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Effect of Nursing Care Bundle on Nurse's Performance Regarding Central Venous Line-Associated Blood Stream Infection

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ABSTRACT

Central venous catheters (CVCs) play an integral role in the management of many critically ill children. **Aim**: To assess the effect of nursing care bundle on central venous line-associated bloodstream infection. **Design**: a quasi-experimental design. setting: It was conducted at the pediatric intensive care unit (PICU) in Menoufia University Hospital. **The sample** included 33 nurses and 34 children with central venous lines. **Data collection instruments**: structured interviewing questionnaire, Observational checklist for nurses' practice, and Laboratory investigation record. **Results:** A very highly statistically significant differences between nurses' knowledge on post-test compared to pretest) as well as nurses' practices on post-test compared to pretest. **Conclusion**: Implementation of care bundle of central venous line improved nurses' performance regarding prevention of central venous line-associated bloodstream infections on the post and follow-up tests than pretest. **Recommendation**s: Ongoing in-service education programs about nursing care bundles for central venous lines should be developed and provided for pediatric nurses working in pediatric intensive care units.

Keywords: Nursing Care Bundle, Central Venous Line, Blood stream Infection, Nurses' Performance

Introduction

Central venous catheters are an essential element in the treatment of very seriously ill children, central venous catheters are a must. It's an important part of resuscitation at PICUs. Central venous catheters serve as a safe vascular entrance point as well as a spot to monitor venous pressure Central venous catheters are also necessary for infusing medications, obtaining venous samples, and keeping strict surveillance in severely unwell youngsters **(Foka and colleagues, 2021).** Antibiotics, chemotherapy, parenteral nutrition, and other life-saving medications that require large-caliber veins are supplied efficiently with this method. It also permits the use of potentially life-saving therapies such as hemodialysis and plasmapheresis **(Chaiyakulsil et al., 2021).** Central venous catheters also, allow children to get polytherapy in general care and critical care units (ICUs), which helps them recover faster and minimizes the number of complications.

A central venous line (CVL) is a standard tool in neonatal intensive care units (NICUs) for critically unwell neonates who require constant monitoring and resuscitation treatment. To battle the incidence of CVL infection, significant data has developed demonstrating that a CVL nursing care bundle is a crucial component of CVL infection prevention practice **(Alfar, et al., 2020)**

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.

Nurses have a critical role in the care of these lines. They are responsible for educating the child, family, and other members who are unfamiliar with central lines. In addition to executing the actual surgeries **(Infusion Nurses Society, 2016).** A good line-care policy that is followed by all parties concerned will help to ensure that a line can be used safely for as long as it is needed.

Pediatric nurses in PICUs have the most direct and ongoing involvement in CVC insertion site procedures, they should be familiar with and willing to use supportive care methods when installing and maintaining central lines. As a result, they are in a strong position to implement the recommendations, and they have a once-in-a-lifetime opportunity to do so **(Payne, et al. 2018).**

Care bundles are a collection of linked, structured packages of evidence-based practices and interventions. They're used to design nursing protocols for managing difficult clinical disorders to improve nursing processes and patient outcomes**(CDC, 2018).** The nursing care bundle usually consists of three to five simple, unambiguous, and attainable evidence-based measures. Care bundles can assist children in

receiving the nursing care they require while also, ensuring that each step of the CLABSI prevention procedure is completed successfully. In Neonatal and pediatric ICUs, care bundles can drastically reduce the incidence of CLABSI across all age groups**(Ista, et al., 2016)**

The Centers for Disease Control and Prevention (CDC) has issued evidence-based prevention bundles including nurses and training, and infection control **(CDC,2017).** Catheter site selection, type of catheters, dressing change, use of the antiseptic solution, administration of total parenteral nutrition, changing the intravenous fluid and blood set, administration of Intravenous infusion fat, and use of antibiotics **(Abou Zed& Mohammed, 2020).**

