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Assessment of Nurse's Knowledge and Practice Regarding Hemodialysis Machine Alarms

Neama Abd El Hay Mostafa[1], Taghreed Talat Shakweer[2], Marwa Abd-Elaziz Abd-Elgabar[3]

Demonstrator at Faculty of Nursing, Fayoum University[1], Assist. Professor of Medical Surgical Nursing, Faculty of Nursing Helwan University[2], Assist. Professor of Medical surgical Nursing, Faculty of Nursing, Helwan University [3].

ABSTRACT

Background alarms of hemodialysis machine play important global role for patient safety These alarms go off when something is wrong with the machine or threatens patient safety such as blood alarms, dialysate alarms and other alarms.

Aim of the study: assess Nurse's Knowledge and Practice level Regarding Hemodialysis Machine Alarms in hemodialysis care unit.

Design: A descriptive exploratory research design was used.

Setting: The study was conducted in the hemodialysis care units at El-Fayoum General Hospital.

Subjects: A Convenient sample of all available nurses (60) nurse from both sex working hemodialysis care units.

Tools: two tools were used for data collection. Tool I: Nurses' self-administered interview Questionnaire: which included (a) Demographic characteristics of nurses (b) Nurses' knowledge regarding hemodialysis machine alarms Tool II: Observational check list to assess nurses' practice regarding hemodialysis machine alarms.

Results shows that (73.3% and 91.7%) of studied nurses had unsatisfactory level of knowledge and level of practice regarding hemodialysis machine alarm among the studied nurses respectively. Additionally, there was a positive strong high statistically significant correlation between total level of knowledge and total level of practice regarding hemodialysis machine alarm.

Conclusion: The study concluded nearly two thirds of the studied nurses had unsatisfactory knowledge regarding hemodialysis machine alarms. And more than three quarter of the studied nurses had incompetent level of practice regarding hemodialysis machine alarms. Additionally, there was a statistically significant correlation between total nurses' knowledge and practice regarding hemodialysis machine alarms. **Recommendations:** Continuing educational program to improve knowledge and practices of nurses regarding hemodialysis machine alarms.

Keywords: Nurses knowledge and practice, hemodialysi ,machine alarms.

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Introduction

the Hemodialysis unit provides all the necessary services required for the optimal management of the patient with acute & chronic renal failure or End-Stage Renal Disease (ESRD). Specialized services include the placement of vascular access for the conduct of therapeutic hemodialysis. The experienced physician and nursing staff of the state-of- the-art inpatient hemodialysis unit deliver the optimal medical support for the patient with acute or chronic renal failure ***(Lee et al.,2013)***.

Hemodialysis units are sites susceptible to the occurrence of Adverse Events (AE) because they have several risk factors, such as invasive procedures, use of complex equipment, water treatment, critical patients, high patient turnover, and administration of potentially dangerous drugs, such as heparin. A study performed in four hemodialysis units in the USA identified that in a 17-month period 88 adverse events occurred during 64,541 dialysis treatments (1 case for every 733 treatments ***(Rocha., 2022)***.

The hemodialysis machine pumps the patient's blood and the dialysate through the dialyzer. The newest dialysis machines on the market are highly computerized and continuously monitor an array of safety-critical parameters, including blood and dialysate flow rates; dialysis solution conductivity, temperature, and pH; and analysis of the dialysate for evidence of blood leakage or presence of air. Any reading that is out of normal range triggers an audible alarm to alert the patient-care technician who is monitoring the patient. blood leak alarms these alarms are essential to the provision of safe dialysis because small blood leaks may be invisible to the naked eye could lead to significant blood loss. The blood leak detector in a hemodialysis machine is composed of a light source and a photocell receptor causing blood flow to stop and triggering both auditory and visual alarms. ***(Hartlein et al., 2021)***.

Every dialysis machine has an automatic alarm, with a pulsing sound and a flashing light on the top of the machine. the responsible nurses should be stay in the ward to observe patient and machine alarm. Dialysis machines have built-in safety alarms These alarms go off when something is wrong with the machine or if something threatens patient safety. When an alarm sounds, the machine needs to be checked. ***(Murdeshwar & Anjum., 2020)***.

