

The Effect of an Educational Program for Vascular Access Care on Nurses' Practical Skills at Dialysis Centers in Khartoum State, Sudan

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Abstract: *End stage renal disease is a world-wide problem that requires highly skilled nursing care. Adequate vascular access is essential for the successful use of hemodialysis (HD). Appropriate practical skills in taking care of vascular access in HD is essential for minimizing complications and recognizing related problems. This report is the practical skills sequel of our previous report on the effect of an educational program on nurses' knowledge at dialysis centers in Khartoum state, Sudan. This was a quasi experimental study (pre-test and post-test). It was performed in nine dialysis centers at Khartoum State. Sixty one nurses working in these HD centers were chosen by Simple Random Sampling method. A structured observational check-list for practical skills related to vascular access care based on six guidelines from the Kidney dialysis Outcome Quality Initiative (K/DOQI) clinical practice guidelines was used. Instrument validity was determined by a panel of experts. Reliability of the instrument was tested by a pilot study to test scores for 15 nurses. The Pearson correlation coefficient obtained was ($r = 0.78$). Data collection was taken prior to and after the educational intervention. A follow-up test was performed three month later, using the same data collection tools. Twenty two paired variables assessing the practical skills levels in aspects related to the six K/DOQI guidelines showed significant improvement in all scores of the nurses' practical skills after the educational intervention ($P < 0.001$). In the follow-up assessment of practical skills after three months, the overall mean score further improved ($p < 0.001$). This probably reflects improvement due to cumulative experience. The study showed that a structured educational program based on the K/DOQI clinical practice guidelines had a significant impact on the dialysis nurses' practical skills in caring for vascular access in HD patients. The practical skills level attained was maintained for at least three months after the intervention, and further improved probably due to the cumulative experience obtained.*

Keywords: Hemodialysis, Vascular access, Nurses, Practical skills, K/DOQI Guidelines

1. Introduction

This report is the *practical skills* sequel of our previous report on the effect of an educational program on nurses' *knowledge* at dialysis centers in Khartoum state, Sudan.⁽¹⁾ The integrity of vascular access for hemodialysis (HD) is closely associated with the outcome of dialysis.⁽²⁾ Nowadays, the arteriovenous fistula (AVF) has become the most favorable access for HD and it is the standard procedure.⁽²⁾ The next best procedure is the synthetic arteriovenous graft (AVG).⁽³⁾ Central venous catheters (CVC) are less favorable because of the high rate of infections associated with their use for HD.^(4,5) However, a large number of dialysis patients use CVC as access for HD, especially in the early phases of dialysis therapy.⁽⁶⁾ In the 2009, US renal data system reported that 82% of 101,688 patients who began HD in 2007 did so using CVC.⁽⁶⁾ In fact commencement of HD with CVC was associated with a two to three fold increase in the risk of death compared with those using AVF, and the most prominent and serious complication with CVC was infection.⁽⁵⁾

The use of AVF and AVG has increased over the years world-wide. However, a number of complications such as thrombosis, infection, stenosis and access loss have complicated the care of these accesses.⁽⁷⁾ Vascular access failure has economic as well as adequacy of dialysis delivery implications.⁽⁷⁾

The American National Kidney Foundation (NKF) published Dialysis Outcome Quality Initiative Guidelines (K/DOQI) which have provided a list of techniques that could be applied for monitoring and surveillance of vascular accesses.⁽⁸⁾

HD patients with poor personal hygiene habits should be taught by nurses how to improve and maintain their personal hygiene.⁽⁹⁾ In addition, there is a higher rate of complications in HD vascular access when new or inexperienced dialysis staff manipulates the patient's vascular access.⁽¹⁰⁾ This emphasizes the responsibility of the senior nurses to follow the juniors while practicing in the dialysis units. The nephrology nurse has a great role in tracking the occurrence of complications such as catheter exit site infection, thrombosis and bleeding, as she can help identify the source and allow corrective action to be taken⁽¹¹⁾ Worldwide, many researches on nursing interventions related to vascular access care are available.^(12,13,14,15)