Significance of the study

Central line-associated bloodstream infections (CLABSIs) are a major source of hospital-acquired infections (HAIs) in PICUs and are associated with high morbidity, mortality, and also increased economic burden **(Abdelmoneim et al., 2020).** Bloodstream infections (BSIs) from central venous catheters (CVCs) increase morbidity and are estimated to increase mortality risk in North America by1.1/1000 central lines per day across 22 PICUs **(Alten et al., 2018).** In Egypt, the rate of central line-associated bloodstream infection (CLABSI) is 14.1 per 1000 central lines per day in the PICU **(Abdelmoneim et al., 2020).** Since the adoption of central line (CL) bundle policies and other practices, CLABSI rates among ICUs collectively have fallen nearly 60% in the past decade **(CDC, 2018).** Above all, there are no adopted central line bundle policies in many hospitals in Egypt. Therefore, there is an intense need to help nurses' to compliance with the nursing care bundle that might decrease CLABSI rates.

Operational Definitions

Care Bundles: A set of three to five evidence-informed practices performed widely across healthcare settings to improve the quality of care **(Lavallée et al., 2017).**

Central Venous Line-Associated Bloodstream Infections: Catheter-associated bloodstream infection was defined as primary bacteremia in the presence of a central venous catheter. Secondary bacteremia was defined as a bloodstream infection that develops as a result of a documented infection with the same microorganism at another body site **(Cho, 2021).**

Aim of the study

The purpose of this study was to examine the effect of the nursing care bundle on nurses' performance & central venous line-associated bloodstream infection in pediatric intensive care units

Research Hypotheses

The following research hypotheses were formulated to achieve the purpose of the study:

1. Nurses who receive care bundle of the central venous line will expected to have a higher level of performance about the prevention of central venous line-associated bloodstream infections on post-test than on pretest.
2. Children who receive nursing care bundle are expected to have decreased incidence of central venous line bloodstream-associated infections.

Methods

1-Research Design:

A quasi-experimental design (pre, and post-test) was utilized for this study.

2. Research Setting:

The study was conducted at the pediatric intensive care unit (PICU) in El-Menoufia University Hospital. This unit lies on the 4th floor. It is divided into 2 sections; the first section contains three parts. The 1st part lies on the left side and contains 2 beds. The second part lies on the right side and includes one bed (mainly for isolation). This part is surrounded by two glass walls with an opening for the entrance. The third part lies behind the isolation room and it is used by nurses for dressing changes. This part is separated by an all-metal wall and has an all-metal door for the entrance.

The second section is separated from the first section with a glass wall on both sides, there is an opening in between for the entrance. This section contains 7 beds. The distance between these beds is about 4 feet and there are no curtains or paravanes between beds. The unit contains ten monitors, ten mechanical ventilation machines, sixteen syringe pumps, one x-ray machine, one refrigerator, and two emergency cars. There are three large windows but none of them have curtains. Lights are switched on all day.

3. Sampling:

3. A convenience sampling of all nurses (33 nurses) in the above-mentioned setting who provided direct care to children was included in the current study.
4. A purposive sample of children admitted to the PICU during the period of the study

Inclusion criteria

5. Children with central venous line

Exclusion criteria

6. Children with any other associated invasive device
7. Children with any other infections

4. Instruments

To achieve the purpose of the study, three instruments were utilized for data collection.

Instrument I: Nurses' Knowledge regarding Catheter-Related- Blood Stream Infection: a structured interview. It was developed by the researcher after reviewing the related literature. This instrument was divided into two parts:

Part one: Characteristics of studied nurses. It included questions about nurses' age, gender, level of education, years of experience, and previous training related to central venous line care.

Part two: Nurses' Knowledge of Evidence-Based Catheter-Related- Blood Stream Infection (CR-BSI): It was developed by the researcher guided by Labeau et al.,(2009) to assess nurses' knowledge about central venous line and nursing care to prevent catheter related bloodstream infection. It included two subparts:

Subpart one: Nurses' Knowledge about central venous catheter (CVC) It contains 7 questions about the definition, indications, types, sites, use of

ultrasound for CVC insertion, use of X-ray to ensure correct location of CVC insertion, and complications of CVC.

