

Effect of Blended Training on Nurses' Performance Regarding Controlling Catheter Associated Urinary Tract Infection

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Abstract

Background: Catheter Associated Urinary tract infection (CAUTI) is one of the most common complications among intensive care patients. Blended learning is a new effective modality applied to improve nurse's performance in critical care units. **Aim:** the study aims to evaluate the effect of blended training on nurses' performance regarding controlling CAUTI. **Design:** The current research design was a quasi-experimental. **Setting:** The research was performed at Minia University Hospitals in the following intensive care units (ICUs): (Trauma, Stroke, Cardiology, Chest, Urology, and Medical ICUs). **Subjects:** Purposive sample involved 80 nurses recruited to work in the previously mentioned units. **Results:** According to the current study, 63.8% of the samples were female and 88.8% of them were between the ages of 20 and 25 years old. Before the blended training was implemented, only 25% of the nurses had satisfactory level of Knowledge about catheter care; after the training, that number had risen to 95%. In terms of practice post implementing the blended training, about 93.8% of nurses reported satisfactory levels regarding catheter care, compared to 22.5% before the implementation of the blended training. **Conclusion:** Blended training improved the critical care nurses' performance regarding controlling of catheter associated urinary tract infection. **Recommendations:** Repeating the study on a larger sample and use blended learning for upgrading nurses' performance.

Key Words: Blended Training, Nurses' Performance, Catheter Associated Urinary Tract Infection.

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Introduction

The CAUTI is present when an indwelling urinary catheter had been in place for more than 2 days. The best preventive measures involve avoiding unnecessary catheterization and removing catheters as soon as possible. Optimizing aseptic technique, hand hygiene; proper insertion and maintaining a closed drainage system with risk reduction (Schweiger, et al., 2020).

Health-care-associated infections (HAIs) are infections contracted while undergoing medical or surgical treatment. It was linked to

higher mortality and morbidity rates, longer hospital stays, and higher healthcare expenses (Rosenthal, et al., 2020). In low- and middle-income countries (LMICs), the risk of developing HAI is up to 20 times higher. The pooled rates of CAUTI as well as central line-associated bloodstream infections (CLABSI) were three to six times higher according to surveillance from the International Nosocomial Infection Control Collaboration (INICC), which includes 45 LMICs, compared with ICUs in the USA (Azak, et al., 2023).

Healthcare associated infections (HAI) occur among critical patients during their hospital stay at the intensive care units (ICUs) or other healthcare facilities. Also these infections occurred during providing healthcare services for the critical ill patients. HAIs are associated with increased mortality rate and economic burden due to prolonged ICU stay, as well connected with poor prognosis (Zhao, et al., 2020). The most popular forms of HCAI are CLABSI, catheter connected with (UTI) urinary tract infection, ventilator-associated pneumonia (VAP), as well as (SSI) surgical site infection. The CAUTI among patients in ICUs are the most popular device-related HAI and have led to an extended hospital stay, increase morbidity rate, and resistance to bacteria (Edwardson, & Cairns, 2019).

Hospitals can use strategies to reduce CAUTI and prevent it through the application of an accepted, evidence-based bundle of care. Hospitals followed guidelines for CAUTI prevention to help lowering their rates, improve patient outcomes, and reduce costs incurred (Eckert, et al., 2020).

Blended learning (BL) is defined as the deliberate integration of different online and face-to-face (F to F) approaches, including lectures, self-paced exercises, and chat rooms. BL could enhance students' convenience, flexibility, improve their learning outcomes, and enhance their engagement in learning. It also allows instructors to communicate with their students more effectively and create a variety of solutions for academic issues (Alammery, 2019). Blended learning is defined as a combination of face-to-face learning and technology-mediated learning, online learning as an example, simulated video, and self-learning, to reduce course delivery costs, time, and effort (Leidl et al., 2020).

Blended learning refers to courses that are taught both F-to-F and virtually online and that use a well-planned combination of a variety of pedagogic strategies. Training through a combined approaches which would assist ICU nurses in enhancing and developing their current skills and knowledge, which would improve the standard of care. Nurses who are unable to attend in-person training sessions

could now continue their education through online courses and video-assisted teaching modules. (Abd Elaziz, et al., 2020).