Registered nurses and Patient Care Technicians (PCTs) have defined roles and responsibilities. Include Patient monitoring and Machine monitoring. It is necessary to ensure that machine functions have been checked and that they work correctly. All extracorporeal alarms should be tested to ensure that they respond appropriately. Arterial pressure, venous pressure, and air detector alarms should all cause the blood pump to stop and the venous line clamp to close. In addition, conductivity and temperature of the dialysate should be tested to ensure that they are within the proper range. These alarms must be always working so that, if any problems arise, the dialysate will be diverted from the dialyzer and a major complication will be avoided ***(Judith, 2012)***.

Significance of the study:

End-Stage Renal Disease (ESRD) is a major cause of morbidity and mortality worldwide. The number of patients with ESRD receiving Renal Replacement Therapy (RRT) is projected to increase from 2.618 million in 2010 to 5.439 million worldwide by 2030 ***(Chen et al., 2022)***. In Egypt, the last statistics was performed in 2004, with a prevalence of 483 per million populations ***(Ghonemy et al., 2016)***.

A hemodialysis machine alarm is very important because it protects patient safety which is the most important goal that should never be compromised. Various ‘‘alarms’’ built into the system can signal impending or ongoing system malfunction. Alarms should never be taken lightly and disarming of alarms should never be practiced. Properly trained nurses who take active action to correct the malfunction are always the ultimate backup to ensure safety. The medical director must establish a culture of safety in the dialysis unit and lead the quality assessment and performance improvement process. ***(Mumaw, Roth & Patterson, 2021)***.

An early descriptive report of errors and adverse events in hemodialysis showed that infiltration of the hemodialysis access and clotting of the hemodialysis circuit was common. Infiltrations represented 35% and clotting 22% of all adverse events. These access-related events occurred in approximately one of every 1300 treatments. The dialysis machine did sound an alarm, but a stressed staff hearing frequent machine alarms did not respond promptly to the alarm this led to dangerous complications such as hemorrhage and air embolism. The charge nurse believed that the facility’s mandate to make shift changes more efficient focused staff more on efficiency than on safety. So that the research point of view the nurse must possess knowledge and practice regarding hemodialysis machine alarm to protect patient safety and prevent complications ***(Kliger., 2015)***.

Aim of the Study

The aim of this study is to assess hemodialysis nurses' knowledge and practice level regarding hemodialysis machine alarms.

Subjects and methods:

I-Technical item:

Research design: Descriptive exploratory research design was used in this study.

Setting:

This study was conducted at El-Fayoum General Hospital.

Subjects:

A convenient sample of all available nurses (60) nurse from both sex. who provide direct patient care and accepted to participate in the study.

Tools for data collection are:

two tools were utilized **for data collection**:

Tool I : Nurses’ self-administered interview Questionnaire:

This tool was adapted from **(Mabrouk, 2019)** and was modified by the researcher based on reviewing related literature and was written in simple Arabic .it has the following parts**:**

Part 1: Demographic characteristics of nurses: such as (age, gender, marital status, educational level, years of experience in dialysis care units, attending training courses and number of patients for each nurse). It composed of (6) closed end question.

Part 2: Nurses’ knowledge regarding hemodialysis machine alarms: This part includes (60) questions in form of (50) multiple choice questions (MCQ) and (10) true & false questions.

Scoring system

This tool consisted of (60 questions(with a total grade (60). One grade was given for correct answers, and zero grade for wrong answers.

- **Satisfactory knowledge:** if the total score was equal or more than 70%, equal to 42 points or more .
- **Unsatisfactory knowledge:** if the total score was less than 70%, equal to 42 or less.

Tool II: Observational check list to assess nurses’ practice regarding dealing with hemodialysis machine alarms.

it was adapted and modified by the researcher from **Silver** et al. (2015) and Hinkle & Cheever (2018). covers data related to dealing with hemodialysis machine alarms.

Scoring system

This tool consists of (88 items (with a total grade (88). one grade was given for done, and zero grade for not done.

