Nurses'Knowledge and Practices regarding Tunneled Catheter Care among Patients on Maintenance Hemodialysis

Aya Ahmed Hussein Mohamed Tahoun, Instructor
Technical Institute Nursing, Faculty of Nursing, Alexandria University.

Yousria Mohamed Salem, Professor
Medical Surgical Nursing, Faculty of Nursing, Alexandria University.

Nabila Ahmed Bedier, Professor
Medical Surgical Nursing, Faculty of Nursing, Alexandria University.

Mervat Adham Ghaleb, Professor
Medical Surgical Nursing, Faculty of Nursing, Alexandria University.

Abstract

Hemodialysis requires vascular access to allow rapid extracorporeal blood flow. Central venous catheters which can either be tunneled or not tunneled. Tunneled catheter used for chronic hemodialysis. Hemodialysis nursing is a specialized area focusing on the needs of patients with renal failure across their lifespan. ***Objective:*** *To assess nurses' knowledge and practices regarding tunneled catheter care among patients on maintenance hemodialysis.* ***Setting:*** *The study was carried out at 3 hospitals in hemodialysis units at Benha city.* ***Subjects:*** *All available hemodialysis nurses involved in care for tunneled catheter comprised of 70 nurses.* ***Tools:*** *Two tools were used for data collection.* ***Tool I*** *was hemodialysis nurses' knowledge questionnaire.* ***Tool II*** *was nurses' practices observational checklist.* ***Results:*** *The present study revealed that the majority of nurses were females and half of studied nurses had secondary school diploma. More than half of the studied nurses possessed a satisfactory overall knowledge and all of the studied nurses possessed an unsatisfactory practice regarding tunneled hemodialysis catheter care and no statistically significant correlation found between overall knowledge and overall practices.* ***Conclusion:*** *The study concluded that nurses' knowledge regarding tunneled hemodialysis catheter care had satisfactory and practice had unsatisfactory.* ***Recommendations:*** *Develop in-service education program for nurses to update their knowledge and practices concerning hemodialysis catheter care.*

Keywords: Maintenance Hemodialysis, Tunneled Catheter Care, Nurse's Knowledge & Practices.

Introduction

Hemodialysis (HD) is the most frequent treatment method for Chronic Renal Failure (CRF). It is used for patients with short term dialysis (days to weeks) and for patients with end stage renal disease who require permanent therapy (Smelter et al., 2014).

Worldwide; the overall incidence of End Stage Renal Disease (ESRD) is 260 cases per one million people of populations per year (pmp) and approximately increases 6% each year (Elmoghazy et al., 2016).In Egypt, the estimated annual incidence of ESRD is around 74 per million and total prevalence of patients on dialysis is 264 per million (Bayoumi et al., 2019).

Access to the patient's vascular system must be established to allow blood to be cleansed. Several accesses are available. Central venous catheters (tunneled &non- tunneled) are achieved by inserting a double lumen or a multilumen catheter in to the subclavian, internal jugular, or femoral vein. Although this method of vascular access involves some risks

(e.g.Hematoma, pneumothorax, infection, thrombosis of the subclavian vein, and inadequate flow (Smelter et al., 2014).

Cuff tunneled catheter can be used instead of non-cuffed catheter which can be placed for patients with chronic kidney disease who require dialysis for more than weeks. When permanent dialysis access is required an arteriovenous hemodialysis fistula is created or a prosthetic arteriovenous graft is placed (Van Der Meersch et al., 2014).

Cuffed catheters with a balloon type barrier near the skin opening are associated with a slightly reduced risk of associated infection when compared with non-cuff catheters (Association for Professionals in Infection Control and Epidemiology [APIC], 2010).

The APIC recommend most follow this guidelines to limitation of infection in hemodialysis included: hand hygiene, maximal sterile personnel protection equipment, chlorhexidine for skin preparation, catheter site dressing regimens, specific sites for catheter placement and checking every day for signs of infection (Bayoumi & Mahmoud, 2017).

