Original Article

Effects of Hickman Catheter Care Training on Practices of Nurses

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Abstract

Abstract: This study was conducted to examine the effects of Hickman Catheter Care Training on nurses' practices. The descriptive study, was pretest-posttest and comparative design, was conducted with 44 nurses. Pre and post test measurements were carried out. After the pre-test, nurses received theoretical and practical training on the Hickman catheter. Following the training, post-test scores were obtained. In the second step of the study, nurses were evaluated while they were practicing their knowledge in clinic. Mean and percentage values, Kolmogorov-Smirnov test, Mann-Whitney U test, Kruskall-Wallis test, and Wilcoxon Signed Rank Tests were used. Total Hicman catheter scores of nurses before the training were significantly higher compared to their scores after the training (p:0.001). One month after the training, 65.9% of the nurses mastered sterile opening of the materials, while only 29.5% washed their hands after removing their gloves. The training had a positive influence on nursing practices. However, nurses were incompetent regarding hygienic hand washing, use of gloves, and antiseptic use. It was also observed that the duration of employment in the nursing profession, working types, routine tasks of nurses, and the number of patients affected catheter care practices. In order to achieve sustainability, training should be provided on a regular basis.

Key Words: Nursing training, nursing practice, Hickman catheter care.

Introduction

Central venous catheters (CVC) have been frequently used particularly in oncology units where chemotherapy applications are provided. Opening vascular access in oncology patients is one of the most difficult applications for both nurses and patients. CVC use has become a standard approach in oncology because it facilitates the blood collection, performing central venous pressure follow-up (CVP), long-term chemotherapy, application of other drugs, and infusion of blood samples (Altuntas et al., 2004; Guleser and Tascı, 2009).

Even though CVCs have various benefits, their common use increases complication rates. Two important complications which can be observed due to the use of CVC are infections and thrombosis (Bakir, 2002; Guleser and Tascı, 2009; Usta, 2005). Immune systems and hematopoietic tissues of cancer patients are temporarily suppressed and thus CVCs are known as a serious source of infection because they deteriorate skin integrity (Guleser and Tascı, 2009; Ozkocaman, 2002). Deterioration of skin elasticity, in particular, makes this risk more important.

The catheter insertion site is one of the access sites of pathogens which can lead to infections. The aim of catheter care is to keep the access site dry and to minimize bacterial colonization. In the literature, it has been specified that the infection risk can be prominently reduced while using tunneled catheters with the help of good catheter care. These tunnel catheters are known to have high risks for infections. Therefore, care of the catheter insertion site is very important in order to reduce infection risk (Arpa et al., 2013; Barnes et al., 2016; Dibble et al., 1991; Eggimann and Pittet, 2002;)

Insertion of catheters is performed by doctors. However, nurses are primarily responsible for catheter care upon insertion. This responsibility

requires effective health care applications. Appropriate care applied by nurses influences infections and other catheter related complications. For this reason, nurses need to acquire care skills. Interventions to improve reliability of care should focus on implementing both best practice and further education (Shapey et al., 2009). But, not only providing theoretical knowledge but also providing regular practical trainings will ensure the sustainability of these catheter care techniques into practice (Cetinkaya Sardan et al., 2013; Safdar and Maki, 2004). It is required for nurses to be trained about the appropriate use and care of central catheters and they should also keep practicing these methods. In this regard, study was conducted in order to answer the following research question: "What is the effect of Hickman catheter care training on practice and the knowledge levels of nurses?"

Methods

Design and Sampling

The descriptive study was pretest-posttest and comparative design. The study was conducted by applying pre-tests and post-tests to nurses who were working in different units where Hickman catheters were commonly used. The study was conducted in a university hospital located in Istanbul between September and May, 2015. Nurses working in the Pediatric/Adult Bone Marrow Unit, the Chemotherapy Unit, the Oncology service, and the Pediatrics service were included. Nurses who cannot be reached since they had an official health report or were on vacation during the study period were excluded. Therefore, the study group was composed of 44 nurses.

