

Strategic Guideline For Nurses' Performance Regarding Preventing Catheter-Associated Urinary Tract Infections At Intensive Care Units

¹Asmaa N. Mosbeh, ²Sahar S. Faheim, ³Asmaa S. Ali.

^{1,2} Pediatric Nursing, ³ Medical Surgical Nursing,

¹Assistant professor, ^{1,3}Lecturer

^{1,3} Ain Shams, ² Beni-Suef Universities

Corresponding Author: 1Asmaa N. Mosbeh

Abstract: Catheter-associated urinary tract infections (CAUTIs) are the most common health care-associated infections in the intensive care units. **Aim:** To evaluate the effect of strategic guideline on nurses' performance regarding preventing catheter-associated urinary tract infections at intensive care units. **Subjects and Methods:** **Design:** A quasi experimental research design was used to conduct this study. **Setting:** The study was carried out at pediatrics and adults intensive care units in Beni-Suef University Hospital, General Hospital and Health Insurance Hospital in Beni-Suef Governorate. **Sample:** A purposive sample was selected and composed of 100 nurses. **Tools:** Three tools were used in this study: First tool: A self-administered questionnaire to assess nurses' socio-demographic characteristics and knowledge regarding CAUTIs and strategic guideline to prevent catheter-associated urinary tract infections in intensive care units. Second tool: Nurses attitude (Likert scale): To assess nurse's attitudes regarding prevention of CAUTIs. Third tool: Observational checklists to assess nurses' practices (catheter insertion and strategic guideline to prevent catheter-associated urinary tract infections) through guideline phases (pre/immediately post and at follow up). **Results:** For 35% of the studied nurses their age ranged between 25-30 years or more with a mean age of 24.68 ± 4.33 , 52% of the them had secondary nursing education, and there was a highly statistically significant difference ($P < .0001$), regarding their knowledge, attitudes and practices before, immediately after, and at follow up guideline implementation toward preventing catheter-associated urinary tract infections. **Conclusion:** This study proved that the strategic guideline had significant effect on improving nurses' performance regarding preventing of catheter-associated urinary tract infections at intensive care units. **Recommendations:** Publication and dissemination of the strategic guideline in all health service departments and ICUs to improve nurses' performance about the care of urinary catheter and prevention of CAUTIs for adults and children. **Key Words:** Catheter-associated urinary tract infections, Pediatrics & Adults, ICUs, Performance and Strategic guideline.

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I. Introduction

A urinary tract infection (UTI) is an infection involving any part of the urinary system, including urethra, bladder, ureters, and kidney. The most common health care-associated infection (HAI) is catheter-associated urinary tract infections (CAUTI) and the most common hospital-acquired infections is urinary tract infection (UTI) 70%–80% of these infections are due to an indwelling urethral catheter (IUC). The problem of CAUTI in pediatric patients is not well diagnosed (1).

Urinary tract infections account for approximately 40% of all hospital-acquired infections annually. Urinary tract infections are also the most common health care-associated infection in the ICU, accounting for 23% of hospital-acquired infections among adult ICU patients in the US; fully 80% of these hospital-acquired UTIs are attributable to indwelling urethral catheters (2&3).

The prevalence rates of CAUTI from intensive care units (ICUs) reported to the National Healthcare Safety Network (NHSN) ranged from 1.2 to 4.5 per 1,000 urinary catheter-days in adult ICUs and from 1.4 to 3.1 per 1,000 urinary catheter-days in pediatric ICUs. Symptomatic UTIs in adult ICUs voluntarily reporting to NHSN declined from 1990 to 2007, with a range of an 18.6% decline in cardiothoracic units to a 67% decline in medical-surgical units, but no changes in incidence reported from ICUs (3). A recent report from the Centers for Disease Control and Prevention (CDC) the NHSN revealed that the pooled mean rates of CAUTI were similar in adult and pediatric intensive care units (PICUs) in 2011 (2).

The duration of catheterization is the most important risk factor for developing infection. Just once a catheter is inserted, the daily prevalence of bacteriuria is 3-10%. Between 10% and 30% of patients who endure short-term catheterization (ie, 2-4 days) develop bacteriuria and are asymptomatic. Between 90% and 100% of patients who endure long-term catheterization progress bacteriuria. About 80% of nosocomial UTIs are associated urethral catheterization; only 5-10% is correlated to genitourinary manipulation (4).

Approximately 75% of urinary tract infections are associated with a urinary catheter, which is a tube inserted into the bladder through the urethra to drain urine. Between 15-25% of hospitalized patients receive urinary catheters during their hospital stay (5). Important risk factors associated with acquiring CAUTI were female gender, patients with prolonged duration of catheterization, prolonged hospital and ICU stay had a significantly higher risk of acquiring CAUTIs (6).