Blended learning is a combination of offline and online learning and all types of relevant technology. Blended learning is common in the field of education as well as in other fields like nursing training. BL is hugely valuable because a teacher takes on a more active role as a mentor or coach who provides specific instructions (Ayob, et al., 2020). So the present study was implemented to help ICU nurses controlling CAUTI and demonstrate urethral catheter insertion in an ideal way according to the evidence-based guidelines for CAUTI prevention.

According to researchers' opinion, training by using the BL would help ICU nurses to develop and refine their existing skills and knowledge, which would lead to improve quality of care and its competence. Training sessions through online courses and video simulation could now be given to nurses in order to continue their education and to save time and effort that related to improve their performance.

Significance of the study;

Intensive Care Unit records at Minia University Hospitals revealed that more than fifty percent of patients admitted to the intensive care units at the year (2019–2020) developed CAUTI. The investigators observed that patients admitted to the ICU were at risk to develop CAUTI regarding their length of stay in the previous mentioned settings. Therefore, the current research is being conducted to train ICU nurses' staff to improve their performance regarding controlling catheter-associated urinary tract infection.

The reported incidence of CAUTI worldwide was approximately 35% of all HAI types. The CAUTI rates in ICUs were 13.05/1000 catheter-days, in relation to the Egyptian Ministry of Health and Population. However, a different study conducted in ICUs at Alexandria, Egypt, indicated that the rates were 15.7/1000 catheter-days. Between 3 - 7% chances of having CAUTI were estimated daily (Abdelmoaty, et al., 2020).

Aim of the study:

To evaluate the effect of blended training on nurses' performance regarding controlling catheter-associated urinary tract infection.

Hypothesis:

The current study hypothesized that:

1. Blended training will improve nurses' knowledge regarding controlling catheter-associated urinary tract infection.
2. Blended training will improve nurses' practice level regarding controlling catheter-associated urinary tract infection.

Design

A pre- and post-test quasi-experimental approach was utilized to conduct the current study.

Setting

The current study conducted at the following units (Trauma ICU, Stroke Unit, Cardiology ICU, Chest ICU, Urology ICU, and Medical ICU) which were affiliated at Minia University Hospitals in Minia City, Egypt.

Subjects

Purposive sample involved 80 nurses who recruited to work in the previously mentioned ICUs were involved in the study. The study included the ICU nurses who accept to participate in the study and they didn't take any training regarding controlling catheter associated urinary tract infection.

According to Isaac and Michael (1995) Formula, which determined the following values ($N = nx30/100$), which used to estimate the sample size.

- N =minimum sample size
- n =total number of 200 critical care nurses working in the previously mentioned ICUs during the period 2019:2020.
- $N = 200 \times 30 / 100 = 60$ nurse

Minimum Sample size: were 60 nurses.

Tools of the study: Two Tools were utilized for gathering data in this study.

First Tool: Nurses' Demographic Characteristics included name or code, age, sex, and experience years at ICUs.

Second Tool: Nurses Assessment Questionnaire it is divided into two parts.

First Part: Nurses' Knowledge Level: (pre/posttest) structured multiple choice questionnaire created by the researchers after revision the relevant literatures (**Mark, 2019**), (**Berman, et al., 2018**) and (**Lynn, 2018**).

This tool utilized to assess nurses' level of knowledge at ICU regarding CAUTI.

The structured multiple-choice questionnaire included: Definition of urinary catheter insertion, and CAUTI. Clinical manifestations regarding catheter relation to nosocomial infection, the CAUTI prevention measures, and ICUs nurses' role during applying catheter care.

The questionnaire scorings system based on (Selim et al., 2018): Each correct answer graded by one score as well as the wrong answer graded by zero score. If the score less than seventy-five percent it indicated unsatisfactory level of knowledge, but if it's equal or greater than seventy-five percent it indicated satisfactory level of knowledge.

Second Part: Nurses' Practice Observational Check List: it was developed by the researchers after revision pertinent literatures (**Mark, 2019**), (**Berman, et al., 2018**) and (**Lynn, 2018**) and center of disease control and prevention (CDC). This part covered the procedure steps of urinary catheter insertion technics, catheter care post insertion, and removing technics.

Scoring system of the Nurses' Practice Level based on (Selim et al., 2018): Each correct step done graded by one score as well as the incorrect step graded by zero score. If the score less than seventy-five percent it indicated unsatisfactory level of practice, but if it's equal

to or greater than seventy-five percent it indicated satisfactory level of practice.

