Nurses' Performance Regarding Prevention of Vascular Access Complications among Children Undergoing Heamodialysis

Ebtesam A. Hammam [(1)], Salma E. Mohammed [(2)], Hoda R. Mohamed [(3)], Mohamed N. El-sharawi [(4)]

1-(B.Sc Nursing 2016)
2-Professor and Head of Pediatric Nursing Department, Faculty of Nursing – Ain Shams University
3-Assistant Professor of Pediatric Nursing, Faculty of Nursing – Ain Shams University
4-Lecturer of Pediatrics, Faculty of Medicine – Ain Shams University

Abstract

Background: Children undergoing hemodialysis are more prone to develop complications related to of vascular access. Therefore, children undergoing hemodialysis requires special nursing care with high skilled personnel trained in the hemodialysis to decrease those kinds of complications. **Aim:** This study aimed to assess nurses' performance regarding prevention of vascular access complications among children undergoing hemodialysis. **Design:** A descriptive exploratory design was utilized in this study. **Settings:** This study was conducted at the Pediatric Hemodialysis Unit in Children Hospital affiliated of Ain Shams University Hospital and Hemodialysis Unit affiliated of Al-Ayyat General Hospital. **Subjects:** A convenient sample composed of 62 nurses. **Tools for data collection:** three tools were used; **Tool I:** A structured interviewing questionnaire: **Tool II:** Observation Checklist. **Tool III:** Nurses' Attitude Rating Scale. **Results:** Half of the studied nurses were in the age group 20: <30 years old and about three quarters of them were female. There were weak correlation between nurses' knowledge, practice and their attitude regarding care of children undergoing hemodialysis. **Conclussion:** More than three quarters of the studied nurses had average knowledge about preventing vascular access complications among children undergoing hemodialysis, and the most of them had incompetent practice toward care of children undergoing hemodialysis. Moreover, great majority of the studied nurses has positive attitude about care of children undergoing hemodialysis. **Recommendation:** Emphasize the importance of continuous training based on actual needs assessment of nurses caring for children undergoing hemodialysis therapy. Replication of the current study on larger probability sample and various setting in Egypt.

Keywords: Children, Complications, Hemodialysis, Nurses' Performance, Prevention, Vascular Access

Introduction

Kidney is one of the most important organs in the body, which is responsible mainly for execration of waste products and regulation of body fluids and electrolytes and produce hormones. In a healthy body the kidney functions go properly, while due to some defects the kidney may be affected negatively **(Goldstein, 2022).**

Chronic renal diseases (CRDs) defined as: Evidence of structural or functional kidney abnormalities (abnormal urine analysis, imaging studies, or histology) that persist for at least 3 months, with or without a decreased of glomerular filtration rate (GFR), less than 60 ml/minute/1.73 m^2 **(Alnazer et al., 2021).**

End stage renal disease (ESRD) is defined as total loss of kidney function, it is a common problem worldwide, and it is diagnosed by several laboratory and imaging diagnostic procedures. It occurs when a disease or condition impairs kidney function, causing kidney damage to worsen over several months or years **(Ravindran et al., 2020).**

The goal of management of chronic renal failure (CRF) in children is not only to prevent progression to ESRD but to fulfill the physiological and emotional needs of children to the best possible quality of life. It can achieve through early and appropriate treatment of reversible causes of CRF. It may help to achieve normal growth, development and periodic monitoring for rate of progression to ESRD to help plan for renal replacement therapy **(Harada et al., 2022).**

Medical management of chronic renal failure includes dialysis to remove waste products and extra water from the blood. There are two types of dialysis; hemodialysis and peritoneal dialysis. Kidney transplantation involves surgically placing a healthy kidney from a donor inside the children body that is used when there is no life threatening medical condition other than kidney failure **(Abd Elkhalik et al., 2019)**.

Hemodialysis is the most common method used to treat advanced and permanent kidney failure in pediatrics. Hemodialysis defined as a medical procedure that uses a special machine to filter waste products from the blood and to restore normal constituents to it again. Chronic hemodialysis has many complications as cardiovascular, nutritional, gastrointestinal, hepatic, endocrinal, nervous system, infections, complication related to vascular access devices **(Machaly et al., 2020).**

Dialysis requires a well-functioning vascular access to be placed in the patient to allow the blood to flow from the patient to the dialysis machine and back again. There are three forms of vascular access depend in part on how quickly the patient needs to begin hemodialysis, including central venous catheters (CVCs) and surgically created arteriovenous access types, i.e. native arteriovenous fistulas (AVFs) and synthetic arteriovenous grafts (AVGs) each of these forms of hemodialysis vascular access has its own specific problems **(Santoro et al., 2023).**

Vascular access (VA) is a major cause of morbidity and mortality in patients on maintenance hemodialysis. More than 30 % of the hospitalizations of long-term hemodialysis patients in the United States are related to VA **(Abdosh et al., 2020)**.