Pediatric patients' hazard of acquiring a CAUTI is increasing with prolonged usage, inappropriate aseptic technique, inappropriate equipment, incorrect insertion, lack of maintenance, inappropriate secure catheters, patient susceptibility to infection, patients receiving immunosuppressant therapy and inappropriate indications such as urethral trauma, urethral injuries and pelvic fractures which are considered contraindications of catheterization in children (7).

The CAUTI can lead to such complications as prostatitis, epididymitis, and orchitis in males, and cystitis, pyelonephritis, gram-negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis in patients. Complications associated with CAUTI cause discomfort to the patient, prolonged hospital stay, and increased cost and mortality (8). It has been estimated that each year, more than 13,000 deaths are associated with UTIs (9).

Strategy: Produce, recruit, deploy and retain the right skill mix of nurses and health workers with appropriate competencies, and with adequate distribution of necessary resources and effective regulation systems, in the right place with expert coordination within and outside the health sector (10).

The most effective strategy to prevent CAUTI is to prompt removal of unnecessary urinary catheters; so it is very serious to insert the catheter only when indicated if the use of catheter is deemed necessary, care should be taken to minimize unnecessary manipulation, prevent trauma and maintain a closed, patent and non-kinked system, and generate high quality evidence regarding types and techniques of catheterization. This recommendation provides the principles for best practice of urinary catheter care to healthcare professionals. It can serve as a model in formulation of strategies, programs and plans for prevention of CAUTIs for patients in ICUs. The ICU nurse must be capable to assess the indication and necessity of urinary catheterization, In addition, maintaining a documentation, care and removal of urinary catheter (11).

The strategic guideline for staff nurses in ICUs is very important to raise their performance including knowledge, attitude, and practices (KAP) regarding to the preventive insertion and maintenance measures of CAUTIs in the orientation program and the in-service refresher training. Also, it ensures that, the health care personnel, who are involved in urinary catheter insertion or care, are trained and competent to perform the procedure with aseptic technique that leads to proper care of the urinary catheter and drainage system and thus preventing the occurrence of UTIs (12&13).

Significance of the study

Catheter-associated urinary tract infection is the most commonly reported hospital-acquired condition, and the rates continue to rise. More than 560,000 patients develop CAUTI each year, leading to extended hospital stays, increased health care costs, and patient morbidity and mortality. The ICU nurse can play a major role in reducing CAUTI rates to save lives and prevent harm. Acute care hospitals have nationally stated an estimate of 800,000 patients per year obtain a CAUTI and 66–86% of those were due to prolonged catheterization (14).

Prevention of CAUTI in children is now regarded as an important hospital policy worldwide. Most studies have focused on ways of reduction/prevention of CAUTI, while effective preventive prediction tool is still lacking. Such tool can be used to identify high-risk for children, while to doctors and parents, as decision when the urinary catheter could be omitted. Little is known about the ability of these evidence-based bundles to prevent CAUTI in children (6).

In the pediatric and adult intensive care units, many patients are catheterized for long periods, thus increasing the risk of acquiring UTI. These patients are in need for special nursing care to minimize their risk of acquiring the infection and developing its complications (15).

In the study settings, there was no statistical report about the incidence of CAUTIs Important risk factors associated with acquiring CAUTI were female gender, patients with prolonged duration of catheterization, prolonged hospital and ICU stay had a significantly higher risk of acquiring CAUTIs

In the study settings the nurses didn't have any guidance and most of them didn't attend any program regarding CAUTIs, the researchers have revealed that the most significant improvement in CAUTI reduction is achieved when nurses are educated about approach to CAUTI reduction in the ICUs, implementation of educational program and good training for

nursing staff about strategies to prevent catheter-associated urinary tract infections. Nurses are still using non-evidence based techniques when caring for patients with catheters. Therefore, it is of highest importance that nurses follow such as the current strategic guideline, to help reduce the chances of their patients catching a CAUTI.

II. Aim of The Study

To evaluate the effect of strategic guideline on nurses' performance regarding preventing catheter-associated urinary tract infections at intensive care units.

Hypothesis:

The strategic guideline will improve nurses' performance regarding preventing of catheter-associated urinary tract infections at intensive care units.

III. Subjects And Methods

Research design:-

A quasi-experimental design was used in order to achieve the aim of the study.

Setting:

The study was conducted at three different settings, at pediatric and adults intensive care units in Beni-Suef University Hospital, General Hospital, and Health Insurance Hospital in Beni-Suef Governorate. These units are considered the biggest units for emergency care and cover all target population residents in Beni-Suef Governorate.

Subjects:

A purposive sample consisting of 100 nurses; 43 nurses selected from Beni-Suef University Hospital(13at PICU& 20 at adult ICU), 34 nurses from Health Insurance Hospital(16 at PICU&18 at adult ICU), 23 nurses from General Hospital(10at PICU& 13 at adult ICU), at Beni-Suef Governorate, were selected according to the following inclusion criteria:

- Nurse inserted urinary catheter before
- Nurse provides care for patients with urinary catheter in ICUs for adult and children.
- Nurse didn't attend any courses about CAUTIs.

