nurses' assessment questionnaire sheet (tool I) was developed by the researcher in Arabic form to suit the nature of the study after reviewing [1], [12]–[16]. It consisted of two parts; the first part was applied only in the pretest phase. It was concerned with the nurses' profile of; age, sex, marital status, education level, years of experience, previous IC courses, previous CAUTI prevention courses and nurses' perception of SCUH-ICU IC policies regarding CAUTI; surveillance, preventive strategies and IUC removal.

The second part was concerned with assessing the studied nurses' knowledge about IUC maintenance nursing care guidelines involved two parts; theoretical part included; general IC definitions and measures, anatomy and physiology, urinary tract infection, CAUTI, and diagnosis and management of CAUTI. And practical part included; daily maintenance care, IUC irrigation, collection of culture urine sample and documentation. This tool was filled by nurses and took about 30 minutes to be completed.

Scoring system of nurses' knowledge was as following; the total number of questions were (59). Most of them had one answers and some had a group of correct answers, each correct answer was given a score of one (1) and the incorrect (0). The total score of the knowledge was 74 grades. These scores were converted into a percent score. Knowledge was considered satisfactory if the percent score was 75% or more and unsatisfactory if less than 75%. The reliability of the evaluating tools was measured by Cronbach's α (alpha). The reliability of each; nurses' knowledge tool exceeded the acceptable level (0.7 standards),

TOOL II: NURSES' PRACTICE CHECKLISTS

Nurses' practice was observed through an observational checklist practice during daily researcher rotation, through different shifts (morning, afternoon and evening) to be able to collect data from some fixed nurses to specific shift. Nurses' practice checklists regarding IUC maintenance nursing care guidelines included three parts. The first part was daily maintenance care, was adopted from Lo et al about "Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute Care Hospitals: 2014 Update", for assessing the nurses' practice level [17]. The second part was urine culture specimen collection checklist for assessing the nurses' practice technique of urine culture sample collection without using IUC access port through injecting the IUC drainage port itself was adopted from [18]–[20]. The third part was IUC irrigation checklist, for assessing the nurses' practice open IUC irrigation that was the only type present according to available unit supplies. It was adopted from [21].

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TOOL III: PATIENT ASSESSMENT SHEET

Assessment of CAUTI occurrence rate included; adult patients admitted to ICU who have been catheterized with IUC form more than two days were monitored daily for signs and symptoms of CAUTI and only symptomatic cases were ordered urine culture to confirm CAUTI diagnosis [18], [22]–[24]. Urine cultures were done either in SCUH or a private lab if not ordered in SCUH. CAUTI diagnosis criteria for conscious patients according to CDC 2018 included patients who had at least one of this signs and symptoms; fever above 38°, suprapubic or costovertebral tenderness, dysuria, urinary urgency without a definite cause, or frequency, and to have a positive urine culture to confirm diagnosis.

International Journal of Novel Research in Healthcare and Nursing

Vol. 6, Issue 3, pp: (524-536), Month: September - December 2019, Available at: www.noveltyjournals.com

For old age ICU patients above 65 years old or unconscious patients, the diagnosis was based primarily on the results of fever and altered mental status and also confirmed by microbiological cultures [25]. In addition, all criteria of CAUTI must be involved within seven days, three days before the first positive urinary culture and three days after [26]. Besides that, consider transferring role as if the date of event is on the date of transfer or a day after, this would be attributed to ICU. To avoid double counting of the same infection CDC recommended counting fourteen days after date of event [26]. The (tool II)I was tested for its reliability by Cronbach's α (alpha) that was excellent (0.92).

ii. INTERVENTION PHASE:

The second phase (intervention phase) included implementation of IUC maintenance nursing care guidelines educational sessions based on relevant literature [14], [17], [21], [27], [28]. The educational sessions total hours were 7 hours and 45 minutes. Nurses were provided these sessions in SCUH Staff Development and Training Center.

The IUC maintenance nursing care guidelines educational sessions divided to theoretical and practical session. The theoretical sessions were 4 sessions each one lasted for one hour. During the theoretical training sessions, the researcher used Arabic, brief, and clear words. Regarding to teaching methods that have been used included; lecture, discussion, and flip chart, through this media; power point presentation, videos, and booklet.