Internationally, hospitals and medical facilities usually keep track of nurses' skills, abilities and education both for regulatory compliance and to ensure delivery of the best possible care to patients.⁽¹²⁾

In Sudan, a study was conducted in 2009 as a national survey for chronic kidney disease (CKD) patients maintained on renal replacement therapy (RRT).⁽¹⁶⁾ At that time, there were 41 active HD centers in the country serving

a total of 2858 patients. In that study patients were reported as being dialyzed via CVC and AVF, though no percentages were given for the respective use of the vascular access type. Current data from the Sudan National Kidney Center reported the total number of patients being dialyzed in Khartoum State as being 3008 patients (personal communication).

The Sudan National Council for Medical and Health Professions (SNCMHP), which was established in 2010, is working hard to promote proper nursing practice that can maintain an accredited professional career. However, the standard K/DOQI guidelines for vascular access care are often not followed in dialysis centers in the Sudan. Moreover, when this study was initiated there were no locally written protocols or procedures for guidance to be followed in the dialysis centers. Most nurses were not aware of the internationally accepted K/DOQI guidelines and they applied their general nursing knowledge and skills to care for vascular access in HD.

The major aim of this study was to evaluate the effect of an educational program using the protocols and recommendations of the K/DOQI guidelines for vascular access care on dialysis nurses' knowledge and practical skills at dialysis centers in Khartoum State, Sudan. In this report we describe the results of the same educational program on the practical skills of the nursing group studied over the same period.

2. Materials and Methods

This was a Quasi experimental study with pretest and post test one- group design, conducted for nurses working in nine dialysis centers at Khartoum state in the period from January 2013 to July 2013. There were 17 HD centers serving 3000 patients in Khartoum State at the time of the study. Of these, nine governmental centers were randomly selected for performing the study. The total number of dialysis nurses working in these nine centers was 167 nurses. The study protocol was explained in detail to the nurses, and those who agreed to participate in the study were included in the random selection for the required sample size. The sample size required for the study was found to be 61 nurses as calculated using the following mathematical equation: ⁽¹⁷⁾

$$N = \frac{(z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + \frac{z_{1-\alpha}^2}{2}$$

Inclusion and exclusion criteria

Nurses holding Bachelor degree in Nursing (BSc) and those holding Master of Science in Nursing (MSN) working in the nine appointed dialysis centers, and willing to participate in the study were enrolled for the study. Their working experience in HD was required to be at least one year. Nurses who had formal training of K/DOQI guidelines and those who participated in the pilot study were excluded from the study.

Data Collection Tools:

A structured, observational check list was constructed by the researcher (KIY) to observe the *practical skills* of nurses while managing vascular access during HD procedures, without their awareness of the observation. Twenty two

points based on K/DOQI guidelines were included in the check-list and subjected for content validity by a panel of expert nephrologists. Reliability of the instrument was determined by a pilot test for assessment of practical skills of 15 nurses' taken prior to the intervention. Pearson correlation coefficient for reliability was ($r = 0.78$). Twenty two paired variables were tested prior to and after the educational intervention. These covered practical aspects related to measures necessary for infection control, steps needed for correct handling the AVF, ability to diagnose and assess vascular access complications, correct steps needed for dialysis catheter hub and cap cleaning and the ability to correctly assess and manage catheter dysfunction. These aspects were based on six guidelines from K/DOQI⁽⁷⁾ These were: Guideline 3 (for AVF fistula needle cannulation); Guideline 5 (for vascular access physical examination); Guideline 7 (for identification and management of catheter dysfunction); Guideline 13 (for infection control measures in the dialysis settings); Guideline 14 (for AVF fistula care); and Guidelines 15 (for HD catheter care). Data collection was taken prior to and after the educational intervention. This was followed up by a repeated test three months later, using the same data collection tools. Statistical tests used were Mean, SD the Paired "t" test, and 95% Confidence Interval (C.I.). Pearson correlation coefficient was used to summarize the magnitude and to determine the relationship between the variables

Ethical Considerations

- The research protocol was examined and approved by the Research Committee on Human Subjects (Medical) of the University of Khartoum post graduates studies.
- Ethical approval for this study was also obtained from each of the hospitals in which the dialysis centers were based.
- No financial incentives were provided and the participants were not under pressure to take part in the study.
- Respondents had the right to withdraw any time if they so wished.

