Application of Care Bundle Approach for Preventing Device Associated Infections: A Training Program for Pediatric and Neonatal Nurses

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Abstract

Background: Care bundle implementation as a small set of evidence-based interventions together was used in this study for giving better outcomes for defined nurses; caring for pediatric and neonatal patients are faced with increased risks of the device-associated infections and life-threatening conditions during exposure to many invasive devices in intensive care units.

Objective: To assess the influence of the application of care bundle approach training program on pediatric and neonatal nurses for preventing device-associated infection.

Methodology: A quasi-experimental study was used. This study was conducted in pediatric and neonatal intensive care units at Ain Shams University Specialized Hospital (ASUSH) in Cairo.A convenient sample of 70 nurses were involved for data collection by two method; **First:** An interviewing questionnaire divided into two parts: Part 1. Nurses demographic data, Part 2. Assessment of nurses' knowledge. **Second:** Observation checklist for assessing nursing performance regarding the bundle of care.

Results: Less than one quarters (21.40%) of the studied nurses had satisfied knowledge preprogram intervention, compared with more than 85.70% of them has a satisfied post-program intervention regarding the level of total knowledge about the bundle of care;Also, 15.70%of the studied nurses had competent total performance regarding the bundle of care pre-program intervention compared with nearly 72.9%of them had a competent performance post-program intervention.

Conclusion: Application of training program reported remarkable improvement in pediatric and neonatal intensive care nurses' knowledge and performance toward the care bundle approach for preventing device-associated infection.

Keywords: *Pediatric and neonatal intensive care, bundle of care, Nurses performance.*

Introduction

The pediatric and neonatal patients are faced with increased risks of the Device Associated Infections (DAIs) and life-threatening conditions because of the low immunity to many pathogens, and exposure to many invasive devices, parenteral nutrition, prolonged hospitalization ,and persistent processes in Intensive Care Unit (ICU) are among the risk factors associated with Hospital Acquired Infection (HAI)[1].Compliance of pediatric nurses in pediatric and neonatal ICUs with the Standard Precautions (SPs) and the bundle of care an efficient means to prevent and control (DAIs)[2]. The main types of HAIs are DAIs, including the following: Ventilator-Associated Pneumonia (VAP), Central Line-Associated Bloodstream Infection (CLABSI), and Catheter-Associated Urinary Tract Infection (CAUTI)[3].

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Invasive devices in pediatric ICUs (PICUs) are the utmost common threat factors for HAI and applying the bundle strategy is recommended for the avoidance of invasive device- related infections. Prevention Control (PC) bundles have been implemented includes three to five key Infection Prevention Control (IPC) elements based on evidence or coming from well-accepted guidelines[4]. So, ICUs guidelines will review important considerations for infection prevention specifically for VAP, CLABSI, and CAUTI.

Bundles of care are practicable, are easy to implement and adhere to, and are effective in reducing the HAI rates constitutively across the world including developed and developing countries. Following evidence-based bundles that are tailor-made to suit the performance[5].

Pediatric and neonatal nurses in ICUs are in the best position to apply evidence- based guidelines into the performance as they are at the pediatric patient's bedside 24 hours daily providing nursing care and therefore performs a vital role in the prevention of HAIs. Nevertheless, pediatric nurses need to have an awareness of the problem as well as knowledge on current research evidence to adhere to such practices lack of knowledge[6].

In Egypt, Device Associated Infections (DAIs) was 24.5% per 1,000 ICU-days. (VAP) rate was 15.8/1,000 ventilator days, (CLABSI) rate was 6.8/1,000 central line days, and (CAUTI) rate was 6.3/1,000 urinary catheter days in different developing countries[7]. These infections are potentially preventable and can be reduced through implementing care bundles. Bundles are sets of evidence- based interventions, which are designed to improve pediatric patient's health and prevent complications from (DAIs)[8].Bundles of care are commonly practical tools in ICUs consist of three to a maximum of six evidence-based 'elements,' for patients in the health care setting. The elements should be practical together to all pediatric and neonatal patients. The power of bundling is to confirm that all elements function together in every pediatric patient to advance pediatric patient health outcomes[9].

