Training Nursing Staff on Infection Control to Prevent Central Line-Associated Bloodstream Infection

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ABSTRACT

Background: The nursing staff has a crucial responsibility for preventing bloodstream infection in patients who have a central line. **This Study Aimed to** evaluate the effect of training nursing staff on infection control guidelines to prevent central line-related bloodstream infections. **Method:** one-group pre-post-test quasi-experimental research design was used. The study was conducted at the intensive care units of Al-Mahala General Hospital. Three tools were used to collect data about the nursing staff's socio-demographic and occupational characteristics, knowledge, and performance. **Results:** There was a statistically significant variation in nursing staff's total knowledge and performance score levels between pre- and post-training sessions about preventing central line-associated bloodstream infection ($p = 0.001$). **Conclusion:** The current study reveals that almost most of the nursing staff had an incompetent total level of knowledge regarding central line-associated bloodstream infection pre-training session implementation, which improved to almost most having a competent total level of knowledge post-training session implementation, and almost the majority of the nursing staff had an incompetent total level of performance regarding preventing central line-associated bloodstream infection pre-training session implementation, which changed to more than half having a competent total level of performance post-training session implementation. **Recommendation:** Scheduling on-duty training sessions for nursing staff on the prevention of central line-related bloodstream infection to ensure their competencies.

Keywords: Bundle, Central Line-Associated Bloodstream Infection, Intensive Care Units, Nursing Staff, Training Session

Introduction

Hospital-acquired infections are infections (HAIs) that occur while receiving healthcare, develop in a hospital or other healthcare facility, and first appear 48 hours or more after hospital admission or within 30 days after having received healthcare **(Haque, Sartelli, McKimm, & Abu Bakar, 2018).** Central line-associated bloodstream infection (CLABSI) is a serious infection that occurs when germs enter the bloodstream through the central line **(Centres for Diseases Control and Prevention [CDC], 2011).**

Implementing central line insertion and maintenance bundles effectively can reduce CLABSI prevalence in intensive care units (ICUs). Wherein a bundle is a set of evidence-based measures that, when implemented together, have been shown to produce better outcomes and have a greater impact than the implementation of individual measures **(Gupta et al., 2021).**

Nurses constitute most healthcare workers as they are rendered in hospitals seven days a week, round the clock, for the full year, and work close to patients.

Nurses are crucial to the prevention of HAIs. Hence, a huge emphasis is being laid on educating and training healthcare workers, especially nurses,to reduce HAIs **(Kakkar, Bala, & Arora, 2021).**

Indeed, nurses' knowledge is essential to the successful prevention and control of infections. Insufficient knowledge regarding the suitability, effectiveness, and application of infection prevention and control (IPC) measures establishes low compliance. The cornerstones of an improvement in IPC practices are education and training to get over these obstacles **(Alhumaid et al., 2021).**

While existing studies have explored the immediate impact of training on knowledge and adherence to IPC measures, intervention studies on this issue still need to target various health team members in general, especially the nursing staff in healthcare facilities.

The study aim

This study aimed to evaluate the effect of training nursing staff on infection control guidelines to prevent CLABSI.

Research Hypotheses

H1: The training on the infection control guideline to prevent CLABSI improves the nursing staff's level of knowledge.

H2: The training on the infection control guideline to prevent CLABSI improves the nursing staff's level of performance.

Method

Design

One-group pre-post-test quasi-experimental research design was utilized.

Setting

This study was carried out at the ICUs of Al-Mahala General Hospital, one of the Ministry of Health and Population, institutions which are composed of five units: medical, surgical, pediatric, cardiac, and neurology.

Participants and Sampling

The study participants included nursing staff working in the above-mentioned setting from both genders, with different qualifications, and being directly involved in patient care. The researchers enrolled 181 out of all on-duty nursing staff (201), 20 nursing staff for pilot testing, with a convenient sampling technique.