Tools Validity:

To determine the extent to which the instruments measure what is intended to be measured, content validity analysis was performed. Five experienced in critical field, including one professor, two assistant professors, and two lecturers from Minia University's Faculty of Nursing, evaluated the data collection tools. All the tools get (100.0%) concurred that the present study instruments were legitimate and pertinent to the study's goal.

Tools Reliability

Reliability was assured statistically by using the Alpha Cronbach test to guarantee that the research tools were reliable. The nurses' knowledge level, and nurse's practice level reliability were (0.71 and 0.86) respectively.

Ethical Considerations:

Before starting the research, the research ethics committee at the nursing faculty approved it. Following an explanation of the study's objectives, to the chief nurses of the ICUs and the hospital's competent authorities gave their approval for the study to proceed. Nurse's consent was obtained before participation in the study post explaining the study's goals and purpose by the researcher. To guarantee that nurses' willingness to participate in the study, their written consent was collected online. The researcher upheld the subjects' data's confidentiality. The nurses were made aware that they might leave their participation in the study at any time without facing any consequences.

The Pilot Study:

The pilot study carried out on (10 %) of the study participants to evaluate the instruments' applicability, the study's viability, and to estimate time needed to fill in the study tools. There were no modifications needed regarding the study tools post the pilot study. Data collection tools were not changed in response to the pilot study's findings. So nurses who participated in the pilot study were included in the study.

Filed Work:

This study was performed through **three phases:** (preparatory, implementation, and evaluation) phases.

1- Preparatory Phase:

The nurses who worked in ICUs setting mentioned before were informed by the researcher about the aim as well as nature of the research. Official letters were sent to the Minia Hospital Directors, and permission was obtained from the nursing faculty research ethics committee before beginning of data collection. The period for gathering data lasted a total of 15 months, from May 2020 to July 2021. The researchers explained the nature and purpose of the study and then obtained online written consent from those who accepted to participate in this study. Before the study begins, ICU nurses assessed their level of knowledge to serve as a baseline for comparison with the test performed after the training. The pre-test was presented to them online using social media. The assessment of nurses' practice level during catheterization procedures, maintenance, and the prevention of CAUTI at ICUs was observed by the researchers once (face to face during their actual shifts) before introducing the simulated video online for training. This was done to be used as a baseline for later comparisons with future posttests.

2-Implementation Phase:

Blended training sessions designed by the researchers based on the pre-test result as an earlier evaluation of ICU nurses' knowledge and practice. So the analysis of the assessment phase used by the researchers to identify nurses needs in order to develop the content of the blended training sessions Following the pre-test, the researchers start the blending training sessions by theoretical lectures that included four recorded videos regarding urinary catheter insertion technique, maintenance, CAUTI, ICU nosocomial infection, and the prevention measures accordance with the CDC recommendations. The theoretical parts and the simulated video covered the previously mentioned items were developed in English and Arabic Language by the researchers depends on revision of the pertinent literature. It was sent to

the study sample online via the social media of what's app web, Facebook, and Messenger to be available for the ICU nurses at any time. The duration of each session was 45 minutes, divided into 35 minutes for the theoretical discussion utilized the presentation of power point and then 10 minutes for summarizing the session content.

The first session was given to the study sample online included the theoretical part through video about urinary catheters, insertion technique, maintenance, CAUTI, ICU nosocomial infection, and its preventive measures. At the starting of this session, the researchers explained the purpose of the research. At the second session's a simulated video regarding the aim for using aseptic technique during urinary catheter insertion and removal techniques which was sent to the study sample online. The third session was conducted face-to-face with the study sample to train each nurse individually about urinary catheters, insertion technique, catheter care post insertion, and technique of urinary catheter removal using a simulated manikin. This was done at the faculty of nursing training lab, to make sure that each nurse included in the study sample performed these techniques correctly.

3-Evaluation Phase:

The last phase of blended training session is the evaluation phase, which involves monitoring the post-test for nurses' knowledge using the same online pre-test questionnaire. After a month from the end of the training using the same previously mentioned social media nurse's outcome were assessed using the same pre assessment tools and compared the results between the pre and post-test questionnaire using the first part of the second tool to assess nurses knowledge. Monitoring the nurses' practice regarding urinary catheters, insertion technique, post-urinary catheter insertion care, and technique of urinary catheter removal were done using the second part of the second tool which was conducted face-to-face.