IV. Study Tools

Three tools were used in this study for data collection:

First tool: A Self-administered questionnaire: Developed by the researchers after reviewing of related literature (7 &16) it was used to assess the following parts:

Part (A): Demographic characteristics of nurses, such as; age, marital status, educational qualification, and years of experience.

Part (B): It was used to assess nurses' knowledge regarding CAUTIs pre, post, and follow up strategic guideline implementation which included 15 open-ended questions regarding (1) Urinary catheter including anatomy and physiology of urinary system, definition of urinary catheter, indications, types, number of usage days, complications, and contraindications, (2) Urinary tract infections include: definition of urinary tract infection, its causes, types, clinical manifestations, diagnostic tests, treatment, complications, and preventing strategies for urinary tract infection.

Second tool: Nurses's attitude (likert scale): Adapted from (17) it was used to assess nurses' attitudes regarding prevention of CAUTIs in NICUs.

Third tool: Observational checklists:

This tool was used to evaluate nurse's practices regarding the following:

- (1) Urinary catheter insertion, it adopted from (18) and composed of 28 items.
- (2) Strategies to prevent CAUTs tract infections: Adopted from (1). It is composed of 22items such as choice of catheter and preparation of equipment, use smallest gauge catheter, aseptic technique/sterile equipment and barrier precautions, antiseptic cleaning of meatus, and obtaining urine samples, ect..

Knowledge scoring system:

For each of the knowledge items, a correct response was scored "two", and an incorrect "one". For total score of knowledge, it was considered satisfactory if the percent score was 85% or more and unsatisfactory if less than 85%. Knowledge total score =30.

Nurses's attitude (Likert scale) scoring system:

Likert scale consists of 10 statements and scores as follows: (3) scores for agree, (2) scores for neutral and (1) score for disagree. The total score level of attitude was classified into: Positive attitude: From 80% and more, indifferent attitude: 60 < 80%, and negative attitude: < 60%.

Practice Scoring system:

For each step of practice done correctly it is scored "2", and not done takes "1" score. For each area of practice, if the percent of total score was 90% or more it is considered competent and incompetent if less than 90%. Total score for urinary catheter insertion = 56 while for strategies to prevent catheter-associated urinary tract infections = 44.

Validity and Reliability:

Content and face validity were performed by 3 professors of the Pediatric specialty of Nursing Faculty and two professors from the Medical Surgical Department, Faculty of Medicine. The reliability test was established by using the Cronbach alpha and Pearson correlation, which showed good internal consistency (construct validity Cronbach alpha = 0.88).

V. Pilot Study

A pilot study was conducted on 10% of the total study sample (100) nurses to test and evaluate the clarity, and applicability of the study tools and to estimate the time required for completion of each study tool. The pilot study sample was included in the main study sample.

VI. Operational Design

Ethical Considerations:

It was also necessary for the researchers to get the consent of the ICUs nurses. So, strict confidentiality was ensured throughout the study process. The study subjects were assured that all data will be used only for research. They were also informed about their right to withdraw from the study at any time without giving any reason.

Field work:

After official permissions to carry out the study, were obtained the aim of the study was explained to the subjects in each study setting. The study was carried out over a period of 9 months started from beginning of September 2016 to the end of May 2017. The average time consumed to fill in the tools was 30 minutes for the self-administered questionnaire, 10 minutes for Likert scale assessment and 45 minutes for the observational checklists. The previously mentioned settings were visited by the researchers three days/week (Saturdays, Mondays & Wednesdays) from 9.00 a.m. to 2.00 p.m.

Strategic guideline phases

This program was conducted on five consecutive phases, assessing, developing, implementing, evaluating, and follow-up.

Phase 1: A pre-strategic guideline assessment was performed using the self-administered questionnaire for data collection from the previously mentioned settings. This phase aimed at assessing ICUs nurses' knowledge, attitude and an observational checklist was used to assess their practices related to the strategic preventive guideline of CAUTI to determine their needs.

Phase 2: A strategic guideline was developed based on actual nurses' need assessment about prevention of CAUTIs in ICUs (knowledge and practices).

The theoretical content covered the following items: Anatomy and physiology of urinary system, definition, indications, types, number of usage days, contraindications and complications of urinary catheter. As well definition, causes, types, clinical manifestation, diagnostic tests, treatment, complications and strategies to prevent CAUTIs

The content of the practical part included the following: The practical procedures of catheter insertion and strategic guideline to prevent CAUTIs such as; choice of catheter and prepare equipment, use smallest gauge catheter, aseptic technique/sterile equipment and barrier precautions, antiseptic cleaning of meatus, and obtaining urine samples, correct draining bag positioning etc.