Instruments

Data was collected using the Personal Information Form, the Hickman Catheter Care Questionnaire, and the Hickman Catheter Care Follow-Form. The Hickman Catheter Training Guide was prepared for the training.

Personal Information Form: This form included questions on demographic and occupational features of nurses and the status of receiving Hickman catheter training and practicing the newly learned catheter care techniques.

Hickman Catheter Pretest-posttest Survey: This survey was composed of 25 questions which measure the knowledge levels of nurses about central catheter types, features of catheters, advantages and disadvantages of catheters, care of catheters, and various preventive interventions against infections during catheter use. The content of this survey was evaluated by experts in the field. Response categories included "right (R)", "wrong (W)" and "I don't know (D). Each right answer received "1" point and each wrong answer received "0" points. The highest total score that can be obtained from the survey is 25.

Hickman Catheter Care Follow-up Form: This form was developed as a control list. Nurses were observed one month after the training and they were evaluated by using the follow-up form. The follow-up form was prepared according to the following application assessments; "should be improved" (1), "sufficient" (2), "mastered" (3), and "not observed" (NO). This form included five parts. The first part was composed of items related to the preparation of materials; the second part included items related to hand hygiene applications, the third part was related to catheter insertion site care, the forth part was related to catheter irrigation, and the fifth part was related to blood collecting from the catheter insertion site.

The Hickman Catheter Guide: It was prepared by the researcher and was composed of the application steps of the Hickman catheter care with the help of figures. Intravascular Catheter-Related Infections Prevention Guidelines prepared in 2011 by Centers for Disease Control and Prevention and Healthcare Infection Control Practices Advisory Committee were used while preparing the guide (O'Grady et al., 2011). This guide consists of information related to the features of central catheters, advantages and disadvantages of Hickman catheters, features of the dressing material, catheter care and materials used in catheter use, irrigation of the catheter, collecting blood samples from the catheter and application of treatments through catheters.

Application Steps

The study was conducted in two steps. After obtaining ethical committee approval and permissions, the first step of the study was planned. In this regard, trainings were organized according to the study programs of the nurses.

Prior to the training, the personal information form and the surveys were distributed in order to obtain pre-test measurements. Afterwards, the training was provided. During the training,

Hickman catheter care methods were demonstrated to the nurses and they were asked to apply them by themselves. A visual presentation consisting of 82 slides was used during the training. The training took two hours. Brainstorming and question and answer techniques were used in the training in order to ensure the active participation of nurses. After the training, the nurses were asked to fill the surveys and thus, post-test measurements were obtained.

The second part of the study was conducted one month after the training. Nurses were observed while they were applying the Hickman catheter care methods and they were evaluated by using the follow-up form.

Statistical analysis

The data of the study were statistically analyzed by using the IBM SPSS Statistics 22.0. Descriptive statistical methods (mean, percentage, standard deviation, minimum and maximum values) were used. Wilcoxon Signed Rank Test was used for parameters which are not normally distributed when pretest and posttest findings were compared. Mann Whitney U test was used in order to compare quantitative data of two groups. Kruskal Wallis test was used to compare more than two groups. Statistical significance was accepted as $p<0.05$.

Results

The mean age of nurses was 25,77±6,8; among the nurses, 86% were female (n=38) and 59.1% had a Bachelor's degree (n=26). Among all nurses, 93.2% worked in different units, 65.9% (n=29) were working in shifts, and 40.9% (n=18) were working 45-60 hours per week. It was found that 36.4% of the nurses were caring for 3 patients per day (n=16) and 36.4% were caring for 7 patients per day (n=16). Among all nurses, 70.5% (n=31) previously received Hickman catheter training and 86.4% (n=38) were using Hickman catheter care applications (Table 4).

In Table 1, mean scores of nurses before and after the trainings were presented. The mean Hickman catheter care score of nurses before the training (19,11±2,87) was significantly higher compared to the mean score obtained after the training (23,09±1,54) (p:0.001).