- **Satisfactory level:** if the total score was equal to or more than 80%.
- **Unsatisfactory level:** if the total score was less than 80%.

the total score was 47 points. The score was distributed according to the following: the task was

performed correctly done was graded as (two) point, the task was performed incorrectly or not done was graded as (one) point. The score was summed up and converted into a percentage.

- **Satisfactory level:** if the total score was equal to or more than 85%
- **Unsatisfactory level:** if the total score was less than 85%

II- Operational Item: operational item included the preparatory phase, validity, reliability of the developed tools, pilot study and field work.

A) Preparatory phase: It was included reviewing of past, current, national, and international related literature and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals, and magazines. During this phase, the researcher also visited the selected setting to be ~~get~~ acquainted with the personal and the study setting. The development of the tools was under supervisors' guidance and experts opinions were considered.

B) Validity:

The tools of the study were revised by a jury of 5 experts: assistant professors and lecturer of medical surgical nursing from faculty of nursing, Helwan University to review tools for clarity, relevance, comprehensiveness, understanding and applicability. Modifications of tools were done according to the panel judgment on clarity of sentence, appropriateness of content, sequence of items and accuracy of scoring.

Reliability:-

The reliability of developed tools was estimated using the chronbach alpha test to measure the internal reliability of the tools. it was found that ;

Knowledge regarding hemodialysis machine alarm	No of items	Alph Cronbach test	Split-Half Coefficient
Total	60	0.965	0.940

Practice regarding hemodialysis machine alarm	No of items	Alph Cronbach test	Split-Half Coefficient
Total	88	0.939	0.750

C) Pilot study:

The pilot study was ~~be~~ carried out on 10% of the sample to test the clarity and applicability of the tools and time needed for data collection. the time needed to fill out the questionnaire was about(30-45minutes). The nurses who were included in the pilot study were included to the sample because no modification was done after conducting pilot study.

D)Field work:

Data were collected in following sequence:

The study protocol was approved and an official permission from hospital director to carry out the study after explanation of the purpose of the study. At the beginning, the researcher introduced herself to the studied nurses and explained the purpose of the study to gain their cooperation and to assure the studied nurse about anonymity of their answers and that the information will be used for scientific research only and was be strictly confidential. Purpose of the study was be explained to the nurses who agree to participate in the study prior to data collection. I was started to collect data from nurses in the morning and afternoon shifts (2 days/week from 9 am to 2 pm. over 6 months) from first November 2022 to end of April 2023.

Tool I was filled out by the subjects, and Tool II was filled by the researcher.

III- Administrative Item:

An official permission was obtained from the Dean of faculty of nursing and the director of Fayoum general Hospital asking for cooperation and permission to conduct the study.

Ethical consideration:

An official permission to conduct the proposed study was obtained from the Scientific Research Ethics Committee in Faculty of Nursing, Helwan University. The researcher explained the aim the study to the nurses. Participation in the study is voluntary and subjects have the right to withdraw from the study at any time, confidentiality, and anonymity of the information where it will not be accessed by any other party without taking permission of the participants. Ethics, values, culture and beliefs have been respected.

IV-Statistical Item:

Upon completion of data collection, data was computed and analyzed using appropriate statistical significant tests as Statistical Package for the Social Science (SPSS), version 24 for analysis. The P value was 0.05. Descriptive statistics tests as numbers, percentage, mean ± standard deviation (± SD were used to describe the results. Appropriate inferential statistics such as “F” test or “t” test was used as well for relations between variables.

Statistical analysis:

Data entry and analysis were performed using SPSS statistical package version 26. Categorical variables were expressed as number and percentage while continuous variables were expressed as (mean ±SD). For comparison of categorical data, the x2 - test was performed. The fisher exact test was used with small, expected numbers. Comparison of quantitative variables between the study groups was carried out using the student t-test for independent samples to compare two groups when normally distributed. Pearson correlation was done to measure correlation between quantitative variables.

For all tests, a two-tailed p-value ≤ 0.05 was considered statistically significant, P-value ≤ 0.01 was considered highly statistically significant. While p-value> 0.05 was considered not significant.

