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# COMPETENCY CHECK: HOW WELL-INFORMED ARE HEMODIALYSIS NURSES IN EASTERN SAUDI ARABIA?

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## ABSTRACT

*Dialysis nursing requires advanced technical and clinical skills, including operation of complex dialysis equipment and management of multiple intravenous access devices, delivered in line with current evidence-based guidelines to ensure safe, effective, and patient-centered care. This study assessed hemodialysis nurses' knowledge of core competencies at tertiary military hospitals in the eastern region of Saudi Arabia and examined sociodemographic predictors of overall competence. A cross-sectional descriptive research design was used, where data were collected using a structured questionnaire comprising a sociodemographic form and a three-subscale competency checklist (basic hemodialysis knowledge, assessment and care, and dialysis treatment), rated on a five-point Likert scale, and administered online to a convenience sample of 93 nurses from urology and hemodialysis units of three tertiary military hospitals. Data were analyzed using SPSS, utilizing descriptive analysis and multiple linear regression. The overall mean nurses' competence score was  $3.33 \pm 1.34$ , with the dialysis treatment competencies having the highest mean score ( $3.52 \pm 1.39$ ). Knowledge was highest for interpreting laboratory values, assessing mental status, and identifying the need for dietary consultation, and lowest for renal pathophysiology (osmosis, diffusion, ultrafiltration). Nurses showed strong competence in promoting patient comfort and documenting care, but weaker skills in assessing bruit and blood flow. Knowledge of dialysis treatment was highest for initiating, monitoring, and discontinuing dialysis, and for adhering to safety measures, and lowest for machine maintenance and alarm recognition. Nurses demonstrated moderate overall knowledge, with the highest mean scores in dialysis treatment, followed by basic knowledge, then assessment and care. Targeted educational programs focusing on renal pathophysiology, infection control, and machine-related competencies are warranted to address identified gaps and enhance hemodialysis nursing competence and care delivery.*

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**KEYWORDS:** Competencies; Nurses' knowledge; Renal Dialysis; Hemodialysis; Saudi Arabia.

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## INTRODUCTION

Chronic Renal Failure (CRF) is defined as a long-term, irreversible, and progressive disease of the kidney in which the kidneys cannot properly filter blood, leading to waste buildup (Vaidya & Aeddula, 2026). Dialysis is the most common treatment modality used for people with poor kidney function. It's a common treatment for people with kidney diseases, dating back to the 17th century. When renal function is compromised due to pathological conditions or trauma, dialysis serves as a therapeutic intervention to cleanse the bloodstream and eliminate metabolic byproducts. Two principal modalities of dialysis exist: the hemodialysis and the peritoneal dialysis (Andreoli & Totoli, 2020; Kallenbach, 2021).

Hemodialysis (HD) is a vital treatment for people with end-stage kidney failure, as it removes waste, toxins, and excess fluid from the blood (Alamoudi et al., 2026). It represents a sophisticated medical intervention for patients, typically conducted within hospital settings or specialized dialysis facilities (Agarwal & Anjum, 2026), occurring predominantly two to three times weekly, thereby necessitating significant alterations to the patients' habitual daily activities, wherein hemodialysis has been established as the most efficacious treatment modality, contributing to enhanced survival rates and sustaining patients' quality of life at an acceptable level (Zhang et al., 2025); nonetheless, despite advancements in procedural techniques and technological apparatus, hemodialysis remains a complex and often burdensome therapeutic approach that demands a collaborative effort from a multidisciplinary healthcare team, comprising the dialysis nurse, nephrologist, dietitian, dialysis technician, and social worker (Pérez Fontán et al., 2022).

The complications associated with hemodialysis may manifest either during the dialysis procedure or as long-term sequelae. Such complications can be categorized into prevalent issues and rare but severe adverse events (Habas et al., 2021). Within the dialysis unit, the nurse plays a critical role in continuous monitoring, support, assessment, and education of the patient (Hadi & Alreda, 2021). Throughout the dialysis process, vigilant oversight of the patient, the dialyzer, and the dialysate bath is imperative, as various complications may arise, including circuit clotting, air embolism, inadequate or excessive ultrafiltration, hypotension, muscle cramping, emesis, blood leakage, contamination, and access-related complications (Ameh et al., 2023).

Dialysis nurses require advanced technical competencies applicable to all forms of dialysis. These skills are essential not only for operating complex dialysis machinery but also for managing various types of intravenous access lines. They must demonstrate strong consideration to detail, as dialysis procedures require strict adherence to established protocols (Akpakli Addo & Senoo-Dogbey, 2025). In addition, dialysis nurses need well-developed motivational and educational abilities to effectively teach patients from diverse backgrounds about their condition and encourage active self-care (Gapira et al., 2020).

Moreover, high-quality nurses consistently enhance patient satisfaction by delivering effective, efficient care aligned with the latest clinical guidelines and standards. By doing so, they address patient needs while also meeting the expectations of healthcare providers. Consequently, healthcare services should strive to meet the expectations of both patients and providers (Ferreira et al., 2023).

