

Nursing Practice for Prevention of Central Line Associated Blood Stream Infection (CLABSI) in A Pediatric Intensive Care Unit

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Abstract:

Background: Children in the intensive care unit (ICU) are at a high risk of hospital acquired infection, particularly central line associated blood stream infection. The aim of the study was to: (1) evaluate adherence with Center for Disease Control guidelines for preventing CLABSI in the pediatric ICU; and 2) to identify barriers for implementing best practice guidelines.

Method: A descriptive research design included a purposive sample of 120 nurses working in pediatric intensive care units at Mansoura University Children's Hospital, Egypt.

Results: The majority of nurses working in the neonatal ICU (92.5%) and cardiac ICU (95%) reported washing their hands and scrubbing the access port and catheter hub with alcohol before accessing the catheter. All units used povidine iodine antiseptic solution on the insertion site and used a gauze and tape dressing for occlusion Although there were high reporting of adherence with total parenteral nutrition and line change protocol recommendations; practice varied with crystalloid fluids and protocols for line changing.

Conclusion: The findings of this study revealed variations in nursing practice for CLABSI prevention emphasizing the need for education and monitoring.

Keywords: evidence best practice; central venous catheter, nursing practice, pediatric; central line associated blood stream infection.

I. Introduction

Central venous catheters (CVCs) are increasingly used to administer medication, fluids, blood sampling and hemodynamic monitoring (Alexandrou *et al.*, 2010). Despite the advantages of CVC use, there are a lot of risks associated with its use, among them the colonization of the catheter and the bloodstream infection. Central line associated bloodstream infection (CLABSI) are a serious complication of CVC implantation and impact on pediatric health outcomes (Saint, 2012; Zack, 2008; Smith, 2007; and Aragon & Sole., 2006).

Central line associated blood stream infection is the most common hospital-acquired infection in the pediatric intensive care unit (PICU) accounting for 28% of all nosocomial infections in this population followed by ventilator-associated pneumonia (VAP) (Almuneef *et al.*, 2006). In Egypt, a prospective cohort surveillance study was conducted at a respiratory intensive care unit and in the pediatric intensive care units (PICUs) of member hospitals of the International Nosocomial Infection Control Consortium (INICC) from December 2008 to July 2010 and concluded that, the incidence of CLABSI rate was 22.5 per 1000 line-days in respiratory ICU and 18.8 in the pediatric ICU (Rasslan *et al.*, 2012).

The Center for Disease Control provide guidelines for prevention of intravascular catheter related infection which covers also pediatric and neonates (O'Grady *et al.*, 2011). These guidelines include recommendations for the education of health-care personnel especially nurses on proper catheter insertion and maintenance, routine monitoring of CLABSI rates, hand washing, using of aseptic technique and maximal sterile barrier, the use of a specialized infusion therapy team, the use of bundle approach, disinfection of the catheter hub, and use of sterile dressing and the early removal of central venous catheter (Loveday *et al.*, 2014 & O'Grady *et al.*, 2011).

Nurses play an important role in the care and maintenance of the CVC insertion site (Lynch, 2012). Nurses adherence with evidence based practice is very important for reducing the incidence of CLABSI and improve pediatric patient outcome (O'Grady *et al.*, 2011). Several studies indicated that, lack of knowledge and skills is one of the main barriers for implementing evidence-based nursing practice (Grimshaw *et al.*, 2004; Kennedy *et al.*, 2004). Therefore, the main goal of this study was to evaluate the current nursing practice for prevention of CLABSI in pediatric intensive care unit and identifying barriers for implementing best practice.

II. Methods

Research design

A descriptive research design with purposive sampling

Research question

Are the nurses following the CDC guidelines for prevention of CLABSI?