Aim of the Study: This study aimed to assess the influence of the application of care bundle approach training program on pediatric and neonatal nurses for preventing device- associated infection

Methodology

Design of Study: A quasi-experimental design was used to achieve the aim of this study. The study was conducted in pediatric and neonatal ICUs (PICU and NICU) at Ain Shams University Specialized Hospital (ASUSH) in Cairo, Egypt. The PICU unit consists of four units (unit zero, one, two, and three). Unit zero consists from two beds for hemodialysis patients, unit one consists of four beds for post-operative cardiac surgery, unit two consists from four beds, and unit three divided by glass partition into two parts and each part consists of five beds, the total beds in the two units is 20 beds.The NICU consists of one unit divided by glass partition into two parts, and closed room equipped by one incubator for isolation cases, the total incubators inthe unit are fifteen incubators one of them is portable. Additionally, both units (PICU and NICU) are equipped with separate ventilator and monitor for each incubator or bed.

Sampling: A convenient sample of all available nurses (70 nurses) from the above-mentioned settings regardless their educational levels,or years of experience, over a period of 6 months. Forty- five nurses from the PICU and 35 nurses were from the NICU.

Tools for data collection: After reviewing of the recent related literatures was adapted from**De Neef *et al.* (2019), Holzmann (2019), Mack *et al.* (2017), The Egyptian Ministry of Health and Population (2016)[10,11,12,13].** and it include two tools were used for data collection as follows:

First tool: An interviewing questionnaire: It was designed by the researchers. This tool was written in Arabic language and divided into two parts.

Part 1: Nurses' characteristics such as: Age, gender, qualification, years of experience, and training of bundle of care for preventing DAIs.

Part 2: Nurses knowledge assessment about DAIs bundle of care pre/post -test:

This part was completed by nurses before and after the program implementation, it was comprised of (51) questions distributed on:

Knowledge about HAI: (6) questions concerned with: Definition of HAI, types of microbes, causes of HAI, modes of infection, the effect of premature patient on HAI, and component of the chain of infection.

Knowledge about SPs: (13 questions) related to: Definition of SPs, measures of SPs, hand hygiene

(types of hand hygiene, types of hand hygiene in case of diarrhea, indication of hand hygiene, required time), and PPE (types in hospital and insertion of a urinary catheter).

Knowledge about bundles of care:

(A): Knowledge about bundle of care to prevent (VAP) (13 questions) related to: Definition of VAP, angle of the elevated head of bed, oral care, the purpose of elevating the head of bed, changing of air vent humidifier, filling of a humidifier, importance of preventing of deep thrombosis in the legs, indication of uses of peptic ulcer drugs, changing of ventilator circuits, emptying suction bottle, using of much sedative drugs and using of saline solution for the suction.

(B): Knowledge about bundle of care to prevent (CLABSI) (8 questions) related to: Definition of CLABSI time of changing transparent dressing and disinfectant of skin prior insertion for less and more than 1000 grams, changing the line system, changing sterile gauze, disinfect the access port and changing the line system in case of changing the solution.

(C): Knowledge about bundle of care to prevent (CAUTI) (11 questions) related to: Component of CAUTI bundle, definition of (CAUTI), symptoms of urinary tract infection, indication of secured urinary catheter, method of urinal disinfectant, caring of pubic area, placing of the urinary bag, relation of rate of urinary tract infection and urinary catheter, irrigation of urinary catheter in case of obstruction and importance of antibiotic ointment.

Scoring System: Nurses' knowledge assessment was scored according to the key answer as follows: A correct answer scored as one and an incorrect answer scored zero. These scores were converted into a percentage score. Scores of all questions (50 points) were summed up and accordingly the total scoring was categorized into:

Unsatisfactory knowledge (<75%).

Satisfactory knowledge (≥ 75%).

Second Tool: Observation checklists pre/post-program intervention:

This tool was used with permission from the director of each pediatric and neonatal ICUs for assessing nursing performance regarding the bundle of care according to standers of checklists. Observational checklists covered the following 5 procedures:

1. Ventilator Associated Pneumonia (VAP) (6) items.
2. Central Line Associated Blood Stream Infection (CLABSI) (6) items.
3. Catheter Associated Urinary Tract Infection (CAUTI) (6) items.
4. Hand hygiene (10) items.
5. Personal protective equipment.