Subpart two: Nurses' Knowledge about nursing care to prevent Catheter-Related- Blood Stream Infection (CR-BSI) contains 15 questions about handwashing before and after CVC insertion, wearing sterile gloves before and during CVC insertion, wearing a mask, gown, and head cover during CVC insertion, use of alcohol before and after CVC insertion, follow unit protocol to prevent catheter-related bloodstream infection, use an antiseptic solution to clean the site of CVC, assess CVC insertion site daily, check the location of CVC, type of dressing used, frequency of dressing change, frequency of dressing change for transparent parts, frequency of I.V set to change for clear fluid e.g. Ringer, sodium chloride. Frequency of I.V set to change for total Parental Nutrition (TPN), Frequency of I.V set to change for blood & blood product, and Needleless access device change (three-way stop cook).

The Scoring system for each question is as follows:

Scoring items	Score	Total score
Correct answer	1	60% - ≥80%
Incorrect answer	0	< 60%

Instrument II Catheter-Related- Blood Stream Infection observational checklist: It was adopted from Elbilgahy (2016) to assess nurses' practices. It included eleven items related to changing CVC such as hand washing before and after the CVC access, wearing sterile gloves during insertion of CVC, wearing personal protective equipment during CVC insertion (mask, surgical gown, cap, full-body sterile drape), scrubbing the access port and catheter hub with alcohol 70% before and after access, daily inspection of the catheter insertion site, changing CVC dressing, changing intravenous set for clear fluid, flush CVC set by saline, changing intravenous set for TPN, changing intravenous set for blood & blood product, Needleless access device change (three-way stop cook).

The Scoring system for this part is:

Scoring items	Score	Total score
Adequately done	2	≥ 80%
Inadequately done	1	60%-<80%
Not done	0	< 60%

Instrument III: Laboratory investigation record. It was developed by the researcher to assess the rate of CR-BSI in studied children. It consisted of two parts:

Part one: Characteristics of studied children. It included child age, sex, diagnosis, date of admission, and date of discharge.

Part two: Laboratory investigation record. It included blood culture and complete blood count.

Validity:

For validity assurance, the three instruments were submitted to a jury of five experts in the pediatric field (two professors and two assistant professors in the Pediatric Nursing and one professor in the Pediatric Medicine). All the required modifications were done.

Reliability

Reliability of the study instruments were estimated among 10 participants by using test retest method with two weeks apart between them. Cronbach' alpha was calculated between the two scores. It was 0.752 which indicates that the instruments were reliable to meet the objectives of the study.

Pilot study:

It was carried out on 10% (4) of studied nurses after the instruments were developed and before starting the data collection to test the practicability, applicability and to estimate the needed time to fill the instruments. No necessary modifications were done.

Ethical Consideration:

1-Approval from the Faculty of Nursing in Menoufia Ethical Research Committee was obtained.

2-Written consent was obtained from the nurses related to their acceptance to share in the study. It was obtained after an initial interview was done to inform the nurses about the purpose and methods of data collection to gain their cooperation. They were assured that the information collected would be treated confidentially and that it would be used only for research. They were informed that their participation in the study was voluntary, and the participants could withdraw from the study at any time.

3-Written approval from the parents of the children was obtained to conduct the study.

4-The anonymity of the personal data was assured by coding all data and putting data through a closed cabinet.

Procedure:

a-Before data collection, written permission to carry out the study was obtained from the director of the unit after submitting an official letter from the Dean of the faculty of Nursing at Menoufia University explaining the purpose of the study and methods of data collection.

b- Data collection for this study was conducted for five months extending from the 1st of October 2020 to the end of May 2021.

c-The researcher introduced herself to the studied nurses who shared in the study and explained the purpose of the study and methods of data collection.

1. The researcher interviewed each nurse and asked her to fill out the structured interviewing questionnaire regarding their knowledge about central venous line and care bundle using instrument I. It took 20 minutes to fulfill (pretest)

2. Nurses were observed three days per week during the morning and afternoon shifts Instrument II(pretest)
3. Laboratory assessment for complete blood count and blood culture for children with central venous lines was done by the researcher using instrument III (pretest)
4. Areas of knowledge and practice deficit were identified and the general& specific objective of the nursing care bundle of the central venous line was designed accordingly. The content of the nursing care bundle booklet was introduced to nurses, also nurses were trained about how to prepare and maintain sterile field and how to use and handle equipment in sterile manner. After explanation of the content of the nursing care bundles, nurses were given copies of the booklet
5. The nursing care bundle was implemented in three sessions for nurses.