Nursing staff play a significant role also in HD; the contributed to the preventive, promotive, and curative aspects of the dialysis by maintaining an aseptic environment during insertion and preparation of catheter and all necessary equipment in aseptic technique.They were responsible for applying their knowledge to reduce infection incidents(Bayoumi & Mahmoud, 2017).

Aims of the Study

This study aims to:

- Assess nurses' knowledge regarding tunneled catheter care among patients on maintenance hemodialysis.
- Assess nurses' practices regarding tunneled catheter care among patients on maintenance hemodialysis.

Research Questions

1. What is the nurses' knowledge regarding tunneled catheter care among patients on maintenance hemodialysis?
2. What are the nurses' practices regarding tunneled catheter care among patients on maintenance hemodialysis?

Materials and Method

Materials

Design: a descriptive research design was utilized to accomplish the present study.

Settings: The study was carried out in 3 hospitals (El-Amery hospital (Benha teaching hospital), El-Humyat hospital &Benha university hospital) in hemodialysis units at Benha city.

Subjects: All available hemodialysis nurses involved in providing care for tunneled catheter were included in the present study, they comprised of 70 nurses worked in the previous selected setting

Tools: Two tools were used to collect data of the study:

Tool I: Hemodialysis nurses knowledge questionnaire concerning tunneled catheter care among patients on maintenance hemodialysis. It was adapted by the researcher from **Saber Mohammed et al. (2017)** to assess nurses knowledge regarding tunneled catheter care. It consisted of two parts:

First part: Hemodialysis nurses profile included socio-demographic characteristics as age, level of education, marital status,years of experience & pervious attendance of training courses related to tunneled catheter care) **second part:** Nurses knowledge questionnaire to assess hemodialysis nurses knowledge about tunneled catheter care which included 40 questions (26 MCQ questions, 9 T or F questions, one question to arrange the steps & 4 matching questions). The questions covered the following:

- General knowledge about tunneled hemodialysis catheter.
- Catheter insertion nursing care

- Catheter connection – disconnection nursing care.
- Catheter exit site care, removal and documentation.
- Catheter infection and complications.
- Hemodialysis catheter discharge care plan.

Scoring system:

Each correct answer took one score; the total scores were 40 grades. Those who obtained less than 80% were considered as having an unsatisfactory knowledge level, while equal to or more than 80 % were considered as having a satisfactory knowledge level (Saber Mohammed et al., 2017).

Tool (II): Nurses practices observational checklist regarding tunneled catheter care among patients on maintenance hemodialysis. It was adapted by the researcher from **SaberMohammed et al. (2017)** to assess nurses practices regarding tunneled catheter care which consisted of 64 domains of nursing practices on tunneled catheter care which includes:

1- Nursing care for catheter during connections.

2- Nursing care for catheter disconnections.

3- Nursing care for catheter exit site care.

4- Nursing care for catheter removal.

5- Discharge catheter plan.

Scoring system

Scoring system:

Each item checked as: done took one score and not done or incorrect done took zero, with a total score of 64 grades, those who obtained 80% or more as a total score considered as having satisfactory practice level, while those who obtained less than 80% considered as having an unsatisfactory practice level (Saber Mohammed et al., 2017).

Method

- Approval from Ethical research committee was obtained from faculty of Nursing, at Alexandria University.
- An official letter from the Faculty of Nursing was directed to the head of Benha teaching hospital, El-Humyat hospital &Benha university hospital in order to obtain their approval to carry out the study in the previously mentioned settings.
- Meetings were held with the directors of the selected settings to clarify the purpose of the study and to gain their cooperation and support during data collection.
- Tool (I) & tool (II) were adapted by the researchers after reviewing the recent relevant literature. It was validated by juries of (5) experts in the field. Their suggestions and recommendations were taken into consideration. Content validity of two tools were 0.778, 0.812 respectively.
- Cronbach Alpha Coefficient was used to ascertain the reliability of tool (I), and (II) (r = 0.879 for tool I, 0.771 for tool II).
- Pilot study was carried out on 7 nurses working in the selected hemodialysis units to ascertain the clarity and applicability of the study tools and to identify obstacles that may be faced during data collection and then necessary modifications were done. These nurses were excluded from the actual study subjects.
- Data was collected by the researchers during the period from the beginning of February 2021 to the end of April 2021 (3 months).