Phase 3: Implementation of the program:

Implementation of the strategic guideline was carried out at the previously mentioned settings. At the beginning of the first session, an orientation of the strategic guideline and its purpose was presented. Nurses were divided

into groups, and each group consisted of 11-12 nurses approximately. Each session started with a summary about what had been given through the previous sessions and the objectives of the new topic, taking into consideration the use of simple language to suit the level of nurses' qualifications. As well, the session ended by a summary of its content and a feedback gained from others.

The strategic guideline was conducted through five sessions, the time of each session ranged between 30 - 45 minutes according to the nurses' needs and condition of the group. The theoretical part of the strategic guideline was presented in three sessions in the form of lectures/discussions, followed by the practical part which consisted of two sessions in the form of demonstration and redemonstration using role play, simulator, real objects, discussions and brainstorming. The researchers used effective media of conveying information as, power point presentations and posters. A guideline handout was developed and offered for nurses as a reference to be used after guideline implementation.

Phase 4 and 5: Evaluation phases:

The evaluation phases was done immediately post implementation of the strategic guideline and at follow up one month later by comparing changes in nurses' knowledge, attitudes and practices regarding strategic guideline for prevention of CAUTIs in children and adults.

VII. Administrative Design

An official approval was obtained from the administrators of the study settings to carry out the study. A clear explanation was given about the aim, nature, importance and expected outcomes of the study.

VIII. Statistical Design

Data collected were organized, and scored, tabulated, and analyzed by computer using the "Statistical Package for the Social Science" (SPSS windows), version 19. Numerical data were expressed as mean ± SD, and range. Qualitative data were expressed as frequency and percentage. Using Chi-square (X^2) test, relations between different numerical variables were tested using Pearson correlation, when P value less was than 0.05, it was considered significant, and less than 0.001, was considered as highly significant.

IX. Results

Table (1): Distribution of Socio-Demographic Characteristics of the Studied Sample of Nurses at ICUs (n = 100).

Items	Frequency	%
Age in years		
< 20	10	10.0
20 < 25	25	25.0
25 < 30	35	35.0
≥ 30	30	30.0
Mean ±SD	24.68±4.33	
Marital status		
Single	10	10.0
Married	82	82.0
Divorced	8	8.0
Educational qualification		
Secondary nursing education	52	52.0
Secondary and technical nursing education	40	40.0
Bachelor of nursing	8	8.0
Years of experience		
< 1	5	5.0
1 < 5	40	40.0
≥ 5	55	55.0
Mean ±SD	8.66±6.23	

Table (1) shows the socio demographic characteristics of the studied nurses. It indicates that, for 35% of them, age ranged between 25 < 30 years, with a mean age of 24.68±4.33 years. Regarding the level of education, more than half (52%) of the nurses had secondary nursing education. As regards nurses' years of experience the same table presents that, more than half (55%) of them have 5 or more years of experience.

Table (2) Percentage Distribution of the Studied Sample of Nurses According to Their Knowledge About Prevention of CAUTIs in ICUs Throughout the guideline Phases (n = 100).

Knowledge related to prevention of catheter-associated urinary tract infections	Pre-program		Post-program		Follow up	
	Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory
	%	%	%	%	%	%
Anatomy and physiology of urinary system	40.0	60.0	95.0	5.0	92.0	8.0
Definition of urinary catheter	37.0	63.0	96.0	4.0	95.0	5.0
Indication of urinary catheter	5.0	95.0	88.0	12.0	85.0	15.0
Contraindications of urinary catheter						
Types of urinary catheter	20.0	80.0	90.0	10.0	90.0	10.0
Number of usage days	0.0	100.0	65.0	35.0	65.0	35.0
Complications of urinary catheter	10.0	90.0	95.0	5.0	95.0	5.0
Contraindications of urinary catheter	3.0	97.0	95.0	5.0	92.0	8.0
Definition of urinary tract infection	25.0	75.0	90.0	10.0	90.0	10.0
Causes of urinary tract infection	30.0	70.0	92.0	8.0	90.0	10.0
Types of urinary tract infection						
Clinical manifestation urinary of tract infection	35.0	65.0	88.0	12.0	85.0	15.0
Diagnostic tests of urinary tract infection						
Treatment of urinary tract infection	40.0	60.0	90.0	10.0	90.0	10.0
Preventing methods of urinary tract infection	4.0	96.0	95.0	5.0	90.0	10.0
Complications of urinary tract infection diseases	20.0	80.0	90.0	10.0	88.0	12.0
Nursing care for catheter-associated urinary tract infections	30.0	70.0	95.0	5.0	92.0	8.0

CAUTIs= Catheter-Associated urinary tract infections

ICUs= Intensive care units

Table (2) points out that, the studied nurses' knowledge toward preventive strategies of urinary tract infection improved through guideline implementation phases as more than two thirds of them (70%) had unsatisfactory knowledge related to the nursing care for catheter associated urinary tract infections before the guideline implementation, which improved to be most of them (95% & 92%) had satisfactory knowledge post guideline implementation and at follow up respectively.

