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Evaluation of Undergraduate Nursing Students' Knowledge Regarding Hemodialysis Care

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ABSTRACT

Hemodialysis is a life-sustaining therapy for patients with end-stage renal disease, and nurses play a vital role in ensuring safe and effective care during the procedure. Adequate knowledge of hemodialysis principles, machine operation, complication management, infection control, and patient education is essential for nursing students before entering clinical practice. This descriptive cross-sectional study evaluated knowledge regarding hemodialysis care among 228 undergraduate nursing students in the 2nd, 3rd, and 4th years of the Bachelor of Science in Nursing program at the Lahore School of Nursing, The University of Lahore. A structured self-administered knowledge questionnaire covering pre-, intra-, and post-hemodialysis care was used. Data were analyzed using SPSS version 26 through frequencies, percentages, means, and standard deviations, with $p < 0.05$ specified for statistical significance. The item-level findings indicated a moderate overall level of knowledge. Students demonstrated relatively stronger knowledge in recognition of dialysis complications, patient monitoring, and dietary and fluid management. For example, 67.1% identified symptoms of dialysis disequilibrium syndrome, 60.1% identified sudden pressure change inside the dialyzer as a cause of blood leakage, 65.8% identified fluid overload in a clinical presentation, and 70.6% identified post-dialysis review of weight and vital signs. In contrast, technical, infection-control, and occupational-safety items showed greater inconsistency, including machine-related procedures, ultrafiltration parameters, hepatitis C screening, and sharps disposal. The findings indicate that undergraduate nursing education provides a reasonable conceptual foundation but requires stronger simulation-based and competency-focused preparation for safe hemodialysis care.

Introduction

Hemodialysis is a cornerstone therapy for patients with end-stage renal disease, and nurses require competence in machine mechanics and settings, fluid and electrolyte balance, vascular access care, complication identification and response, and patient education and psychosocial support. The increasing prevalence of chronic kidney disease and the expansion of dialysis services

create a continuing need for nurses who can provide safe and effective dialysis-related care. The source study emphasizes that undergraduate preparation for dialysis care is therefore important.

Evidence reviewed in the research project indicates knowledge and competency gaps among nurses working in dialysis settings, particularly in vascular access care, machine safety, complication management, and infection control. Studies cited in the project describe variable knowledge and practice across different settings, including inadequate performance in some dialysis procedures despite reasonable theoretical knowledge. These findings suggest that technical skills may not be adequately consolidated through passive learning alone. Compared with the literature on practicing dialysis nurses, fewer studies have focused specifically on undergraduate nursing students. The research project identifies a gap concerning students' understanding of dialysis principles, vascular access care, machine operation, complication recognition, and infection-control practices before entry into clinical practice. The project also notes a limited number of student-targeted assessment tools for hemodialysis knowledge. Addressing these gaps is relevant to nursing education and patient safety. Early exposure to dialysis-care knowledge can support readiness for clinical rotations, identify weak areas for targeted teaching, and reduce the risk of procedural errors. The present study therefore evaluated undergraduate nursing students' knowledge regarding hemodialysis care at the Lahore School of Nursing, The University of Lahore.

Objective: To evaluate the overall extent of nursing students' knowledge regarding hemodialysis care and identify areas of stronger and weaker knowledge.

Materials and Methods

Study Design and Setting: A descriptive cross-sectional study design was used to evaluate the level of knowledge regarding hemodialysis care among undergraduate nursing students. The study was conducted at the Lahore School of Nursing, The University of Lahore, Pakistan.

Study Population and Sampling: The population comprised BSN students in the 2nd, 3rd, and 4th years who had completed or were undertaking clinical postings in dialysis or medical-surgical units. Non-probability purposive sampling was used to select students who met the eligibility criteria and were willing to participate. The planned sample size was 218 participants based on the finite-population calculation reported in the research project (N = 500). The completed dataset analyzed in the results contained 228 participants.

Data Collection Instrument: Data were collected using a structured knowledge questionnaire divided into demographic information and knowledge questions. The knowledge section assessed pre-, intra-, and post-hemodialysis nursing care. Each correct response received 1 point and each incorrect response received 0 points. The research project describes categorization based on a total score out of 33: excellent knowledge ≥75% (≥25/33), good knowledge 50–74% (17–24), and poor knowledge <50% (<17 correct answers).

Validity and Reliability: Content validity was planned through review by three experts in nephrology nursing and medical-surgical education. A pilot study involving 10 nursing students was planned to assess internal consistency, with a target Cronbach's alpha of at least 0.70. The pilot participants were not to be included in the main study.