According to the observations one month after the training, it was found that 95.5% of the nurses (n=42) became experts in wearing gloves appropriately, while only 65.9% of them (n=29) were able to open sterile materials appropriately and only 29.5% were (n=13) washing their hands after removing the gloves. Also, 81.1% of them (n=36) were able to follow the catheter region by considering skin rashes, and 11.4% of them were able to follow and clean the catheter region when there was a discharge on the skin (Table 2).

The mean "material preparation" score was 20.91±0.6; the mean "hand hygiene" score was 30.09±3.58; the mean score of "catheter irrigation" was 23.7±1.09; and the mean score of "blood sample collection" was 26.66±1.38. Total scores changed between 76 and 114 and the mean total scores was 106.45±6.2 (Table 3).

Table 1. The mean scores of nurses before and after the trainings (N=44)

	Min-Max Scores	**Pretest Min-Max**	**Posttest Min-Max**	**Z and p**
	0-25	7-24	19-25	
		Mean±SD	**Mean±SD**	
Hickman chatater care mean		19.11±2.87	23.09±1.54	z=5.386 **p=0.001***

** WilcoxonSignedRanks Test* *p<0.01*

Table 2. The observations one month after the training (N=44)

		Should be developed	Sufficient	Mastered	Not observed
		n (%)	n (%)	n (%)	n (%)
Preparation of Materials	Wears sterile gloves	0 (0)	1 2.3)	43 (97.7)	-
	Prepares Sterile gauze sponges	0 (0)	0 (0)	44 (100)	-
	Prepares antiseptic solution	0 (0)	0 (0)	44 (100)	-
	Prepares 2 adet physiological saline	0 (0)	0 (0)	44 (100)	-
	Prepares 1 vial of Heparin	0 (0)	1 (2.3)	43 (97.7)	-
	Prepares 3 injectors (10 ml)	0 (0)	1 (2.3)	43 (97.7)	-
	Prepares Hypafix and catheter fixing pads	0 (0)	1 (2.3)	43 (97.7)	-
Hand Hygiene	Washes hands in line with hygienic hand washing rules	8 (18.2)	22 (50)	14 (31.8)	-
	Wears the gloves appropriately	0 (0)	2 (4.5)	42 (95.5)	-
Chatater insertion site care	Opens the materials by keeping them sterile	0 (0)	15 (34.1)	29 (65.9)	-
	Opens the old dressing	0 (0)	4 (9.1)	40 (90.9)	-
	Removes the gloves and again washes hands	15 (34.1)	16 (36.4)	13 (29.5)	-
	Wearls again the sterile gloves	0 (0)	10 (22.7)	34 (77.3)	-
	Controls the chatater insertion site for skin rashes	0 (0)	8 (18.2)	36 (81.8)	-
	Controls the chatater insertion site for iching	0 (0)	18 (40.9)	26 (59.1)	-
	Cleans the chatater insertion site if there is a discharge from the skin	0 (0)	3 (6.8)	5 (11.4)	36 (81.8)
	Cleans the chatater insertion site from inside to outside	0 (0)	10 (22.7)	34 (77.3)	-
	Uses different sterile gauze for each cleaning	0 (0)	5 (11.4)	39 (88.9)	-
	Waits the Povidone iodine to dry	4 (9.1)	17 (38.6)	23 (52.3)	-
	Closes the chatater insertion site	0 (0)	1 (2.3)	43 (97.7)	-
	Writes the name, surname and the date on the chatater dressing	0 (0)	7 (15.9)	37 (84.1)	-
Chatater irrigation	Prepares the materials entirely	0 (0)	1 (2.3)	43 (97.7)	-
	Opens the chatater clamp	0 (0)	1 (2.3)	43 (97.7)	-
	Aspirates the heparine in the chatater (3 ml)	0 (0)	1 (2.3)	43 (97.7)	-
	Control the blood return	0 (0)	1 (2.3)	43 (97.7)	-
	Do not apply pressure in case there is no blood return	0 (0)	7 (15.9)	37 (84.1)	-
	Complete the 1 unit heparin to 5ml with serum physiological saline	0 (0)	0 (0)	44 (100)	-