Dysfunctional dialysis access disrupts scheduled dialysis treatment and associates with higher mortality rates. Thus, preservation of patent dialysis access is essential to the care of hemodialysis patients. So it's important to take care of the VA to prevent complications **(Sobh et al., 2019).**

The dialysis nurse plays a vital role in providing information, care, support, understanding and therapeutic counseling to the pediatric patient and his family throughout the entire illness. The nursing management must be provided in order to reducing the complications of renal function and the stresses of dealing with a life threatening illness **(Al Rafay et al., 2021).**

Significance of the study

In Egypt, the estimated annual incidence of End-Stage Renal Disease (ESRD) is around 74 per million and the total prevalence of children on dialysis is 264 per million **(Kamal et al., 2024).** Nurses can help by involving the pediatric patient as much as possible in their health care decision, informing them of all treatment options and placing an emphasis on self-care. Sometimes nurses fail to adopt modern or recent nursing care for the children undergoing hemodialysis due to the lack of knowledge **(Nazly et al., 2021).** So, this study conducted to assess nurses' performance regarding prevention of vascular access complications among children undergoing hemodialysis.

Aim of the Study

This study aimed to assess nurses' performance regarding prevention of vascular access complications among children undergoing hemodialysis. This aim achieved through:

- Assessing the nurses' knowledge regarding prevention of vascular access complications among children undergoing hemodialysis.
- Assessing the nurses' practices regarding prevention of vascular access complications among children undergoing hemodialysis.
- Assessing the nurses' attitude regarding prevention of vascular access complications among children undergoing hemodialysis.

Research Questions:

- What are the levels of nurses' knowledge regarding prevention of vascular access complications among children undergoing hemodialysis?
- What are the levels of nurses' practices regarding prevention of vascular access complications among children undergoing hemodialysis?
- What are the levels of nurses' attitude regarding prevention of vascular access complications among children undergoing hemodialysis?

Subjects and Methods

The Subject and Methods for the current study was portrayed under the four main designs as following:

I. Technical design:

The technical design included research design, Settings, subjects and tools for data collection.

Research design:

A descriptive exploratory design was utilized in this study.

Research settings:

This study was conducted at the Pediatric Hemodialysis Unit in Children Hospital affiliated to Ain Shams University Hospital and Hemodialysis Unit affiliated to Ministry of Health (Al-Ayyat General Hospital) (which added because of number of nurses at Ain Shams University).

The hemodialysis unit at Children Hospital affiliated to Ain Shams University was located in a separate unit in the first floor which consists of 5 rooms (3 rooms for negative hepatitis C virus (HCV) Patients, each room include 7 chairs &7 hemodialysis machines, 1 room for Positive HCV Patient that include 3 chairs with 3 hemodialysis machines and the last room has 1 chair and 1 bed with 2 hemodialysis machines separated for isolation), this unit receive 37 child daily with total capacity of 74 child (66 negative HCV child , 8 positive HCV child). There are water treatment room, equipment and supply room, medical devices maintenance room, stock medication drawer, medication storage refrigerator, 21 fixed monitor, body composition monitor (BCM), weight scale, crash car & defibrillator, sphygmomanometer and electrocardiograph device.

The Hemodialysis Unit Affiliated to Ministry of Health (Al-Ayyat General Hospital) is located in the first floor which consist of 7 rooms; 4 rooms for negative HCV Patients (2 rooms for adult & 2 rooms for pediatric), each of them include 6 beds with 6 hemodialysis machines, 2 rooms for Positive HCV Patients (1 room for adult & 1 room for pediatric) each of them include 4 beds with 4 hemodialysis machines and the last one for isolation include 4 beds with 4 hemodialysis machines with capacity of 86 patient. There are medication preparation room, water treatment room, equipment &

supply room, medication storage refrigerator and weight scale, crash car, and electrocardiograph device.

Research subjects

A convenient sample composed of 62 nurses working at previous mentioned settings 24 nurses from Children Hospital affiliated to Ain Shams University and 38 nurses from Al-Ayyat general hospital regardless age, gender, qualifications, years of experience and agree to participate in this study.

Tools for data collection:

Data was collected through using the following tools:

Tool I: A structured interviewing questionnaire: It was adopted from **Moore et al., (2020)**; it was designed by the researcher in the light of relevant literatures and reviewed by supervisors. It was written in simple Arabic language and included two parts as the following:

- **Part 1:** Characteristics of studied nurses include: age, gender, level of education, marital status, years of experience and previous attend of training courses.
- **Part 2:** Nurses' knowledge regarding hemodialysis vascular access and its complications it consists of 24 questions classified as:

i. (17 questions) in the form of multiple choice questions (MCQ) are divided into 2 categories: 1) nurses' knowledge about hemodialysis (10 questions) such as definition, purpose, indications & contraindications, types of vascular access and complication of hemodialysis & vascular access devices. 2) nursing intervention toward children undergoing hemodialysis (7 questions) it was included nursing intervention (before, during and after hemodialysis) and nursing role for prevention of vascular access complications.

ii. (7 questions) in the form of true & false, It was included nursing intervention in case of vascular access devices infection, leakage, occlusion, clots and dysfunction).

Scoring system:

The responses of nurses were checked with a model key answer and accordingly the knowledge of nurses categorized into either correct answer which scored one mark and incorrect answer which scored with zero. The total score of questions was 24. These scores were summed up and converted into a percent score, then it was classified into 3 categories: Poor knowledge (score < 60%), average knowledge (score 60% - 75%) and good knowledge (score > 75%).