Scoring System: Each step of a procedure was scored according to the weighing of this step that makes a total score (33 items equal 100%). If any item was done correctly, getting one score while zero score was allotted to the wrong or not done step.

The total scoring system of nurses' performance was classified into:

"Competent" was considered for ≥ 80% and above.

"Incompetent" were considered for < 80%.

Results

A total of 70 nurses(Forty- five nurses from the PICU and 35 nurses were from the NICU) were enrolled at this study.

Part (1): Demographic characteristics of the studied nurses: The mean age and SD of the studied nursing staff age was 30.19±6.34, and the majority of them (91.4%) were females. It was found that 35.7% of them were a technical institute, and 38.6% have ≥10 years of experience. Also, less than one third of them (32.9%) attended a training program on the bundle of care.

Part II: Knowledge of the studied nurses about bundle of care.

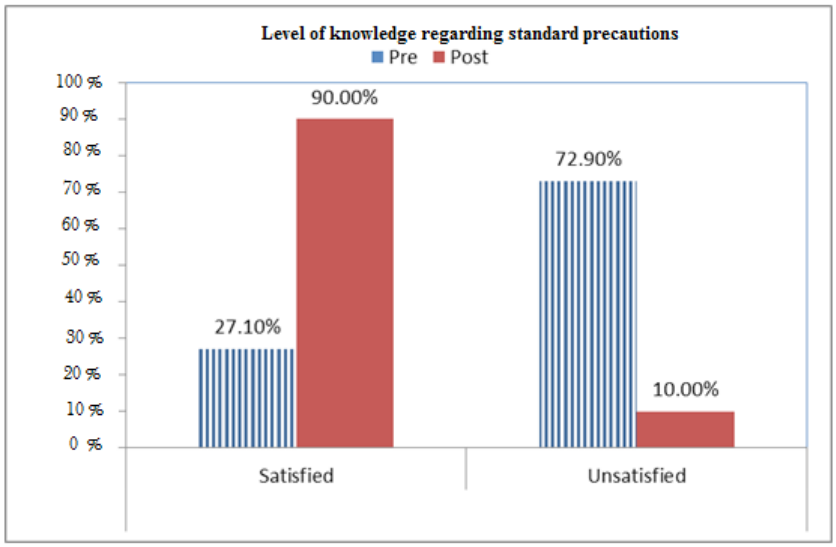

Figure (1): Distribution of the studied nurses according to their knowledge regarding Standard Precautions (SPs) (N=70).

Less than one third of the studied nurse (27.10%) had satisfied knowledge regarding SPs preprogram intervention when compared with the majority (90%) of them had satisfactory knowledge post program intervention. This reflects a statistically significant difference between pre and post application of SPs (p-value <0.001).

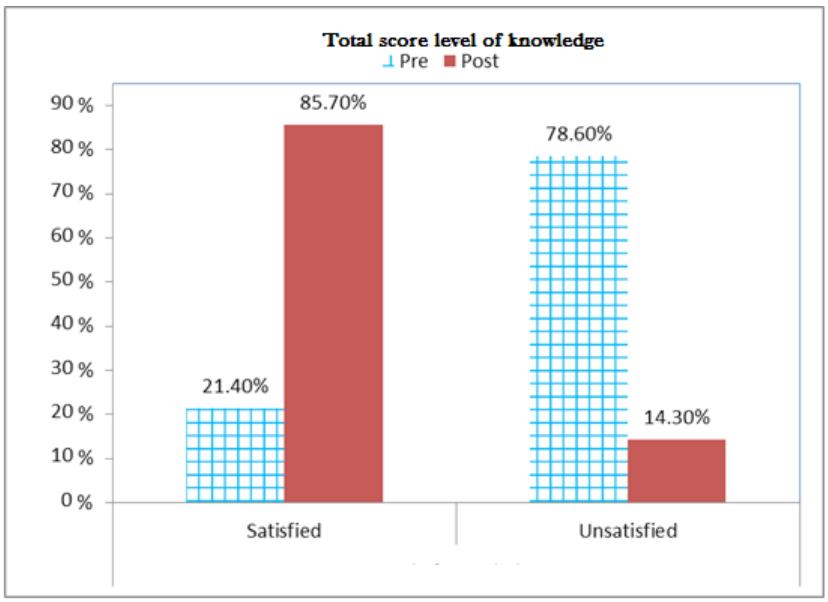

Figure (2): Distribution of the studied nurses' according to their level of knowledge about bundle of care pre post program intervention (N=70).