Nurses' overall awareness and knowledge of hemodialysis competencies show considerable variation, with several studies reporting average to good baseline knowledge in areas such as complication recognition and vascular access management, yet persistent gaps in practical application and specialized skills, including infection control and emergency procedures. In cross-sectional assessments, approximately 70% of nurses were classified as knowledgeable regarding overall hemodialysis care (Legesse et al., 2023), and educational interventions consistently enhanced knowledge scores, increasing mean scores significantly from 45.3 to 67.96 ( $p < 0.001$ ) in fluid management and patient safety domains (Khalid et al., 2025).

Nevertheless, suboptimal practices remained prevalent, with more than half of nurses demonstrating poor performance in permanent vascular access care (61.7% poor knowledge, 76.7% incompetent practices) (Mahmoud et al., 2024), underscoring a gap between theoretical understanding and clinical competence. Hemodialysis, a critical therapy for end-stage renal disease affecting millions worldwide, requires specialized nursing expertise to prevent complications such as infections and fluid imbalances; however, fragmented training and resource limitations frequently compromise proficiency. The objective of the present investigation was to assess nurses' knowledge of the basic hemodialysis competencies at selected hospitals located in Eastern Saudi Arabia.

## Significance of the study

Nurses in hemodialysis units are expected to demonstrate a high level of proficiency and comprehensive understanding of the technical procedures involved in managing patients receiving hemodialysis. Over the past few decades, only a limited number of studies in Saudi Arabia have evaluated nurses' knowledge of basic renal dialysis skills and competencies, highlighting the need for further investigation in this area (Al Qahtani & Almetrek, 2017; Alrasheeday et al., 2024; Alsolami & Alobaidi, 2024). Identifying nurses' knowledge of fundamental hemodialysis competencies can help reveal specific knowledge gaps and guide the development of tailored, evidence-based educational programs that enhance nurses' expertise, improve performance, and promote safer clinical practice. Accordingly, the current study aimed to assess nurses' awareness of basic hemodialysis competencies at military hospitals in the Eastern Region of Saudi Arabia.

## Aim of the study

The primary objective of the investigation was to evaluate nurses' self-reported knowledge and comprehension of fundamental hemodialysis competencies at military hospitals in the Eastern Region of Saudi Arabia.

### Specific objectives:

1. To explore nurses' knowledge of hemodialysis competencies at three tertiary military hospitals in the Eastern Region of Saudi Arabia.
2. To identify the key predictors of nurses' knowledge of hemodialysis competencies based on sociodemographic data.

## MATERIALS & METHODS

### Study Design

Employing a cross-sectional descriptive research design, the researcher used a quantitative, questionnaire-based approach to conduct the current investigation. This design allows observation and description of a group at a single point in time, without manipulation or follow-up.

### Setting

This study was conducted across all urology and hemodialysis units of three tertiary military hospitals in the Eastern Region of Saudi Arabia, including King Abdulaziz Airbase Hospital (Armed Forces Hospital) in Dhahran, King Fahd Military Medical Complex in Dhahran, and King Abdulaziz

Naval Base Hospital (Armed Forces Hospital) in Jubail.

## Sample and Sampling

Using OpenEpi (Version 3) for sample size estimation for a finite population, considering about 120 nurses within the inclusion criteria working in the hemodialysis and urology units of the selected hospitals, the hypothesized outcome frequency was set at 50%, with a 5% absolute precision (d) and a 95% confidence level, assuming a design effect (DEFF) of 1. Under these parameters, the calculated minimum required sample size was 92 nurses, ensuring adequate power to estimate the proportion of nurses with the desired level of knowledge and competencies in hemodialysis practice. Convenience sampling was used to recruit 93 nurses from the urology and hemodialysis units of military hospitals in Eastern Saudi Arabia.

Nurses were eligible to participate if they worked in the urology or hemodialysis units, had at least 6 months of dialysis experience, and could read and write in English. Nurses were excluded if they were on probation, secondment, or extended leave during the data collection period, or if they declined to participate or were unable to complete the questionnaire.

## Data collection tool

To achieve the study objectives, a structured survey consisting of two parts was used. The first part collected data on participants' sociodemographic characteristics, including age, marital status, gender, years of experience, and other relevant variables. The second part focused on nurses' knowledge of the basic competencies required of dialysis nurses. These items were adopted from a standardized instrument developed by the Learning Nurse Resource Network, titled the Nursing Competency Advanced Self-Assessment Tool (Learning Nurse, 2021). The questionnaire is an openly available checklist designed to assess nurses' knowledge of basic renal dialysis competencies and was used in its original form without modification. The checklist comprises three domains: basic dialysis nursing knowledge, daily assessment and care, and dialysis treatment. Competencies were rated on a five-point Likert scale (1 Not applicable, 2 Developmental, 3 Competent, 4 Desire to enhance, and 5 Excellent). The mean score across all items (range 1–5) was used as an overall indicator of nurses' competence in basic hemodialysis care.

To ensure the clarity and feasibility of the survey, a pilot study was conducted on 15 nurses from

different hospitals who met the same inclusion criteria. The instrument was found to be clear and easy to understand; therefore, no modifications were required, but the findings were excluded from the final report as the participants were from other hospitals. Test-retest reliability was assessed in the pilot sample, and the resulting Cronbach's alpha coefficient of 0.845 indicated acceptable reliability and internal consistency of the survey.