Results

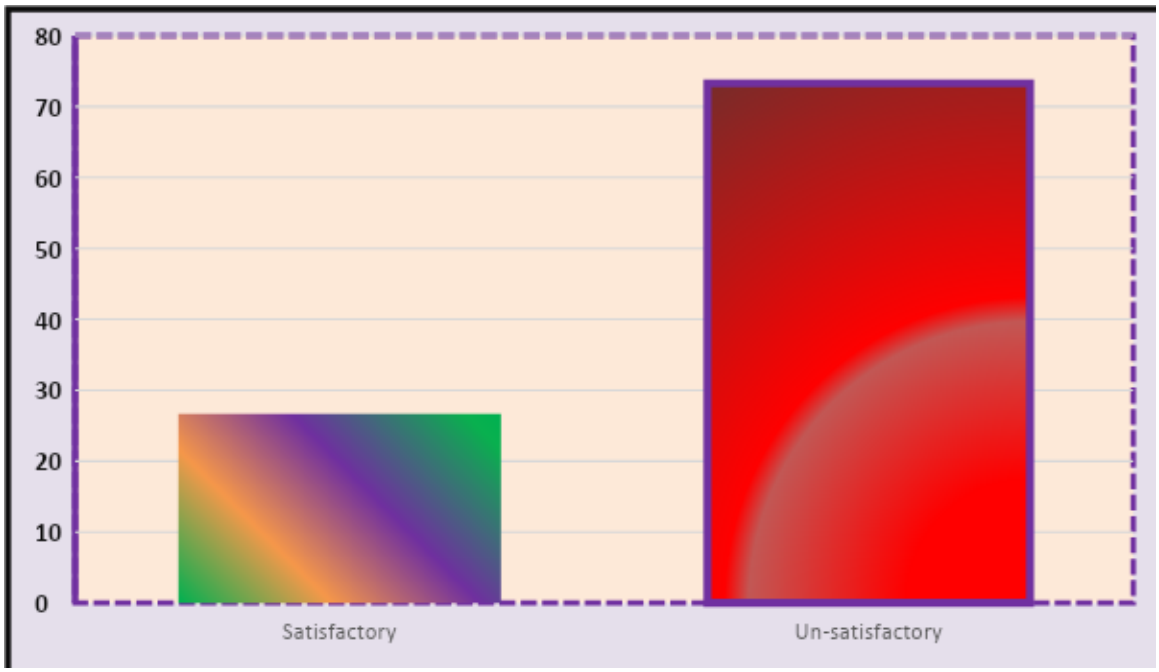
Part (I): Demographic characteristics of the studied nurses (Table: 1).

Table (1): Frequency distribution of studied nurses regarding their demographic characteristics (n= 60)

Items		No.	%
Gender	▪ Female	46	**76.7**
	▪ Male	14	23.3
	▪ **Male to Female ratio**		**0.3:1**
Age (year)	▪ 18 < 40 year	45	**75.0**
	▪ 40 - < 60 years	15	25.0
	▪ **Mean ± SD**		**30.78 ± 8.37**
Educational level	▪ Secondary school of nursing	11	18.3
	▪ Technical institute of nursing	20	33.3
	▪ Bachelor nursing degree	28	**46.7**
	▪ Master's degree	1	1.7
Years of experience	▪ < 5 years	40	**66.7**
	▪ 5 < 15 year	15	25.0
	▪ ≥ 15 years	5	8.3
	▪ **Mean ± SD**		**7.13 ± 5.97**
Previous training courses	▪ Yes	13	**21.7**
	▪ No	47	78.3
Patient to nurse ratio	▪ 1: 1	3	5.0
	▪ 2: 1	24	40.0
	▪ 3: 1	28	**46.7**
	▪ > 3: 1	5	8.3

Table (1): as regard to **demographic** characteristics among the studied nurses. it illustrates (**76.7%) of** the studied nurses were female with a **Male to Female ratio = 0.3:1**. Moreover, (**75%)** of the age of the studied nurses were between 18 to less than 40 year-old with a mean age of **30.78 ± 8.37**. considering educational level, (**46.7%)** of the nurses have a Bachelor nursing degree. Moreover, **(21.7%)** of the studied nurses attended previous training courses. Finally, patient to nurse ratio of 3:1 was presented by **(46.7%)** of the studied nurses .