Data Collection Tools

Data was gathered using the following developed tools, which were reviewed for face and content validity by a jury panel of five experts from the community health nursing Faculty of Nursing Mansoura University for relevancy, applicability, and comprehensiveness, and according to their opinions, necessary modifications were made accordingly.

Tool I: Self-Administered A Structured Socio-Demographic and Occupational Traits Questionnaire for Nursing Staff. The researchers identified age, place of residence, qualifications, gender, and training courses of nursing staff.

Tool II: Self-Administered Structured Knowledge Questionnaire for Nursing staff. This questionnaire was developed based on Haddadin, Annamaraju, and Regunath (2022); Buetti et al. (2022); Gahlot, Nigam, Kumar, Yadav, and Anupurba (2014) in Arabic and included seven items as follows:

definition of central line (3 items), definition of CLABSI (2 items), risk factors for developing CLABSI (9 items), signs and symptoms of CLABSI (7 items), causes of developing CLABSI (4 items), method of diagnosis of CLABSI (2 items),and insertion and maintenance bundles to prevent the incidence of CLABSI (9 items).

Scoring system. Every right answer was weighted with a mark, while the erroneous or unknown answer was weighted with zero. The knowledge score varied from zero to seven. The knowledge levels were divided into the following three groups based on the researchers' cut-off point.

Incompetent for below 60% of the total scores (below 4.2)Improving from 60% to below85% of the total scores (from 4.2 to below 5.95)Competent for 85% and more of the total scores (5.95 and more)

Tool III: Nursing Staff's Performance Observational checklist. This checklist was in English, Covered two parts, and included 42 statements as follows: prevention of CLABSI proper insertion practices (27 items), prevention of CLABSI handling and maintaining central lines appropriately (15 items), based on CDC (2010). *Scoring system.* Each correct step was weighted with one mark and zero for incorrect. According to the researchers' cut-point, the performance levels were divided into three levels, as follows:

Incompetent for below 60% of the total scores (below 25.2)

Improving from 60% to below 85% of the total scores (from 58.8 to below than 35.7)

Competent for 85% and more of the total scores (35.7 and more)

Tools Reliability Cronbach's alpha was used to test study tools. Its value of the nursing staff knowledge domain was 0.848 and of the nursing staff performance domain was 0.823.

A Pilot Study was conducted on 10% (20 nursing staff) recruited conveniently and omitted from the actual sample for testing, reliability, and relevance of the study tools. There was no required modification.

The Faculty of Nursing, Mansoura University's Research Ethics Committee, revised and approved this study's research proposal. The participants verbally agreed to participate in the study. They were informed about the study's aim

and assured that their identities and responses were kept anonymous and confidential, their participation was voluntary, and it would have no effect on their work conditions. It was explained to participants that they could ask any questions they had about the study and withdraw at any moment; no explanation was needed.

The director of Al-Mahala General Hospital, which is affiliated with the Ministry of Health and Population, received an official letter from the Mansoura University Faculty of Nursing requesting permission to perform the current study.

Preliminary assessment. The principal researcher attended ICUs at Al-Mahala General Hospital three days per week (Saturday, Sunday, and Thursday), covering the three work shifts. The nursing staff's socio-demographic and occupational characteristics were identified, knowledge was assessed, and concealed observation on the performance was (indirectly) using tools I, II, and III. This step started from September 2023 to October 20, 2023.

Content development. The researchers developed the training contents in detail based on the initial preliminary assessment findings, the Egyptian National Guide toInfection Control (2020), and a literature review; the researchers developed the

contents of the training in detail. The message focused on what the nursing staff had to know and perform. The contents were written in English, in short sentences, and a positive voice encouraged the nursing staff to comply with standards. In addition, the contents were supported with illustrative figures and videos. The researchers utilized different teaching materials, such as audiovisual aids, a booklet, PowerPoint presentations, and videos, through different teaching methods such as group discussion, interactive lectures, demonstrations, and re-demonstrations, during the implementation of the training.