Ethical considerations:

- Written informed consent was obtained from nurses and witness written consent from head nurse for observation before data collection after providing appropriate explanation about the purpose of the study.
- Privacy of study participants was asserted.

- Confidentiality of data collection was asserted.

Statistical Analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was judged at the 5% level.

Results

Table (1) shows the distribution of studied nurses according to nurses' profile. As regards their distribution among hospitals, it was observed that more than half (57.1%) of the studied nurses were from Al Amery hospital (Benha teaching hospital).

Concerning sex and marital status, the results showed that the majority of the studied nurses were females (97.1%) & were married (88.6%) respectively. Regarding age, it can be noticed that more than third (38.6%) of the studied nurses were less than 30 years with a mean age of 34.11 ± 10.20.

While the majority of them were working from 7-12 hours a day (97.1%) & (92.9%) of them were responsible for 3-4 patients per one shift. As regards qualification & years of experiences, it was observed that half (51.4%) of the studied nurses hold secondary school diploma but the few (8.6%) of the studied nurses hold bachelor degree & less than half (41.4%) of the studied nurses had less than 10 years of experience in hemodialysis unit with mean years of (13.59 ± 10.61/ year).

Regarding previous attendance of training courses, it was observed that more than half (65.7%) of them received training courses related to tunneled catheter care & the majority of them (93.5%) received training courses two times & more than half (62.9%) of them trained by nurses.

Table (2) shows the distribution of the studied nurses according to their overall mean percent score of knowledge satisfactory level regarding tunneled hemodialysis catheter care. The table demonstrated that, (62.9%) of the studied nurses possessed a satisfactory overall knowledge level, while (37.1%) of studied nurses possessed unsatisfactory overall knowledge level regarding tunneled hemodialysis catheter care.

Figure (1) revealed that the majority of the studied nurses (91.4%) possessed a satisfactory knowledge level in relation to general knowledge about tunneled hemodialysis catheter, while the majority of the studied nurses (88.6%) possessed unsatisfactory knowledge level regard of catheter exit site care.

Table (3) shows the distribution of the studied nurses according to their mean percent score of satisfaction level of practice related to nursing management of tunneled hemodialysis catheter. The finding revealed that 100% of the studied nurses possessed an unsatisfactory practice level in relation to nursing management of tunneled hemodialysis catheter.

Table (4): Demonstrates the correlation between overall knowledge and overall practices mean percent score. The table shows that there were no statistical significant correlation between overall knowledge and overall practices at (r= 0.108, p= 0.371)

Discussion

Hemodialysis (HD) is the most commonly used therapy among patients with end-stage renal disease (ESRD). Although HD therapy has improved the care of many patients, there are still concerns about the quality of care provided by dialysis facilities (Moursy & Sharaf, 2017).

Regarding to sex, the present study showed that the majority of the nurses were females. This may be due to the feminization of the nursing profession is potentially considered a gender barrier for men to become nurses and the public perception is still that nursing is female occupation.

This is similar to the findings of Magnaghi et al. (2021) who revealed that the majority of the sample were females. While the findings were not in accordance with Shang et al. (2021) who found that the highest percentage of the nurses was male. This can be explained by the fact that graduation of male nurses had been started in all Egyptian universities since 13 years.

Regarding as marital status, the present study showed that the majority of the nurses were married. This finding was in line with the findings of Ali et al. (2018) which revealed that the highest percentage of the nurses was married. This was in contrast with the study findings of Mukhtad et al. (2019) which revealed that the majority of their studied nurses were single. Concerning age, the studied sample had a mean age of 34.11 ±10.20, which mean that they were young in age. This finding agrees with Saggu et al. (2018) findings where the studied nurses had a mean age of 30.88± 4.62.