Figure (1): Percentage distribution of level of total knowledge regarding hemodialysis machine alarm among the studied nurses (n= 60)



Satisfactory to Un-satisfactory ratio= 0.4:1
x2=13.06, P=0.000**

FIGER (1) shows that **(73.3%)** of studied nurses had unsatisfactory level of knowledge regarding **hemodialysis machine** alarm among the studied nurses. On other hand, **(26.7%)** of them had satisfactory level. In addition, there is a highly statistically significant difference between satisfactory and unsatisfactory levels at **P= 0.000.** Moreover, the satisfactory to un- satisfactory ratio is **0.4:1.**

Part (II): level of nurses' practice regarding hemodialysis machine alarms.
Table (2): Total mean score of practice regarding hemodialysis machine alarm among the studied nurses (n= 60)

Total checklist Divide it into 2 categories: Dealing with blood alarms Dealing with dialysate alarms	N	%	Min	Max	$\bar{x}$	SD	T test	P value
Unsatisfactory ▪	55	91.7	7	69	41.44	13.4		
Satisfactory ▪	5	8.3	74	88	78.20	5.63		
Total ▪	**60**	**100.0**	**7**	**88**	**44.50**	**16.53**	**6.01**	**0.000****

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01 NS: Not significant at P > 0.05

Table (2) represents that total mean score of practice regarding hemodialysis machine alarm among the studied nurses is $\bar{x} \pm$ SD= **44.50± 16.53** with a highly statistically significant difference between satisfactory and unsatisfactory mean scores at **P = 0.000.**

Table (3): Correlation between total knowledge regarding hemodialysis machine alarm and demographic characteristics among the studied nurses(n=60)

Item	Total knowledge	
	r	P
Age ▪	0.900	0.000**
Educational level ▪	0.675	0.000**
Years of experience ▪	0.536	0.000**

Patient to nurse ratio ▪	0.339	0.008**

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01

Table (3) illustrates that there was a positive strong highly statistically significant correlation between total knowledge regarding hemodialysis machine alarm and demographic characteristics in relation to age, education, and years of experience among the studied nurses among the studied nurses at r ranged from 0.900 to 0.536 & P= 0.000). Additionally, that there was a positive weak highly statistically significant correlation between total knowledge regarding hemodialysis machine alarm and demographic characteristics in relation to patient to nurse ratio among the studied nurses among the study.

Table (4): Correlation between total practice regarding hemodialysis machine alarm and demographic characteristics among the studied nurses (n= 60)

Item	Total practice	
	r	P
Age ▪	0.957	0.000**
Educational level ▪	0.581	0.000**
Years of experience ▪	0.790	0.000**
Patient to nurse ratio ▪	0.330	0.01**

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01

Table (4) illustrates that there was a positive strong highly statistically significant correlation between total practice regarding hemodialysis machine alarm and demographic characteristics in relation to age, education and years of experience among the studied nurses among the studied nurses at r ranged from 0.957 to 0.790 & P= 0.000). Additionally, that there was a positive weak highly statistically significant correlation between total practice regarding hemodialysis machine alarm and demographic characteristics in relation to patient to nurse ratio among the studied nurses among the studied nurses at r = 0.33. & P= 0.01).

Table (5): Correlation between total knowledge and practice regarding hemodialysis machine alarm among the studied nurses (n= 60)

Item	Total knowledge	
	R	P
Total practice ▪	0.874	0.000**

*Significant p ≤ 0.05 **Highly significant p ≤ 0.01

Table (5) illustrates correlation between total knowledge and practice regarding hemodialysis machine alarm among the studied nurses. It clarifies that there was a positive strong highly statistically significant correlation between total knowledge and practice regarding hemodialysis machine alarm among the studied nurses at r= 0.874 & P= 0.000).

Discussion

the present study finding stated that less than half of the studied nurses perceived that patient to nurse ratio was 3:1. This may be attributed to the fact that there is a shortage of nurses in Egypt. Likewise, a study performed by **Saleh et al., (2018)** entitled "Nurses compliance to standards of nursing care for hemodialysis patients" and reported that patient to nurse ratio was 3:1.