Tool II: Observation Checklist: It was designed to assess nurses' practice for vascular access & prevention of its complications. It was included the following:

- **Hand washing** it was adopted from **Smeltzer & Bare, (2004)** which included times & procedure (9 steps).
- **Personal protective equipment wearing** it was adapted from **Yassin et al., (2018)** which included wearing face mask, over shoes, hair cover, gown or unit uniform, and gloves (11 steps).
- **Care of hemodialysis catheter** it was adapted from **Llapa-Rodríguez et al., (2019)** which included connections & disconnections (23 steps).
- **Care of arteriovenous fistula/ graft** it was adapted from **Hill et al., (2020)** which included cannulation & decannulation (16 steps).
- **Care of children undergoing heamodialysis before, during and after** hemodialysis session it was adapted from **Kliegman et al., (2018)** (21 steps).

- **Care of vascular access device infection** it was adapted from **Aloush & Alsaraireh, (2018)** (8steps).
- **Care of catheter embolism** it was adapted from **College of Registered Nurses of British Columbia, (2015)** (11 steps).
- **Prevention of catheter occlusion** it was adapted from **Pan et al., (2019)** (7 steps).
- **Care of catheter malposition or kinking** it was adapted from **Bolton, (2013)** (8steps).
- **Centeral veinous access device dressing change** it was adapted from **Craswell et al., (2020)** (10 steps).

Scoring System:

A scoring system was followed to assess nurses' practice, each checklist was assigned a score according to sub steps, These steps were evaluated as "done" was taken one mark and "not done" was taken zero. These scores were summed up and converted into a percentage score. Then the result were classified into 2 categories competent practice if score ≥85% and incompetent practice if score <85%.

Tool III: Nurses' Attitude Rating Scale: It was adapted from **Magennis et al., (1999),** to assess nurses' attitude for vascular access & prevention of its complications. It consists of 16 statements.

Scoring system:

Nurses' responses were scored by 5 likert rating scale which classified to: strongly agree, agree, sometimes, disagree and strongly disagree and scored (5, 4, 3, 2 and 1). The scores of the items were summed up and converted into a percentage score. The total nurses' attitude were classified into two categories positive attitude if score ≥ 60% and negative attitude if score < 60%.

II - Operational design:

The operational design included preparatory phase, tool validity and reliability, ethical consideration, pilot study and field work.

Preparatory Phase:

This phase included a review of the past and current related literature covering the various aspects of the research problem using articles, journals, text books, magazines and internet to be acquainted with the research problem to develop the study tools & content.

Tool validity

Tools of data collection were translated into Arabic and investigated for their content validity through distribution to 3 experts from Pediatric nursing department: (1) professor and (2) assistant professors from Faculty of Nursing, Ain Shams University to test the content validity of the instruments and to judge its clarity, comprehensiveness, relevance, simplicity, and accuracy. All their remarks were taken into consideration; sometimes were re-phrased to arrive at the final version of the tools. The tools were regarded as valid from the experts' point of view.

Tool reliability

Reliability of the tools was applied by using Cronbach's alpha coefficient test, the result were 0.51, 0.85 and 0.77 for knowledge, practice and attitude respectively.

Ethical Considerations

Approval of the study protocol was obtained from the ethical committee in the Faculty of Nursing at Ain Shams University before starting the study. The researcher clarified the objective and aim of the study to nurses included in the study. The researcher assured maintaining anonymity and confidentiality of subjects' data. Nurses were informed that they are allowed choosing to participate or withdraw from the study at any time without giving reason.

Pilot Study

Pilot study was carried out on 10% (6) of nurses before starting the data collection to

assess the applicability, clarity and efficiency of the study tools. Based on results of the pilot study, some modification was done for tools. Subjects who shared in the pilot study were excluded in the main study sample.

Field Work

The purpose of the study was simply explained to the nurses who agreed to participate in the study prior to data collection. The nurses assured about confidentiality of data collection that were used only for the purpose of the study. The researcher was available all the time to clarify any ambiguities and answer any questions, Then the tools were collected and checked for completeness. Each nurse was observed closely using the observational checklist individually and separately while performing the care for Children undergoing hemodialysis. The characteristics of nurses and their knowledge questionnaire and nurse' attitude at the form of Likert scale were filled by the nurse him/herself. The data collection was started and completed within six months from the beginning of February (2023) and ended at July (2023), Data were collected by the researcher through four days per week (Sunday and Monday) in children hospital from (9:00Am -3:00 pm) and (Wednesday and Thursday) in Al-Ayyat hospital from (9:00 Am -3:00 pm). The time consumed to fill out the full study tools ranged from 40 to 50 minutes, it took 15-20 minutes for each nurse to complete knowledge also, about 5-10 minutes to complete attitude and it took about 5-10 minutes for every procedure for observational checklist. The average number of nurses interviewed were 2-3nurses/day depending on the response of the participants.

III Administrative design

An official approval to carry out this study was obtained from the Faculty of Nursing, Ain Shams University to the nursing directors of Ain Shams hospital & Al-Ayyat General Hospital. A written approval from the hospital nursing director was taken, the purpose and the methods of the data collection was explained as well.

IV Statistical design:

The collected data were organized, categorized, tabulated and statistically analyzed using the statistical package for social sciences (SPSS) version 23. Quantitative data were presented as mean and standard deviation (SD) while qualitative data were expressed as frequency and percentage. Chi-square test used to test significance between qualitative variables. Coefficient correlation was used to assess correlation between quantitative variables.