As regards qualification, the present study revealed that; half of the studied nurses had secondary school diploma. This result may be due to the fact that bachelor degree & technical nurses usually worked at intensive care units and operating rooms. This result was supported by Hosney et al. (2021) who reported that more than three quarters of studied nurses had diploma level of education, while the findings were in contrast with Alnawafleh et al. (2018) and Elsaidy et al. (2019) findings where the majority of the studied nurses had bachelor degree of nursing.

Regarding the years of experiences in hemodialysis unit, less than half had less than 10 years of experience in hemodialysis unit. This was in agreement with Elsadeq Khadrawi (2019) finding who reported that the studied nurses have 5< 10 years of experience.

Regarding attending training courses, this study noted that more than half of the studied nurses had attended training courses related to tunneled catheter care. This finding was corresponded with the findings of Osman et al. (2021) who revealed that the majority of the studied nurses attended training workshops concerned with tunneled catheter care. This result was incongruent with Manandhar et al. (2017) who found that more than half of the studied nurses didn’treceive training courses.

Regarding nurses’ knowledge related to tunneled hemodialysis catheter care, that covers general knowledge about tunneled hemodialysis catheter care, the present study results revealed that more than half of the studied nurses had satisfactory level of overall knowledge regarding tunneled hemodialysis catheter care.This result might be supported by the present study where more than half of the studied nurses received training courses related to tunneled catheter care by more than half of the studied nurses.

This finding was corresponded with the results of Esposito et al. (2017) who demonstrated that nurses have an adequate level of knowledge concerning evidence-based recommendations for preventing central line associated blood stream infections, where the majority of studied nurses were aware about the main recommendations for patients with central venous catheters , such as the type of dressing and / or frequency changes of the catheter insertion site. This result was also incongruent with Moursy and Sharaf (2017) findings who concluded that the overall nurses' knowledge about infection prevention and control practices during vascular access care was fair.

Regarding nurses’ practices related to tunneled hemodialysis catheter care, which covers nursing care for catheter connections and disconnections, exit site care, catheter removal and patient discharge care, the present study results revealed that all of the studied nurses had performed an unsatisfactory practice level regarding tunneled hemodialysis catheter care. This result could be due to poor monitoring and supervision, lack of proper training.This was

supported by Yousef et al. (2019) findings which revealed that nurses' practices regarding HD and infection control are inadequate. This finding also agreed with Abou El-Enein and El Mahdy (2011) who emphasized that during the study period, none of the nurses washed hands before and after the different activities that required hand washing. In contrast, all of the studied nurses wore non sterile gloves before or after the different activities that required wearing gloves. Moreover, all of the participants had unsatisfactory performance level regarding preparation of patients in the predialysis phase.

Interestingly, a similar study carried out byMoursy and Sharaf (2017) reported that the studied nurses had poor level of practice during cannulation and decannulation of VA care. Furthermore, the results of the present study contradicted with the finding of Abdelsatir (2013) who indicated that almost three quarters of the studied nurses were adherent to hand hygiene before access manipulation and almost all nurses evaluated HD access function before connection but only half of them evaluated the site for signs of infection.

Regarding the correlation between overall knowledge and overall practices mean percent score, the present study results revealed that there was no statistical significant relation between overall knowledge and overall practices.It may be related to poor training, supervision, and work overload can be skilled in this result. This results were supported by Sakshi and Saluja (2019) who revealed that there was no significant association found between knowledge scores and practice scores of nursing personnel regarding CVC Care. This study finding was mismatched with results of Saber Mohammed et al. (2017) which revealed that there was a significant statistical correlation between total knowledge scores and total practices scores.

Conclusion

Based upon the findings of the current study, it could be concluded that:

- Most of the studied nurses had a satisfactory level of knowledge regarding tunneled hemodialysis catheter care.
- All of the studied nurses had an unsatisfactory practice level regarding tunneled hemodialysis catheter care.
- There were no statistically significant relations between overall knowledge and overall practices.