The practical sessions were 7 sessions each one lasted for thirty minutes. Through the practical sessions' nurses were able to demonstrate the demonstrated skill, for example establishing sterile field, aspirate culture urine sample, irrigate IUC and removing IUC properly. The educational booklet was given to the ICU nurses to allow them reviewing training knowledge and skills at home and to remind them if any knowledge was missed.

iii. EVALUATION PHASE

This phase was concerned with evaluating effectiveness of IUC maintenance nursing care guidelines educational sessions through reassessing nurse's knowledge and practice using tool I and II and CAUTI occurrence rate using tool III.

STATISTICAL ANALYSIS:

Statistical Package of Social Services Version 20 (SPSS) was used to analyze collected data [29]. Data was analyzed for variance using t test, to test significance difference of parametric variable and Man Whitney test for nonparametric variables at confidence interval 95% to determine P-value less than 0.5.

TESTING CONTENT VALIDITY:

It was established by a jury of seven expertise (three Medical Surgical Nursing professors, two physicians in Anesthesia and ICU Medicine and two ICU head nurse) who reviewed the assessment tools and CAUTI preventive educational guidelines program for clarity, relevance comprehensiveness, understanding, applicability, and easiness for administration. necessary modifications were performed.

PILOT STUDY:

A pilot study was conducted on 10% of nurses and 10% of patients on ICU to check and ensure the clarity, applicability, relevance and feasibility of the tools, to identify the difficulties that, may be faced during the application. According to the results of the pilot study, some items were modified, omitted and added. Nurses and patients who participated in the pilot study were excluded from the main study sample.

ADMINISTRATIVE DESIGN AND ETHICAL CONSIDERATION

To carry out this study, official permission was obtained from the directors of SCUH. This was done by submission of a formal letter from the Vice Dean for Graduate Studies and Research of the Faculty of Nursing to them explaining the objectives of the study. The director of SCUH resent study formal letter to both ICU coordinators and Staff Development and Training Unit for cooperation. Meeting and discussion were held between the researcher and ICU managers and nursing administrative personnel to make them aware about the aim of the study and objectives of the research, as well as to get better cooperation.

At the initial interview, each nurse and patient were informed about the nature, purpose and benefits of the study and informed that, his/her participation was voluntary. Confidentiality and anonymity of the subjects were also assured through coding of all data. The researcher assured that, the data collected, and information would be confidential. A written consent was obtained after explanation of the purpose of the study

3. RESULTS

Through the current study, the studied ICU nurses' demographic data represented the following; nurses age group was 21-25 years for 78.7% of them with mean age 24.58 ± 2.5 . About 69.7% were females and 54.5% married. In relation to education 78.7% were Technical Institute education with years of experience not exceeding 5 years for 63.6% of them. Regarding to previous IC courses, 69.7% expressed that they had took general IC courses, but only 15.1% took CAUTI preventive courses as demonstrated in table (1).

Table (2): represented nurses' perception of current polices, showed that all the studied nurses 100% were aware of IC nurse presence in ICU. Most of the studied ICU nurses had a wrong perception about CAUTI surveillance activities in ICU, as about 78.8% of them thought that CAUTI incidence was only measured during outbreaks. In relation to IUC removal; 51.5 % of the studied nurses disclose that IUC was only removed with doctors order. Most Nurses were founded aware that they should remind doctor to order removing IUC 87.9%.

Nurses total knowledge was 24.2% satisfied before intervention that improved significantly (p -value=.000) to be 84.8% after intervention as shown in table (2). Nurses knowledge was divided in to theoretical and practical part. The theoretical part statistically significant doubled after completion of CAUTI preventive maintenance care guidelines at (p -value =.000). Before implementation, the total theoretical part was satisfied for 42.4% of ICU nurses and after that raised to 81.8% as presented in figure (1). The highest theoretical item score was about general IC measurers in which 100% satisfied answers. In the other side the lowest theoretical item score was diagnosis and management of CAUTI 24.2%.

Regarding to the practical knowledge part, figure (1) represents the practical knowledge part total satisfied score improvement from 27.3% to 90.9% after implementation of IUC maintenance nursing care guidelines. This improvement was statistically significant at p -value .000. The most noticed statistically significant enhancement items were; urinary bag care, followed by collection of culture urine sample from IUC and IUC securement to patients body from 9.1%, 9.1%, and 36.4% to 60.6%, 57.6%, and 69.7% respectively at (p -value =.000).

Regarding to total nursing toward IUC maintenance nursing care guidelines, a statistically significant increase of satisfied at (p -value =.000) was noticed. A significant relation between nurses' knowledge and practice was clearly noticed during assessment and evaluation phase as shown in table (2). Nurses' practice was assessed for the following items; daily maintenance care, urine culture specimen collection, and IUC irrigation as demonstrated in figure (2).