Implementation of the training sessions. This stage included training sessions covering theoretical and practical aspects related to the infection control guidelines to prevent CLABSI. The principal researcher divided participants into five groups according to their working units (medical, surgical, pediatric, cardiac, and neurology). The principal researcher implemented

training sessions; each session lasted for one hour for each group. The principal researcher replicated the same training sessions for the other four groups (G2-G5). Each training session started at 6 p.m.–7 p.m. And this step started from November 2023 to January 22, 2024.

Evaluation phase. Following completion of the training, the principal researcher administered a post-test by following the same technique as in the pre-test to assess the effect of the training on improving the nursing staff's knowledge and performance regarding the prevention of CLABSI.

Statistical Analysis

The gathered data was organized, categorized, coded, and tabulated. Suitable statistical tests were used to present the obtained data and test the significance of the results. IBM's SPSS statistics version (20) was utilized for statistical analysis of the collected data.

Results

Table1 shows that 40.8% of nursing staff were aged below 30 years, with a mean of 26.94 (4.87). Regarding gender, marital status, and residence, 98.9%, 79.6%, and 57.5% of nursing staff were women, married, and residents of rural areas, respectively. A bachelor of nursing was a level of education for 50.8% of nursing staff. Finally, 51.8% of nursing staff had less than five years of experience, with a mean of 4.86 (2.83).

Table 2 illustrates that 37% of nursing staff attended training courses, while 88.05% had less than two training courses.

Table 3 clarifies that there was a statistically significant variation in the knowledge level score of nursing staff between pre- and post-training sessions about central line-related bloodstream infection (p = 0.001) since 89% of the nursing staff had an incompetent level score pre-training, which changed to 88.4% having a competent level score post-training sessions.

Table 4 clarifies that there was a statistically significant variation in the nursing staff's performance levels score pre- and post-training sessions about preventing CLABSI. (p = 0.001) since 77.9% of the nursing staff had an incompetent level score pre-training, which changed to 58.6% having a competent level score post-training sessions.

Table 1 *Nursing Staff's Socio-Demographic and Occupational Characteristics*

Item	n (181)	%
Age		
20 > 25	51	28.1
25 > 30	74	40.8
30 and more	56	31.1
Mean (SD)	26.94(4.87)	
Gender		
Male	2	1.1
Female	179	98.9
Marital status		
widow	11	6.1
Single	26	14.7
Married	144	79.6
Residence		
Urban	77	42.5
Rural	104	57.5
Qualifications		
Technician nursing	2	1.1
Diploma in nursing	86	47.5
Bachelor in nursing	92	50.8
Master's degree in nursing	1	0.6
Years of work experience		
0 > 5	94	51.8
5 >10	74	40.9
10 >15	12	6.7
15 and more	1	0.6
Mean (SD)	4.86(2.83)	

Table 2 *Nursing Staff's Participation in the Training Program*

Item	n =181	%
Participating in a training program	67	37.0
Number of training courses		
1 to less than 2	59	88.05
2 and more	8	11.94

Table 3 *Nursing Staff's Levels of Knowledge Regarding Central Line-Related Blood Stream Infection Pre- and Post-Training Sessions*

Knowledge level	Test time n =181				t. test	p value
	Pre		Post			
	n	%	n	%		
CLABSI Total knowledge						
Competent	2	1.1	160	88.4		
Improving	18	9,9	21	11.6	49.813	0.001
Incompetent	161	89.0	0	0.0		
$\bar{x}$ (SD)	16.02(4.53)		33.34(2.44)			

Table 4 *Nursing Staff's Total Score Levels of Performance Regarding Prevention of Central Line-Related Bloodstream Infection Pre- and Post-Training Sessions*

performances	Test time n =181				t. test	p value
	Pre		Post			
	n	%	n	%		
CLABSI total performance						
Competent	2	1.1	106	58.6		
Improving	38	21.0	71	39.2	35.966	0.001
Incompetent	141	77.9	4	2.3		
x̄ (SD)	20.61(3.98)		35.51(3.05)			

Discussion

The CDC defines HAIs as infections or complications resulting from surgery or device implantation. These HAIs result in higher rates of death, morbidity, and a substantial financial burden **(Ganesan et al., 2021).**

It has been shown that the implementation of care bundles reduces the incidence of HAIs, and the rate of infection has significantly decreased as a result of implementing infection control educational programs and providing continuing performance evaluations **(Negm et al., 2021).**

The current study reveals that almost most of the nursing staff had an incompetent level of knowledge about CLABSI pre-training session implementation, which improved to almost most having a competent total

level of knowledge post-training session implementation.