   The first session. It contained theoretical knowledge related to central venous line and its

care e.g. definition, indications, types, places of CVC, use of ultrasound for CVC insertion, use of X-ray to insure the right site for insertion of CVC and complications of CVC. It took 30 minutes. The researcher provided a summary of the knowledge provided in the first session. Structured interviewing questionnaire regarding their knowledge about central venous line and care bundle using instrument I.

The second session (one hour)**:** It contained a practical part of the care bundle for central venous line e.g wash hands, wear sterile gloves & wear personal protective equipment, and clean C.V.C site using antiseptic solution.

Third session(one hour): It contained a practical part of the care bundles about (inspect C.V.C site, change C.V.C dressing change I.V set daily for clear fluid flush C.V.C by saline, change I.V set for T.P.N, change I.V set for blood & blood product, and change three way stop cook)

6. Training about a practical part of the central venous line and care bundles done through using demonstration and re-demonstration.
7. Immediate evaluation was done for evaluating the effect of nursing care bundle**.**
8. Reassessment of nurses' knowledge regarding central venous line and its care by the researcher using instrument I(posttest).
9. Reassessment of nurses' practices regarding central venous line care bundle was done immediately following the training sessions by the researcher using instrument II (posttest).
10. Reassessment of children a complete blood count and blood culture was done using instruments III (posttest).
11. Evaluation was done two months later for evaluating the effect of nursing care bundle((follow- up test)

Statistical Analysis:

1. Data were analyzed statistically using the SPSS (statistical package for social science) program version 13 for Windows, with a P-value of 0.05 deemed statistically significant in all analyses.
2. Data are shown as a mean, range, or value, as well as a 95 percent confidence interval (95 percent CI), as well as frequency, and percent. For qualitative variable analysis, the Chi-square test was used, and a p-value of 0.05 was considered significant. The ANOVA test was used to compare three variables: one qualitative variable and the other two quantitative variables of normally distributed variables, with a p-value of 0.05 considered significant for detecting mean and standard deviation, and post hoc tests were used to determine the relationship between variables within groups.
3. The LSD test is a post hoc analysis that was performed on variables with a significant difference.

Results

Table 1 and figure 1: Showed the characteristics of the studied nurses. It was obvious that t about half of the studied nurses (48.5%) were between

25 to 30 years old, and most of them (97%) were females. Regarding academic qualifications, more than half of nurses (57.6 %) graduated from a technical institute of nursing, while 12.1% only graduated from the faculty of Nursing and more than half of them (57.6 %) did not attend any training course in infection control related to the central venous line.

Table 2: Displayed the mean score of nurses' knowledge about children's central venous catheter (C.V.C) on pre, post, and follow-up tests. As clarified in the table, the mean score of nurses' knowledge was 10.25 ± 1.24 and 8.5 ± 2.7 on post and follow-up tests. Meanwhile, it was 8.11± 1.5 on the pretest. So, there were very highly statistically significant differences between the mean score of nurses' knowledge on the post and follow-up test on the pretest (P<0.001).

Table 3: Displayed the mean total score of nurses' knowledge about nursing care to prevent bloodstream infection on pre, post, and follow-up tests. As clarified in the table, the mean score of nurses' knowledge was 25.33±1.81 and 24.42±2.34 on post and follow-up tests respectively. Meanwhile, it was 18.60±4.14 on the pretest. So, Therefore, there were very highly statistically significant differences between the mean score of nurses 'knowledge on the post and follow-up tests and the pretest (P<0.0001).

Table 4: Illustrated levels of nurses' knowledge about children's central venous catheter (C.V.C) on pre, post, and follow-up tests. It was obvious from this table that the majority of nurses (75.7%) had poor knowledge of the pretest. Meanwhile, the majority of nurses had good knowledge of the post and follow-up tests (81.9% and 75.7% respectively). So, Therefore, there were very highly statistically significant differences between the level of nurses 'knowledge on the post and follow-up tests and the pretest (P<0.0001).