The first part of nursing practice was the daily maintenance care of IUC that showed a significant increase by about one-fold at (p -value=.006). Before intervention the most defective skills were about maintain a sterile, continuously closed drainage system and IUC securement to patient's body according to sex 5% and 8% respectively. Urinary bag was founded to be emptied by the ICU healthcare assistant personal through a shared container not a separate one as recommended and draining spigot was touching the collecting container. Besides that, ICU indication was not documented and rationalized. The most affirmative action was that metal area was not cleaned with antiseptic solutions for all of ICU nurses 100% but sometimes not cleaned at all especially for the opposite nurse sex.

Concerning nursing practice of culture urine sample collection founded to increase statistically significant from 30.3 % to 54.5% at p -value .000. The most pitfall steps were; disinfect IUC above drainage port junction site and aspiration of urine sample by injecting IUC above drainage port junction site for 84.8% and 87.9% respectively. Disposal of equipment appropriately was the highest scored action.

Regarding to IUC irrigation, before intervention the pitfall step of irrigation was covering of disconnected IUC drainage lines which was used to be left uncovered on the patient's bed or under the patient's thigh for 63.6% of the studied nurses. The total satisfied nursing practice of IUC irrigation improved statistically significant from 30.3% to 60.6% at p -value =.00.

Table (4) represented patient data, the maximum age was 80 and 91 years old during assessment pretest group and evaluation post-test group respectively. No significant change in patients age was noted. Females patients were more than

males during both phases and no significant change was noted regarding patient sex. The total number ICU of days was 312 during pretest and 344 during post-test.

Table (5) was concerned with CAUTI diagnosing criteria. The suprapubic tenderness frequency days were 22.4 % of total patient's days before intervention and 13.9% after with no significant change. Cervical Vertebral (CV) angle was 2.5 before intervention. Only fever above 38°C body decreased significantly during post-test group from 30.1% to 11.9% respectively. Total number of urine cultures decreased from 45 to 36. CAUTI rate decreased from 54.48 to 31.9 per 1000 catheter day after completion of CAUTI maintenance care preventive guidelines.

4. DISCUSSION

Indwelling urinary catheter is one of the major factors of devolving HAI and threats patient's cure during hospitalization. particularly for patients with multiple system failure, low immunity, nutritional depletion, and highly resistant colonized environment which all describe ICU patient's state. Hopefully most of the CAUTI is preventable depending on nursing care for IUC during insertion, maintenance and removal [30]. So, this study aimed to determine effect of implementing nursing guidelines on decreasing catheter associated urinary tract infection in ICU.

The result of the current study portrayed that most previous IC courses that nurses have attended was regarding general IC practices and the minimum was for CAUTI prevention, beside low nurses' knowledge and practice score for CAUTI preventive guidelines and high incidence rate of CAUTI among ICU patients. This reflect that CAUTI prevention IC courses was not enough and needs more attention of frequent application. This was agreed with [31], [32] studies that was conducted in Egyptian hospitals.

Nurses knowledge and practice regarding CAUTI preventive guidelines were significantly improved after implementation of educational sessions. In Egypt two studies were discussing the same issue from different points. The first was conducted in Zagazig University Hospital to evaluate the effectiveness of CAUTI preventive IC program involving both ICU resident physicians and nurse's knowledge and practice regarding IUC insertion and maintenance care showed a significant improvement [31]. The second one was implemented in

The result of the current study portrayed that most of the studied nurses had satisfactory total knowledge toward IUC care after implementation of CAUTI preventive guidelines with a significant difference. This was also noticed *Yoon et al., (2013)* in Washington, USA who studied "Changing Behavior among Nurses to Track Indwelling Urinary Catheters in Hospitalized Patients" founded that most of nurses had satisfactory knowledge regarding CAUTI after implementation CAUTI preventive guidelines educational sessions compared with less than half before starting the education.

This finding was also noted by *Shaver et al., (2018)* study in USA who studied "trauma and intensive care nursing knowledge and attitude of Foley catheter insertion and maintenance" reported that nurses knowledge increased after application of CAUTI preventive guidelines. Beside improving nurses' practice toward IUC insertion and maintenance care. This was in the same line with a studies conducted in Egypt by (*Abdel-Hakeim & Hamza, 2018*) and (*Selim et al., 2018*)

But this result was disagreed with a study conducted in USA by *Conner et al., (2013)* study was about "exploring factors associated with nurses' adoption of an evidence-based practice to reduce duration of catheterization" founded that nurses knowledge regarding evidence based practice toward CAUTI prevention was not significantly changed neither with the study group nor control group.