The observed differences and associations were considered as follows:

- $P > 0.05$ was considered non- Significant (NS).
- $P \leq 0.05$ was considered Significant (S).
- $P \leq 0.001$ was considered High Significant (HS).

Results:

Table (1) showed that half (50%) of the studied nurses were in the age group 20: <30 years old with mean age 31.8 ± 9.4 years and 38.7% and 37.1% of them have <5 years of experience in pediatric hemodialysis and attained previous training program about pediatric hemodialysis respectively.

Figure (1) showed that nearly three quarters (74%) of the studied nurses were female.

Figure (2) clarified that, more than one third (35.5% & 34.5%) of the studied nurses were graduated from technical health institute of nursing and held diploma respectively.

Figure (3) showed that more than three quarters (79%) of the studied nurses had average knowledge about preventing vascular access complications among

children undergoing hemodialysis. On the other hand, 4.8% and 16.2% of them had good and poor Knowledge respectively.

Figure (4) showed that 17.7% of the studied nurses had competent practice toward care of children undergoing hemodialysis, while the most (82.3%) of them had incompetent practice.

Figure (5) showed that, the majority (96.8%) of the studied nurses has positive attitude about care of children undergoing hemodialysis**.**

Table (2) revealed that there were weak negative correlation between nurses' knowledge, practice and their attitude regarding care of children undergoing hemodialysis.

Table (1): Distribution of studied nurses according to their characteristics

Nurses' characteristics	Total number = 62	
	NO	**%**
Age/ years		
< 20	3	4.8
20 < 30	31	**50**
30 < 40	11	17.7
40 & more	17	27.4
Mean ± SD	**31.8 ± 9.4**	
Marital status		
Single	19	30.6
Married	40	64.5
Widow	3	4.9
Years of experience		
< 5	24	**38.7**
5 < 10 years	14	22.6
10 < 15	2	3.2
15 ≤ 20	22	35.5
Mean ± SD	**9.2 ± 6.6**	
Attained previous training program about hemodialysis care.		
Yes	23	**37.1**
No	39	62.9
Number of previous training program	**No (23)**	
Once	22	95.6
Twice	1	4.4
Name of previous training program	**No (23)**	
Caring for children undergoing hemodialysis	22	95.6
Infection control	1	4.4

Figure (1): Percentage distribution of studied nurses according to their gender.

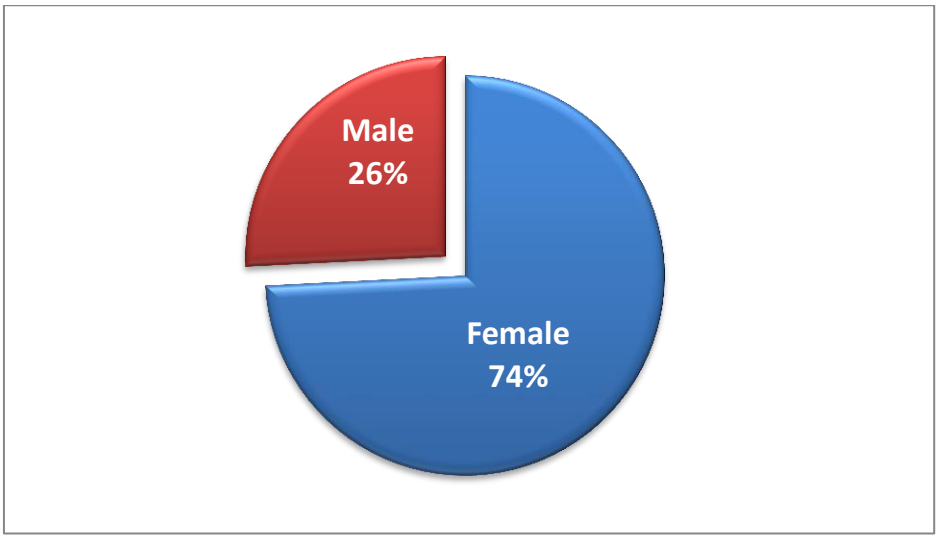

Figure (2): Percentage distribution of studied nurses according to their level of education.