### Data collection procedures

Data collection was initiated and continued over two months (July–August 2025) upon obtaining ethical approval from Prince Sultan Military College of Health Sciences in Dhahran, acting as a representative of the Ministry of Defense healthcare institutions in the eastern region. The questionnaire was administered electronically via WhatsApp and the official email to all accessible nurses working in the urology and hemodialysis units of the selected hospitals. Completed Google Forms were subsequently downloaded, coded, and prepared for analysis. To optimize the response rate, weekly reminders were sent—alongside administrative support from the hospital nursing departments—to encourage all eligible and willing nurses to complete the survey, yielding a response rate of approximately 77%.

### Statistical analysis

After data collection, all responses were cleaned, coded, organized into tables, and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 30. Descriptive statistics (Means, standard deviations, percentages, and frequencies) were used to summarize sociodemographic variables and dialysis-related competencies, while means and standard deviations were intended to determine the overall level of competence. Multiple linear regression was used with the mean total competence score (1–5) as the dependent variable and gender, age, marital status, educational level, job title, and years of experience as predictors; model assumptions (linearity, residual normality, absence of multicollinearity) were assessed

descriptively. It was performed to identify significant independent predictors of nurses' knowledge based on their sociodemographic characteristics, and P values were considered significant at  $p < 0.05$ .

### Ethical considerations

All ethical guidelines pertaining to scientific inquiry were adhered to in alignment with the Declaration of Helsinki. Ethical clearance was secured from the Institutional Review Board of Prince Sultan Military College of Health Sciences, located in Dhahran (IRB-2025-NUR-043) on April 23, 2025. Electronic informed consent, including approval to participate, was obtained from all participants before they completed the survey. Participation was voluntary, with no obligation to take part. Anonymity and confidentiality were strictly maintained: participants were not asked to provide their names, and questionnaires were identified only by numerical codes. Registration via email was requested only to ensure that no nurse participates in the study more than once. The cover letter explained the study's purpose, potential benefits, and possible inconveniences and clarified that the data would be used solely for research purposes.

### RESULTS

The study included 93 nurses, most of whom were female (55.9%), with males representing 44.1% of the sample. The largest age groups were 30–34 years (36.6%) and 25–29 years (29.0%), while only 4.3% were 40 years or older. Just over half of the participants were married (57.0%), and 43.0% were single. Regarding education, the majority held a BSN degree (60.2%), followed by diploma holders (21.5%) and those with postgraduate qualifications (18.3%). In terms of job title, most were nurse specialists (57.0%), with the remainder almost equally split between nurse technicians and head nurse/assistant head nurse/charge nurses (21.5% each). Regarding work experience, 37.6% had 6 months to 5 years, 28.0% had 5–10 years, 23.7% had 11–15 years, and only 10.8% had more than 15 years (Table 1).

**Table 1: Participants' Sociodemographic (N=93).**

Sociodemographic data		n	percent
Gender	Male	41	44.1%
	Female	52	55.9%
Age	20-24	18	19.4%
	25-29	27	29.0%
	30-34	34	36.6%
	35-39	10	10.8%
	>39 years	4	4.3%
Marital status	Single	40	43.0%

	Married	53	57.0%
Educational level	Diploma	20	21.5%
	BSN	56	60.2%
	Postgraduate education	17	18.3%
Job title	Nurse technician	20	21.5%
	Nurse specialist	53	57.0%
	Head Nurse Assistant Head Nurse or charge nurse	20	21.5%
Experience years	6 months to less than 5 years	35	37.6%
	5-10 years	26	28.0%
	11-15 years	22	23.7%
	16-20 years	5	5.4%
	More than 20 years	5	5.4%

Overall, nurses showed moderate hemodialysis knowledge, with substantial variation across specific competencies. Clinical judgment and critical thinking in the dialysis role were mostly rated as “not applicable” or “developmental,” reflected in a low mean score of 2.78, indicating limited perceived competence in this higher-order skill. Knowledge of anatomy and physiology, as well as renal failure pathophysiology, also tended to cluster in the “developmental” range. However, understanding symptoms and disruption of kidney function reached mean scores above 3, suggesting more solid, but still improvable, knowledge.

In contrast, nurses reported higher competence in recognizing clinical manifestations and complications, such as hypertension, edema, mental status changes, lab values, weight changes, and need for dietary consult, with mean scores ranging from 3.56 to 4.06 and many ratings in the “excellent” category. However, some fundamental scientific concepts (osmosis, diffusion, ultrafiltration), glucometric control (Acuchecks), and application of standard precautions and asepsis scored lower (means around 2.46–2.67), highlighting notable gaps in basic theoretical understanding and infection control-related competencies (Table 2).