3. Results

Demographic data:

The calculated and recruited sample size was 61 nurses. Four participants dropped out of the study before completion for personal and family reasons. Fifty seven nurses (94%) completed the study. Mean age of the study sample was 34.31 years (range 25 -30, standard deviation 6.59). The majority of the nurses (72%) were younger than 36 years of age (Figure 1). There were 47 female nurses (82.5%) involved in this study. Seventy five percent of the nurses were university graduates and 25% of the participants had Master degrees in nursing. Most of the nurses (89.5%) had experience in HD between 1-10 years.

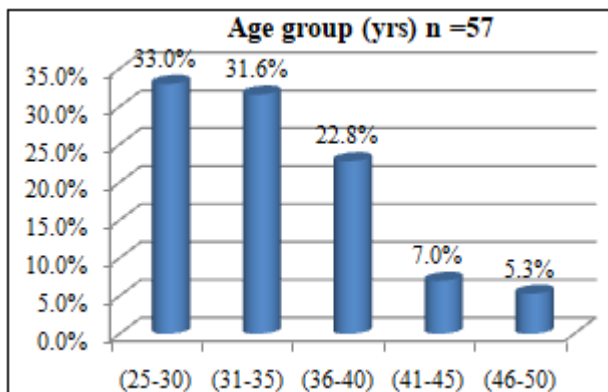


Figure 1: Shows the age distribution of the study sample

Figure 2 shows the overall scores attained for practical skills by nurses participating in the study prior to and after the educational intervention. Prior to the intervention 60% of the nurses scored levels of "good" grade or less, 40% scored "very good" and none scored level of "excellent". After the educational intervention almost all of the nurses (95%) scored level of "excellent".

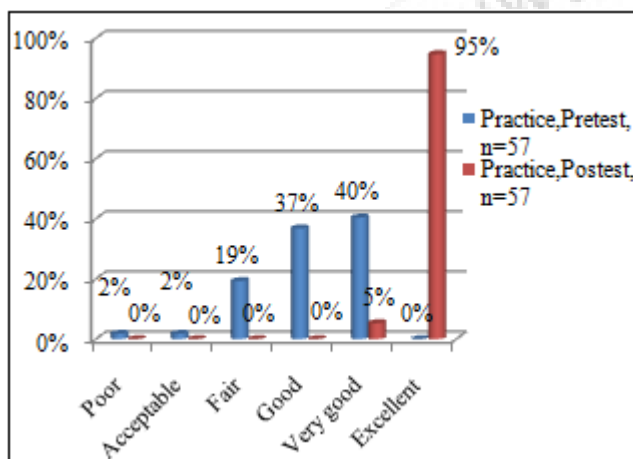


Figure 2: Comparison between the overall scores of the levels of practical skills among nurses participating in the study pre and post the educational intervention

Table 2: The Effect of educational program on nurses' practice in handling AVF (n=57)

Variable	Pretest		Posttest		95% C I		T	P
	Mean	SD	Mean	SD	Lower	Upper		
Physical examination	5.23	0.258	5.93	1.018	-1.93	-1.193	-8.487	<0.001
Fistula cannulation	0.77	0.423	0.81	0.398	-0.185	0.115	-0.468	0.05
Assessment of bleeding after cannulation	3.32	1.794	4.79	0.453	-1.835	-1.147	-8.679	<0.001
Monitoring circulation	2.68	0.985	3.6	0.884	-1.362	-0.78	-7.347	<0.001
Correct connect/ disconnect blood lines	2.63	0.587	2.82	0.428	-0.37	-0.016	-2.186	0.033

Tables 3 shows details of practical- skills variables related to catheter care and management of dysfunction tested prior to and after the educational intervention. There were statistically significant differences in all the variables.