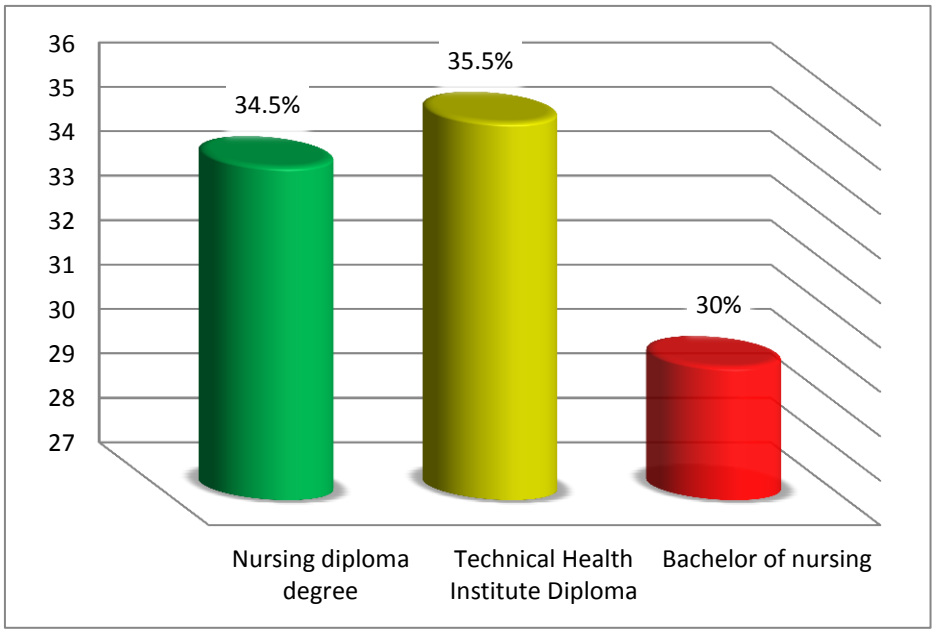

Figure (3): Percentage distribution of studied nurses according to their total knowledge regarding preventing vascular-related complications among children undergoing hemodialysis.

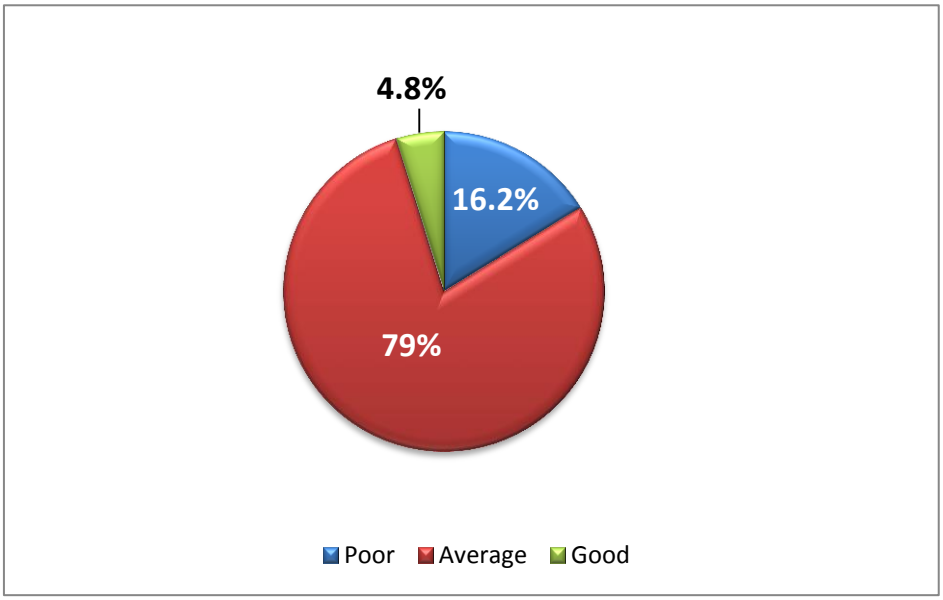

Figure (4): Percentage distribution of studied nurses according to their total practice toward care of children undergoing hemodialysis.

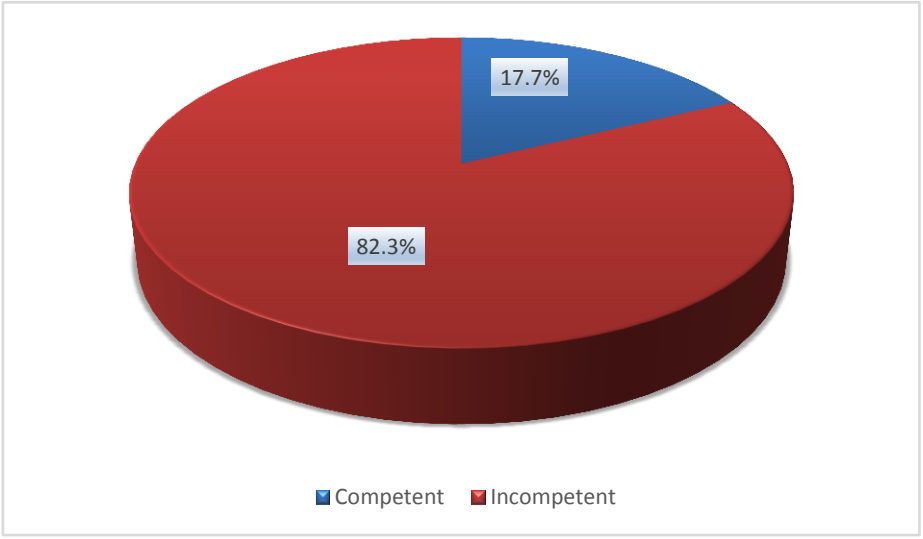

Figure (5): Percentage distribution of studied nurses according to their total attitude toward care of children undergoing hemodialysis.