Setting and study participant

This study was conducted in four pediatric ICU including medical, surgical, neonate and cardiac ICU at the Children's Hospital affiliated to Mansoura University, Egypt. The study sample include all nurses (120) working at the units and departments described above

Study Measures and Questionnaires

Tool 1: Nursing practice for Prevention of CLABSI in pediatric and barriers for implementing evidence-based practice This questionnaire was developed by the researcher after reviewing related literature to evaluate the current nursing practice used by nursing staff while caring for children with CVC before, during and after the insertion (Taylor et al., 2014 & Vandijck et al., 2009). Questions were in the form of multiple choice questions. The questionnaire was assessed for its content validity and reliability by nurse experts before. The questionnaire had two parts as follows:

Part I: Socio-demographic data of nurses including: age, level of education, years of experience, department and previous attendance of training program about prevention of CLABSI.

Part II: This section was include (13) question related to actual practice of CVC change, dressing type and frequency of change, antiseptic solution used, management of administration set, unite protocol for prevention of CLABSI and compliance with hand washing and maximal sterile barrier. In addition, the nurses were also asked about the main barriers that hinder the implementation and compliance with evidence-based practice.

Data collection

Data collection of this study was carried out over two months in the period from the beginning of September 2015 to the end of October 2015. A pilot study was carried out 10% of the total sample size, to ascertain the feasibility, applicability and clarity of the tool and some modifications were made consequently.

III. Data Analysis

The Statistical Package of Social Sciences (SPSS) version 16 was used for processing and analysis of the data. Descriptive statistics (means, SDs, frequencies, percentages) were used to describe the characteristics of the study population and main variables. The significance level for all tests was set at $P \leq .05$.

Ethical Considerations

Ethical approval was obtained from Research Ethics Committee at the Faculty of Nursing - Mansoura University. Oral consent was obtained from every nurse after explaining the aim of the study. Confidentiality of data and anonymity as well as nurses' right to withdraw from the study at any time was ascertained.

IV. Results

Table 1 describes the characteristics of nurses participating in the study. Approximately half of the nurses (49.2%) were in the age group from 30 to less than 35 years and three quarter (73.3%) of nurses had not previously a training program about CLABSI prevention. Three quarter of nurses (75.8%) had bachelor in nursing. Approximately two third of nurses (60%) having 10 years of experience.

Nurses self report of current practice related to general preventive measures of CLABSI are provided in Table 2. The majority of nurses (92.5% & 95%) working in NICU & cardiac ICU was reported they always washing their hands before and after caring of CVC comparing to approximately half (53.7% & 47.4%) of nurses working in PICU and SICU and the difference was statistically significant.

The majority of nurses (80.5%) in NICU and 100% of nurses in cardiac ICU reported they always scrub the access port compared to approximately one third (34.1%) in PICU and 21.1% in the SICU. In addition, all unites used saline flush via protocol and more than half of nurses (57.5%) in the NICU reported that heparin lock

Table 3 showed nurses self- reported practice related to CVC insertion care and dressing. All ICUs used povidone iodine antiseptic solution on the insertion site and using gauze and tape dressing. In addition, the majority of nurses routinely change dressing every day. Daily inspection of the insertion site was done by more than half (52.6%) of nurses in SICU compared to minority in the other unites.

Nurses' practice related to management of administration set and access port is shown in Table 4. The replacement of intravenous fluids and administration sets varied considerably. Some consistency in practice was seen with total parenteral nutrition and line change; however, practice varied with crystalloid fluids and routine for CVC line changes. Table 5 provides a picture of adherence with CDC recommendations in the study setting. We compared the results to the CDC guideline and summarized the compliance as a percentage Reported practices varied across the units and were not always consistent with the published guidelines.

Table 6 reports the barriers for implementing evidence-based guidelines into clinical practice. When the nurses were asked about the main barriers approximately one half reported lack of training was an issue. The lack of a standard procedure for maintenance of CVCs and recording procedures were also identified. In addition, (41.7%) of nurses reported that, shortage of nurse and work overload also a barrier for compliance with the best practice.

