Effect of Care Bundle Education Program on nurses' knowledge and practice Regarding CLABSI in NICU

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ABSTRACT

Background: Neonatal nurses in neonatal intensive care units play the most direct and continuous role in the care and maintenance of the CVC insertion site and should have experience with supportive care activities in the insertion and maintenance of central lines. Therefore, neonatal nurses are well- positioned to implement the recommendations and have a unique opportunity to contribute to the primary prevention of these infections through evidence-based best practices. ***Aim***: Explore the effect of an educational program about central venous catheter bundle care on nurses' performance and bloodstream infection in neonates. ***Subjects and Method:*** A quasi experimental (one group pre, post-test and follow up 3 months later) research design was utilized to conduct this study was conducted at Neonatal Intensive Care Unit (NICU) at one of the Ministry of Health hospitals, titled Minya El Qamh Central Hospital in Sharqia governorate. A convenient sample of all available nurses working in the previously mentioned study setting was included during period of data collection (33 nurses). Three tools were used to gather the required data consisted of; Tool (1) Assesse the nurses' knowledge about central venous catheters. ***Results:*** Clarifies that there was statistically significant inverse correlation between nurses' knowledge, practice and attitude scores and incidence of infection. ***Conclusion:*** Implementation of Central Venous Catheter Bundle Care improved nurses' performance and blood stream Infection in neonates on the post and follow-up tests than pretest. **Recommendation:** Continuing in-service education programs on central venous catheter bundle care should be developed and provided to nurses working in neonate intensive care units. ***Key words:*** *Blood stream infection, bundle care, educational program, neonates, nurses.*

INTRODUCTION

A central venous catheter (CVC) also known as a central venous access catheter, central venous line or central line. The history of cannulation of a central venous structure can be traced back to 1929, when Forssmann described advancing a plastic tube near the heart by puncturing his own arm. In the 1950s, Aubaniac used the subclavian vein to insert a central venous catheter. Since

then, several more access routes have been described. In 1952 CVC was mentioned and considered as a time honored and proven solution to access the major venous system (Ellithy, Abdelmonem, Helal & El Gohary., 2019).

Central line associated blood stream infections (CLABSI) are considered preventable healthcare acquired infections, and are associated with significantly increased morbidity, mortality, and length of hospital stay. A CLABSI is defined as the development of a laboratory-confirmed bloodstream infection in a patient with a central line in place during the forty-eight-hour period before the onset of infection that is not related to an infection at a different site of the body (CDC, 2021).

Neonatal Intensive Care Unit nurses should implement a central venous catheter bundle care as structured process of nursing care, in an attempt to deliver the best possible practice for reducing the incidence of CLABI to zero risks and improving the pediatric and neonatal ICU health outcomes (Salama, Jamal, Al Mousa & Rotimi., 2016). The bundle approach and evidence-based clinical practices are primarily performed through effective interventions during the insertion and maintenance of central catheters **(**Sedrak et al., 2019). One of the most essential preventive strategies for central line-associated bloodstream infections (CLABSIs) is continuous training and education of nurses, which is necessary at each stage from catheter insertion to removal.

Significance of the Study:

Central venous catheter is a complex procedure that has immediate and delayed complications and should only be done in areas with adequate physical conditions, equipment, monitoring and trained assistance (Kornbau, Lee, Hughes & Firstenberg, 2015).

The incidence of central line-associated bloodstream infections in adult ICU patients ranged from 1.6 to 44.6 cases per 1,000 central line days, whereas the incidence in neonatal ICU patients ranged from 2.6 to 60.0 cases per 1,000 central line days, in addition to a mortality rate of 2.8 to 9.5. Central line-associated

bloodstream infections are the primary significant contributor to nosocomial sepsis in a tertiary neonatal intensive care unit. To reduce the incidence of central line-associated have been implemented to decrease the incidence of central line-related infections. However, bundle of care approaches has been shown to have the greatest success (Abbady, Gaballah, Abotakia & Sherif, 2019).

The aim of the study is to:

Explore the effect Care Bundle Education Program on nurses' knowledge and practice Regarding CLABSI in NICU

Research hypothesis:

- nurses' knowledge and practice about bundle care in neonatal intensive care unit will be improved after implementation of an educational program.
- Incidence of neonatal central line-associated bloodstream infections will be decreased after implementation of educational program.