In relation to nurse's knowledge of maintenance care including; closed sterile IUC system and perineal care improved significantly after CAUTI preventive guidelines. who expressed that ICU nurses in Zagazig University hospital had low information about the importance of maintaining IUC closed system and daily care for both perineum and IUC tube. From this finding the researcher concluded that the ministry of health in Egypt needs to focus attention on CAUTI preventive guidelines, especially for IUC, indication and maintenance care.

Also it was agreed with a study conducted in USA by *Schelling et al., (2015)* study of "reducing catheter-associated urinary tract infections in aneurospine intensive care unit" reported that compliance to IUC correct securement to patient body according to patient sex improved to involve all patients after implementation of nursing protocol and daily rounds to encourage nurses to a achieve the protocol goals. So, promoting nurses' knowledge would motivate nurses secure IUC to the patient's body

Following CAUTI preventive evidence-based practice is directly linked to education and training they have been received [37]. The total nurses' practice toward CAUTI preventive guidelines improved significantly from fifteen percent to twenty seven percent during pretest observation. A similar finding reported by *Houston et al., (2013)* who mentioned that improving nurses knowledge improved nurses practice and managed in decreasing CAUTI incidence by about thirty percent. Besides that, *Meddings et al., (2014)*, *Abdel-Hakeim & Hamza, (2018)*; *Selim et al., (2018)*; *Talaat et al., (2010)* all supported this finding

Furthermore, nurses practice had a higher mean score and lower SD during post-test than pretest observation with a significant difference. This was agreed with *Roy, Philip, Fulwadiya, & Dhabade, (2018)* in India who have conducted a study titled "Prevention of Catheter Associated Urinary Tract Infection (CAUTI)" reported an increase in mean practice score when compared with pretest score with a strong significance difference. All that indicated that CAUTI prevention guidelines was effective tool to promote nurses' practice and this promotes the primary hypothesis.

No significant change was observed regarding emptying of the collecting bag, all studied nurses founded not to evacuating IUC bag neither during pretest nor post-test phases. This finding is explained by the fact that the Unite healthcare assistant personal according to SCUH polices, the responsible personnel for emptying of the IUC bags. This finding was in contrary with a study conducted in Egypt by *Abdel-Hakeim & Hamza, (2018)* mentioned that all nurses were emptying IUC urinary bags regularly.

Concerning nurses' practice toward culture urine specimen collection, a significant improvement through disinfection above IUC the drainage port junction site before collecting culture urine sample and aspirating of urine specimen using 10 ml syringe. This was supported by *Assadi, (2018)* from USA who investigated the strategies for preventing CAUTI, reported that IUC and urine collecting tubes must be not disconnected for obtaining culture urine sample. Also, to obtain it either from sample port or by injecting the IUC with sterile needle above the junction site between IUC and collecting tubes.

In the current study, nurses' practice regarding UC irrigation improved statistically significant. For example, open system irrigation of IUC the result of the present study documented that three quarters of the ICU studied nurses covered IUC line with irrigation syringe cover during posttest observation compared with only about twelve percent while pretest observation with a significant difference in nursing practice. This could be explained by improving nurses' practice as a result of doubling knowledge through post-test answers about catheter irrigation. This result was inconformity with *Wicks, (2015)* in Australia through a study about "Investigation of nursing knowledge of catheter selection following the introduction of a catheter decision support tool" who reported that most nurses' knowledge improved regarding catheter irrigation during post-test.

The result of the current study portrayed that CAUTI occurrence diminished about twenty-two per thousand after implementation of CAUTI preventive guidelines. This result was supported with *Al-Hameed et al., (2018)* on their study which have been conducted six hospitals from three Arabian Gulf countries Saudi Arabia, Oman, and Bahrain about "Applying preventive measures leading to significant reduction of catheter-associated urinary tract infections in adult intensive care unit" founded a reduction in CAUTI rate however raised urinary catheter utilization rate and clarified this to strict compliance to systemic approach CAUTI preventive guidelines.

5. CONCLUSION

The study concluded, that CAUTI prevention is a global trend as part of patient safety programs. In this study, implementation of CAUTI preventive guidelines improved nurse's knowledge and practice significantly. Nurses knowledge founded to be correlated with their practice regarding CAUTI preventive guidelines. Improving nurse's knowledge and practice reflected on the CAUTI occurrence through the great reduction on CAUTI rate that was noted after implantation of the guidelines.