**Table 2. Hemodialysis Basic Knowledge and Competencies**

Hemodialysis Basic Knowledge and Competencies	Not applicable	Develop	Competent	Desire to Enhance	Excellent	Mean	SD	
	n (%)	n (%)	n (%)	n (%)	n (%)			
1. Demonstrate knowledge and ability to apply critical thinking and clinical judgment in the dialysis role.	29 (31.2)	16 (17.2)	8 (8.6)	26 (28.0)	14 (15.1)	2.78	1.51	
2. Demonstrate knowledge of human anatomy and physiology, specifically the urinary system, renal function, and cardiovascular system.	11 (11.8)	31 (33.3)	16 (17.2)	18 (19.4)	17 (18.3)	2.99	1.32	
3. Demonstrate knowledge of pathophysiology, symptoms, treatment, and interventions of renal failure	Pathophysiology of renal failure	17 (18.3)	32 (34.4)	16 (17.2)	16 (17.2)	12 (12.9)	2.72	1.31
	Symptoms	3 (3.2)	21 (22.6)	20 (21.5)	25 (26.9)	24 (25.8)	3.49	1.19
	Disruption to kidney function	4 (4.3)	24 (25.8)	15 (16.1)	28 (30.1)	22 (23.7)	3.43	1.23
	Osmosis, diffusion, ultrafiltration	34 (36.6)	19 (20.4)	12 (12.9)	19 (20.4)	9 (9.7)	2.46	1.41
	Symptoms related to poor dialysis	12 (12.9)	19 (20.4)	19 (20.4)	29 (31.2)	14 (15.1)	3.15	1.28
	Treatments: peritoneal dialysis, hemodialysis, diet and fluid restrictions, sodium, potassium, calcium and phosphorous restrictions	6 (6.5)	22 (23.7)	23 (24.7)	29 (31.2)	13 (14.0)	3.23	1.15
4. Demonstrate knowledge and ability to assess associated health problems	Acuchecks	33 (35.5)	16 (17.2)	12 (12.9)	19 (20.4)	13 (14.0)	2.60	1.49
	Edema	7 (7.5)	8 (8.6)	33 (35.5)	16 (17.2)	29 (31.2)	3.56	1.23
	Hypertension	4 (4.3)	12 (12.9)	20 (21.5)	15 (16.1)	42 (45.2)	3.85	1.25
	Ischemic feet	17 (18.3)	20 (21.5)	17 (18.3)	20 (21.5)	19 (20.4)	3.04	1.41
	Lab values	3 (3.2)	11 (11.8)	7 (7.5)	28 (30.1)	44 (47.3)	4.06	1.15
	Mental status	5 (5.4)	10 (10.8)	12 (12.9)	19 (20.4)	47 (50.5)	4.00	1.25
	Need for dietary consult	3 (3.2)	14 (15.1)	10 (10.8)	24 (25.8)	42 (45.2)	3.95	1.21
Weight changes	4 (4.3)	15 (16.1)	24 (25.8)	20 (21.5)	30 (32.3)	3.61	1.22	
5. Demonstrate knowledge and ability to apply standard precautions, regulations, and principles of asepsis in Dialysis Nursing.	36 (38.7)	13 (14.0)	10 (10.8)	14 (15.1)	20 (21.5)	2.67	1.62	

The findings indicate that nurses' competencies in hemodialysis assessment and care were generally moderate, with notable strengths and weaknesses across specific skills. Assessment of vascular access showed lower perceived competence in detecting flow problems, bruits, thrills, and aneurysms (mean scores around 2.62–2.78), whereas competence improved in identifying clotting, infection, and medication-related issues (mean scores around 3.0–3.6).

Nurses reported relatively high competence in creating a supportive environment for patient comfort, particularly in observing and reporting

physical and emotional changes and responding appropriately, with mean scores of 3.81 and 3.68 and many ratings in the "desire to enhance" and "excellent" categories. Documentation of nursing assessments, treatments, and outcomes also scored well (mean= 3.70). In contrast, competence in applying the full nursing process and administering medications in the dialysis environment remained only fair (means around 2.96–3.04). Health teaching for clients and families demonstrated moderate competence (mean 3.27), suggesting room for further development in patient education (Table 3).