The study was conducted according to the four designs following:

I. Technical design
II. Operational design
III. Administrative design
IV. Statistical design

I. Technical design:

Technical design included the study design, setting, subjects and tools for data collection.

Study design:

A quasi experimental (one group pre, post-test and follow up 3 months later) research design was utilized to conduct this study.

Setting:

This study was conducted at Neonatal Intensive Care Unit (NICU) at one of the Ministry of Health hospitals, titled Minya El Qamh Central Hospital in Sharqia governorate. NICU consists of

two rooms for neonates having different diagnosis, the first room contained 15 incubators and the second room 7 incubators.

Subjects:

A convenient sample of all available nurses working in the previously mentioned study setting was included during period of data collection (33 nurses).

Tools of Data Collection (pre/post educational program):

The study data were collected by using three tools (Appendix I):

Tool (I): A structured interviewing questionnaire sheet. This tool adapted by researcher in an Arabic language based on literature review from Abbady et al (2019); APSIC, (2016); CDC, (2017); to Assesse the nurses' knowledge about central venous catheters, before and after program implementation and includes two parts:

Part (1):

a structured interviewing questionnaire regarding personal data of studied nurses and neonates: (A): Personal data of studied nurses which included (age, gender, educational level, years of experience in neonatal nursing and attendance of training courses related to central venous catheter bundle care).

(B): Personal data of the studied neonates which taken from medical sheet such as (Diagnoses, Gender, Site of insertion of CVC, Does the child have a bloodstream infection on admission? and Number of staying days at hospital

Of the neonate).

Part (2): Nurses' knowledge regarding central venous catheters (CVC), Central Line Associated Blood Stream Infection (CLABSI) and neonatal central venous catheter bundle care it included:

A. Nurses' knowledge about central venous catheters in the neonatal intensive care unit, multiple choices questions (7 items); Definition of catheter, indications, type, insertion site, complication, flushing of CVC catheters and rub hands with alcohol.
B. Nurses' knowledge of Central Line Associated Blood Stream Infection (CLABSI) included (6 items); definition of CLABSI, signs and symptoms, the vein more infection, risk factors, causes and culture of infection for CVC.
C. Nurses' knowledge of central venous catheter bundle care, it included (15 items): 5 items of multiple choices questions (the best of disinfectants to prevent infection, disinfectants are used for child less than two months old, the administration set of (TPN) should be changed every, when using transparent dressing must be changed every and General principles and strategies for CVC bundle to prevent of

CLABSI. And 10 items of True or False (hand wash, guide wire, bundle care, use multi- lumens, disinfected of lumens, remove of CVC every three days, remove of CVC when occur of fever, wear PPE necessary when insert CVC, necessary using antibiotic ointment of insert site and remove of CVC when insert in emergency within 24 hours).

Scoring system of knowledge

The studied Nurses' answers were compared with a model key answer, where correct answer (1) and incorrect answer (0). The total scores of nurses' knowledge regarding central venous catheters (CVC) and Central Line Associated Blood Stream Infection (CLABSI) were ranged from 0 to 13 questions, while the total scores of neonatal central venous catheter bundle care were ranged from 0 to 14; the total number of questions was 27.

The total score of nurses' knowledges was calculated and then the percentage scores were obtained by dividing the obtained score over the maximum score and multiplied by 100 was categorized as the following:

- Satisfactory (≥ 85 %).
- Unsatisfactory (< 85%).

TOOL II: Nurses' practice Checklist about Central Venous Catheter Bundle Care

Nurses' practice Checklist about central venous catheter bundle care before and after program. This tool was adopted from Abbady et al (2019); CDC, (2017); El bilgahy et al (2016). It designed in an English language. Practice checklists were used to assess and evaluate nurses' practices related to central venous catheter bundle care in the neonatal intensive care unit. This checklist covers actual nurses' practices, included surgical hand hygiene (9items), wearing protective barriers (sterile gloves and sterile gown) (25 items), the role of nurses in assisting with the insertion of CVC (38) and nurses' practices related to the components of the CLABSI care bundle (10 items).

Scoring system of nurses' practice

The score of each item of nurses' practice was classified into done (1) and not done (0). The total score was ranged from (0-82) of nurses' practice were divided into two categories as the following:

- Competent (≥ 85 %).
- Incompetent (< 85%).