Table 5: Displayed the mean total score of nurses 'practice to prevent central line-associated bloodstream infection on pre, post and follow-up tests. It was obvious from this table that the mean score of nurses' total practice was 25.30±1.99 and 23.40±0.93 on post and follow-up tests respectively. Meanwhile, it was 22.20±1.81 on the pretest. So, there were very highly statistically significant differences between the score of nurses 'practice on the post and follow-up tests than the pretest (P<0.001).

Table 6: Clarified the level of nurses 'practice to prevent central line-associated bloodstream infection on pre, post, and follow-up tests. It was obvious from this table that the majority of nurses (90.9%) were incompetent on the pretest. Meanwhile, the majority of nurses were competent on a post and follow-up tests (90.9% and 81.8% respectively). So, there were very highly statistically significant differences between the level of nurses 'practice on pre, post, and follow-up tests (P<0.001).

Figure 2: Showed the correlation between total knowledge score and total practice score. The findings revealed that there was a significant positive correlation between total knowledge score and total practice score on pre, post, and follow-up tests. So, there was a highly statistically significant correlation between total knowledge score and

total practice score on the post and follow-up tests than pretest (P<0.001).

Table 7: Displays the mean and standard deviation of studied children's laboratory tests on pre, post, and follow-up tests. The findings revealed that there were very highly statistically significant differences regarding hemoglobin, red blood cells, and C - reactive protein (P<0.0001). However, there was no statistically significant difference in white blood cells.

Figure 3: Displays the distribution of blood culture findings for studied children on pre, post, and follow-up tests. As indicated in the Figure, blood culture findings were positive (Streptococci) on pre and post-test. Meanwhile, it was negative on the follow-up test. So, there was a very highly statistically significant correlation between blood culture findings on pre and post-test than on the follow-up test (P<0.0001).

Table (1): A- Characteristics of Studied Nurses (N=33)

Characteristics of studied nurses	No (N=33)	%
Age		
< 20 years	1	3.0
20 -24 years	5	15.2
25 -30 years	16	48.5
> 30 years	11	33.3
Sex		
Male	1	3.0
Female	32	97.0
The academic qualification obtained in Nursing		
High school Nursing diploma	10	30.3
Technical Institute of Nursing	19	57.6
Bachelor's degree in Nursing	4	12.1
Years of experience in Pediatric Nursing		
< 1 year	6	18.2
1 - 5 years	11	33.3
6 - 10 years	7	21.2
>10 years	9	27.3
Attending training course in infection control related to the central venous line		
No	19	57.6
Yes	14	42.4

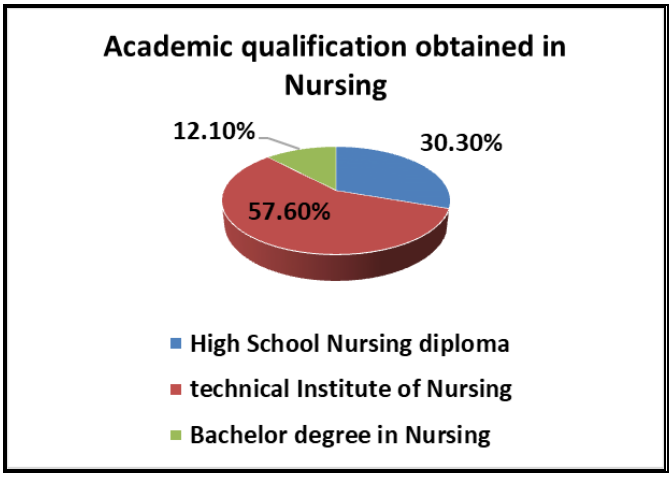

Figure (1): Characteristics Of Studied Nurses According To Their Qualifications.

Table 2: Mean Score Of Nurses' Knowledge About Children's Central Venous Catheter (C.V.C) On Pre, Post, And Follow-Up Tests.