**Table 3. Hemodialysis Assessment and Care Competencies**

Dialysis Assessment and Care Competencies		Not applicable	Develop	Competent	Desire to Enhance	Excellent	Mean	SD
		n (%)	n (%)	n (%)	n (%)	n (%)		
1. Demonstrate knowledge and assessment of the access to evidence of:	Flow	33 (35.5)	15 (16.1)	13 (14.0)	18 (19.4)	14 (15.1)	2.62	1.50
	Presence of fistula, graft, or central line	4 (4.3)	18 (19.4)	38 (40.9)	13 (14.0)	20 (21.5)	3.29	1.14
	Presence of bruit	31 (33.3)	13 (14.0)	16 (17.2)	22 (23.7)	11 (11.8)	2.67	1.45
	Clotting	15 (16.1)	13 (14.0)	29 (31.2)	24 (25.8)	12 (12.9)	3.05	1.25
	Palpate for thrill	34 (36.6)	9 (9.7)	14 (15.1)	21 (22.6)	15 (16.1)	2.72	1.54
	Aneurysm	31 (33.3)	9 (9.7)	16 (17.2)	23 (24.7)	14 (15.1)	2.78	1.50
	Infection	5 (5.4)	12 (12.9)	26 (28.0)	25 (26.9)	25 (26.9)	3.57	1.17
2. Demonstrate ability to create an atmosphere that is conducive to patient comfort needs:	Knowledge of client's medications - purpose, frequency, side effects, and correct infusion and administration procedures.	4 (4.3)	15 (16.1)	21 (22.6)	27 (29.0)	26 (28.0)	3.60	1.18
	Observe and report client's physical and emotional condition and take appropriate action	4 (4.3)	11 (11.8)	16 (17.2)	30 (32.3)	32 (34.4)	3.81	1.16
3. Demonstrate ability to apply the nursing process to the care of the dialysis client.	Sensitive, diplomatic, and empathetic manner.	3 (3.2)	15 (16.1)	21 (22.6)	24 (25.8)	30 (32.3)	3.68	1.18
		26 (28.0)	16 (17.2)	12 (12.9)	14 (15.1)	25 (26.9)	2.96	1.59
4. Demonstrate knowledge and ability to provide medications in the dialysis environment, as per agency policy.		28 (30.1)	12 (12.9)	8 (8.6)	18 (19.4)	27 (29.0)	3.04	1.65
5. Demonstrate ability to document nursing assessments, treatments, effects, and outcomes.		7 (7.5)	6 (6.5)	24 (25.8)	27 (29.0)	29 (31.2)	3.70	1.20
6. Demonstrate ability to provide health teaching to clients and family throughout the process.		6 (6.5)	20 (21.5)	30 (32.3)	17 (18.3)	20 (21.5)	3.27	1.21

The findings show that nurses demonstrated generally good competence in core dialysis treatment skills, with higher confidence in monitoring and routine procedures than in technical equipment management. Most participants self-assessed their proficiency in executing venipuncture as ranging from competent to excellent, exhibiting recognition of excessive weight gain, evaluating needling complications, upholding medical asepsis, extracting blood from access sites, monitoring vital signs, documenting findings and reporting to the team leader, as well as responding to emergencies, which is evidenced by mean scores

predominantly exceeding 3.5 and reaching as high as 4.18.

Conversely, lower mean scores (approximately 2.7–2.9) were observed for tasks such as calculating and modulating fluid removal, evaluating and rectifying access issues, initiating repairs and maintenance of equipment, assembling hemodialysis apparatus, and identifying alarm conditions, thereby reflecting lower perceived competence in these more specialized technical domains. Competence was highest for using glucometers and adhering to safety measures (mean 4.25 for both), suggesting strong performance in patient safety and basic monitoring tasks (Table 4).

Table 4. Dialysis Treatment Competencies

Dialysis Treatment Competencies		Not applicable	Develop	Competent	Desire to Enhance	Excellent	Mean	SD
		n (%)	n (%)	n (%)	n (%)	n (%)		
1. Demonstrate knowledge and ability to initiate, monitor, and discontinue a dialysis treatment:	Auscultate lungs prn	14 (15.1)	16 (17.2)	16 (17.2)	25 (26.9)	22 (23.7)	3.27	1.39
	Perform venipuncture	4 (4.3)	12 (12.9)	21 (22.6)	24 (25.8)	32 (34.4)	3.73	1.19
	Recognize excessive weight gain and know limitations for fluid removal	12 (12.9)	15 (16.1)	24 (25.8)	19 (20.4)	23 (24.7)	3.28	1.35
	Calculate and adjust fluid removal	33 (35.5)	10 (10.8)	13 (14.0)	16 (17.2)	21 (22.6)	2.81	1.61
	Assess and correct access difficulties	27 (29.0)	13 (14.0)	15 (16.1)	21 (22.6)	17 (18.3)	2.87	1.51
	Assess needling problems	6 (6.5)	15 (16.1)	20 (21.5)	26 (28.0)	26 (28.0)	3.55	1.24
	Maintain medical asepsis	7 (7.5)	8 (8.6)	12 (12.9)	24 (25.8)	42 (45.2)	3.92	1.27
	Draw blood from access sites - collect, label, send specimens	6 (6.5)	8 (8.6)	8 (8.6)	17 (18.3)	54 (58.1)	4.13	1.26
	Monitor vital signs	6 (6.5)	8 (8.6)	8 (8.6)	12 (12.9)	59 (63.4)	4.18	1.28
	Respond appropriately to unusual symptoms or emergencies, i.e., hypotension, confusion, cramping	8 (8.6)	10 (10.8)	25 (26.9)	14 (15.1)	36 (38.7)	3.65	1.32
	Control bleeding from the patient's access site	7 (7.5)	15 (16.1)	22 (23.7)	13 (14.0)	36 (38.7)	3.60	1.34
	Note the clotting time	22 (23.7)	13 (14.0)	12 (12.9)	16 (17.2)	30 (32.3)	3.20	1.59
	Document and report to the team leader	7 (7.5)	10 (10.8)	12 (12.9)	21 (22.6)	43 (46.2)	3.89	1.31
2. Demonstrate knowledge and ability to understand the mechanics of dialysis and related equipment:	Initiate equipment repairs and maintenance	36 (38.7)	9 (9.7)	11 (11.8)	17 (18.3)	20 (21.5)	2.74	1.63
	Conductivity and pH meters	9 (9.7)	12 (12.9)	13 (14.0)	21 (22.6)	38 (40.9)	3.72	1.37
	Glucometers	5 (5.4)	5 (5.4)	11 (11.8)	13 (14.0)	59 (63.4)	4.25	1.19
	Assemble or assist with assembling equipment, including hemodialysis machines	34 (36.6)	10 (10.8)	8 (8.6)	16 (17.2)	25 (26.9)	2.87	1.68
	Recognize alarm conditions	36 (38.7)	9 (9.7)	11 (11.8)	17 (18.3)	20 (21.5)	2.74	1.63
	Order supplies	9 (9.7)	12 (12.9)	13 (14.0)	21 (22.6)	38 (40.9)	3.72	1.37
	Adherent to safety measures	5 (5.4)	5 (5.4)	11 (11.8)	13 (14.0)	59 (63.4)	4.25	1.19