II. Operational Design:

The operational design included preparatory phase, content validity, reliability, ethical consideration, pilot study, and fieldwork.

Preparatory phase:

During this phase, the researcher reviewed national and international relevant literature by using extensive related search theoretical knowledge of various aspect of the study using recent text books, scientific specialized journals, articles, magazines and internet periodicals in order to build up acquaintance about the study topic and to develop the tool for data collection.

Validity

The tools of the study were ascertained for clarity, relevance, understanding and applicability by panel of expert's jury consisting of five experts which three in pediatric nursing and two in medical-surgical nursing, necessary modifications were done (**Appendix III).**

Reliability

The reliability of the developed tools was estimated using the Cronbach's Alpha test to measure the internal consistency of the tools. It was found that, the reliability for the structured questionnaire sheet for assessment of nurses' knowledge was (0.92) and for observational checklists used to assess nurses' practices regarding Central Venous Catheter Bundle Care was (0.90) and (0.97) for Likert scale.

Ethical Considerations :(Appendix V).

An approval was taken from Scientific Research Ethics Committee of the Faculty of Nursing, Port Said University NUR (2/10/2022) (18). All ethical issue was taken into consideration during all phases of the study and included: Explain the aim of the study to the director of studied hospital to take his permission to do the study. A brief explanation of the study was given to the participants, and that the information obtained was confidential and used only for the purpose of the study. The researcher informed the study participants that they have the right to withdraw from the study at study at any time they wish to do.

Pilot study:

Before entering the actual study, a pilot study was conducted on 10 % of the total sample size (3nurses) to examine the applicability, clarity and feasibility of the study tool, to estimate the proper time required for answering the questionnaire and to identify obstacles that may face during data collection. No radical modification had been occurred in the tools. So nurses who shared in the pilot study were included in the study sample.

Field work:

The present study was carried out in the Minya El Qamh Central Hospital, during the period of six months from 1st of April 2024 until the end of September 2024, which data collection from nurses in Neonatal Intensive Care Unit were performed.

Neonatal Intensive Care Unit (NICU) was visited for three days per week (Friday and Saturday) from the beginning of the morning shift to the night shift (6:00 am - 8:00 pm) but the Monday beginning from afternoon shift to the night shift (3:00 pm to 9 pm). The program was implemented in five sessions; three first sessions were related to the theoretical part of the program and the last two sessions included the practical part. The program session continued for five days to complete the program contents for each group of nurses.

At the beginning of the first session, the relationship was initiated with the nurses, an orientation to the program and its purpose was done and the nurses were informed about the time of the next sessions. Each session started by a summary about what was given during the previous sessions and the objective of the new one. The duration of each session was one hour daily for five days including time for asking any question.

The study was conducted through four phases: assessment, planning, implementation and evaluation.

- **Assessment Phase:**

This phase-involved the preparation of the tools and assess Nurses' knowledge and practices regarding central venous catheter bundle care. It took approximately 35 to 40 minutes to fulfill the interview. The data collected in this assessment phase were utilized as assessment data that served in preparing the educational program, and for the later evaluation of the program effectiveness at post program. At the beginning of interview, the researcher welcomed each nurse, explained the purpose, duration and activities of the study take oral consent.

- **Program Planning Phase:**

The researcher prepared power point presentations of the topics. Different instructional strategies, method of teaching, media and method of evaluation were selected to suit the learner's needs and achieve the objectives and contents of the program. It was aimed to provide nursing with much experience as possible. The teaching sessions were achieved by using available resources, relevant contents and instructional strategies for each session. Different methods of teaching were used such as lecture, group discussion, and brain storming. Instructional media included data show, white board and handout prepared by the researcher and distributed to all nurses in the first day of the education program.

- **Program Implementation Phase:**

The program was implemented in five sessions; in which the studied nurses were divided into 11 groups, each group consist of 3 nurses, the program has taken 5 sessions for each group and were implemented according to nurses' needs assessment and readiness, distributed as the following; (3) session for theoretical part each session ranged from 45 to 60 minutes and (2) session for practical part, each session kept from 45 to 60 minutes. It took about (8) weeks for program implementation.