	Gives 3ml solution with heparin throught the chatater heparinli	0 (0)	1 (2.3)	43 (97.7)	-
	Closes the chatater clamp	0 (0)	1 (2.3)	43 (97.7)	-
Collecting blood samples	**Prepares the materials entirely**	0 (0)	2 (4.5)	42 (95.5)	-
	Opens the chatater clamp	0 (0)	1 (2.3)	43 (97.7)	-
	Aspirates the heparine in the chatater (3 ml)	0 (0)	1 (2.3)	43 (97.7)	-
	Control the blood return	0 (0)	1 (2.3)	43 (97.7)	-
	Do not apply pressure in case there is no blood return	0 (0)	6 (13.6)	38 (86.4)	-
	Collects the blood samples	0 (0)	1 (2.3)	43 (97.7)	-
	Gives 10 ml serum physiological solution throught the chatater	0 (0)	1 (2.3)	43 (97.7)	-
	Gives 3ml solution with heparin throught the chatater heparinli	0 (0)	1 (2.3)	43 (97.7)	-
	Closes the chatater clamp	0 (0)	1 (2.3)	43 (97.7)	-

Table 3. Observation scores of nurses one month after trainings (N=44)

Main groups related to the care Gruplar	Min-Max Scores of Form	Min-Max	Mean±SD
Material preparation	7-21	17-21	20.91±0.6
Hand hygiene	2-6	3-6	5.09±0.77
Chatater insertion site care	12-36	21-36	30.09±3.58
Chatater irrigation	8-24	17-24	23.7±1.09
Blood sample collection	9-27	18-27	26.66±1.38
Total	38-114	76-114	106.45±6.2

Table 4. The scores of nurses one month after trainings according to demographic and occupational characteristics (N=44)

	Demographic and Occupational characteristics	Preparation of materials	Hand hygiene	Chatater insertion site care	Chatater irrigation	Blood samples collection	Total
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
&Age	20 year-old or younger n=8	21±0	5.13±0.83	30.25±2.82	23.75±0.46	26.75±0.46	106.88±4.05
	21-25 year-old n=18	21±0	5.06±0.54	29.22±2.88	23.89±0.32	26.89±0.32	106.06±3.11
	26 year-old and older n=18	20.78±0.94	5.11±0.96	30.89±4.4	23.5±1.65	26.39±2.12	106.67±8.98
	X^2 and p*	1.444 0.486	0.321 0.852	3.201 0.202	0.778 0.678	0.778 0.678	2.755 0.252
&Education Status	High school n=12	21±0	5.33±0.49	31.08±3.48	23.83±0.39	26.83±0.39	108.08±4.06
	Associate Degree n=6	21±0	4.5±0.84	27.83±2.93	23.5±0.55	26.67±0.52	103.5±4.23
	Undergraduate n=26	20.85±0.78	5.12±0.82	30.15±3.65	23.69±1.38	26.58±1.77	106.38±7.21
	X^2 and p*	0.692 0.707	4.658 0.097	3.528 0.171	5.889 0.056	1.520 0.468	4.662 0.097
&& Working style	Daytime n=15	21±0	5.53±0.52	32.67±2.02	24±0	27±0	110.2±2.18
	Shifts n=29	20.86±0.74	4.86±0.79	28.76±3.5	23.55±1.33	26.48±1.68	104.52±6.73
	Z and p**	-0.719 0.472	-2.747 0.006	-3.414 **0.001**	-2.048 0.041	-2.048 0.041	-3.619 **0.001**
&Occupational working duration	Less than 1 year n=17	20.76±0.97	4.94±0.83	28.94±3.7	23.47±1.7	26.29±2.17	104.41±8.21
	1-5 years n=16	21±0	5±0.73	29.5±2.85	23.75±0.45	26.81±0.4	106.06±3.8
	longer than 6 years n=11	21±0	5.45±0.69	32.73±3.26	24±0	27±0	110.18±3.66
	X^2 and p*	1.588 0.452	3.422 0.181	9.545 **0.008**	2.936 0.230	2.890 0.236	9.761 **0.008**
&&Occupational Tasks	Unit Nurse n=41	20.9±0.62	5.05±0.77	29.8±3.54	23.68±1.13	26.63±1.43	106.07±6.25
	Nurses working during overnight n=3	21±0	5.67±0.58	34±1	24±0	27±0	111.67±1.15
	Z and p**	0.271 0.956	1.386 0.221	2.155 **0.026**	0.770 0.659	0.770 0.659	2.058 **0.036**
Patients Cared per	No patient n=3	21±0	5.67±0.58	34±1	24±0	27±0	111.67±1.15
	3 patients n=16	21±0	5.25±0.58	29.25±3.89	24±0	26.94±0.25	106.44±4.27
	5 patients n=16	20.75±1	4.56±0.81	28.94±3.38	23.19±1.72	26.13±2.22	103.56±8.29