Less than one quarters (21.40%) of the studied nurses had satisfied knowledge preprogram intervention, compared with more than three fourths (85.70%) of them has a satisfied post program intervention regarding the level of total knowledge about the bundle of care. Also, there was a statistically significant difference between pre and post regarding level of total knowledge about bundle of care (p-value <0.001).

Part III: Practice of the studied nurses about bundle of care.

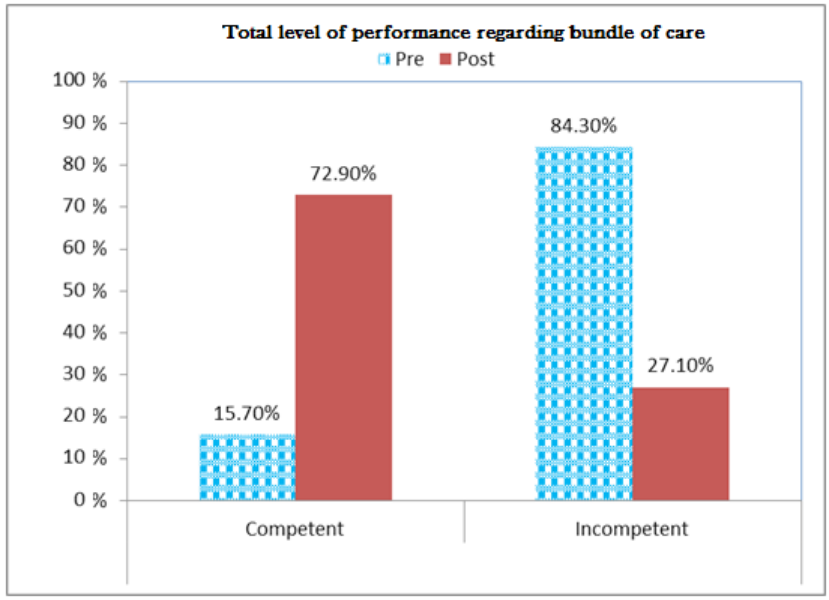

Figure (3): Distribution of the studied nurses according to their total performance regarding bundle of care Pre/post program intervention (N=70).

One quarter (15.70%) of the studied nurses had competent total level of performance regarding bundle of care preprogram intervention compared with nearly three quarters (72.9%) of them had a competent performance post program intervention, there was a statistically significant difference between pre and post -program intervention regarding nurses levels of performance (p-value <0.001).

Part IV: Relation between the studied variables: The studied nurses' total level of knowledge and their demographic data, namely educational level, years of experience, and training courses were statistically significant with p-value (p<0.05).

There were statistically significant relations between the studied nurse's total level of performance about the bundle of care and their demographic data namely educational level, years of experience, and training courses, with p-value (p<0.05).

Table (1): Relation between nurses' level of knowledge and level of performance pre/ post program (N=70)

	Level of performance	Level of Knowledge				Total		Chi-square test	
		Satisfied		Unsatisfied				χ^2	p-value
		No.	%	No.	%	No.	%		
Pre intervention	Competent	11	73.3%	0	0.0%	11	15.7%	47.853	<0.001**
	Incompetent	4	26.7%	55	100.0%	59	84.3%		
	Total	**15**	**100.0%**	**55**	**100.0%**	**70**	**100.0%**		
Post intervention	Competent	51	85.0%	0	0.0%	51	72.9%	31.316	<0.001**
	Incompetent	9	15.0%	10	100.0%	19	27.1%		
	Total	**60**	**100.0%**	**10**	**100.0%**	**70**	**100.0%**		

**p-value <0.001 HS

The studied nurses' level of knowledge pre and post level of performance were highly statistically significant (p<0.001).

Table (2): Correlation between the total score of knowledge and total score of performance pre / post program intervention (N=70).

Total score of performance	Total score of Knowledge	
	Rs	p-value
Pre	0.481	<0.001**
Post	0.625	<0.001**

**p-value <0.001 HS

There is a positive correlation and significant relation between total score of knowledge and their total score of performance regarding bundle of care pre-program and post-program intervention with (p-value<0.001).