Theoretical part; the first session of program included introduction to the educational program, modes of transmission of infection in NICU and CVC as definition, causes, types and complication, the second session of program included Central Line Associated Blood Stream Infection (CLABSI) such as definition of CLABSI, signs and symptoms, risk factors, causes and culture of infection for CVC. Third session included Neonatal Central Venous Catheter Bundle Care (hand hygiene, maximal barrier precautions, skin antisepsis, daily review of catheter necessity, and removal of unnecessary catheters).

Practical part concerned with nursing care of neonatal regarding central venous catheter bundle care; the first session included wearing Personal Protective Equipment (PPE) such as sterile gloves, sterile gowns, wearing arrange and taking off PPE, Finally the second session included Practical application of how to wash hands, daily care of the catheter as flushing, change the dressing and disinfected the hubs by alcohol. These sessions were repeated to each subgroup of nurses.

- **Program Evaluation Phase:**

After program implementation, the post test was carried out to assess nurses' knowledge and practices about central venous catheter bundle care through using the same tool which is used in the pretest to evaluate the effect of the program. The post test was done after the implementation of the training program after the five session of neonatal central venous catheter bundle care. The effectiveness of implemented program was based on assessing the improvement of nurses' knowledge and practices about central venous catheter bundle care and decrease blood Stream infection in neonates. This was achieved through comparing the pretest results with post test results after program implementation.

III. Administrative Design: (Appendix IV).

An official letter from the Dean of the Faculty of Nursing, Port Said University was sent to Hospital administrator and head of department of Neonatal Intensive Care Unit of Minya El Qamh Central Hospital in Sharqia governorate to conduct the study, also permission was obtained from Minya El Qamh Central Hospital. A clear explanation was given about the nature, aims and expected outcomes of the study then it was possible to carry out the study. Additional written consent was taken from nurses who participate in the study.

IV. Statistical Design:

Statistical analysis was done by using Statistical Package for Social Sciences (SPSS) version 25. Data were collected, revised, coded, organized, tabulated, and analyzed using frequencies, number, percentage, mean scores, standard deviation and correlation coefficient. Data were presented in the form of tables and figures. Quantitative data was presented by mean (x) and standard deviation (SD). Qualitative data was presented in the form of frequency distribution tables, number and percent. It was analyzed by Chi- Square test (x2) & correlation to detect the relation between the variables of the study (P- value). Statistical significance was considered as follows:

- P- value < 0.05 Significant
- P- value < 0.001 Highly Significant
- Chi- Square test (x2)

RESULTS

Table 1 showed that, all of studied nurses were female, 60.6% of them; their age ranged between 25 and 35 years, around two thirds of them (66.7%) had under 5 years' experiences, slightly more than half of studied nurses (57.6 %) had graduated from Nursing Technical Institute. In relation to their marital status more than two thirds of them (69.7%) were married, the majority of them were getting their information through training courses (84.8%), regarding number of family members; approximately half of were four members (51.5%) and 54.5**%** of the studied nurses stated that their salaries are fairly enough.

Figure 1 illustrates that the most of studied nurses had satisfactory knowledge level post educational program and 3 months later phases (91 %, 87.8%) respectively compared with pre-educational program phase (12.2%).

Table 2: Clarifies that there was statistically significant improvement in knowledge of nurses regarding central venous catheter bundle care in the post and 3 months later phases as compared to the pre- program phase ($P \leq 0.05$), The percentage on preprogram wase on these items (the

optimal of disinfected solution, disinfectants are used for children under two months of age & time of dressing the Transparent) (15.2%, 69.7% & 30.3%) respectively increased to be (87.9%, 100% & 90.9) respectively in post program, then became (90.9%, 100% & 93.9) respectively in follow up.

Table 3: Illustrates that there was a statistically significant improvement in total practices of nurses regarding central venous catheter bundle care competence in the post and 3 months later follows up phases as compared to the pre- program implementation phase ($P \leq 0.05$). The percentage on preprogram was on the items of (performing hand hygiene, wearing PPE, using an appropriate antiseptic solution to prepare the skin before insertion & scrub the access port or hub with 70% alcohol for 10-15 second) with done (45.5% 48.5%, 48.5% & 30.3%) respectively, increased to be (100%, 100%, 87.9, & 93.9%) respectively in post program, then declined to (97%, 87.9%, 97 & 97%) respectively in follow up.