Nurses' Knowledge About(C.V.C)	Pre test	Post test	Follow-up test	Anova test	P- value
X±SD	8.11±1.5	10.25±1.24	8.5±2.7	38.73**	P<0.001**

**P<0.001: Means highly statistical significant difference.

Table 3: Mean Total Score Of Nurses' Knowledge About Nursing Care To Prevent Bloodstream Infection On Pre, Post, And Follow-Up Tests.

Nurses' Knowledge About Nursing Care To Prevent Bloodstream Infection	(N=33)			X^2 P-value
	Pretest	Posttest	follow-up test	
	X ± SD	X ± SD	X ± SD	
Mean ± SD	18.60±4.14	25.33±1.81	24.42±2.34	0.0001**

**P<0.001: Means highly statistical significant difference.

Table 4: Levels Of Nurses' Knowledge About Children's Central Venous Catheter (C.V.C) On Pre, Post, And Follow-Up Tests.

Level of Nurses' knowledge	Pretest (n=33)		Posttest (n=33)		Follow-up test (n=33)		P1 –value
	No	%	No	%	No	%	
Poor knowledge	25	75.7%	0	0.0%	3	9.2%	P<0.001**
Fair knowledge	5	15.1%	6	18.1%	5	15.1%	
Good knowledge	3	9.2%	27	81.9%	25	75.7%	

**P<0.001: Means highly statistical significant difference.

Table 5: Mean Total Score Of Nurses 'Practice To Prevent Central Line-Associated Bloodstream Infection On Pre, Post And Follow-Up Tests

Total Practice Score	(N=33)			P-value
	Pretest	Posttest	follow-up test	
	X ± SD	X ± SD	X ± SD	
Mean ± SD	22.20±1.81	25.30±1.99	23.40±0.93	0.001**

Table 6: Level Of Nurses 'Practice To Prevent Central Line-Associated Bloodstream Infection On Pre, Post, And Follow-Up Tests

Nurses 'Practice level	Pre (n=33)		Post (n=33)		Follow-up (n=33)		X^2 P1 – value
	No	%	No	%	No	%	
Competent	3	9.1	30	90.9	27	81.8	14.84** P<0.001
Incompetent	30	90.9	03	9.1	6	18.2	

**P<0.001: Means highly statistical significant difference.

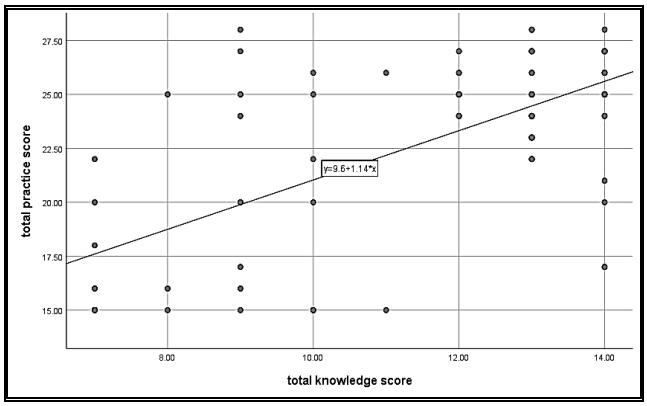

Figure (2): Correlation Between Total Knowledge Score And Total Practice Scores

Table 7: Mean And Standard Deviation Of Studied Children's Laboratory Tests On Pre, Post, And Follow-Up Tests

laboratory tests	Pretest	Posttest	Follow Uptest	F-test	P-value
Hemoglobin	9.63±0.88	10.50±1.05	9.53±0.48	4.419	0.020 ns
Red Blood Cells	4.63±0.69	3.70±0.21	3.90±0.51	10.009	0.001**
White Blood Cells	6.40±0.47	6.65±0.16	6.40±0.47	1.319	0.282ns
C-Reactive Protein	13.17±0.65	12.60±0.63	10.50±0.43	4.606	0.018*