Table 1: Study participant characteristics

Characteristics	(n=120)	%
Educational level		
Diploma	15	12.5
Technical institute of nursing	14	11.7
Bachelor degree of nursing	91	75.8
Years of experience		
<10	73	60.8
10-<20	40	33.3
20 & more	7	5.8
Type of intensive care unit		
Medical	41	34.2
Neonatal	40	33.3
Surgical	19	15.8

Nursing Practice for Prevention of Central Line Associated Blood Stream Infection (CLABSI) in A....

Cardiac	20	16.7
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Table 2: Nurses self-report of current practice related to care of the central venous catheter

Clinical practice	PICU n=41		SICU n=19		NICU n=40		CICU n=20		Test of significance X ² & P
	No	%	No	%	No	%	No	%	
Hand washing before and after access the CVC									
Always	22	53.7	9	47.4	37	92.5	19	95	X ² =26.62 P <0.001*
sometimes	17	41.5	9	47.4	3	7.5	1	5	
Never	2	4.9	1	5.3	0	0	0	0	
Wearing sterile gloves during insertion of CVC									
Always	41	100	19	100	40	100	20	100	
Wearing personal protective equipment during CVC insertion (mask, surgical gown, cap, full body sterile drape)									
Always	8	19.5	7	36.8	33	82.5	4	20	X ² =49.45 P <0.001*
sometimes	23	56.1	7	36.8	5	12.5	16	80	
Never	10	24.4	5	26.3	2	5	0	0	
Scrub the access port & catheter hub with alcohol 70% before and after access the catheter									
Always	14	34.1	4	21.1	33	82.5	20	100	X ² =50 P <0.001*
sometimes	25	61	11	57.9	5	12.5	0	0	
Never	2	4.9	4	21.1	2	5	0	0	
Unite protocol for prevention of CLABSI infection									
Saline flush after the end of care	37	90.2	19	100	17	42.5	18	90	X ² =56.12 P <0.001*
Antibiotic lock	4	9.8	0	0	0	0	0	0	
Heparin lock	0	0	0	0	23	57.5	2	10	

Cardiac intensive care unit= CICU;CLABSI = central line associated blood stream infection; CVC=central venous catheter; neonatal intensive care unit = NICU; pediatric intensive care unit= PICU; surgical intensive care unit =SICU.

Table 3: Nurses' self- reported practice

Clinical practice	PICU n=41		SICU n=19		NICU n=40		CICU n=20		Test of significance X ² & P
	No	%	No	%	No	%	No	%	
Antiseptic solution for preparation& maintenance of CVC site									
Povidone–iodine	40	97.6	19	100	25	62.5	17	85	X ² =29.74 P <0.001*
70% alcohol	1	2.4	0	0	15	37.5	3	15	
0.5% chlorhexidine gluconate with alcohol	0	0	0	0	0	0	0	0	
Daily inspection of the catheter insertion site									
Always	27	65.9	5	26.3	39	97.5	20	100	X ² =49.39 P <0.001*
sometimes	14	34.1	14	73.7	1	2.5	0	0	
Frequency of inspection of the catheter insertion site									
Once \ day	12	29.3	10	52.6	8	20.0	3	15	X ² =22.62 P =0.007*
Twice \ day	11	26.8	9	47.4	19	47.5	13	65	
More than twice	11	26.8	0	0	9	22.5	4	20	
other	7	17.1	0	0	4	10.0	0	0	
Type of dressing used in the majority of patients									
Gauze & tap	40	97.6	19	100	25	62.5	17	85	X ² =29.74 P <0.001*
Transparent (semi permeable)	1	2.4	0	0	15	37.5	3	15	
Frequency of changing CVC dressing									
Every shift	23	56	1	5.3	24	60	18	90	X ² =56.47 P <0.001*
Every day	9	22	0	0	10	25	0	0	
Only when indicated as (soiled, loosened)	9	22	18	94.7	6	15	2	10	

Cardiac intensive care unit= CICU;CLABSI = central line associated blood stream infection; CVC=central venous catheter; neonatal intensive care unit = NICU; pediatric intensive care unit= PICU; surgical intensive care unit =SICU.