Recommendations

In line with the findings of the study, the following recommendations are made:

- Develop in-service education program for nurses to update their practices concerning hemodialysis catheter care.
- Establish teaching classes in hemodialysis unit about the care of hemodialysis catheters for new & admitted nurses.
- Ongoing clinical and educational competency evaluation should be carried out to nurses in all clinical settings.
- Replicate the study on a large probability sampling and on different geographical settings for generalization of the result.
- Explore factors that affect nurse's knowledge and practices regarding tunneled hemodialysis catheter.

Limitation of the study

The catheter insertion and removal done in intensive care at vascular department by physician so observation of nurses' practice during insertion & removal can't be done by the researcher.

Table (1): Distribution of studied nurses according to nurses' profile (n = 70)

Nurses' profile	No.	%
Hospital		
Benha university hospital	20	28.6
Benha teaching hospital	40	57.1
El-Humyat hospital	10	14.3
Age		
<30	27	38.6
30 – <40	19	27.1
40 – <50	18	25.7
≥50	6	8.6
Min. – Max	21.0 – 59.0	
Mean ±SD.	34.11 ±10.20	
Sex		
Male	2	2.9
Female	68	97.1
Qualification		
Bachelor degree	6	8.6
Technical institute diploma	28	40.0
secondary school diploma	36	51.4
Marital status		
Single	8	11.4
Married	62	88.6
The number of patients responsible for them		
1-2 patients per one shift	2	2.9
3-4 patients per one shift	65	92.9
More than 4 patients per one shift	3	4.3
Years of experience in hemodialysis unit		
<10	29	41.4
10 – <20	12	17.1
20 – <30	25	35.7
≥30	4	5.7
Min. – Max	0.42 – 33.0	
Mean ±SD.	13.59 ±10.61	
The number of daily working hours		
From 6-8 hours a day	0	0.0
From 7-12 hours a day	68	97.1
Other hours as (24 hours)	2	2.9
Previous attendance of training courses related to tunneled catheter care		
Yes	**46**	**65.7**
No	24	34.3
If yes, mention the number times		
1	3	6.5
2	43	93.5
Who explained and trained you on how to care for tunneled hemodialysis catheter (before, during, after hemodialysis) *		
Physician	4	5.7
The nurse	44	62.9
Previous education	3	4.3
Other sources		
- Hospital protocol and policies	14	20.0
- Experience gained during the working period	23	32.9

*** More than one answer**

Table (2): Distribution of the studied nurses according to their overall mean percent score of knowledge level regarding tunneled hemodialysis catheter care (n = 70)

Nurses' knowledge	Unsatisfactory <80%		Satisfactory ≥80%	
	No.	%	No.	%
General knowledge about tunneled hemodialysis catheter	6	8.6	64	91.4
Catheter insertion nursing care	33	47.1	37	52.9
Catheter connection – disconnection nursing care	23	32.9	47	67.1
Catheter exit site care	62	88.6	8	11.4
Catheter removal and documentation	61	87.1	9	12.9
Catheter infection and complications	27	38.6	43	61.4
Hemodialysis catheter discharge care plan	25	35.7	45	64.3
Overall knowledge	**26**	**37.1**	**44**	**62.9**