	7 patients n=9	21±0	5.56±0.53	32.33±1.87	24±0	27±0	109.89±1.83
	Z and p**	1.750	12.597	9.999	14.184	8.829	11.660
		0.626	**0.006**	**0.019**	**0.003**	**0.056**	**0.009**
&Working hours per week	**46-50 n=18**	21±0	5.44±0.51	31.39±3.33	24±0	27±0	108.83±3.52
	51-55 n=16	21±0	5.06±0.77	29.56±3.35	23.94±0.25	26.81±0.4	106.38±4.08
	56-60 n=10	20.6±1.26	4.5±0.85	28.6±3.92	22.8±2.1	25.8±2.78	102.3±10.11
	X^2 and p*	3.40	8.680	4.120	18.73	7.850	6.410
		0.183	**0.013**	0.127	**0.001**	**0.020**	**0.041**

&*Kruskall Wallis Test* &&*Mann-Whitney U Test* **p<0.05 and **p<0.01*

Findings related to demographic and occupational characteristics of nurses which were measured one month after the training were presented in Table 4. Accordingly, the mean Hickman catheter follow-up form score was not significantly different according to age and educational level. The scores of nurses who were working in daytime were significantly higher compared to the scores of nurses who were working in shifts. The mean scores were also significantly different between groups according to the duration of the profession. It was found that "care of catheter insertion site" total scores of nurses who had been working for more than 6 years were significantly higher compared to the scores of nurses who had been working for less than a year (p:0.002; p<0.01). There were also significant differences between nurses in terms of their tasks. "Care of the catheter insertion site" total scores of nurses who were working in shifts were significantly higher compared to the total scores of nurses who were working in units (p<0.05). The numbers of patients also led to significant differences. The "Care of the catheter insertion site" scores of nurses who were caring for 5 patients per day were significantly lower compared to the scores of nurses who did not have to care for any patients or nurses who were caring for 7 patients per day (p: 0.004, p: 0.011). The "catheter irrigation" scores of nurses who were caring for 3 patients per day were lower compared to the scores of nurses who were caring for 5 patients per day. Hand hygiene scores, catheter irrigation scores, and total scores of nurses who were working for 46-50 hours per week were significantly higher compared to the scores of nurses who were working for 56-60 hours per week (p<0.01).