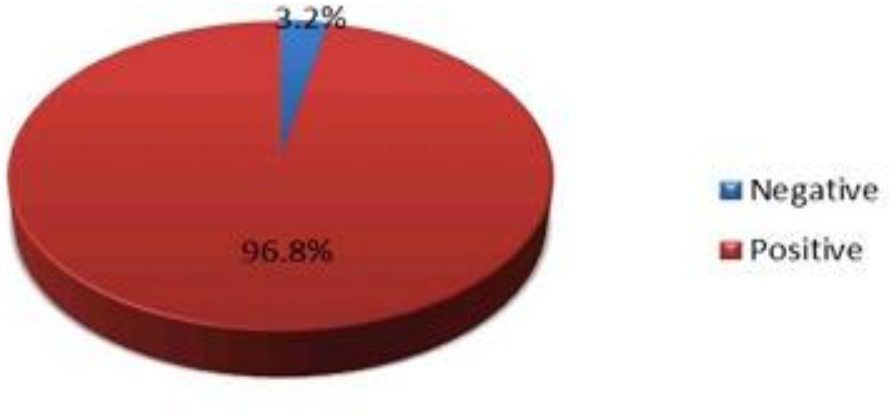

Table (2): Correlation between studied nurses' knowledge, practice and their attitude regarding care of children undergoing hemodialysis

Nurses' performance	Knowledge		Practice	
	R	P	r	p
Knowledge	--	--	- 0.10	0.694
Practice	- 0.10	0.694	--	--
Attitude	- 0.13	0.312	- 0.20	0.167

Discussion

Chronic kidney disease can be treated by hemodialysis, peritoneal dialysis, or a kidney transplant. Hemodialysis involves the use of a machine to filter blood outside the body. Addition, patients during the process of hemodialysis require vascular access for prolonged periods, repeated opportunities exist for person-to-person transmission of infectious agents, directly or indirectly via contaminated devices, equipment and supplies, environmental surfaces, or hands of personnel and they also require frequent hospitalizations and surgery, which increases their chances of contracting healthcare-associated infections **(Magor et al., 2022)**. The current study conducted to assess nurses' performance regarding prevention of vascular access complications among children undergoing hemodialysis.

As regard to age of the studied nurses, the current study result showed that half of the studied nurses were in the age group 20: <30 years old with mean age 31.8±9.4 years **(Table 1).** This could be due to the demanding nature of dialysis service so that older nurses may find it difficult to cope with the load of work required. These results in agreement with **Raafat et al., (2022)** who applied study entitled " Effect of Educational Guidelines on Nurses' Performance related to Care of Arteriovenous Fistula Puncture for Children undergoing Hemodialysis" and showed that about half of the studied nurses were in the age group of 25-< 30 years old with mean age 25.84±4.02 years.

Regarding to years of experiences, less than two fifths of the studied nurses had <5 years of experience in pediatric hemodialysis and attained previous training program about pediatric hemodialysis **(Table 1)**. This result may be due to most of the studied nurses were recently graduated. This result was in accordance with **Ibrahim et al., (2019)** who

applied study in Egypt entitled " Assessment of nurses' performance regarding care of children undergoing hemodialysis therapy" and revealed that less than half of studied nurses were had from 5 < 10 years of experience (X±SD 9.1 ± 6.36 years). While highly percentage of them not attended training courses about care of children undergoing hemodialysis therapy.

Regarding to gender of the studied nurses, nearly three quarters of the studied nurses were females **(Figure 1).** This reflects the general nursing situation in Egypt where most of the nursing is carried out by females and may also related to the studying of nursing in Egyptian universities were exclusive for females only till few years ago This result was supported with **Ibrahim et al., (2019)** who reported that more than three quarters of the studied nurses were females.

Concerning to level of education among studied nurses, more than one third of the studied nurses were graduated from technical health institute of nursing and held diploma **(Figure 2)**. From the investigator point of view, this may be because many bedside nurses in governmental hospitals graduated from the nursing technical institute, and the findings of this study might be due to the fact that the nursing technical institute provided the community with a large number of the nursing graduates than the other agencies such as the faculties of nursing.

This result was disagreed with **Afify et al., (2022)** who studied about "Nurses' knowledge and practices regarding care of children undergoing vascular access and its related complications" and found that more than half of the studied nurses had bachelor degree of nursing science

Concerning to total knowledge of the studied nurses regarding preventing vascular-related complications, more than three quarters of the studied nurses had average knowledge about preventing vascular access complications among children undergoing hemodialysis **(Figure 3)**. This may be explained that more than one third of the studied nurses were graduated from technical health institute and had diploma in nursing also about one third of the studied nurses had attended training courses about care of children undergoing hemodialysis.

This result was contrasted with **Ali et al. (2018)** in a study in Egypt among 35 nurses entitled "Awareness of nurses regarding hemodialysis complications" and revealed that the majority of the studied nurses had good level of knowledge regarding hemodialysis complications and this result was disagreed with **Chen et al. (2022)** who demonstrated that less than three quarters of the studied nurses had correct knowledge about preventing vascular access complications among children undergoing hemodialysis.

According to total practice toward care of children undergoing hemodialysis, the present study result revealed that less than one fifth of the studied nurses had competent practice toward care of children undergoing hemodialysis, while the most of them had incompetent practice **(Figure 4).** This might be due to the lack of nurses' application of knowledge especially regarding nursing care with common complications that occur and misunderstanding of their roles as there is no job description or definition of responsibilities in the hemodialysis unit.