Table 3: The effect of educational program on nurses' practice in infection control measures catheter care. (n=57)

Variable	Pretest		Posttest		95% C I		T	p
	Mean	SD	Mean	SD	Lower	Upper		
Assess Patient and environment hygiene	3.84	0.996	4.93	0.258	-1.359	-0.816	-8.03	<0.001
Correct open/ close the catheter	3.32	1.794	4.25	0.689	-1.389	-0.471	-4.056	<0.001
Assess catheter pre dialysis for infection	3.84	0.96	5.05	0.692	-1.514	-0.907	-7.979	<0.001
Care of infected catheter	2.74	1.044	4	0.886	-1.605	-0.921	-7.398	<0.001
Steps of catheter flushing	4.39	1.031	5.26	0.613	-1.161	-0.593	-6.188	<0.001
Management of catheter dysfunction	4.82	1.12	6.21	0.725	-1.706	-1.066	-8.673	<0.001

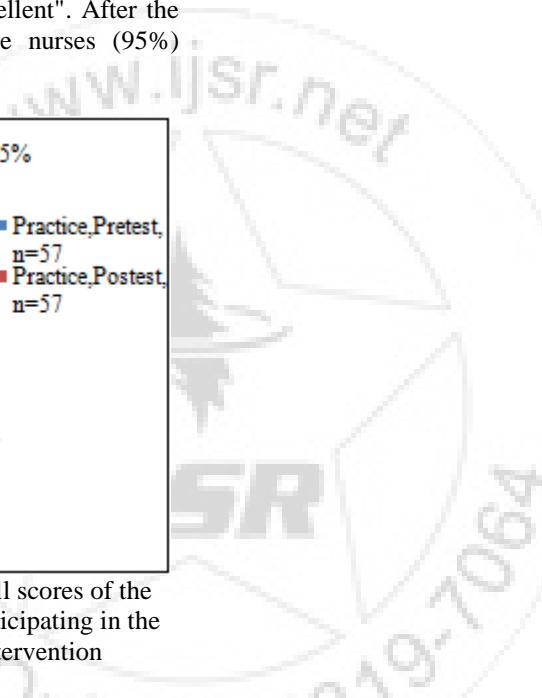
Table 1 shows the difference between the overall scores attained by nurses in practical skills prior to and after the educational intervention. The statistical difference in improvement in practical skills was highly significant at $p = <0.001$

Table 1: The effect of the educational program on nurses' overall practice skills prior to and after the educational intervention (n=57)

Variable	Pretest		Posttest		95% C I		t	P
	mean	SD	mean	SD	lower	upper		
Total practice scores *	51.9	6.00	62.96	2.74	-15.04	-12	-17.95	<0.001

*Maximum score = 69

Tables 2 shows details of practical skills variables related to handling the AVF, tested prior to and after the educational intervention. There were statistically significant differences in the improvement of the scores attained in all the variables



Tables 4 shows details of practical- skills variables related to catheter handling and heparinization tested prior to and after the educational intervention. There were statistically significant differences in the improvement of all the variables.

Table 4: Effect of the educational program on nurses' practice in catheter care and heparinization. n=57

Variable	Pretest		Posttest		95% C I		T	P
	Mean	SD	Mean	SD	Lower	Upper		
Catheter luer cap and hub care	3.49	0.848	3.93	0.32	-0.689	-0.188	-3.5	0.001
Soaking catheter cap in 10% iodine	0.37	0.487	0.61	0.491	-0.406	-0.085	-3.1	0.003
Steps for catheter flushing	2.61	0.726	2.89	0.409	-0.498	-0.064	-2.59	0.012
Heparin volume for catheter lock	3.28	0.794	3.63	1.25	-0.202	-0.009	-2.2	0.033
Catheter and hup cleaning	2.3	1.133	3.63	0.587	-1.678	-0.988	-7.74	0.001

Table 5 shows the comparison between the posttest and the follow up test on nurses' overall level of practice after three months from the end of the study. . The practical skills improved further than their immediate post intervention

scores, probably due to experience obtained by regular practice. The statistical difference was highly significant ($P = <0.001$).