**P<0.001: Means highly statistical significant difference.

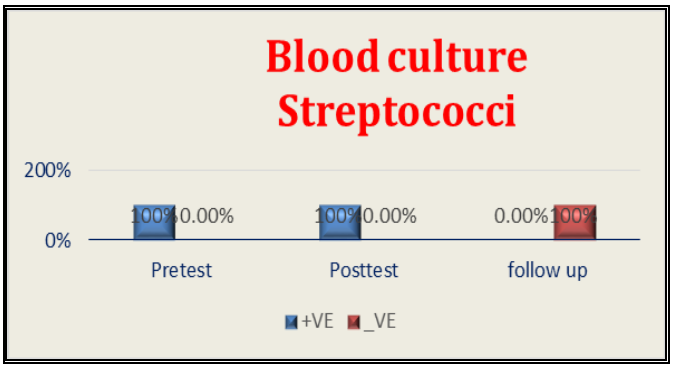

Figure (3): Distribution of Blood Culture Findings for Studied Children On Pre, Post, And Follow-Up Tests

Discussion

Children in pediatric intensive care units require the use of central venous catheters (CVCs) (PICUs). When it comes to administering therapies, giving nutritional or blood support, and performing blood tests, central venous catheters (CVCs) provide a higher level of comfort and efficiency **(Foka et al., 2021).** The most prevalent healthcare-associated infections (HAIs) in children are central line-associated bloodstream infections (CLABSI). They're linked to longer hospital stays, higher healthcare costs, and higher mortality rates. With suitable aseptic practices, surveillance, and management tactics, 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 children admitted to PICU **(Bell & O'Grady, 2017).** As a result, nurses' compliance with an evidence-based care package during their practise is critical for lowering CLRBSI and improving pediatric patient outcomes **(Savage et al., 2018).**

In relation to nurses' knowledge about children's C.V.C on pre, post, and follow-up tests. The study revealed that the highest level of nurses 'knowledge was on the posttest. From the researcher's perspective. These findings were consistent with **(Deshmukh and Shinde, 2014)** who found that structured education was effective in increasing nurses' knowledge scores regarding venous access device care in their study "Impact of structured education on knowledge and practice regarding venous access device care among nurses," which stated that structured education was effective in increasing nurses' knowledge scores regarding venous access device care. From the researcher perspectives' this could be attributed to the positive effect of CVC care bundle implementation. Also, PICU nurses were enthusiastic to learn more about how to prevent infection related to a central line.

Regarding nurses' knowledge about nursing care to avoid bloodstream infection on pre, post, and follow-up tests. It noted that the majority of nurses had the highest total mean scores of knowledge about nursing care to prevent CLABSI on posttest and follow-up. This finding was supported by Abdul Kareem's(2014) research on the "Effect of implementing standard guidelines on the prevention of cardiovascular disease."

Furthermore, this result came in agreement with El-Sol and Badawy, (2017) in their study about "The effect of a designed teaching module regarding prevention of central-line associated bloodstream infection on ICU nurses' knowledge and practice. "They found that there was a considerable difference in nurses' knowledge

before and after the designed teaching module. Besides, such findings came in a line with **Bayoumi & Mahmoud (2017)** in their study "Effect of an education program on nurses' knowledge and practice regarding care of central venous line in pediatric hemodialysis: evidence-based practice guidelines," they concluded that most nurses in the pediatric hemodialysis a highly statistically significant improvement in total knowledge scores about venous line post implementation of the EBG. From the researcher's perspective, this could be attributed to the clarity and simplicity of the methods of teaching (oral presentations, group discussion, smartphone, communication board, feedback, and explanatory booklets) that were used in sessions which in turn helped nurses to acquire and improve their knowledge about children central venous catheter (CVC) and nursing care to prevent bloodstream infection. Besides, It could show that the nursing care bundle was successful in improving nurses' knowledge. Also, it highlighted the need of implementing nursing care bundles to improve nurses' knowledge.

Concerning mean total score of nurses 'practice to prevent central line-associated bloodstream infection on pre, post and follow-up tests, the current study revealed that the lowest level of nurses' practice was discovered in this study on the pretest. On the other hand, it found that nurses' practices improved immediately after implementing the nursing care bundle. This finding was supported by **Venkatesan and Manikandan's (2018)** study, "Effectiveness of central line bundle care on the knowledge and compliance of ICU staff nurses." They found that nurses' general pre-test practice regarding the insertion and management of CVC catheters was poor, with a significant difference between the pre-test and post-test. This indicates that the nursing care bundle was successful in enhancing nurses' performance.