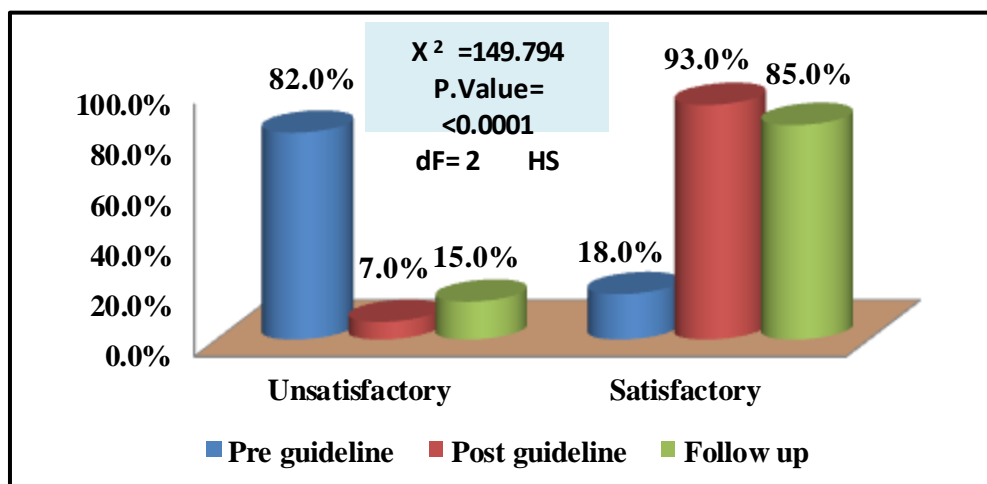


Figure (1): Percentage Distribution of Total Score Knowledge of the Studied Nurses About Prevention of CAUTIs in ICUs Throughout the Guideline Phases (n = 100).

Figure (1) describes the studied nurses' total knowledge score. The majority of them (82%) had unsatisfactory level before the guideline implementation, which improved for most of them (93.0%), to satisfactory knowledge immediately post guideline implementation. However, the same figure illustrates that, the majority of studied nurses (85%) had satisfactory level in their total knowledge scores in follow up phase of guideline implementation, with a highly statistically significant difference ($P<.0001$).

Table (3): Percentage Distribution of Studied Nurses According to Their Practices About Prevention of CAUIs in ICUs Throughout the Guideline Phases (n = 100).

Items	Pre-program		Post-program		Follow up	
	Done	Not done	Done	Not done	Done	Not done
	%	%	%	%	%	%
Appropriate insertion procedure	12.0	88.0	80.0	20.0	87.0	22.0
Documentation of catheter insertion	11.0	89.0	75.0	25.0	75.0	25.0
Hand hygiene	75.0	25.0	96.0	4.0	96.0	4.0
Evaluation of necessity and indications	15.0	85.0	90.0	10.0	85.0	15.0
Evaluation of alternative methods	8.0	92.0	85.0	15.0	82.0	18.0
Regular review of ongoing need	28.0	72.0	94.0	6.0	92.0	8.0
Choice of catheter and prepare equipment	6.0	94.0	85.0	15.0	80.0	20.0
Use smallest gauge catheter	65.0	35.0	94.0	6.0	95.0	5.0
Aseptic technique/sterile equipment	20.0	80.0	95.0	5.0	90.0	10.0
Barrier precautions for insertion	10.0	90.0	100.0	0.0	96.0	4.0
Antiseptic cleaning of meatus	57.0	43.0	96.0	4.0	94.0	6.0
Secure patient's catheter	78.0	22.0	98.0	2.0	95.0	5.0
Closed drainage system	100.0	0.0	97.0	3.0	94.0	6.0
Obtain urine samples aseptically	10.0	90.0	92.0	8.0	90.0	10.0
Replace system if break in asepsis	10.0	90.0	98.0	2.0	95.0	5.0
Routine change in catheter	6.0	94.0	85.0	15.0	80.0	20.0
Routine hygiene for meatal care	20.0	80.0	95.0	5.0	92.0	8.0
Avoid irrigation for purpose of preventing infection	33.0	77.0	92.0	8.0	90.0	10.0
Separate patients with catheters	15.0	85.0	90.0	10.0	85.0	15.0
Use of pre connected system	6.0	94.0	85.0	15.0	85.0	15.0
Performance feedback	28.0	72.0	94.0	6.0	92.0	8.0
Observe rates of CAUTI and bacteremia	20.0	80.0	95.0	5.0	92.0	8.0

Table (3) demonstrates that, the studied nurses' practices improved through guideline implementation phases as most of them (94%) don't practices before the guideline implementation regarding to choice of catheter and prepare equipment, routine change in catheter, and use of pre connected system, which improved to reach the majority of them (85.0%) done practices immediately post guideline implementation and at follow up. As well, the table demonstrates that, all of studied nurses (100%) improved their practices to be done immediately post guideline regarding to the procedures of barrier precautions for insertion, and (96,97,98) of them done hand hygiene, secure patient's catheter and closed drainage system respectively.