The figure shows that nurses demonstrated an overall moderate level of knowledge and competence in hemodialysis care, with a total mean score of  $3.33 \pm 1.34$  on the five-point scale. Among the three domains, dialysis treatment competencies had the

highest mean score ( $3.52 \pm 1.39$ ), followed by hemodialysis basic knowledge and competencies ( $3.27 \pm 1.31$ ), while dialysis assessment and care competencies scored slightly lower ( $3.20 \pm 1.34$ ), indicating this as the relatively weaker area (Figure 1).

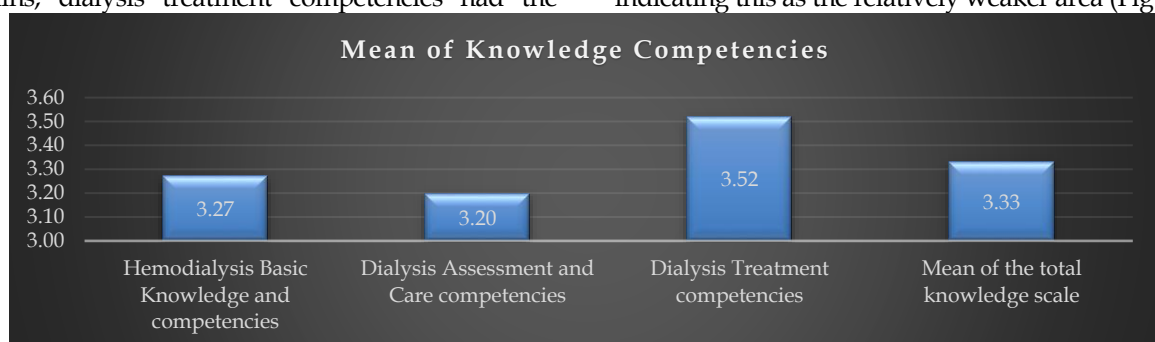


Figure 1. Description of the mean score of nurses' knowledge subscales

The multiple linear regression model identified age and years of experience as significant predictors of the overall hemodialysis knowledge and competence score. In contrast, gender, marital status, educational level, and job title were not significant. Increasing age was positively associated with higher total knowledge scores ( $B = 0.682$ ,  $p < 0.001$ ). Longer experience also showed a significant effect ( $B = 0.489$ ,  $p = 0.006$ ),

indicating that nurses with more years in practice tended to report greater competence. Descriptively, the highest mean knowledge score was observed among nurses aged 35–39 years (mean 4.36), and among those with 16–20 years of experience (mean 4.26), whereas younger nurses (20–24 years) and those with shorter or very long experience had comparatively lower mean scores (Table 5).

**Table 5. Regression analysis of the mean total knowledge scale based on sociodemographic characteristics**

ANOVA Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.843	6	2.307	3.136	.008 <sup>b**</sup>
	Residual	63.280	86	0.736		
	Total	77.123	92			
Regression Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.152	0.624		5.049	0.000
	Gender	-0.099	0.197	-0.054	-0.506	0.614
	Age	0.682	0.177	0.789	3.854	0.000 <sup>**</sup>
	Marital status	-0.131	0.193	-0.071	-0.677	0.500
	Educational level	0.109	0.213	0.075	0.512	0.610
	Job title	-0.121	0.138	-0.134	-0.876	0.383
	Experience years	0.489	0.174	0.611	2.812	0.006 <sup>**</sup>

<sup>a</sup>. Dependent Variable: Mean of the Total Scale

<sup>b</sup>. Predictors: (Constant), Experience years, Marital status, Gender, Educational level, Job title, Age

<sup>\*\*</sup> significant at less than 0.01

## DISCUSSION

The current study aimed to assess nurses' knowledge of the hemodialysis basic competencies at selected military hospitals in eastern Saudi Arabia, with a focus on renal dialysis basic knowledge, dialysis assessment and care, and dialysis treatment. Concerning the findings of the nurse's basic knowledge of the hemodialysis process, the nurses in the current study reported that they had the greatest knowledge and ability to assess the renal dialysis-associated health problems, particularly, the knowledge about the assessment of the patients' laboratory values, mental status, and the need for renal dialysis patients for dietary consultation. This may be explained by the fact that most of the nurses studied had satisfactory experience and that the knowledge required for these issues (laboratory values, mental status, dietary consultation) is practiced daily by hemodialysis nurses and considered part of their routine.