Regarding total mean score of knowledge regarding hemodialysis machine alarm among the studied nurses, the current study represents that additional and dialysate alarms gained higher percentage of satisfactory level, while general information and causes of blood alarm gained a lower percentage of satisfactory level with a highly statistically significant difference. This result was supported by **Abdel-Latif et al., (2019)** who stated that more than half of the studied nurses had unsatisfactory level of knowledge about hemodialysis machine alarms.

In addition, the present study declared that nearly three quarters of the studied nurses had unsatisfactory level of knowledge regarding hemodialysis machine. On other hand, more than one quarter of them had satisfactory level. In addition, there was a highly statistically significant difference between satisfactory and unsatisfactory knowledge levels. Moreover, the satisfactory to un- satisfactory ratio is 0.4:1. This can be attributed to the largest proportion of the study subjects had less than 5 years of work experience and didn't attend training courses.

This result was congruent with a study carried out by **Ismael, (2023)** found that most of the studied nurses had low level of knowledge about hemodialysis machine. Also, a study performed by **Desoky & Fathy, (2019)** who stated that most of the studied nurses had unsatisfactory level of knowledge about hemodialysis machine before intervention. In the opposite line, a study conducted by **Nasarullah et al., (2021)** who mentioned that majority of the studied nurses had high level of knowledge about hemodialysis machine alarms.

According to total mean score of practice regarding hemodialysis machine alarm among the studied nurses, the present study highlighted that total mean score of nursing practice regarding hemodialysis machine alarm among the studied nurses was. As well, most of them had incompetent unsatisfactory level of practice regarding hemodialysis machine alarm, while less than one tenth of them had satisfactory level

with a high statistically significant difference between ~~competent and~~ mean scores. This may be due to most of the studied nurses had unsatisfactory level of knowledge, had less than 5 years of experience and didn't attend training courses about managing hemodialysis machine alarm.

Similarly, a study conducted by **Alramadhan et al., (2019)** declared most of the studied nurses had unsatisfactory practice regarding hemodialysis alarms. On contrary, a study carried out by **Alnawafleh et al., (2019)** about "Nursing audit: The gap between the current nursing management and nursing care standards for patients undergoing hemodialysis at Ma, an Hospital-Jordan" and reported that the majority of the studied nurses had satisfactory level of practice regarding hemodialysis. This discrepancy may be due to the difference between both study subjects level of knowledge, experience and training courses.

Concerning elation between total knowledge about hemodialysis machine alarm and demographic characteristics among the studied nurses, the present study declared that there was a significant statistically relation between gender, age, educational level, years of experience, previous training courses and patient to nurse ratio, and total level of knowledge. This can be explained as females and older nurses and those who have high level of education, more years of experience and attended training courses were more knowledgeable than others. Also, patient to nurse ratio has a significant effect on nurses' level of knowledge.

This result agreed with **Fanta et al., (2023)** who conducted a study entitled "Nurses Knowledge and Associated Factors towards Hemodialysis Care at Governmental Dialysis Units in Addis Ababa, Ethiopia" and stated that nurses experience in working dialysis, training of nurses were significantly associated with the knowledge of nurses regarding hemodialysis. In the opposite line, a study conducted by **Abeid et al., (2022)** who noticed that there was no statistically significant relationship between the studied nurses' knowledge score and gender, age, education, or experience.

As regard relation between total practice regarding hemodialysis machine alarm and demographic characteristics among the studied nurses, the present study portrayed that there was a highly significant statistically relation between age, educational level, years of experience, previous training courses and total level of practice, while there was no significant relation with their gender and patient to nurse ratio. This can be interpreted as older nurses and those who have high level of education, more years of experience and attended training courses were more competent than others.

This result was supported by **Kim & Lee, (2019)** who conducted a study about "Influence of the Workload and Years of Experience of Nurses on Hemodialysis Quality Using Korean National Hemodialysis Adequacy Evaluation Data. INQUIRY" and reported that nurses' years of work experience and training courses had significant relation with their competency level of performance. Also, **Baeez, (2023)** reported that there was statistical significant relation between nurses' practice and their age, education, years of experience and training courses.