Table (4): Total Nurses' Attitude Toward Strategies To Prevent CAUIs In ICUs Through Guideline Phases (N=100).

Items	Total Attitude					
	Pre guideline		Post guideline		Follow up	
	No	%	No	%	No	%
Positive	20	20.0	80	80.0	75	75.0
Negative	80.0	80.0	20	20.0	25	25.0
Mean attitude score	0.822±0.42		2.48±1.04		2.12±0.96	
X ²	X ² (1) = 16.02 X ² (2) = 21.20 X ² (3) = 12.04				P value < 0.001**	

<0.001** highly statistically significant

X² (1) Pre intervention versus post intervention

X² (2) Pre intervention versus follow up

X² (3) Post intervention versus follow up

Table (4) reveals that, there is an improvement in nurses' total attitude immediately, after, and at follow up guideline implementation scores for the majority of them, (80%) and 75% of studied nurses showed positive attitude toward preventing CAUT, while, for the majority (80%) of them, their total attitude toward preventing CAUI was negatively associated pre guideline implementation. As well, this table confirms that, there is an improvement in mean scores of nurses' total attitude immediately, after, and at follow up (after three months) of guideline implementation with a highly statistically significant difference ($P < 0.001$).

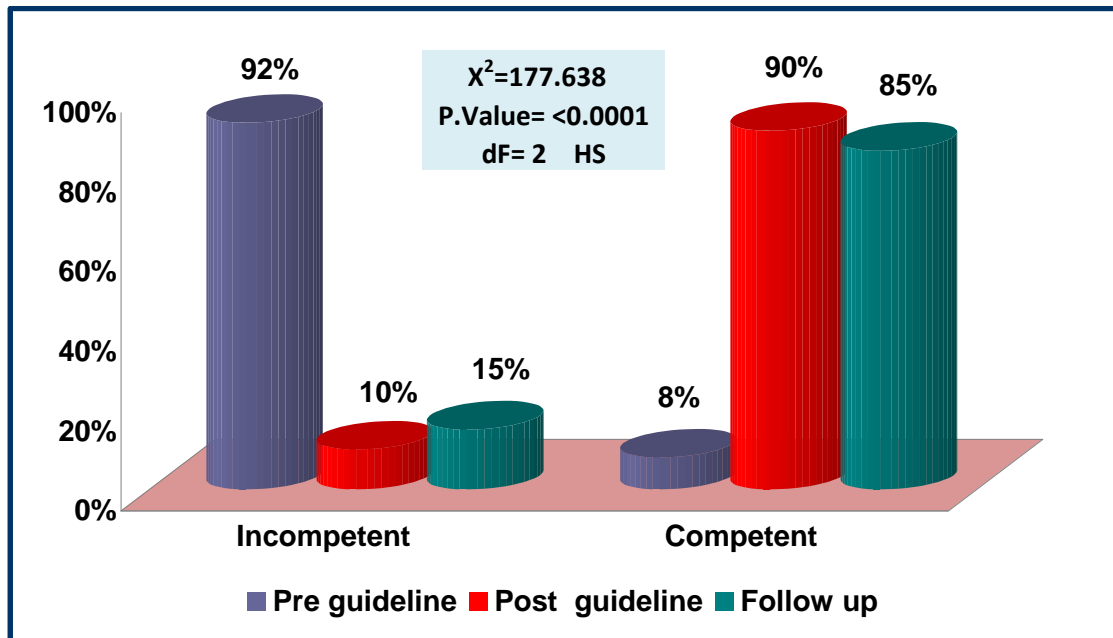


Figure (2): Percentage Distribution of Total Practices Score of the Studied Nurses About Strategies to Prevent Catheter-Associated Urinary Tract Infections in ICU Throughout the Program Phases (n = 100).

Figure (2) illustrates that, as regards the studied nurses' total practices score, most of the studied nurses (92%) had incompetent level before the guideline implementation, which improved for most of them (90%) to have competent practices immediately post guideline implementation. Furthermore, the same figure shows that, majority of studied nurses (85%) had competent level in their total scores of practices in the follow up phase of guideline implementation with a highly statistically significant difference ($P < .0001$).

X. Discussion

The findings of this study revealed that the studied nurses' knowledge toward the preventive strategic guideline of urinary tract infections for more than two thirds of them was unsatisfactory knowledge before the guideline implementation, which improved for most of them to be satisfactory knowledge at post and follow up, as regards indication, types, number of usage days, complications and contraindication of urinary catheterization. As well, urinary tract infections include, definition, causes, complications, and nursing care for CAUTIs (**Table 2**). This may be due to that, the settings of the study do not follow any guideline or give opportunity for attending programs regarding insertion and care of urinary catheter for nurses, which negatively affected their awareness and performance.