This was in line with **Aloush (2018),** who demonstrated that ICU nurses' knowledge about CVC prevention guidelines was inadequate; however, significant improvement was achieved in their knowledge after the completion of the educational program. Furthermore, **Al Qadire and Hani (2022)** study in critical care units in Jordan indicated that there was a lack of knowledge among nurses regarding the criteria for preventing CLABSI.

Based on **Dyk, Matusiak, Cudak, Gutysz-Wojnicka, and Mędrzycka-Dąbrowska (2021),** a study in ICUs in Poland showed that the nursing staff's

knowledge about the recommended practices for preventing CLABSIs was inadequate. Also, **Badparva et al. (2023)** presented that ICU nurses had inadequate knowledge of how to prevent CLABSI.

The results of this study report that almost the majority of the nursing staff had an incompetent total level of performance about preventing CLABSI pre-training session implementation, which changed to more than half having a competent total level of performance post-training session implementation.

These results are in agreement with **Singh, Pandey, Aggarwal, and Pal (2023),** who displayed in a study in Haryana State, India, that the healthcare providers' practices significantly improved as a result of the educational intervention in the prevention of CLABSI.

As well as **Sahni et al. (2017),** a study at an ICU Tertiary Care Center in North India, showed that, following extensive education and training of staff nurses on hand hygiene and CLABSI bundles, there was a significant reduction in the incidence of CLABSI in the post-intervention phase.

A Chinese study in Guangdong Province by **Chi et al. (2020)** and another one in ICUs of Alexandria Main University Hospital, Egypt by **Alkubati, Ahmed, Mohamed, Fayed, and Asfour (2015)** illustrated a lack of practice regarding evidence-based guidelines for the prevention of CLABSIs among ICU nurses and healthcare workers, respectively.

In addition, **Oliveira et al. (2023)** illustrated that implementing educational programs increases nursing compliance with CLABSI prevention practices; also, a study in Taiwan ICUs by **Lai et al. (2018)** illustrated that implementing central-line bundles reduces the rates of CLABSI.

In light of the researchers' perspective, these results can be linked to, first, the younger age of nursing staff, which is linked with relatively shorter years of experience. Second, almost half of the nursing staff graduated from the Technical Institute of Nursing. Third, less than two-thirds of nursing staff attended training courses but a smaller number; all of these factors contribute to

incompetent knowledge and performance. Therefore, continuous education and training are important to sustain nursing staff knowledge and performance up to recent evidence.

Conclusion

Based on the findings of this study, the researcher concludes that there is a statistically significant improvement in nursing staff knowledge and performance about preventing CLABSI pre- and post-training sessions as almost most of the nursing staff had an incompetent total level of knowledge regarding CLABSI pre-training session implementation, which improved to almost most having a competent total level of knowledge post-training session implementation and almost the majority of the nursing staff had an incompetent total level of performance regarding preventing CLABSI pre-training session, which changed to more than half having a competent total level of performance post-training session implementation.

Recommendation

Considering the results of the study, the following recommendations are suggested: Scheduling on-duty training sessions for nursing staff on the prevention of CLABSI to ensure their competencies. Adopting visualization reminders concerning measures for the prevention of CLABSI. Supervising and coaching nursing staff during three working shifts to ensure adherence to CLABSI prevention, and Conducting further research to explore other factors that contribute to nursing staff adherence to CLABSI prevention guidelines.

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Conflict of Interests

Conflicts of interest do not exist for the authors

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