Statistical Analysis

With the use of a computer and the Statistical Package for Social Services, Version 20 program, the gathered data was input and examined (SPSS). Tables and graphs were used

to display the results. A mean and standard deviation were used to depict continuous data. Frequency and proportional representations of qualitative data were used. Quantitative data were analyzed using the Student's t test (t), and McNemar test was used to test paired data as appropriate, it was used to determine if there were differences on a dichotomous dependent variable between to related groups. A p value of 0.05 was considered significant in each test. Using Pearson correlation, correlation was tested.

Results

Figure 1: Showed that 88.8% of the study samples' ages ranged from 20 to 25 years old and 63.8% of them were female. In relation to experience's years, it was found that 83.8% had less than 5 years' experience.

Table 1: Showed that 75% of nurses had unsatisfactory knowledge level regarding catheter care before implementing the blended training, while nearly all nurses (95%) had a satisfactory knowledge level regarding catheter care and CAUTI prevention after implementation of the blended training with a highly statistically significant difference presented by P value equal (0.001).

Table 2: revealed a highly statistically significant difference regarding nurses' practice scores towards female and male catheter insertion as well as CAUTI prevention, as evidenced by p value equal 0.001.

Table 3: Demonstrated that 77.5% of nurses had unsatisfactory practice level regarding catheter care before implementing the blended training, while 93.75% had a satisfactory practice level after training, with a highly statistically significant difference presented by P value equal 0.001.

Figure 2: revealed that before training, the mean score of nurses' knowledge and practice regarding catheter care and CAUTIs prevention were 22.2 ± 2.66 and 45.6 ± 8.49 respectively, after training, the mean score improved to 29.1 ± 1.53 and 59.6 ± 3.87 respectively.

Table 4: The table showed a positive statistically significant correlation between nurses' knowledge and practice after Blended Training implementation ($P = 0.049$).

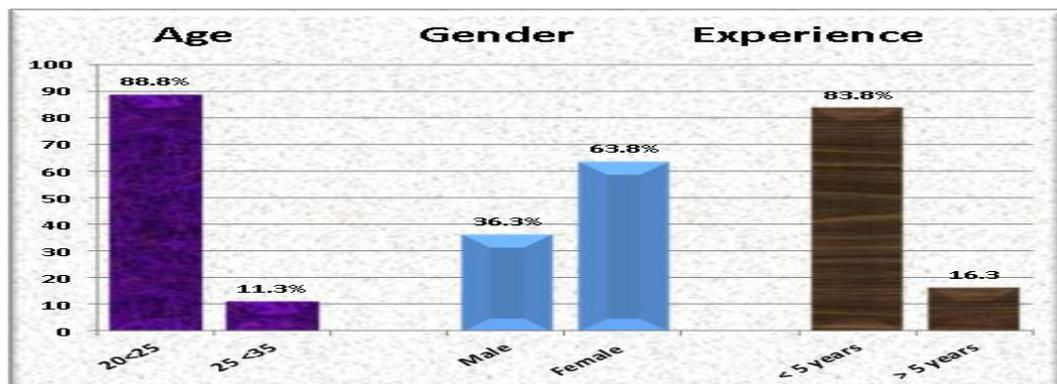


Figure 1: Distribution of Study Subjects Regarding Their Demographic Characteristics (n = 80)

Table 1: Distribution of Nurses' Knowledge Level Regarding Catheter Care and CAUTI Prevention Before and After the Execution of the Blended Training (n = 80)

Knowledge Level	Pretest		Posttest		P. Value
	No.	%	No.	%	
Un-satisfactory Knowledge	60	75	4	5	0.001**
Satisfactory Knowledge	20	25	76	95	

** Highly Statistically Significant with ($P \leq 0.001$) P Value: Mc Nemar Test.

Table 2: Mean Scores of Nurses' Practice Regarding Catheter Insertion and CAUTIs Prevention Pre and Post Implementing of the Blended Training (n = 80)

Nurse's Practice Score	Pretest	Posttest	P. Value
	Mean \pm SD	Mean \pm SD	
Female Catheter Insertion.	16.3 \pm 2.08	22.3 \pm 1.81	0.001**
Male Catheter Insertion.	20.7 \pm 1.38	25.2 \pm 1.20	0.001**
CAUTI Prevention.	6.50 \pm 1.87	12.5 \pm 1.24	0.001**