Discussion

Central venous catheters are commonly used in supportive treatments. The Hickman catheter is a tunnel type catheter which results in less infection compared to other catheters (Acun et al., 2004; Orak et al., 2006). Common use of the catheter can lead to complications in addition to its benefits (Guleser and Tascı, 2009). This risk increases particularly during treatments in which the immune system is directly affected. It is important to prevent catheter mediated infections by conducting appropriate catheter care during the treatment (Safdar and Maki, 2004). Nurses are primarily responsible for catheter care (Cetinkaya Sardan et al., 2013; Karadeniz et al., 2003; Usta, 2005). Infections developed due to catheters have recently been evaluated as one of the indicators of the quality of nursing care. Decrease in the infection rates leads to positive outcomes for patients and nursing services (Arpa et al., 2013). Therefore, nurses who are using catheters in treatments should be aware of these complications, and should know about and efficiently apply catheter care. In order to achieve this, nurses should receive trainings regarding catheter use and care (Guleser and Tascı, 2009; Safdar and Maki, 2004). Csomós et al. (2008) conducted a study and showed that nurses had insufficient knowledge on CVC use and related infections in Hungary. Yılmaz et al., (2007) conducted a study in which they examined the effects of training on catheter related infections. According to their results, infection risks can be minimized by ensuring that

nurses are trained on a regular basis, by informing nurses about the positive and negative outcomes retrospectively, by awarding positive outcomes, by preventing the replacement of the workforce in units, and by building a specific team for such invasive interventions. Safdar and Maki (2004) examined the pathogenesis of catheter-related bloodstream infection and found thata number of measures are effective in the prevention of CVC-related BSI. Foremost among these is the education of personnel regarding the catheter insertion technique and catheter care practices. Several large prospective studies yielded a 30-70% relative risk reduction through focused education programs**.**

In the current study, it was found that catheter care total scores of nurses significantly increased following the training (Table 1). This finding provided an answer to the research question "what is the effect of Hickman catheter care training on the knowledge levels of nurses?". Even though catheter care training only led to increase in scores, its long-term outcomes and effects regarding patients, the nursing profession, and health institutions are very important. Appropriate care of catheters and receiving catheter trainings reduce infection risk and extend the duration of catheter use in patients (Guleser and Tascı, 2009). Sherertz et al. (2000) specified that upon one day long training on infection control and intravenous catheter use led to a 73% decrease in infection rates (1000 CVCs, decreased from 3.3 to 2.4). Warren et al. (2004) showed that trainings reduced infection rates by 50% (1000 CVCs, decreased from 94 to 5.5) and that trainings were also cost-effective. Yılmaz et al. (2007) showed that practical trainings reduced the infection rate by 41%, and blood circulation rates by 43.4%.

According to the hickman catheter care evaluation of nurses one month after the training, it was observed that the majority of nurses became masters in catheter care (Table 2). During observations, 97.7% of the nurses (n=43) were good at the preparation of materials, and 95.5% of them (n=42) were good at wearing gloves (Table 2). However, 18.2% of the nurses (n=8) were not good at hand hygiene, 34.1% of them (n=15) were not washing their hands after the removal of gloves, and 9.1% of them (n=4) were not good at povidone iodine drying process (Table 2). These findings indicated that catheter care should be further improved. There were no findings related to discharge and redness in 81.8% of the catheter controls (n=36).

According to the catheter care evaluation conducted one month after the training, nurses had high scores (Table 3) and they also began to apply the methods they learned during the training. The theoretical and practical trainings supported the transformation of knowledge into skills. It was found that only scores related to catheter insertion site care did not reach higher levels (Table 3). Trainings should be routinely repeated by strengthening weak spots for such applications.

When we examined the factors which can influence Hickman catheter care training, we observed that the scores did not show significant differences according to age and educational level (Table 4). The working type, duration of the profession, nursing tasks and working hours per week were factors affecting practices after the training (Table 4). The "catheter care" scores of nurses who were working in daytime were significantly higher compared to the scores of nurses who were working in shifts. (Table 4). In clinics, nurses have tasks in addition to daytime patient care and treatment applications. However, the number of staff working overnight is higher and thus health professionals can spare sufficient time for health care practices during the night.

Nurses who were working daytime were frequently audited by their managers and thus they should be more attentive and careful. This can be the reason why nurses who were working in shifts had lower mean scores compared to nurses who were working daytime.