This result was supported with **Salman & Muttaleb, (2023)** who found that the studied nurses had poor practices about the application of standardized precaution measures for children in hemodialysis unit. While disagreed with **Osman et al., (2021)** in a study entitled "The effects of educational interventions on nurses' knowledge and practices in Hemodialysis Unit regarding infection control practices" and revealed that half of the studied nurses had "fair" level of practice and the other half

had "poor level" of practice in hemodialysis unit regarding infection control practices.

According to total attitude of the studied nurses toward care of children undergoing hemodialysis, the current study result revealed that the majority of the studied nurses has positive attitude about care of children undergoing hemodialysis **(Figure 5).** From the researcher point of views, it might be due to the stress of work and feel of responsibility related to severity of children condition in hemodialysis units.

This result was contrasted with **Abd Elkhalik et al., (2019)** who found, more than half of the studied nurses had negative attitude, while six percentage(minority) of them had positive attitude regarding care of children undergoing hemodialysis therapy, and disagreed with **Shahdadi and Rahnama, (2018)** in a study about Experience of nurses in hemodialysis care: A phenomenological study and found that nurses' attitudes about the care of children undergoing hemodialysis are often negative, due to feelings of burnout, depression, and anxiety. Excessively long workdays, high workloads, and insufficient resources led to a depletion in the nurses' physical and emotional status

As regard to correlation between studied nurses' knowledge, practice and their attitude regarding care of children undergoing hemodialysis, the current study results revealed that there were weak negative correlation between nurses' knowledge, practice and their attitude regarding care of children undergoing hemodialysis **(Table 2).** From the researcher point of view due to studied nurses had average level of knowledge and don`t implement this knowledge in their work

These results were in the same line with **Ibrahim et al., (2019)** who reported that there was no a statistically significance relation between total scores of nurses' performance (knowledge, practice and attitude). While these results were disagreed with **Magor, et al., (2022)** in a study about Effect of Video-Assisted Educational Guidelines on Nurses' Performance Regarding Infection Control Measures for Children undergoing Hemodialysis and reported that there was a positive statistically significant correlation between total scores of nurses' knowledge and their total practices' scores regarding infection control measures during care of children undergoing.

Conclusion

In the light of the current study findings, it can be concluded that

More than three quarters of the studied nurses had average knowledge about preventing vascular access complications among children undergoing hemodialysis,and the most of them had incompetent practice toward care of children undergoing hemodialysis. Moreover majority of the studied nurses has positive attitude about care of children undergoing hemodialysis.

Recommendations

Based on the current study findings the following recommendations were proposed:

- ✓ Periodic assessment of knowledge, practice and attitude for all nurses dealing or providing care to children undergoing hemodialysis therapy.
- ✓ Emphasize the importance of continuous training based on actual need assessment of nurses caring for children undergoing hemodialysis therapy.
- ✓ Assess factors affecting nurses' performance positively for better care of children undergoing hemodialysis therapy.
- ✓ Procedure book should be available in hemodialysis units as a reference for all nurses.

- ✓ Replication of the current study on larger probability sample and various setting in Egypt.

References

Abd Elkhalik, I. M., El-Sayed, W., & Salah I, S. (2019). Assessment of nurses' performance regarding care of children undergoing hemodialysis therapy. Egyptian journal of health care, 10(3), 113-125.

Abdosh, K., Suliman, I., & Ahmed, G. (2020). Complications of permanent vascular access in hemodialysis patients. Journal of The Egyptian Society of Nephrology and Transplantation, 20(3), 157.

Afify, A, R., El-Sayed O, W., Mohamed, S, K., & Mohammed, S. (2022). Nurses' Knowledge and Practices regarding Care of Children Undergoing Vascular Access and its Related Complications. *Journal of Nursing Science Benha University*, 3(1), 981-995.

Al Rafay, S. S., Tantawi, H. R., El Farsy, M. S., & Ramadan, D. H. (2021). Role of Pediatric Nurses Regarding Children's Needs Undergoing Hemodialysis Therapy. Egyptian Journal of Health Care, 2021 EJHVol 12. no.3

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.

Alnazer, I., Bourdon, P., Urruty, T., Falou, O., Khalil, M., Shahin, A., & Fernandez-Maloigne, C. (2021). Recent advances in medical image processing for the evaluation of chronic kidney disease. Medical Image Analysis, 69, 101960.

Aloush, S. M., & Alsaraireh, F. A. (2018). Nurses' compliance with central line associated blood stream infection prevention guidelines. Saudi medical journal, 39(3), 273.

Bolton, D. (2013). Preventing occlusion and restoring patency to central venous catheters. British journal of community nursing, 18(11), 539-544.

Chen, H., Chen, L., Zhang, Y., Shi, M., & Zhang, X. (2022). Knowledge of vascular access among hemodialysis unit nurses and its influencing factors: a cross-sectional study. Annals of Palliative Medicine, 11(11), 3494502-3493502

College of Registered Nurses of British Columbia. (2015). Scope of Practice for Registered Nurses: Standards, limits and conditions. Retrieved September 6, 2013Cook, L. S. (2013). Infusion-Related Air Embolism. Journal of Infusion Nursing, 36(1), 26-36.

Craswell, A., Massey, D., Wallis, M., Sriram, D., Gray, N. A., Kotwal, S., & REDUCCTION Investigators. (2020). Current practice in dialysis central venous catheter management: Multi-disciplinary renal team perspectives. Nephrology, 25(5), 406-412.