Table 5: Comparison between the posttest and the follow up on nurses' overall level of practice (n=57)

Variable	Posttest		Follow up		95% C.I		T	P
	Mean	SD	Mean	SD	lower	upper		
Total practice scores	62.96	2.76	65.39	2.7	-2.809	-2.033	-12.49	<0.001

4. Discussion

Fifty-seven dialysis nurses were randomly selected from nine different HD centers in Khartoum State to participate in this study. The majority of the nurses (82.5%) were females. This reflects the general nursing situation in Sudan, where most of the nursing is carried out by females.⁽¹⁸⁾ The mean age of the study sample was 34.31 years, and the majority of the nurses (72%) were younger than 36 years of age. This is consistent with the findings of Bakey and Jafar⁽¹⁹⁾ who showed, in a study conducted at Baghdad teaching hospitals, that the majority of HD nurses were 30 years of age or younger. Similar findings were reported by Uğur⁽²⁰⁾ who stated that (73.9%) of nurses in HD units in Ankara were under 30 years of age. This, perhaps, reflects the demanding nature of dialysis service so that older nurses may find it difficult to cope with the load of work required. Almost 90% of the nurses had experience in HD practice ranging from one to 10 years, and 47% of them had experience of more than five years in HD.

improved from a score of good (66.6%) to excellent (93.4%).⁽²³⁾

It is interesting that there was a positive correlation between the degree of education and scores attained in knowledge level: nurses who had Master degrees in nursing did better than those who had only Bachelor degrees. The international standardized K/DOQI guidelines have great contribution to prevention of vascular access infection worldwide.⁽²¹⁾ In this study, the participating nurses were subjected to a unified test prior to the educational intervention based on the K/DOQI clinical practice guidelines for vascular access care⁽²¹⁾ using an interview questionnaire. When the same questionnaire was repeated after the educational intervention, there was a significant improvement in the level of knowledge. These findings are in agreement with a study from Nepal which showed that the overall knowledge level of the participants improved from 50% to 75% after applying an educational program in vascular access care (p value=0.001).⁽²²⁾ Similarly, in another interventional study conducted in Bagdad University teaching hospitals in the dialysis units , the response after an educational program

There are several publications that show the importance of proper assessment of HD vascular access complications with aim of reduction of morbidity and vascular access loss.^(24,25,26) In this study, the educational interventions resulted in significant improvement in the nurses' practical skills in all these aspects. According to the K/DOQI, continuous assessment for vascular access prevents further complications.^(27,28) These measures have great impact on our clinical practice. It has been shown that maintaining high standards of infection prevention measures reduces the chances of introduction of skin microflora into the patient's blood stream during procedures such as needle cannulation and catheter connection in the dialysis process.⁽²⁹⁾ K/DOQI guideline number 15⁽³⁰⁾ recommended specified steps in the care of catheter hub and cap cleaning. These steps are quite important for the identification of the source of infection and allow for correct actions to be taken.⁽²⁹⁾ It is comforting that our nurses showed significant improvement in their handling of the catheter hub and cap cleaning after the educational program. Similar significant improvements were noted in following the correct steps in catheter luer cap changing.

Assessing the patient circulation during dialysis reduces the complications that can affect patient dialysis adequacy.⁽³¹⁾ Repeated catheter dysfunction has been shown to increase the morbidity and mortality, aside from the high economic expenditure.⁽³²⁾ Moreover, there is real concern that 60% of the patients fear thrombosis of the access associated with pain which disturbs their quality of life.⁽³³⁾ Dialysis catheters are usually flushed before and after each dialysis procedure, or if used off the dialysis day or for any therapeutic or diagnostic procedure, and it is important that such steps should be carried out in the correct recommended fashion.⁽³⁴⁾

In our study there was a highly significant difference in our nurses' practical skills between the paired examinations in all aspects related to these assessments.

5. Conclusion

The study showed that a structured educational program based on the K/DOQI clinical practice guidelines for HD vascular access care had a significant impact on the dialysis nurses' practical skills. The skills level attained were maintained, and even further improved, after three months after the educational intervention.

6. Acknowledgement

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