When we examined the effects of working hours on catheter care practices, we observed that nurses who had been working for more than 6 years had higher "catheter insertion site care" scores compared to others (Table 4). It is possible that nurses improved their catheter care skills by experiencing this practice for years. This hypothesis is supported by the finding that nurses who are working in shifts had higher scores compared to others (Table 4).

The duration of the occupation and the number of patients nurses care for are important factors which determine the efficiency of practices and applications. Working hours per day and per week is one of the most important factors affecting nursing applications. Long working hours increase the possibility of making mistakes

(Yılmaz et al., (2007). In parallel to previous research, we also determined that nurses who were working for 46-50 hours per week had higher scores compared to nurses who were working for 56-60 hours per week (Table 4). The change in scores according to the number of patients nurses care for is also a clear indication for these findings. In terms of hand hygiene, catheter insertion site care, catheter irrigation and blood sample collection parameters, nurses who were caring for 5 patients per day had lower total scores compared to those who were caring for 3 and 5 patients per day (Table 4). The reason for this can be that nurses who were caring for 7 patients per day were working in outpatient chemotherapy units, nurses who were caring for 3 patients per day were new in the nursing profession (less than 1 year), and nurses who were caring for 5 patients per day were working in units where there were intense treatments (such as bone marrow transplantation and oncology units). It is known that the risk of infection increases when the number of nurses per patient falls below a critical level. For this reason, several important suggestions can be considered: health professionals should be trained to use, place and care for intravenous catheters and should know about infection control measures; the entire personnel's information on and compliance with current guidelines in terms of placement and care of intravascular catheters should be evaluated periodically; in the placement and care of central venous catheters, only personnel who are competent and trained in only this area should be employed; and there should be sufficient numbers of nurses in intensive care units. Cakar (2008) specified that the infection risk increased when the number of nurses was below a critical level and when nurse: patient rate increased from 1:1 to 1:2, which was an important independent factor for the increased blood circulation infection risks. According to health regulations, it is recommended that nurse : patient rates should be 1:5 in oncology units, 1:4 in pediatrics units and 1:2 in intensive care units.

Conclusion

It is concluded that theoretical and practical Hickman catheter care training can effectively lead nurses to convert their knowledge into practice. These trainings should be given regularly in order to reach excellence. However, factors which can affect the training should also be considered. The duration of the profession, working daytime or on shifts, increased experience, and number of patients cared for per day can influence the efficacy of training programs. According to our results, nurses can improve themselves by receiving regular theoretical and practical Hickman catheter care trainings in relevant units and clinics where patients are treated. Furthermore, preparing written guidelines about important applications and practices about catheter care and infusions, arranging appropriate time schedules according to tasks of nurses in units where catheters are frequently used, ensuring that nurses follow up developments about catheter complications and care, and ensuring them to actively participate in meetings and trainings can also help them to be experts in catheter care.

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References

Acun, Z., Ulukent, S. C., Cihan, A., Ucan, B., Comert, M., Cesur, A. (2004). Central venous catheterizations and complications. Damar Cerrahi Dergisi. 13(2), 13-16.

Altuntas, F., Yildiz, O., Unal, A. (2004). Intravenous catheter infections in patient with hematological malignancy. Erciyes Medical Journal. 26, 25-32.

Arpa, Y., Aygun, H., Yalcınbas, Y., San, D., Ulukol, A. (2013). Comparison of catheter related infection rates in pediatric cardiovascular surgery patients with use of transparent cover and transparent cover saturated with chlorhexidin gluconate in central catheter care. HEMARG. 15(2), 57-67.

Bakir, M. (2000). Epidemiology, etiology and pathogenesis in catheter infections. Ankem Dergisi. 14(4), 456-9.

Barnes, H., Rearden, J. McHugh M.D. (2016). Magnet recognition and central line infection rates. Research in Nursing & Health. 39, 96–104.