Pertaining to correlation between total knowledge and practice regarding hemodialysis machine alarm among the studied nurses, the current study highlighted that there was a positive strong statistically significant correlation between total knowledge and practice regarding hemodialysis machine alarm among the studied nurses. This can be interpreted as knowledge has a significant positive impact on practice. The more gaining knowledge the more gaining correct practice in managing hemodialysis alarms.

This result was in accordance with **Saleh et al, (2018)** who reported that there was a strong positive correlation between nurses' knowledge and their performance. Likewise, **Hamdy, (2017)** his study showed statistically significant correlation between nurses' knowledge and nurses' practice regarding hemodialysis**.** Conversely, **Abd Elkhalik et al., (2019)** stated that there was no statistically significance correlation between total scores of nurses' knowledge and practice

Conclusion

Based on the results of the current study, the following can be concluded:

The nearly two third of nurses has unsatisfactory level of knowledge and more than three quarter of nurses had level of practice regarding hemodialysis machine alarms and. Also, there was high statistically significance relation between demographic characteristics (age, social status, educational level, years of experience , nurse to patient ratio, attending training courses and total level of knowledge and there was high statistically significance positive correlation between total score of knowledge and practice regarding care hemodialysis machine alarms among the studied nurses.

Recommendations

Based upon the results of the current study, the following recommendations are suggested:

- Providing well organized training program to improve and refresh nurses' knowledge and practice regarding Hemodialysis machine alarms.
- An orientation program should be prepared to help the newly appointment nurse's to revise, acquire and develop the knowledge and practice regarding Hemodialysis machine alarms.

Recommendations for further researches

- Replication of the study on other sample selected from different hospitals in Egypt to generalize the study findings.

References:

A El-Aziz, R., Abd El Whab, E. A., & Aref, S. M. (2018). Developing, Implementing and Evaluating Patients Safety Guidelines for Nurses at Hemodialysis Units in Ministry of Health Hospitals. *Minia Scientific Nursing Journal*, *3*(1), 70-76.

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

Abdel-Latif, N. A., ELghany, O. A., AbdEl-Aziz, M. A., & Abd ELhamid, S. K. (2019). Assessment of

Nurses Knowledge and Practices Regarding Complications of Hemodialysis Patients in Intensive Care Unit. *Assiut Scientific Nursing Journal*, *7*(19), 165-174.

Abeid, H. M., Eltarhuni, A. S., Ali, F. A. S., & Kurrani, H. (2022). Knowledge of Standard Precautions and Practice among Nurses working in Hemodialysis in Hawari Center in Benghazi. *Libyan Journal of Basic Sciences*, 17(1), 44-45.

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

Saleh, M., Ali, J., & Afifi, W. (2018). Nurses compliance to standards of nursing care for hemodialysis patients: Educational and training intervention. *IOSR Journal of Nursing and Health Science (IOSR-JNHS) e-ISSN*, 2320-1959.

Alnawafleh, K. A., Mohammad, Z. A. E. L., & Al-Nwafleh, H. A. (2019). Nursing audit: The gap between the current nursing management and nursing care standards for patients undergoing hemodialysis at Ma, an Hospital-Jordan. *International Journal of Novel Research in Healthcare and Nursing*. 6(2), 1740-1748.

Alramadhan, E., Alsayed, S., & Alshalawi, A. (2019). Assessment of the nurses' skills during caring for hemodialysis patients. *Austin Journal of Nursing & Health Care*, *6*(1), 1-5.

Alyassin, F. F. (2018). The patient care and complications of hemodialysis procedure for renal failure patients: A descriptive study at Al Nasiriya city, south of Iraq. *Journal of Global Pharma Technology*, *10*(03), 356-365.

Mohammed, A., & Baeez, Y. K. (2023). Assessment of Nurses' Knowledge and Practices Regarding Nursing Management for Patients on Hemodialysis at Kirkuk General Hospital/Iraq. *Mosul Journal of Nursing*, *11*(1), 48-58.

Chen, H. C., Wu, C. Y., Hsieh, H. Y., He, J. S., Hwang, S. J., & Hsieh, H. M. (2022). Predictors and Assessment of Hospice Use for End-Stage Renal Disease Patients in Taiwan. *International Journal of Environmental Research and Public* Health, 19(1), 85.