Figure 2 Clarified that, the majority of studied nurses (87.8 %, 84.9%) had competent practice at post and 3 months later of educational program phases respectively compared with pre-program implementation which was (6 %).

Table (4): Revealed that, there was a positive correlation between total nurses' knowledge, practices and attitude scores at the different training phases ($P \leq 0.05$), when the nurses' knowledge increases, they acquired more practice.

Table (5): Clarifies that there was statistically significant inverse correlation between nurses' knowledge, practice and attitude scores and incidence of infection, this means that, when the nurses had more knowledge and practice, the incidence rate is lower.

Table (1): Frequency distribution of studied nurses regarding their personal characteristics (n=33).

Personal characteristics	No.	%
Age/ years		
> 25	11	33.3
25 - >35	20	60.6

35 - >45	1	3.0
≥ 45	1	3.0
Mean ± SD	27.9 ± 5.2	
Gender		
Female	33	100.0
Marital status		
Single	9	27.3
Married	23	69.7
Divorced	1	3.0
Have children		
No	10	30.3
Yes	23	69.7
No. of children		
1	12	36.4
2	9	27.3
3 + More than 3	2	6.0
Education		
Nursing Technical Institute	19	57.6
Bachelor degree in Nursing	11	33.3
Diploma	3	9.1
Source of information		
Education	11	33.3
Training Courses	28	84.8
Coworkers	18	54.5
Social media	17	51.5

Experience		
> 5 years	22	66.7
5 - >10 years	8	24.2
≥ 10 years	3	9.1
Address		
Near	18	54.5
Far	15	45.5
No. of rooms		
2	26	78.8
3	7	21.2
No. of family members		
2	3	9.1
3	3	9.1
4	17	51.5
> 4	10	30.3
Income		
Enough	11	33.3
Fairly enough	18	54.5
Not enough	4	12.1

Figure (1): Total score of nurses' knowledges regarding (C.V.C) bundle care throughout educational program phases (n=33).

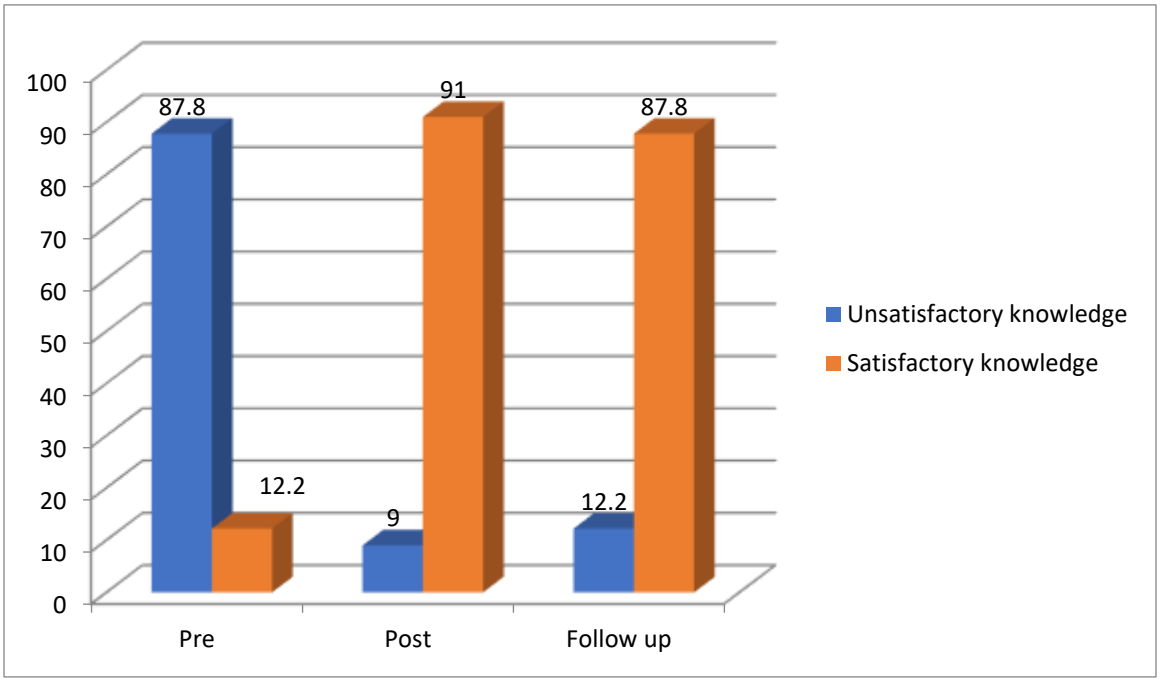

Table (3): Frequency distribution of studied nurses' total practices regarding (C.V.C) bundle care throughout the program phases n=33.