Regarding the nutritional instructions for patients on renal dialysis, a recent study from Iraq found that the majority of nurses had a fair knowledge score in the nutritional management of renal failure. At the same time, 17.6% had a good knowledge score and 11.8% had a low knowledge score (Rasheed et al., 2018).

On the contrary, nurses' knowledge of osmosis,

diffusion, and ultrafiltration as part of the pathophysiology of renal dialysis and renal failure was reported to be the least among the participants, followed by their knowledge of the importance of glucocheck and Accucheck during the renal dialysis process. It may be difficult for nurses to retain such theoretical knowledge related to the pathophysiology of renal dialysis and renal failure for a long time, even if they have extensive experience, which doesn't guarantee the retention of such information, especially since it is not practiced daily and requires follow-up and continuous education programs to be reviewed. These findings align with a recent study by Yousif et al. (2017), which evaluated the effect of an educational program on nurses' knowledge in renal dialysis units. The study showed that most nurses (about 90%) had knowledge scores below "good" before the educational intervention, confirming that they may have unsatisfactory knowledge of some aspects of the renal dialysis process (Yousif et al., 2017).

The results of the investigation regarding the nurses' comprehension pertaining to the evaluation and management of renal dialysis patients indicated that the foremost proficiency was observed in their capability to cultivate an environment that is supportive of satisfying patient comfort requirements, particularly in relation to the nurses' meticulous observation and documentation of the patient's physical and emotional state, followed by

the implementation of appropriate interventions. Furthermore, the nurses' competency in recording nursing assessments, interventions, outcomes, and their effects was identified as the second most significant aspect of their knowledge in hemodialysis assessment and management.

These findings indicate that the nurses' clinical practice was reflected in their experience in providing comfort measures for the renal failure patients during dialysis, reporting the physical and emotional condition of the patients and taking appropriate action, if necessary. Documentation is considered a vital competency for nurses in renal dialysis units, requiring them to document assessment findings, treatments, effects, and patient outcomes.

The findings from a previous study showed that nurses were most aware of dealing with blood pressure changes, precautions when caring for hepatitis patients, managing ruptured blood loss during dialysis, and the complications of dialysis for patients (Ali et al., 2018). In another study from Bangladesh, the findings indicated a deficit in nurses' practices that should be applied throughout hemodialysis treatment to care for patients in the hemodialysis unit, as evidenced by a moderate level of practice across the majority of the scale's items (Bakey, 2012).

On the other hand, the lowest level of nurses' knowledge in the current study was recorded in their ability to assess the presence of bruit during hemodialysis blood access assessment, followed by their ability to assess blood flow in that hemodialysis access. The skills of bruit assessment and examination of the pulse and blood flow at the hemodialysis access are considered among the finer skills that require expertise and clinical competence in hemodialysis.

These findings differed from a previous study that aimed to explore nurses' practices and patient care in renal dialysis in Abha, Saudi Arabia. The findings indicated that nurses' practice was high in technical skills, such as vital signs, bruit assessment, and blood flow monitoring, despite a knowledge deficit. Gaps in practice were identified in areas including improper adherence to hand washing, non-compliance with the use of eyewear when blood splash is likely, simultaneous care for hepatitis positive and hepatitis-negative patients, passing needles from hand to hand, and recapping needles after use (Al Qahtani & Almetrek, 2017).

In the current study, the nurses' knowledge of hemodialysis treatment was generally satisfactory. The highest nurses' knowledge about dialysis

treatment was for their ability to initiate, monitor, and discontinue dialysis treatment, especially in the monitoring of the vital signs of patients during renal dialysis, as well as their knowledge and ability to understand the mechanics of dialysis and related equipment, especially for glucometers, and for adherence to safety measures.

Among the most important competencies of nurses in renal dialysis units is the frequent monitoring of patients' vital signs throughout the dialysis process, as revealed by a recent study assessing nurses' basic competencies in dialysis units (Lee et al., 2021). Moreover, adherence to safety measures and infection control precautions during dialysis, and the monitoring of patients' blood glucose levels on hemodialysis machines, are also crucial competencies and vital practices for nurses in renal dialysis units.

Nurses reported in the current investigation that their lowest level of knowledge regarding hemodialysis treatment was associated with the repair, maintenance, and recognition of dialysis machine alarm conditions. This reflects technical issues that require more expertise and specialized training in troubleshooting hemodialysis machines, which will certainly affect patient condition, dialysis machine effectiveness, and patient health and safety.

Nurses in the current study demonstrated moderate overall knowledge and competence in hemodialysis care. Among the three domains, dialysis treatment competencies had the highest mean score, followed by hemodialysis basic knowledge and competencies. In contrast, dialysis assessment and care competencies scored slightly lower, indicating this as the relatively weaker area. These findings were supported by a previous study that found that nurses demonstrate moderate overall knowledge in hemodialysis care, with treatment competencies often scoring highest, followed by basic knowledge and assessment/ care lowest (Legesse et al., 2023).