Table 4: Nurses self reported practice related to management of administration set and access port

Variable	PICU n=41		SICU n=19		NICU n=40		CICU n=20		Test of significance X ² & P
	No	%	No	%	No	%	No	%	
Change of administration set for clear fluid									
Daily	24	58.5	4	21.1	28	70	20	100	X ² =33.92 P <0.001*
48 h	11	26.8	11	57.9	12	30	0	0	
72 h	1	2.4	0	0	0	0	0	0	
96 h	5	12.2	4	21.1	0	0	0	0	
Change of administration set for TPN									
Immediately after the end of infusion	2	4.9	10	52.6	9	22.5	10	50	X ² =22.84 P <0.001*
24 h	39	95.1	9	47.4	31	77.5	10	50	
Change of administration set for blood & blood product									
Immediately after the end of infusion	17	41.5	7	36.8	21	52.5	11	55	X ² =17.46 P =0.042*
Daily	20	48.8	7	36.8	19	47.5	9	45	
48 h	4	9.8	4	21.1	0	0	0	0	
Others	0	0	1	5.3	0	0	0	0	
Needless access device change (3 way)									
Daily	30	73.2	9	47.4	23	57.5	8	40	X ² =27.08 P =0.001*
48 h	4	9.8	3	15.8	7	17.5	11	55	
72 h	2	4.9	4	21.1	8	20	1	5	
Others	5	12.2	3	15.8	2	5	0	0	

Table 5: Nurses compliance to Center for Disease Control (CDC) evidence-based guidelines

Recommendations	CDC Level of evidence	Compliance %
Education of all health care provider about CVC catheter insertion and maintenance care and prevention of CLABSI	IA	26.7
Perform hand washing either by washing hands with conventional soap and water or with alcohol-based hand rubs (ABHR) before and after any contact with CVC	IB	72.5
Prepare skin with a >0.5% chlorhexidine preparation with alcohol before central venous catheter insertion and during dressing changes NB: chlorhexidine not available and they are use povidone-iodine instead	IA	100*
Use sterile gauze or sterile transparent, semipermeable dressing to cover the catheter site	IA	100
Change gauze dressing every 2 days or when clinically indicated	II	29.2
Replace fluid administration sets for clear fluid no more frequently than 96 h but at least every 7 days	IA	7.5
Replace administration sets for blood, blood products, or fat emulsions within 24 hours of initiating the infusion	IB	74.2
Change needleless connectors no more frequently than every 72 hours or according to manufacturers' recommendations	II	12.5
Scrub the access port with appropriate antiseptic	IA	59.2
Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a sterile full body drape, for the insertion of CVCs	IB	43.33

Category IA: strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies

Category IB: strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale; or an accepted practice (e.g., aseptic technique) supported by limited evidence

Category IC: required by state or federal regulations, rules, or standards

Category II: suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.

Table 6: Barriers for implementing evidence-based guidelines

Variable	No (120) #	%
Lack of training	55	45.8
Unfamiliar with the guidelines	25	20.8
Lack of policy about CLA BSI bundles	39	32.5
Lack of standard clinical procedure of maintenance catheters	54	45
Lack of policy about CVC nursing records	54	45
Shortage of nurses and over-workload	50	41.7

(#) more than one answers

V. Discussion

The current study revealed that, there was limited education provided to nurses regarding prevention of CLABSI as presented in Tables 1 and 5. Therefore, the compliance rate with CDC recommendation was less than optimal. These findings was in agreement with Taylor et al., (2014) who reported in his study limited education provided to medical and nursing staff. In contrast Snarski et al., (2015) reported in a similar study that, all of the healthcare professionals who managed CVCs underwent specific training in 91% of the centers included in his study. In all of these centers, the training was direct, nurse-to-nurse or physician-to-physician and included some training under supervision. Moreover, 47% of the centers also provided indirect training, including lectures and instructional videos. In 89% of the centers, personnel were required to undergo specific training prior to managing patients with CVC (Snarski et al., 2015).