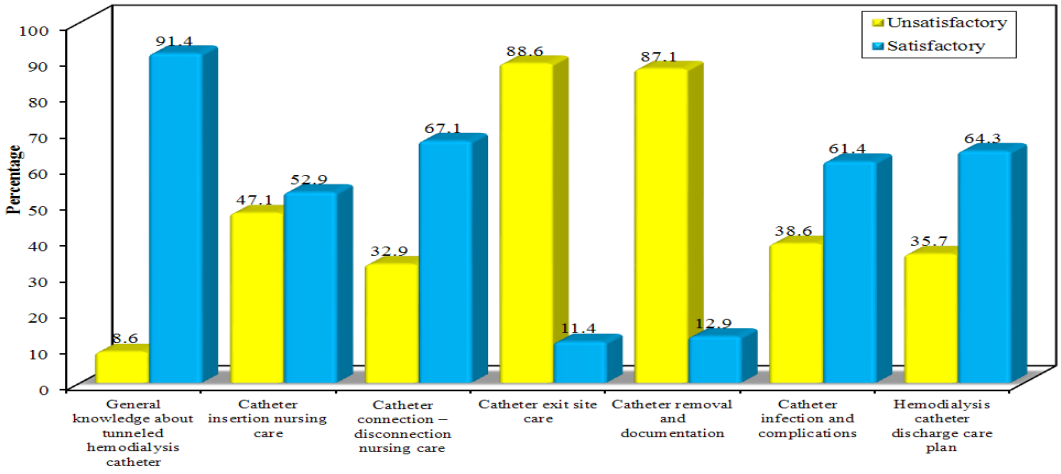

Figure (1): Distribution of the studied nurses according to their overall mean percent score of knowledge level regarding tunneled hemodialysis catheter care.

Table (3): Distribution of the studied nurses according to their mean percent score of level of practice related to nursing management of tunneled hemodialysis catheter (n = 70)

Nurses' practices	Unsatisfactory <80%		Satisfactory ≥80%	
	No.	%	No.	%
1-Nursing care for hemodialysis catheter connections	70	100.0	0	0.0
2- Nursing care for hemodialysis catheter disconnections	70	100.0	0	0.0
3-Nursing care for catheter exit site care	70	100.0	0	0.0
4-Nursing care for catheter removal:	–	–	–	–
5– Patient health education about catheter:	70	100.0	0	0.0
Overall observation	70	100.0	0	0.0

Table (4): Correlation between nurses' overall knowledge and overall practices mean percent score

	Overall practices	
	R	P
Overall knowledge	0.108	0.371

r: Pearson coefficient

References

- Abdelsatir, S. (2013). Evaluation of nurses awareness and practice of hemodialysis access care in Khartoum state, Sudan. *Arab journal of nephrology and transplantation*, *6*(2), 119-121.
- Abou El-Enein, N. Y., & El Mahdy, H. M. (2011). Standard precautions: a KAP study among nurses in the dialysis unit in a University Hospital in Alexandria, Egypt. The Journal of the Egyptian Public Health Association, 86(1-2), 3-10.https://doi.org/10.1097/01.epx.0000395430. 92943.69.
- Ali, S. A., Mahammad, Z. A. E.-l., El-mohsen, A., & Ali, S. (2018). Awareness of Nurses Regarding Hemodialysis Complications. *Assiut Scientific Nursing Journal*, *6*(15), 126-132.
- Alnawafleh, K. A., Mohammad, Z. A., & Al-Nwafleh, H. A. (2018). Auditing of Nursing Care for Hemodialysis Patients at Ma, an Governmental Hospitals-Jordan. *Assiut Scientific Nursing Journal*, *6*(15.00), 89-98.
- Association for Professionals in Infection Control and Epidemiology [APIC]. (2010). *Guide to elimination of infection in hemodialysis*: APIC.
- Bayoumi, M., Ahmed, A., & Hassan, H. (2019). Nurses' Practices Toward Applying Infection Control Measures Using NOTICE Checklists at a Dialysis Unit. *CONNECT: The World of Critical Care Nursing*, *13*(2), 90-101.
- Bayoumi, M., & Mahmoud, N. (2017). Effect of education program on nurses' knowledge and practice regarding care of central venous line in pediatric hemodialysis: evidence-based practice guidelines. *Egyptian Nursing Journal*, *14*(2), 87-99.
- Elmoghazy, G. E., Hassan, S. A., Sorour, A. S., & Donia, A. F. (2016). Nursing Intervention for Enhancing Hemodialysis Patient Adherence to Therapeutic Regimen. *Journal of American Science 12*(11), 84-93.
- ElsadeqKhadrawi, S. M. (2019). Assessment of nurses' knowledge and practice related to caring of central venous line at Aldamam Hospital. *Journal of Nursing and Health Science*, *8*(1), 52-57.
- Elsaidy, Z., Weheida, S., & Zaki, S. (2019). *Risk factors exposing hemodialysis patients to blood borne infections* (Master Thesis). Faculty of Nursing.
- Esposito, M. R., Guillari, A., & Angelillo, I. F. (2017). Knowledge, attitudes, and practice on the prevention of central line-associated bloodstream infections among nurses in oncological care: A cross-sectional study in an area of southern Italy. *PloS one*, *12*(6), e0180473.
- Hosney, Z. A., Mohamed, M. A., Abdelmowla, R. A. A., & Azouz, N. (2021). Nurses' Aseptic Technique Knowledge, Practice, and Compliance for Patients Receiving Hemodialysis. *Assiut Scientific Nursing Journal*, *9*(25.0), 145-154.
- Magnaghi, C., Caruso, R., Brioni, E., Apuzzo, L., Galli, M., Massari, C. . . . & Manara, D. (2021). Describing nurses' awareness of biological risk in delivering care for renal-dialysis patients: an Italian pilot survey. *Acta bio-medica*, *92*(S2), e2021003.
- Manandhar, D. N., Chhetri, P. K., Poudel, P., Baidya, S. K., & Agrawaal, K. K. (2017). Knowledge and Practice of Hemodialysis Amongst Dialysis Nurses. *JNMA J Nepal Med Assoc*, *56*(207), 346-351.
- Moursy, A., & Sharaf, A. (2017). Vascular access care at hemodialysis unit; nurses compliance to infection prevention and control practices. *IORS Journal of Nursing and Health Science*, *6*(2), 61-69.
- Mukhtad, A. A., Alfahkry, R. R., Mousa, W. O., Alzawi, A. M., & Abd El, A. A. E.-A. (2019). Assessment of Knowledge, Attitudes and Practices of Nurses Regard Infection Control Program in El-Hawwary Renal Dialysis Centre in Benghazi City,