6. RECOMMENDATIONS

Based on the result of the present study, the following recommendation were suggested:

- Conducting aperiodic survey to CAUTI prevalence in ICU.
- Involve healthcare assistant personal on CAUTI prevention guidelines education.

Empty the collecting bag regularly using a separate collecting container for each patient

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International Journal of Novel Research in Healthcare and Nursing

 Vol. 6, Issue 3, pp: (524-536), Month: September - December 2019, Available at: www.noveltyjournals.com

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APPENDICES – A

Table 1: Distribution of nurses’ profile of ICU nurses

Nurses profiles	N	%
Age		
21≤25	26	78.7
26≤30	7	21.3
Mean ± SD	24.58 ± 2.5	
Median	25	
Sex		
Male	10	30.3
Female	23	69.7
Marital status		
Single	13	39.3
Married	18	54.5
Widow	0	0
Divorced	1	3
Education		
Technical Institute	26	78.7
University	7	21.3
Experience years in ICU		
1≤5	21	63.6
6≤10	6	18.1
11≤15	6	18.1
Previous IC courses	23	69.7
Number previous IC courses		
1-2	15	65.2
3-4	8	34.7
Previous CAUTI prevention IC courses	5	15.1

Table 2: Nurses’ awareness about IC polices present in ICU (n=33)

Nurses awareness	No	%
Presence of IC nurse in ICU	33	100
CAUTI incidence in ICU is measured	24	72.7
When CAUTI incidence in ICU is measured		
Every year	1	3
Every 6 months	1	3
When high incidence appears	26	78.8
Non	5	15.2
Nurse reminds physician to order removing IUC	29	87.9
Nurse has to remind physician to order removing IUC every		
Shift	18	54.5
Day	3	9.1
Two day	2	6.1
Week	6	18.2
IUC is removed when		
patient transfers to internal units	1	3
Patient transfers to another hospital	1	3
Patients regain level of consciousness	1	3
IUC complications appears	6	18.2
Doctor order	17	51.5
Others	7	21.2

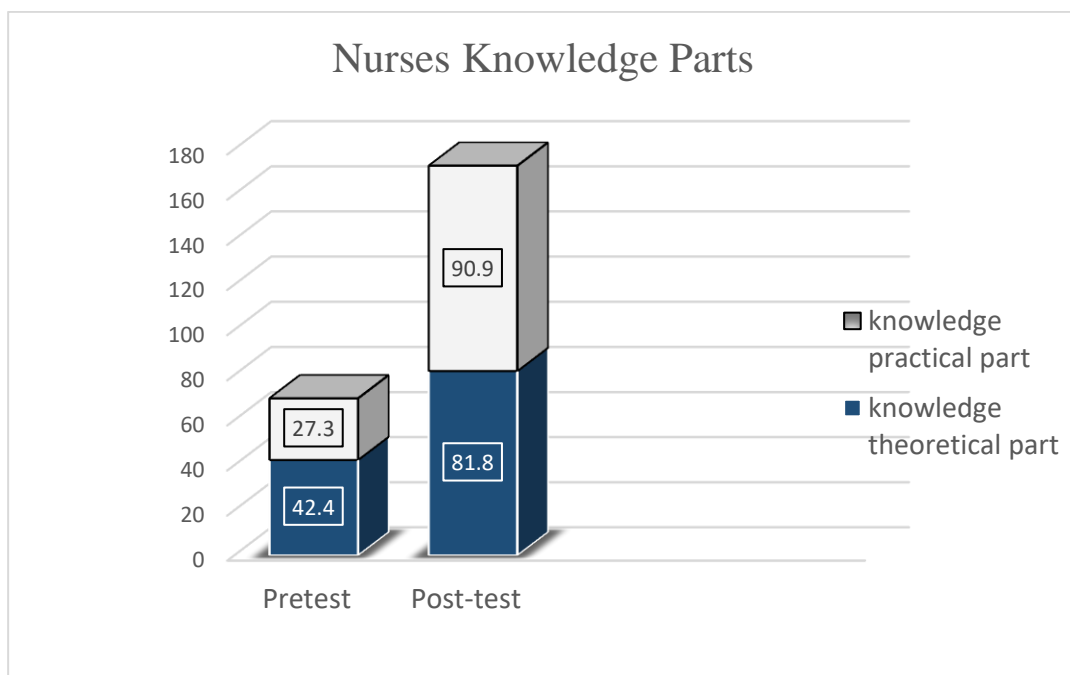


Figure 1: Totals theoretical and practical parts of nurses knowledge during pretest and post-test (n=33)