In addition, the finding of the study indicates that, a large percentage of nurses implemented some preventive measures for CLABSI prevention. Nursing practice varied among nurses in different ICUs; neonatal ICU nurses were more compliant to evidence-based guidelines for prevention of CLABSI compared to nurses in others unit. The finding of the current study demonstrated 100% compliance with the CDC recommendation and consistency in nursing practice regarding type of dressing use across nurses in different unit. Furthermore, results showed that a variation in dressing site care. The majority of nurses working on ICU were not following CDC recommendation and routinely changing dressing. In contrast, the majority of nurses (94.7%) working on surgical ICU reported that, change of CVC dressing was done only when solid or loose or clinically indicated. This reflects variation in nursing practice among department in the same hospital.

Another variation in nursing practice was the frequency of change of the administration set for clear fluid. Despite the CDC recommendation to change administration sets no more frequently than 96 hour except the administration sets for blood transfusion and for parenteral nutrition (O'Grady et al., 2011). The results of the current study showed that, only 7.5% of the nurses in ICUs comply with CDC recommendation (Table 5). This result was in an agreement with Taylor et al., (2014) who reported in his study that, only one third of studied nurses compliant with CDC recommendation regarding replacement of administration set for clear fluid. The duration of time for replacement of administration sets are left for the hospital policy and consideration made to extend routine changes to at least 96 hour. This will prevent unnecessary replacement of lines and potentially reduce the risk of infection. Moreover, this practice change will save cost, nursing time and environmental waste (Taylor et al., 2014 & Gillies et al., 2005).

The use of chlorhexidine for skin disinfection before insertion or dressing change of a CVC was recommended by CDC. Furthermore, the safety and efficacy of chlorhexidine use in children under the age of 2 months is not resolved (O'Grady et al., 2011). In the current study chlorhexidine was not used in the hospital and povidone-iodine was used in skin preparation and during dressing change; this could be explained by the lack of appropriate solution on the market.

The external surface of the catheter hub is the main portal of entry of microorganism to the blood stream causing CLABSI. Therefore, scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol) for 15 second and allowed to dry and accessing the port only with sterile devices were recommended (O'Grady et al., 2011; Casey et al., 2007 & McDonald et al., 1998). The current study showed that, more than half of nurses were compliant with the CDC recommendation regarding scrubbing the CVC hub before accessing the port. In addition, the CDC recommended changing the needless connector or the stopcock no more frequently than every 72 hours or according to manufacturers' recommendations for the purpose of reducing infection rates (O'Grady et al., 2011). The result of the present study revealed that only 12.5% of the nurses in different unit were follow CDC recommendation. This result was in an agreement with Taylor et al., (2014) who reported in his study that only 18 % of studied nurses were replacing needless connector every 72 hour.

Strengths and limitations of the study

The results of the current study represent nursing practices for prevention of CLABSI in four pediatric intensive care unit at one Children's University Hospital in Egypt; therefore, we cannot make generalization from the current study. Moreover, study instruments were investigator developed. In spite of these limitations, we were encouraged in the transparency of participants' responses providing an excellent opportunity for improving health outcomes.

VI. Conclusion

The current study provides a picture of the current nursing practice for prevention of CLABSI in pediatric ICUs. The findings revealed variations in nursing practice for CLABSI prevention among nurses across the studied ICUs. In addition, the study illustrated an absence of a uniform protocol for prevention of CLABSI in the studied ICU. This indicates the need for developing a protocol for CLABSI prevention based upon current evidence based guidelines. There is also a need for establishing a system to implement prevention protocols and the monitoring of adherence and CLABSI

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