Libya. *International Journal of Advances in Nephrology Research, 2*(1), 1-10.

- Osman, F. K., El Banna, H. M., Sharaf, A. Y., & Mohammed, Y. F. (2021). The Effects of Educational Interventions on Nurses' Knowledge and Practices in Hemodialysis Unit Regarding Infection Control Practices. *The Egyptian Journal of Hospital Medicine, 84*(1), 1739-1748.
- Saber Mohammed, R. M., Mohammed, W., & ElSalam Seloma, Y. (2017). Non tunneled hemodialysis catheter among acute renal failure patients: nurses' knowledge and practices at El Fayoum insurance hospital. *Egyptian Nursing Journal, 14*(3), 217-225.
- Saggu, Y., Asmat, K., Margrate, M., & Ahmad, N. (2018). Preventing Central Line Infections among Hemodialysis Patients: Nurses' Knowledge and Practices in Accordance With Center for Disease Control and Prevention (CDC) Guidelines. *Isra Medical Journal, 10*(2), 102-108.
- Sakshi, M. V., & Saluja, V. (2019). Effectiveness of education program regarding central venous catheter (CVC) care bundle in terms of knowledge and practice of nursing. *International Journal of Advanced Research, 7*(10), 1026-1033.
- Shang, W., Li, Y., Li, H., Li, W., Li, C., Cai, Y., & Dong, J. (2021). Correlation between laboratory parameters on admission and outcome of COVID-19 in maintenance hemodialysis patients. *International urology and nephrology, 53*(1), 165-169.
- Smelter, S. C., Bare, B. G., & Hinkle, J. L. (2014). *Brunner and Suddarth's text book of medical surgical nursing* (13th ed.). China: Kluwers Health / Lippincott Williams &Willins.
- Van Der Meersch, H., De Bacquer, D., Vandecasteele, S. J., Van den Bergh, B., Vermeiren, P., De Letter, J., & De Vriese, A. S. (2014). Hemodialysis catheter design and catheter performance: a randomized controlled trial. *American journal of kidney diseases, 64*(6), 902-908.
- Yousef, Y. E., Elashir, U. M., Mahmoud, S. R., & Maghraby, N. (2019). The effect of nursing educational program on knowledge and practice of nurses regarding infection control measures for children under hemodialysis. *Egyptian Nursing Journal, 16*(1), 1-9