** Highly Statistically Significant with ($P \leq 0.001$) P value: Paired Sample t Test.

Table 3: Percentage Distribution of Nurses Practice Level Regarding Catheter Care Before and After Implementing the Blended Training (n = 80)

Nurses Practice Level	Pretest		Posttest		P. Value
	No.	%	No.	%	
Un-satisfactory Practice Level	62	77.5	5	6.25	0.001**
Satisfactory Practice Level	18	22.5	75	93.75	

** Highly Statistically Significant with ($P \leq 0.01$) P value: McNemar test

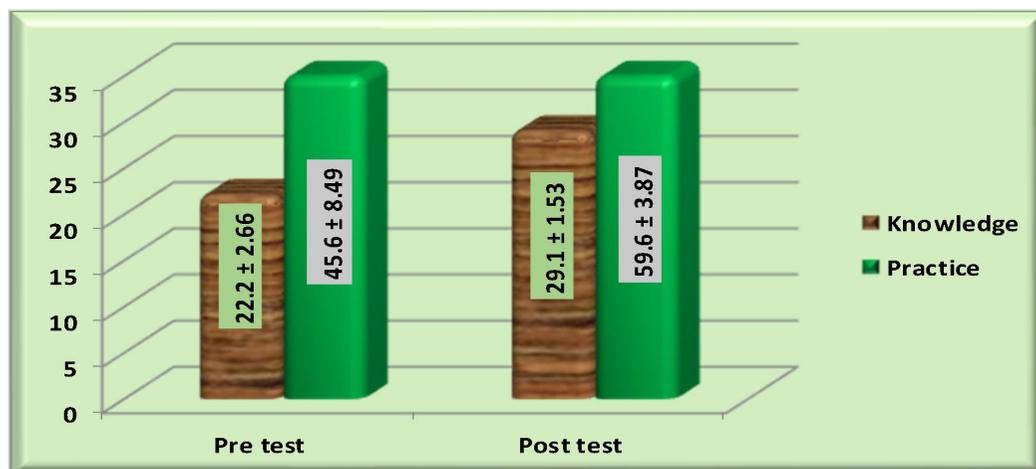


Figure 2: Mean Score of Nurses' Knowledge and Practice Regarding CAUTI Prevention, Pre and Post Implementation of the Blended Training (n = 80)

Table 4: Correlation between the Nurse's Total Knowledge Score and the Total Practice Score Regarding Catheter Care, Pre- and Post-Implementation of the Blended Training (n = 80)

	Total Knowledge			
	Pretest		Posttest	
	R	P	r	P
Total Practice	0.490	0.078	0.646	0.049*

* Statistical Significant ($P \leq 0.05$).

Discussion

The HAIs are infections contracted while undergoing medical or surgical treatment. It was linked to higher mortality and morbidity rates, long hospital stays, and higher healthcare expenses (Rosenthal, et al., 2020). In low- and middle-income countries (LMICs), the risk of developing HAI is up to twenty times higher than the international level. The pooled rates of CAUTI and CLABSI were three to six times higher according to surveillance from the IINICC, which includes 45 LMICs, compared with ICUs in the USA (Azak, et al., 2023)

In hospitals, particularly in ICUs, urinary catheterization is a vital procedure. The inappropriate use of urinary catheters and disregard for catheterization instructions account for roughly 70–80% of all acquired UTI (Majumder et al., 2018). Most CAUTIs could be avoided by adhering to the right procedures and precautions, such as washing hands properly using the right methods, taking meticulous care of any indwelling catheters and removing catheters by the correct way. Urinary

catheterization that is not necessary should not last for an extended period (Balu et al., 2021).

Evidence-based practices must be guided to enhance nursing practice in the ICUs and patient outcomes. Innovative approaches should be applied in nursing training to enhance continuous nursing education. BL training becomes a more popular design for formal training. With the fast enhancement of technologies and practice both enabling the improvement of online education in combination with face-to-face education, as this become a newly ubiquitous educational mode which expected to be continue and displayed in the critical care nursing specialty. (Kim, et al., 2021).