Moreover, nurses demonstrated moderate overall knowledge of hemodialysis care, with a mean score of 7.97 out of 12 in a cross-sectional survey of 426 nurses from 25 hospitals in eastern China (Zhao et al., 2026). Nurses demonstrated sufficient knowledge and practice in hemodialysis care in a cross-sectional study in Sudan involving 103 nurses, with mean scores indicating moderate competence (Sagiron & Jarelnape, 2022). On the other hand, nurses demonstrated inadequate knowledge of providing nursing care to hemodialysis patients in a study of 50 nurses from the Baghdad Teaching Hospital, which used a

descriptive study design with a non-probability purposive sample (Mahmood & Hussein, 2025).

The current study revealed that nurses' age and years of experience were significant predictors of the overall hemodialysis knowledge and competence score. Older age and greater years of experience were associated with higher mean knowledge about hemodialysis. This was supported by an Ethiopian study that found that nurses with 4 or more years of experience in a dialysis unit were more knowledgeable than those with fewer than 4 years (Legesse et al., 2023). Additionally, nurses' years of experience in hemodialysis units were a significant predictor of their overall hemodialysis knowledge, as found in a descriptive study in Iraq (Mahmood & Hussein, 2025).

Nurses' age and years of experience were significant predictors of their nutritional knowledge in hemodialysis settings, as identified in a systematic review of 6 cross-sectional studies involving 455 nurses (Alizadeh et al., 2024). On the other side, nurses' age and years of experience were not significant predictors of overall hemodialysis knowledge, as shown in a study that included 55 nurses from Kirkuk, Iraq (Mohammed & Baez, 2023).

To address the knowledge gap among hemodialysis nurses, continuous nursing education and in-service training programs on hemodialysis are recommended to enhance practicing nurses' knowledge and skills (Alsolami & Alobaidi, 2024). Periodic monitoring of nurses' knowledge and practice to assess their level of knowledge is highly recommended to keep them up to date with the latest references and to upgrade their practices based on the best evidence (Rasheed et al., 2018).

Offering tailored educational programs in hemodialysis units can significantly improve nurses' knowledge and performance, thereby enhancing patient safety and improving the quality of care delivery (Negin et al., 2026). In a study in Sudan, a structured instructional program based on clinical practice guidelines was found to significantly improve dialysis nurses' knowledge of caring for vascular access in patients with renal failure. Moreover, the knowledge gained from the educational program was retained for at least 3 months after the intervention (Yousif et al., 2017). In a quasi-experimental study of 40 nurses in Egypt, educational programs in hemodialysis units significantly improved nurses' knowledge and practice regarding arteriovenous fistula care (Bayumi et al., 2020).

## CONCLUSIONS

Nurses demonstrated moderate overall knowledge of basic hemodialysis competencies in assessment, care, and treatment, with the highest mean scores in dialysis treatment, followed by basic knowledge and then assessment and care. Knowledge was strongest for recognizing dialysis-related health problems, particularly interpreting laboratory values, assessing mental status, and identifying the need for dietary consultation. In contrast, understanding of renal pathophysiology (osmosis, diffusion, ultrafiltration) and blood glucose monitoring were weakest. Competence was high in creating a therapeutic environment, monitoring patients' physical and emotional status, and documenting care, but comparatively low for assessing bruit and blood flow in vascular access.

In dialysis treatment, nurses were most knowledgeable about initiating, monitoring, and discontinuing dialysis—especially vital-sign monitoring, glucometer use, and adherence to safety measures—while competence in equipment repair, maintenance, and alarm recognition was limited. Age and years of experience emerged as significant positive predictors of overall hemodialysis knowledge and competence. These findings underscore the need for targeted, evidence-based educational interventions focusing on theoretical principles and technical machine skills to enhance nurses' proficiency in hemodialysis practice.

## Recommendations

The study identified important gaps in nurses' understanding of hemodialysis, particularly regarding renal pathophysiology (osmosis, diffusion, ultrafiltration) and blood glucose monitoring. Targeted, unit-based educational interventions—such as structured training programs, supervised on-the-job training, and continuous professional development activities led by nurse managers and education departments—are therefore recommended to strengthen these core theoretical and technical competencies (e.g., pathophysiology modules, alarm troubleshooting workshops, vascular access assessment training).

As self-report is a subjective method of assessing knowledge, future evaluations should incorporate more objective measures (e.g., written tests, skills checklists, or simulation-based assessments) to more accurately determine nurses' competence in hemodialysis assessment, care, and treatment. Future research should also recruit a larger, randomly

selected sample from multiple dialysis units across different regions of Saudi Arabia and employ open-ended questions and a mixed-methods design to generate deeper insights into nurses' knowledge and practice in renal dialysis care.

### Limitations

One notable limitation of the present investigation is the use of a self-reported survey, which is inherently subjective and may introduce bias. The use of nonrandom convenience sampling is considered a threat to the current study. Inclusion of a single geographic region with a relatively small sample size is another threat to the generalizability of the study's findings.

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### Declarations

**Ethics Approval:** Ethical clearance was secured from the Institutional Review Board of Prince Sultan Military College of Health Sciences in Dhahran (IRB-2025-NUR-043) obtained on April 23, 2025.

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