These findings are congruent with those of (19), in his study about: "Improving compliance with healthcare associated infections' (HAIs) practice guidelines to reduce the acquisition of HAIs" at the University of Massachusetts, Amherst in US which stated that, unsatisfactory or poor knowledge about indication of urinary catheter, types of urinary catheter, number of usage days, complications of urinary catheter, contraindications of urinary catheter have resulted in major negative effect in the care of UTIs in children and adults patients.

In a similar study, done by (2), about: "Reduction of catheter-associated urinary tract infections, among patients in a neurological intensive care unit: A single institution success" demonstrated that enhancement of health workers' implementation of an evidenced-based UTI prevention bundle can substantially reduce catheter utilization. Their program, which encompassed continuous quality improvement, physician and nursing reminders for early catheter removal, proper indications for catheter insertion, product standardization, and improvements in sterile catheter insertion, maintenance and early removal, all these significantly reduced the

urinary catheter utilization rate. Most importantly, a significant decrease in the rate of CAUTIs was observed. As well, the findings of the present study agreed with those of (12) who identified that, improvement nurses' role toward the primary strategies for CAUTI prevention is reducing unnecessary catheter placement, minimizing the duration of the catheter, appropriate insertion procedure, appropriate indication and contra indications, types of urinary catheter, and urinary catheter number of usage days, in their study about: "Strategies to prevent catheter-associated urinary tract infections in acute care at Cambridge University".

This finding was also supported by (20), who found that, an educational guideline intervention regarding catheter indications, contraindications and appropriate insertion with beginning of active CAUTI surveillance, resulted in an improvement in nursing knowledge and practices in their study entitled: Active training and surveillance: 2 good friends to reduce urinary catheterization rate. Otherwise, (21) mentioned in their study about: "The impact of a quality improvement intervention to reduce nosocomial infections in a PICU" that, hospitalized children with urinary catheters have a significant risk of developing a CAUTI. As well, a significant reduction in CAUTIs was associated with a multidisciplinary, hospital-wide quality improvement (QI) initiative that developed and implemented a pediatric CAUTI prevention strategies through health team.

The present study demonstrates that, the studied nurses' practices improved through guideline implementation phases as most of them don't practices before the guideline implementation regarding to choice of catheter and prepare equipment, routine change in catheter, and use of pre connected system, which improved to reach the majority of them done practices immediately post guideline implementation and at follow up. (Table 3). The researchers opinion in that, lack of knowledge, incompetence in practice, could be attributed to not attending training courses in addition to unavailability of resources, and insufficient materials and equipment in most governmental hospitals which lead to inappropriate nursing care.

On the other hand, patients should be provided with adequate information regarding the need for insertion, maintenance and removal of the catheter by the person planning their care and be given the opportunity to discuss the implications of urinary catheterization as mentioned by (22), in their study about: "Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults".

An educational guideline should be available and applied for newly appointed staff and on a regular basis for HCWs. It should include the following: Indications for catheterization, insertion technique and maintenance of the catheter system, as mentioned by (23), in their study about: "The relationship of indwelling urinary catheters to death, length of hospital stay, functional decline, and nursing home admission in hospitalized medical patients". This result is in accordance with (7) who conducted his research in Walden University, entitled: "The effects of nursing education on decreasing catheter associated urinary tract infection rates", and found that, the educational program for nurses on best practices according to the control disease centre (CDC) guidelines, in their study, pre-educational, CAUTI rates were 10.40, and post-educational intervention, CAUTI rates were zero and the differences were statistically significant ($p < 0.05$), and found that, reducing CAUTI rates in their study was related to the effects of nursing education.

The current study result showed that, there is an improvement in nurses' total knowledge and total practices and there were highly statistically significant differences ($P < 0.001$) between pre, post, and follow up guideline implementation (Figs. 1&2). The researchers attributed this finding to, continuous education for nursing is very important to the patients by promoting safety and ensuring that preventive measures are implemented to reduce the risk of CAUTIs. In addition, annual re-education and reinforcement of the vital behaviors will provide nurses with the complete required knowledge and practices such as, appropriate catheter insertion technique and appropriate care.

Prevention of CAUTI, and information about risk of CAUTI should be provided to health providers, children and family members and would be better in the form of team, task oriented and problem based (6&15).

Recent studies have shown the effectiveness of the implementation of multidimensional urinary tract infection prevention strategies and bundles in critical care units. These strategies have been successfully employed in both adult and pediatric critical care areas. These multidimensional infection control programs for CAUTI prevention have shown reduction in the CAUTI rates of CCUs, which were associated with improvement in hand hygiene, as an integral component of a multi-faceted strategy, and as a result of providing education and training on CAUTI prevention measures by means of introducing bundles of interventions. Thus, improvements in processes of care can lead to a reduction in the risk of CAUTI, and their adverse consequences, especially in CCUs of resource-limited countries like India (24& 25).