Desoky, G. M., & Fathy, R. (2019). Effect of Implementing a United Protocol of Nursing Care in Ministry of Health Hospitals on Hemodialysis Nurses Knowledge and Hemodialysis Patients level of Satisfaction. *IOSR Journal of Nursing and Health Science*, 8 (1), 76-88.

Fanta, A., Legesse, T., & Legesse, T. (2023). Nurses Knowledge and Associated Factors towards Hemodialysis Care at Governmental Dialysis Units in Addis Ababa, Ethiopia.

Judith, Z. (2012). Review of Hemodialysis for Nurses and Dialysis Personnel. available at *https://books.google.com/books/about/Review_of_Hemodialysis_for_ Nurses_and Di.html?id=TDZ5E56kuNoC* 2 pm 20/3/2022

Hamdy, W. M. (2017). Nurses Performance in Dialysis Unit. Retrieved from:http://research.asu.edu.eg/bitstream/12345678/6669/1/J3927.pdf

Hartlein, M., Hauf, L. D., Garett-Golden, C., & FASDIN, D. M. M. F. (2021). Hemolysis as Cause of Hemodialysis Blood Leak Alarm: Case Study of a Patient with Freshwater Near-Drowning. *Nephrology Nursing Journal*, *48*(3), 237-240.

This reference is not Master's level

Hinkle, J. L., & Cheever, K. H. (2018). *Brunner and Suddarth's textbook of medical-surgical nursing*. Wolters kluwer india Pvt Ltd.

Ismael, N. H. (2023). Awareness of Nurse's Knowledge Regarding Hemodialysis Procedure and Complications in Dialysis Center of Sulaimani city. *Mosul Journal of Nursing*, *11*(1), 104-112.

Kliger, A. S. (2015). Maintaining safety in the dialysis facility. *Clinical Journal of the American Society of Nephrology*, *10*(4), 688-695.

Lee, Y. K., Kim, K., & Kim, D. J. (2013). Current status and standards for establishment of hemodialysis units in Korea. *The Korean journal of internal medicine*, *28*(3), 274.

Kim, Y., & Lee, K. (2022). Influence of the Workload and Years of Experience of Nurses on Hemodialysis Quality Using Korean National Hemodialysis Adequacy Evaluation Data. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, *59*, 00469580221087887.

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), 346-51.

Mumaw, R. J., Roth, E. M., & Patterson, E. S. (2021). Lessons from the glass cockpit: Innovation in alarm systems to support cognitive work. *Biomedical Instrumentation & Technology*, *55*(1), 29-40

Nasarullah, S., Hussain, M., Perveen, K., & Afzal, M. (2021). Assessment of Nurses Awareness Regarding Hemodialysis Complications: A Cross-Sectional Study in Lahore, Pakistan. *International Journal of Health, Medicine and Nursing Practice*, *3*(3), 13-24.

Rocha, R. D. P. F. (2022). Patient safety in hemodialysis. available at *https://www.intechopen.com/online-first/79901* 6 pm 21/3/2022

Sagiron, E. I., & Jarelnape, A. A. (2022). Knowledge and Practice Regarding Hemodialysis Procedure Among Nurses Working at the Dialysis Centers, in Khartoum, Sudan: A Cross-sectional Study. *Sudan Journal of Medical Sciences (SJMS)*, 599-609.

Saleh, M., Ali, J., & Afifi, W. (2018). Nurses compliance to standards of nursing care for hemodialysis patients: Educational and training intervention. *IOSR Journal of Nursing and Health Science (IOSR-JNHS) e-ISSN*, 2320-1959.

Silver, S. A., Thomas, A., Rathe, A., Robinson, P., Wald, R., Harel, Z., & Bell, C. M. (2015). Development of a hemodialysis safety checklist using a structured panel process. *Canadian journal of kidney health and disease*, *2*(1), 1-9

Yodchai, K., & Dandecha, B. (2018). Competency of nurses on the nursing practitioner course in renal replacement therapy (hemodialysis) Prince of Songkla University. *Songklanagarind Journal of Nursing*, *38*(2), 60-69.