The current research finding observed that the majority of the nurses were between the ages of 20 and 25 years old, the majority was female. While the outcomes of the present study showed that the majority of participants had less than five years of experience. The findings were in line with a study done by (Algarni, et al., 2019), who found that greater than fifty of the studied participants were female. While in a

study done by (Crentsil, 2020), found that less than quarter of the nurses' were among the ages of twenty to thirty years old, and 32.2 percent had less than 5 years of experience,

Concerning nurse's knowledge in relation to catheter care and CAUTI prevention, the current outcomes showed that greater than fifty percent of nurses had unsatisfactory knowledge level during the baseline observation, while most of them had satisfactory knowledge level after implementing the blended training. This was consistent with, a study done by (Mukakamanzi 2017) who found that the majority of ICUs nurses (64.52%) had unsatisfactory knowledge level regarding CAUTI prevention. While in study done by (Shehzadi et al. 2018) they reported that about fifty of the participants in Pakistan had little understanding about CAUTI prevention. As the greater number of nurses had unsatisfactory knowledge level regarding prevention of CAUTI, which may be the great reason for getting CAUTI among patients via length of the hospital stay. The present study results were agreed with the finding of study done by (Abdelmoaty, et al., 2020) who reported that nurse's median knowledge had changed from fifty prior to training into 81.25 out of one hundred points after execution of the blended designed education.

Current research result found that, more than half of the study nurses possess inadequate practices regarding to catheter insertion and CAUTI prevention prior to implementing the BL training as a simulated video. This result agrees with a study done by (Selim et al. 2018), who discovered a significant number of nurses had implemented several CAUTI preventive methods improperly. When compared to prior training, the causes of unsatisfactory nurses' practice may be due to that nurses did not follow CAUTIs prevention guidelines effectively.

The ICU nurses' level of practice had increased after implementing the blended training. The use of blended training, which combines with an online lectures with simulated videos and then followed by an application on virtual manikin training to demonstrate and re-display catheter insertion, management, and

removal procedures, which had a significant impact on the training. This result agreed with the finding of a study done by (Crentsil, 2020) who documented that education enhanced nurses' competence to insert, maintain, and remove catheters, improved patient outcomes and reduced the risk of CAUTIs. The current study's findings are consistent with the finding of a study done by (Mudgal's 2018) who demonstrates that staff nurses who received educational training their mean practice scores post-test significantly become higher than their pre-test scores.

Present study finding clearly showed that, the level of nurses' practice prior to and following blended training showed highly statistically significant different between both finding. This finding reflects the positive effect of blended training on nurses' knowledge and practice levels and their participation in the training which improved urinary catheter management. This is in accordance with the finding of a study done by (Selim et al. 2018) who reported that urinary catheterization procedures in the analyzed intensive care units improved significantly following the intervention.

The present research revealed a significant connection between nurses' knowledge and practices levels, which reinforced the idea that knowledge could be enhance practice. The similar findings seen by the finding of a study done by (Oswald et al. 2020) who Prove that it is important to enhance online educational training to increase nurses' knowledge and practice about catheter management and prevention of complications. The present finding agrees with the finding of a study done by (Zachariah 2016), who reported a strong, positive correlation between nurses' knowledge and CAUTI prevention methods. This result does not match with the finding of a study done by (Anwar et al. 2017), who clarify that although no statistically significant correlation between nurses' knowledge as well as practices concerning the CAUTI was found, but this could be due to decrease nurses' knowledge and practices levels.

The current study findings proved the importance of blended training in improving

critical care nurses' knowledge and practice as the combining between the online and face to face training had improved nurses' attention, provided a chance to repeat the training session after seeing simulated video more than once, and allowed open discussion about knowledge and practice regarding catheter insertion, care according to the CDC infection control guide, and CAUTI prevention in order to improve ICU nurses competence.

According to the finding of a study done by (Keane, et al., 2020) who reported that a small number of studies found that online simulation may be useful to healthcare professionals working in various health care settings, In same line the finding of a study done by (Alex, et al., 2022) who reported that combining simulated training experiences with audio-visual online collaborative learning facilities and enables learner to be involved in the training process, encourage them for interpersonal relation between the learner and the educator, and promotes open participation during conducting the training of knowledge into practice.

Conclusion

According to the current research finding, blended training was a successful strategy for raising ICU nurses' performance levels regarding urinary catheter care and CAUTI prevention.

Recommendations

Repeating the study on a larger sample. Blended training should be widely used for all nurses in different units and departments to ensure updated knowledge and practices through continuing education centers.

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