Discussion

Pediatric intensive care unit patients develop life-threatening (HAIs) more frequently than other old patients due to their acute illness and invasive device procedures. So, device-associated infections remain a major issue of pediatric patient health safety and outcomes[14]. A care bundle is defined as a group of evidence-based interventions related to a specific condition when applied together significantly improves pediatric patient outcomes. And prevent DAIs in pediatric and neonatal intensive care units[15].

The finding of study nurses was in the age group ≥ 35 years and more with the mean age and SD of the studied nursing age was 30.19, SD ±6.34. These findings were not supported by **Eskander *et al.*(2013)[16]**. Also, our study revealed that more than one-third of them were technical institute. These findings are not supported by **Mohammed (2016)[17].** This may be due to the presence of a technical nursing institute among the hospital and the most of nursing working in the hospital graduated from it. Additionally, our study revealed that more than one-third of them have ≥10 years' experience. These findings are not supported by **Abolwafa *et al.*(2013)[18]** due to most of the studied nursing age more than 35 years and working in ICU since graduation. Regarding the training program, less than one -third of them attended a training program on the bundle of care. This goes in the same line with **Ebied (2011)[19]**.

Concerning gender, the current study demonstrated the dominance of females than males which in agreement with **Atalla *et al.*(2016)[20]**, this result may be due to female were the majority of nursing staff in this hospital and also no male nurses were working in the NICU.

Regarding nurses total knowledge about SPs, the current study revealed that less than one- third of the studied nurse had satisfied knowledge regarding SPs preprogram intervention when compared with the majority of them had satisfactory knowledge post-program intervention statistically significant difference between pre and post regarding level of knowledge on the application of SPs (p-value <0.001).This results in the same line with **Mahmoud *et al.* (2020)[21]**. Indeed, our study showed less than one- quarters of the studied nurses had satisfied knowledge preprogram intervention, improved to more than three- fourths of them post -program intervention This finding is consistent with **Sodhi, (2013)[22]**. Which agreed with our opinion that suggests that the knowledge of the studied nurses increased due to effective program and the availability of handbooks.

According to the total level of performance of the studied nurses, the present study showed that the education program was successful inupdating and enhancing their total performance regarding bundle of care to prevent DAI in PICU and NICU. In addition, this study showed that one quarter of the studied nurses had a competent total level of performance regarding bundle of care preprogram intervention compared to nearly three quarters of them post- program intervention. Also, there was a statistically significant difference between pre- and post- program intervention regarding level of performance (p-value <0.001). This finding was supported by **Ceballos *et al.*(2013)[23]**.

The present study showed that there were significant relations between the studied nurse's total level of knowledge and their demographic data, namely educational level, years of experience, and training courses, with p-value (p<0.05) which was in the same line with **Chen *et al.* (2011)** and **Prasanna (2015)[24,25],** on the other hand it is contradicted with **Mukakamanzi (2017)[26],** who found no significant relation between nurses' knowledge or performance and training on infection control. Also, a significant relation between (qualification) level of education and nurses' level of performance was proven in agreement with a study conducted by **Esposito *et al.*(2017)[27].**As regards nurses' knowledge and their level of performance regarding bundle of care, there were highly statistically significant relations (p<0.001). This result in accordance with a study conducted by **El Sayed Ghonemy et al.(2018)[28]**. The researcher opinion suggests that, as the pediatric nurses' knowledge rises up, their performance increase.

Finally,In Egypt; there is a shortage of nursing staff and professionals. So, knowledgeable nurses are considerably important and required to make perfect performance in pediatric and neonatal care and diminish the hazards of HAI[29,30]. Indeed, Nurses must perform all appropriate preventative evidence-based practice interventions as presented in multiple bundles of care guidelines in order to do these roles, nurses must be well educated on the preventative strategies and be able to translate that knowledge into performance.

Conclusion

Based on the results of the present study, there is a positive correlation and significant relation between the total score of knowledge and their total score performance regarding bundle of care pre and post program intervention. In conclusion, the educational training program reported remarkable improvement in pediatric and neonatal nurse's knowledge and performance toward a bundle of care.

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