Figure (2): Total scores of nurses' practices regarding (C.V.C) bundle care throughout educational program phases (n=33).

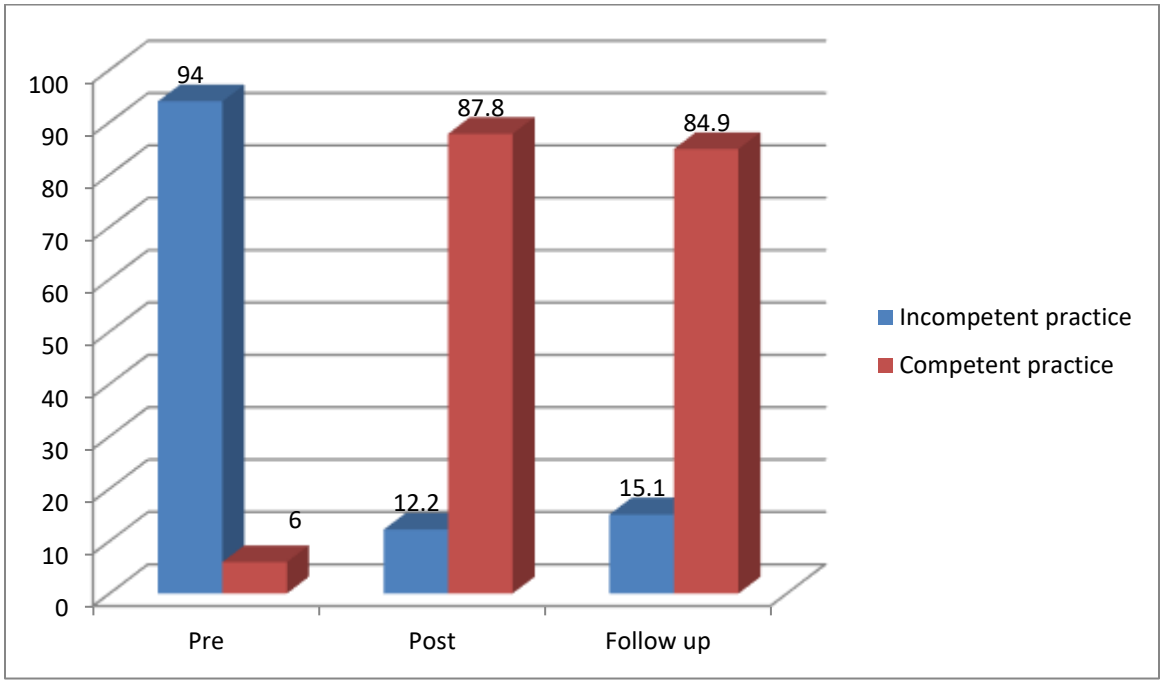

Table (4): Correlation between knowledge, practice and attitude of studied nurses.

Scores	Knowledge		Practice		Attitude	
	r	P	r	p	r	p
Knowledge	1					
Practice	0.96	0.00*	1			
Attitude	0.74	0.00*	0.81	0.00*	1	

***Significant at p-value<0.05**

DISCUSSION

Central venous catheters are widely used in neonatal care. Although such catheters provide indispensable vascular access for medications and TPN, their use is associated with increased risk for serious infectious complications, including CLABSI. CLABSIs are one of the most important healthcare-associated infections (HAIs), due to their morbidity, mortality and cost. Therefore, the prevention and treatment of CLABSI is a significant health care challenge (Khieosanuk et al., 2022).

The most prevalent healthcare-associated infection (HAI) in neonate is central line-associated bloodstream infection (CLABSI). It is associated with significantly increased morbidity, mortality, and length of hospital stay. With suitable aseptic practices, surveillance and management, the majority of instances can be avoided (Hamza et al., 2021). With a focus on direct education for nurses, the implementation of catheter care bundle guidelines would drastically reduce central line associated bloodstream infections in neonate admitted to NICU (Bell & O'Grady, 2017). As a result, nurses' compliance with an evidence-based care package during their practice is critical for lowering CLRBSI and improving pediatric patient outcomes (Savage et al., 2018).