In a recurrent study, carried out by (26) suggested that, a method of reducing CAUTI rates in hospital, a multidisciplinary education and training campaign is highly effective. In their case study, the education focused on teaching the latest evidence-based practices, including implementing tightly defined indications for indwelling catheter use, the importance of a daily review, and a discussion of the alternatives to catheterisation. This education was successful in not only reducing the incidence of CAUTI, but also increased the awareness of HCWs about the consequences of CAUTI, and the importance of CAUTI prevention in their study about: "Effects of a catheter-associated urinary tract infection prevention campaign on infection rate, catheter

utilization, and health care workers' perspective at a community Safety Net Hospital previously, (27), in their study about: Reducing inappropriate urinary catheter use: Quality care initiatives, highlighted the importance of teaching nurses about the risks and consequences of CAUTI, and ways of CAUTI prevention.

Alternatively, (28) recommends that the teaching of CAUTI could be integrated into the nurses' learning of the catheterisation skill and reported in their findings that after a period of time, nurses are likely to regress to old habits and practices. This highlights the importance of continuing education, and on-going support for nursing staff. As well, it is mentioned in the CDC Guidelines for CAUTI prevention to "ensure that healthcare personnel and others who take care of catheters are given periodic in-service training regarding techniques and procedures for urinary catheter insertion, maintenance, and removal, in their study about: "A review of strategies to decrease the duration of indwelling urethral catheters and potentially reduce the incidence of catheter associated urinary tract infections".

In this respect, (29 & 30) stated that there is a need to understand the transformation of knowledge into practice regarding Evidence Based Practices (EBPs) and guidelines of IUCs. Therefore, further studies have become essential to the importance of nursing education in EBPs for the reduction of nurse-driven indicators such as CAUTIs, in a study carried out by (31) about the effects of nursing education on decreasing catheter associated urinary tract infection rates in Walden University. From the point of view of researchers, the difference in this study finding was a result for the good effect of the health education program, which had an impact on improving nurses' knowledge, attitudes and practices toward strategies to prevent catheter-associated urinary tract infections, which lead to decreasing CAUTIs rate and its complications:.

The current study showed that there is an improvement in nurses' total attitude immediately post and one month after guideline implementation as the positive attitude. There was a highly statistically significant difference ($P < 0.001$) between pre, post, and follow up (Table 4). This may be due to that, strategic guideline had evident effect on enhancing nursing performance through implementation phases.

Positive attitude towards infection prevention and control can reduce the rate of hospital, acquired infections as respiratory and CAUTIs that which is stated in a study conducted by (16) to assess: "Knowledge and attitude of health-care workers and patients on health care associated infections in a regional hospital in Ghana, and indicated that attitudinal change is the best means of prevention. In this context, (32) assessed the level of knowledge, attitudes and practices regarding disinfection procedures among nurses in Italian hospitals. The study findings revealed an extremely positive attitude towards the utility of guidelines and protocols for disinfection procedures such as, central line, urinary catheter, etc.

The current study results study agreed with those of a study done by (33) entitled: "Findings of the International Nosocomial Infection Control Consortium (INICC) Part I: "Effectiveness of a multidimensional infection control approach on catheter-associated urinary tract infection rates in pediatric intensive care units of 6 developing countries" which stated that, the result of providing education and training on CAUTI prevention measures by means of bundle of interventions. The present study findings confirm that improvements in practices and attitudes can lead to a reduction in the risk of CAUTIs and their adverse consequences in PICUs in resource-limited countries.

This study result is in accordance with (34) who concluded in the study about: "Knowledge, attitudes and practices of nurses in infection prevention and control within a tertiary hospital in Zambia" that, the studied nurses have a satisfactory level of knowledge and positive attitude towards infection prevention and control regarding all invasive procedures. Similarly, (35) assessed knowledge, attitudes and practices of health-care-providers towards waste management, at Ain Shams University Hospitals, in Cairo, Egypt. The study results showed that training and duration of work experience were not significantly associated with knowledge, attitude and practice scores, except for nurses with longer experience, who were more likely to have satisfactory knowledge about waste disposal.

XI. Conclusion

Based on the results of the current study the researchers concluded that: The strategic guideline improved nurses' performance regarding prevention of catheter-associated urinary tract infections in adult and pediatric ICUs.

XII. Recommendations

Based on the findings of the study, the following recommendations were suggested:

1. Publication and dissemination of the strategic guideline in all health service departments and ICUs to improve nurses' performance about the care of urinary catheter and prevention of CAUTIs for adults and children.
2. There is a continuous need to foster sustained improvements in practices toward CAUTIs
3. Further longitudinal study should be done to evaluate the effect of the researchers' strategic guideline on the nurses' performances toward CAUTIs in ICUs and different health service department

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