In addition, the current study found that on post and follow-up test, the majority of nurses had competent performance in regards to the care bundle of central venous lines for prevention of central venous line-associated bloodstream infections than on pre-test. This could be related to the training approaches utilized in sessions, which helped nurses learn and improve their practices with central venous line care bundles. The care bundle of central venous line operations was demonstrated and re-demonstrated during these sessions. Nurses also felt empowered to use the care bundle for a central venous line to assist children with central lines in reducing central venous line-related bloodstream infections.

In relation to mean and standard deviation of studied children's laboratory tests on pre, post, and follow-up tests, the findings of this study showed that children who received a central line care bundle had a considerably decreased rate of central line-associated bloodstream infections. These results were in harmony with **Melville & Paulus (2014)** in their study about the "Impact of a central venous line care bundle on rates of central line-associated bloodstream infection (CLABSI) in hospitalized children." They found that the introduction of a CVL care bundle produced a

significant sustainable reduction in hospital-acquired CLABSI rates in a children's hospital setting. This can be interpreted that they used the same care bundle. Thus, Training and enhancement of knowledge and skills about central line care bundle become an urgent need to prevent central line associated bloodstream infection. Thus, Training and enhancement of knowledge and skills about central line care bundle become an urgent need to prevent central line associated blood stream infection

Also, this finding was in line with Whitfield (2019), who conducted a study about" Reducing Central Line-Associated Bloodstream Infections." It was found that the project has the potency to promote reducing the risk of CLABSI. In the same context, Chaiyakulsi et al., (2021) in their study on "Can central venous access device care bundles and regular feedback reduce central line-associated complications in pediatric patients?" They illustrated that reinforcing CVAD care bundles with direct feedback could significantly decrease CVAD-associated complications in terms of infection at 6-month post-intervention.

Furthermore, in his study titled "The Association between Central Line Insertion Practices and Central Line-Associated Bloodstream Infections," Elgowainy (2020) found a link between "Central Line Insertion Practices and Central Line-Associated Bloodstream Infections." He discovered that increased central line insertion practices (CLIP) bundle adherence was linked to lower infection rates. Meanwhile, Hamza et al., (2021) discovered that by using a multidisciplinary quality improvement plan that included central line insertion and a maintenance care bundle, the rate of CLABSI in our pediatric and neonatal ICUs was effectively reduced.

Mahmoud et al., (2021) concluded that, it is critical to educate the personnel about the CLABSI bundle. The infection control unit plays a crucial part in staff education, providing them with necessary equipment and supplies, and monitoring the nurses' compliance. The infection control department and hospital management should delegate the implementation of the bundle items to the nurses. Implementing the CLABSI bundle will reduce infection rates while also improving care quality. It could be recognized that central line care bundle training and updating of knowledge and abilities has become a critical requirement for preventing central line-related bloodstream infection.

Conclusion

Based on the finding of the present study, the following is concluded:

Nurses who received health education about care bundle of central venous line had higher level of knowledge about prevention of central venous line-associated bloodstream infections on the posttest than on pretest. Also, Nurses who received health education about the nursing care bundle of the central venous line had higher level of practice in the prevention of central venous line associated bloodstream infections on the post-test than on the pretest. Furthermore, children who received a bundle of care had decreased the rate of bloodstream-associated infection.

Recommendations

In the light of the findings obtained from the current study and its conclusion, the following recommendations are suggested:

4. Integrating nursing care bundle for central venous line in all pediatric intensive care units to prevent central venous line-associated bloodstream infection.
5. In-service educational training programs about nursing care bundles for central venous lines should be developed and provided for pediatric nurses working in pediatric intensive care units.
6. Continuous training program for developing nurses' knowledge and practices regarding CVC care based on nurses' needs for practices.
7. Advanced booklets and electronic media about nursing care bundles for central venous lines should be available at each pediatric intensive care unit.
8. Further studies should be applied to a larger sample to investigate the effect of nursing care bundles on central venous line-associated bloodstream infection to ensure the generalizability of results.

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