Cakar, V. (2008). Intravascular catheters and prevention of peripheral venous catheter-related infections. Journal of Education and Research in Nursing. 5 (1), 24-33.

Cetinkaya Sardan, Y., Guner, R., Cakar, N., Agalar, F., Bolaman, Z., Yavasoglu, İ., Kunt, A., Yılmaz, G. R. (2013). Guidelines for the prevention of intravenous catheter infections Turkish Journal of Hospital Infections. 17(2), 233-279.

Csomos, A., Orban, E., Reti, R. K., Vass, E., Darvas, K. (2008). Intensive care nurses' knowledge about the evidence-based guidelines of preventing central venous catheter relate dinfection. Orv Hetil. 149, 929-934.

Dibble, S. L., Bostrom-Ezrati, J. Rizzuto, C. (1991). Clinical predictors of intravenous site symptoms. Research in Nursing & Health. 14(6), 413–420.

Eggimann, P., Pittet, D. 2002. Overview of catheter-related infections with special emphasis on prevention based on educational programs. Clin Microbiol Infect. 8, 295-309.

Guleser, G., Tascı, S. (2009). The Care of Central Venous Catheters in Oncology. Fırat Univercity Medical Journal of Health Sciences. 23(1), 47 – 51.

Karadeniz, G., Kutlu, N., Tatlisumak, E., Ozbakkaloglu, B. (2003). Nurses' knowledge regarding patients with intravenous catheters and phlebitis interventions. J Vasc Nurs. 21, 44-47.

O'Grady, N. P., Alexander, M., Burns, LA., Dellinger, EP., Garland, J., Heard, S. O., Lipsett, P. A., Masur, H., Mermel, L. A.,. Pearson, M. L., Raad, II., Randolph, A. G., Rupp, M. E., Saint, S., The Healthcare Infection Control Practices Advisory Committee (HICPAC). (2011). Guidelines for the prevention of intravascular catheter-related infections. Clin Infect Dis. May, 52(9), e162–e193.

Ozkocaman, V. (2002). Management and to define of related infections with tunnelled central venous catheter (Hickman type). Uludag Medical Journal. 28(3), 101-103.

Safdar, N., Maki, D. G. (2004). The pathogenesis of catheter-related bloodstream infection with noncuffed short-term central venous catheters. Int Care Med, 30, 62-**7.**

Shapey, I.M., Foster, M.A., Whitehouse, T, Jumaa, P, Bion J.F. (2009). Central venous catheter-related bloodstream infections: improving post-insertion catheter care. J Hosp Infect,71(2),117-22.

Sherertz, R. J., Ely, E. W., Westbrook, D. M., Gledhill, K. S., Streed, S. A., Kiger, B., Flynn, L., Hayes, S., Strong, S., Cruz, J., Bawton, D. L., Hulgan, T., Haponik, E. F. (2000). Education of physicians-in-training can decreasethe risk for vascular catheter infection. Ann Intern Med. 132:641-8.

Usta Yesilbalkan, O. (2005). Commonly used venous access device in oncology patients: implante port catheter. C.U. Hemsirelik Yuksek Okulu Dergisi. 9(2), 49-54

Ustundag, M., Guloglu, C., Aldemir, M., Dogan, H. (2006). Factors that effect on complication development while inserting central venous catheter. Turk J Emerg Med. 6(2),51-55.

Theaker, C. (2005). Infection control issues in central venous catheter care. Intensive Crit Care Nurs. 21(2), 99-109.

Yilmaz, G., Caylan, R., Aydın, K., Topbas, M., Koksal, I. (2007). Effect of education on the rate of and theunderstanding of risk factors for intravascular catheter-related infections. Infect Control Hosp Epidemiol. 28(6), 689-694.

Warren, D. K., Zack, J. E., Mayfield, J. L., Chen, A., Prentice, D., Fraser, V. J., Kollef, M. H. (2004). The effect of an education program on the incidence of central venous catheter-associated bloodstream infection in a medical ICU. Chest. 126(5),1612-8.