Table 3 : The difference and correlation of nurse’s knowledge and practice through pretest and post-test

Items	Pretest	Post-test	Difference	Pretest relation	Post-test relation
	Total and Mean SD				
Knowledge	24.2% 53.8 ±6.77	84.8% 66.5 ±6.77	t= 10.6 p= .000*	r= .464 P=.007*	r= .742 P=.000*
Practice	12.1% 16.54 ±5.77	27.3% 20.6 ±4.36	t= 6.15 p= .000*		

* P-value=.05

t= t- test (difference test of dependent variables)

r= spearman correlation test

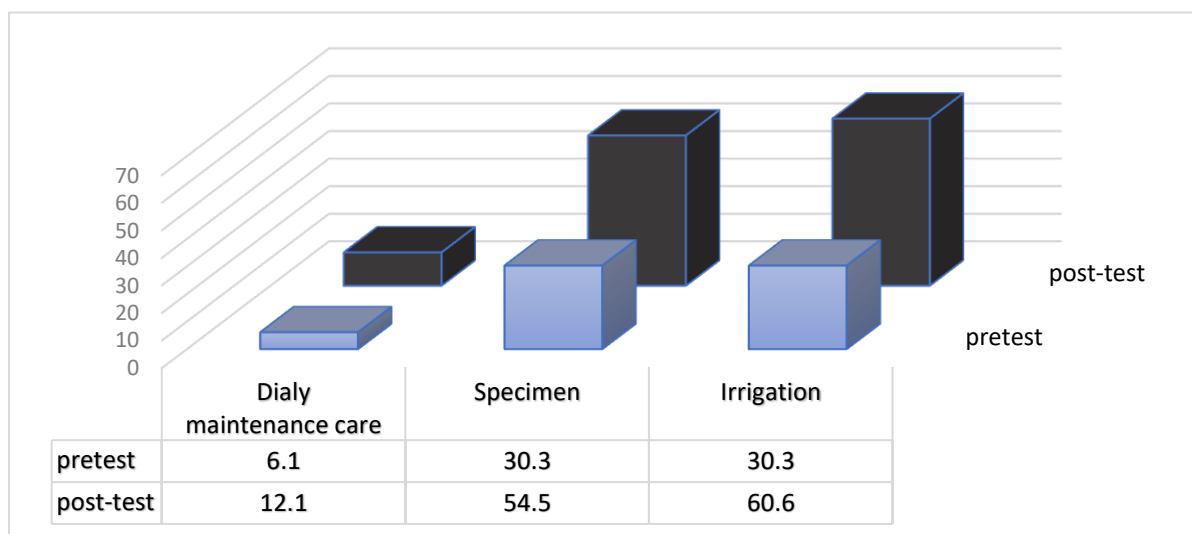


Figure 2: Percentage of nurses' totals satisfactory practices score toward CAUTI prevention guidelines items during pretest and post-test (n=33)

Table 4: patients personal profile data during pretest and post-teat phase

Personal profiles of studied patients	Pretest		Post-test		Significant
	n	%	N	%	
Age					U= 871 P= .151
21≥35	10	21.3	5	11.1	
36≥50	8	17	10	22.2	
51≥65	20	42.6	13	28.9	
≥ 66	9	19.1	17	37.8	
Minimum	21		21		
Maximum	80		91		
Median	58		61		
Sex					U= 1036.5 P= .849
Male	21	44.7	21	46.7	
Female	26	55.3	24	53.3	
Duration of ICU admission	312		344		U=868 P= .136
Median	5		6		
Mode	4		8		
Range	20		17		

Table 5: Percentage distribution and difference of CAUTI Diagnosis criteria

CAUTI Diagnosis criteria	Pretest		Post-test		Significance	
	N	%	n	%	U	P
CAUTI Symptoms days:						
Suprapubic tenderness	70	22.4	48	13.9	912	.181
CV angle tenderness	8	2.5	0	0	1012	.312
Fever \geq 38	94	30.1	41	11.9	796	.044*
Total Urine culture	45	14.4	36	10.4	1014	.719
CAUTI Rate	17	36.1	11	24.4	1030	.818
CAUTI per 1000 catheter days	54.48		31.9		-	

pretest group (n =312) post-test group (n =344)

CV= Cervical Vertebral

P-value=.05

U = Mann whitney