Goldstein, D. L. (2022). Renal and extrarenal regulation of body fluid composition. In Sturkie's avian physiology (pp. 411-443). Academic Press.

Harada, R., Hamasaki, Y., Okuda, Y., Hamada, R., & Ishikura, K. (2022). Epidemiology of pediatric chronic kidney disease/kidney failure: learning from registries and cohort studies. Pediatric Nephrology, 1-15.

Hill, K., Sharp, R., Childs, J., Esterman, A., Le Leu, R., Juneja, R., & Jesudason, S. (2020). Cannulation practices at haemodialysis initiation via an arteriovenous fistula or arteriovenous graft. The Journal of Vascular Access, 21(5), 573-581.

Ibrahim M., Ouda W. & Ismail S. (2019). Assessment of nurses' performance regarding care of children undergoing hemodialysis therapy, Egyptian Journal of Health Care,10(3):113-125

Kamal, F., Sayed, F., & Mohammed Elmawafie, S. (2024). Assessment of Anxiety and Stress Levels in Children Undergoing Hemodialysis. Egyptian Journal of Health Care, 15(1), 82-102.

Kliegman, R., Behrman, R., and Jenson, H., (2018): Renal failure. In:Elk Grove Village, editor. Nelson textbook of pediatrics. 18th ed. Philadelphia, PA: Elsevier; 2018. 2210-2214.

Llapa-Rodríguez, E. O., Oliveira, J. K. A. D., Melo, F. C., Silva, G. G. D., Mattos, M. C. T. D., & Macieira, V. P. (2019). Insertion of central vascular catheter: adherence to infection prevention bundle. Revista Brasileira de Enfermagem, 72, 774-779.

Machaly, E., Bahgat, R., Hassan, H., & Kafl, R. H. (2020). Effect of implementing evidence based nursing guidelines on nurses' performance about care provided for children undergoing hemodialysis. Journal of Nursing and Health Sciences, 9(3), 21-28.

Magennis, C., Slevin, E., & Cunningham, J. (1999): Nurses' attitudes to the extension and expansion of their clinical roles. Nursing Standard (through 2013), 13(51), 32.

Magor, N. R. E., Abdella, N. H. A., Hegazy, A. E. S. A., & Ayed, M. M. A. (2022). Effect of Video-Assisted Educational Guidelines on Nurses' Performance Regarding Infection Control Measures for Children undergoing Hemodialysis. Tanta Scientific Nursing Journal, 27(4), 11-29.

Moore, C., Wearden, A., Carter, L.A., Mitra, S., Skevington, S.M. (2020): Development of a measure for patients preparing to start dialysis and their partners: The Starting Dialysis Questionnaire (SDQ). Health and quality of life outcomes;18(1):1-9.

Nazly, A., Khamis, E., & Al Khatib, H. (2021). The knowledge and educational needs of nurses regarding pain management of patients on maintenance hemodialysis: a qualitative study. The Open Nursing Journal, 15(1).

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.

Pan, M., Meng, A., Yin, R., Zhi, X., Du, S., Shi, R., ... & Fang, H. (2019). Nursing interventions to reduce peripherally inserted central catheter occlusion for cancer patients: a systematic review of literature. Cancer Nursing, 42(6), E49-E58.

Raafat, M. R., Soliman B, R., Gharib S, A., & Mohammed, A. E. G. (2022). Effect of Educational Guidelines on Nurses' Performance related to Care of Arteriovenous Fistula Puncture for Children undergoing Hemodialysis. Journal of Nursing Science Benha University, 3(1), 36-50

Ravindran, A., Sunny, A., Kunnath, R. P., & Divakaran, B. (2020). Assessment of quality of life among end-stage renal disease patients undergoing maintenance hemodialysis. Indian journal of palliative care, 26(1), 47.

Salman, N. T., & Muttaleb, W. M. (2023). Evaluation of Nurses' Practices Toward the Application Standard Precaution Measures in Children Hemodialysis Unit. Pakistan Heart Journal, 56(2), 274-283

Santoro, D., Gembillo, G., & Siligato, R. (2023). Central Venous Access for Hemodialysis. In Handbook of Dialysis Therapy (pp. 183-191). Elsevier.

Shahdadi, H., & Rahnama, M. (2018). Experience of nurses in hemodialysis care: A phenomenological study. Journal of Clinical Medicine, 7(30), 1-8. http:// doi:10. 3390/jcm7020030

Smeltzer, S.C. and Bare, B.G. (2004): Brunner & Suddarth's Textbook of Medical-Surgical Nursing (10th ed.,) (volume 2). Philadelphia, Lippincott: Williams & Wilkins.

Sobh, H., Shereif, W., Mohammed, H., salama, M. (2019). Effect of Nursing Intervention on Prevention of Vascular access Complications for Patients undergoing Regular Hemodialysis International Journal of Novel Research in Healthcare and Nursing Vol. 6, Issue 3, pp: (440-453), Month: September - December 2019, Available at: www.noveltyjournals.com

Yassin, S. I., Soliman, M., Hoda, I., Osman, N. A., & Salma, A. (2018). Assessment of Infection Control Knowledge and Practices among Hemodialysis Nursing Staff in Kasr Al-Ainy Hospitals. The Medical Journal of Cairo University, 86(June), 1649-1656.