According to Mirzaei et al. (2025), inadequately trained nurses represent a major risk in providing effective nursing care to neonates with CVC; their study demonstrated that training based on evidence-based guidelines significantly improved nurses' knowledge and care practices. So that the present study aimed to explore the effect of an educational program about central venous catheter bundle care on nurses' performance and bloodstream infection in neonates.

Regarding total knowledge levels of the nurses related central venous catheter (C.V.C) bundle care in the neonatal intensive care unit (NICU) during educational program phases, the present study illustrated that there was difference between the studied nurses' total knowledge level through the program phases, which indicated that the program had a positive effect on improvement of nurses' knowledge level about (C.V.C) bundle care in (NICU) throughout immediately post and follow- up phases (after three months later) of program compared with the preprogram phase; the most of nurses had satisfactory knowledge level during immediately post program phase and the majority of them in follow up phase (after three months later) respectively compared with preprogram phase. From researcher opinion these may due to the greater effect of educational program in improving nurses' knowledge. During the follow up phase, there was a slight decrease in the nurse's total knowledge. This is normal issue because information is easy to forget, that's way nurses need continuing education and training.

The Egyptian assessment study by Abdel-Salam et al. (2021) found that less than half of NICU nurses had adequate knowledge of the CLABSI bundle, and more than half demonstrated incompetent practice. The study highlighted the absence of standardized protocols and inadequate

training, underlining the necessity of continuous education and guideline adherence among neonatal nurses in Egypt.

Concerning total CVC bundle care practices levels of the studied nurses during educational program phases the study results cleared that, there was a highly statistically significant improvement in level of practices of the studied nurses about CVC bundle care throughout post and follow up phases; Majority of nurses had a good practices level during immediately post program phase and follow up phase (after three months). While minority of them had poor practices level during preprogram phase of the study compared with immediately post program and follow up phases. This might be due to lack of supervision and the lack of role model can contribute to noncompliance with CVC bundle care guidelines and lack of training courses. After the implementation of the educational program, this reflects the positive effect of implementing CVC bundle care practices and nurses were excited to apply competent care with neonatal CVC bundle care.

A study conducted in Egypt found that more than half of neonatal ICU nurses demonstrated inadequate practices regarding central line-associated bloodstream infection (CLABSI) prevention, and less than half had sufficient knowledge. The study emphasized the lack of standardized protocols and highlighted the urgent need for structured and continuous training programs (Abdel-Salam, Nour El-Din, & El-Masry, 2021).

In general, the current study elaborated that there was a statistical positive correlation between total nurses' knowledge score and total nurses' practice scores throughout the program phases. This result was expected as increasing nurses' knowledge about CVC bundle care will lead to improve nurses' performance by applying their theoretical knowledge in practice (the more knowledge, the higher the nurses' performance). For this reason, knowledge and practices are considered the backbone of the prevention of bloodstream infection.

Nurses with sufficient knowledge can transform their knowledge into attitude and demonstrate knowledge through skills and practice while caring for patients with CVC, thus it can reduce the risk of CLABSI (Matlab et al., 2022). Concerning correlation between studied nurses' knowledge, attitude, practice scores thorough the program phases, the current finding clarified that there was positive statistical significant correlation between nurses' total knowledge and practice scores at immediately post program and follow up program phase (after three months) compared with preprogram phase. From researcher opinion this may due to knowledge are the most important guide for the attitude and practice to anyone.

Recommendations

In the light of the current study findings, the following is recommended:

1. Nursing managers and the infection control team should plan for periodic educational and training programs based on EBP.

2. Educate nursing staff as regards the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections.
3. Periodically assess knowledge of and adherence to guidelines for all nurses involved in the insertion and maintenance of intravascular catheters.
4. Continuing training courses for nurses to demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters.
5. Apply EBP guidelines for CVC care and maintenance in other pediatric care settings, such as pediatric and neonatal ICUs.

Conclusion

In the light of the current study findings, the following is concluded:

The current study concluded that nurses who received evidence-based guidelines educational program as regards central vascular catheter maintenance and care showed a statistically significant improvement in nurses' knowledge and practice after immediate and 3 months after implementation of the program than that before.

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