Data Collection and Analysis: Ethical approval was sought from the University of Lahore research ethics committee, permission was obtained from the nursing department, and written informed consent was obtained. Participation was voluntary and confidentiality and anonymity were maintained. Data were entered and analyzed using SPSS version 26. Frequencies, percentages, means, and standard deviations were used for descriptive analysis. Pearson's correlation was specified in the analysis plan, with $p < 0.05$ considered statistically significant; however, the research project reports primarily item-level descriptive results and does not provide completed inferential correlation results.

Results

A total of 228 undergraduate nursing students were included in the reported analysis. Male students constituted 75.9% of the sample (n = 173), while females constituted 24.1% (n = 55). Most participants were aged 22–28 years (65.4%, n = 149), followed by 15–21 years (34.6%, n = 79). Regarding year of study, 77 students (33.8%) were in the 2nd year, 71 (31.1%) in the 3rd year, and 80 (35.1%) in the 4th year.

Table 1: Demographic Features

Variable	Category	n	%
Gender	Male	173	75.9

	Female	55	24.1
Age	15–21 years	79	34.6
	22–28 years	149	65.4
Year of study	2nd year	77	33.8
	3rd year	71	31.1
	4th year	80	35.1

Table 2. Selected clinical knowledge and complication-recognition items (N = 228)

Knowledge area	Correct/selected response	n	%
Dialysis disequilibrium syndrome symptoms	Nausea, vomiting, headache, cramping feet, irritability	153	67.1
Blood leakage from dialyzer	Sudden change in pressure inside the dialyzer	137	60.1
Early termination of dialysis	Dialysis disequilibrium syndrome	158	69.3
Clinical presentation in uremia	Fluid overload	150	65.8
Post-dialysis review	Weight and vital signs	161	70.6
Blood return after dialysis	Normal saline	145	63.6

Students demonstrated relatively stronger knowledge in recognition of common dialysis complications and patient monitoring. The highest selected correct response among the highlighted items was post-dialysis review of weight and vital signs (70.6%), followed by recognition of dialysis disequilibrium syndrome as a reason for early termination (69.3%).

Table 3. Selected technical and machine-related knowledge items (N = 228)

Knowledge area	Reported response	n	%
Recent clots in tubing	Warm normal saline with heparin	127	55.7
Maximum ultrafiltration rate	10 ml/kg/hr	130	57.0
Machine temperature/connections	Avoid hemolysis	156	68.4
Hemodialysis efficacy	Patients' blood flow	107	46.9
Circuit with changed blood color	Tubing has clotted	104	45.6

Technical knowledge was less consistent than clinical recognition. The research project specifically identified variability in machine handling, ultrafiltration parameters, tubing care, and related procedures. For example, 57.0% selected 10 ml/kg/hr for the maximum ultrafiltration rate, while 46.9% selected patients' blood flow as a factor affecting hemodialysis efficacy.

Table 4. Selected patient-management, dietary and fluid-management items (N = 228)

Knowledge area	Reported response	n	%

Protein intake	1 g/kg body weight/day	143	62.7
Potassium-rich food	Carrot	90	39.5
Permitted drink in renal failure	Lemon juice	99	43.4
Food increasing thirst	Salty foods	148	64.9
Interdialytic weight gain	Less than 3 kg	118	51.8
Avoid increased potassium	Reduce uncooked vegetables/fruits	158	69.3
Avoid weight gain	500 ml plus urine-equivalent fluid	138	60.5
Permitted food in renal failure	Lettuce	124	54.4

Patient-management knowledge was comparatively stronger in several areas. The highest highlighted response was reduction of uncooked vegetables and fruits to avoid increased blood potassium (69.3%), followed by identification of salty foods as increasing thirst (64.9%) and the prescribed fluid approach to avoid weight gain (60.5%).

Table 5. Selected infection-control and occupational-safety items (N = 228)

Safety area	Reported response	n	%
Hepatitis C screening of unit employees	Every 6 months	92	40.4
External blood contamination of machine	Chlorine	114	50.0
Venipuncture injury prevention	Puncture-proof container	96	42.1
Care of hepatitis C-positive/negative patients	Change gloves and wash hands between patients	119	52.2
Authorized practice in unit	Wear a coat over unit clothing when leaving	116	50.9

Knowledge related to infection control and occupational safety was inconsistent. Only 40.4% selected six-month hepatitis C screening, 42.1% selected puncture-proof sharps disposal, and 50.0% selected chlorine for external blood contamination of the hemodialysis machine. These patterns were highlighted in the source research as areas requiring reinforcement. Overall pattern of findings: The research project characterizes the students' overall knowledge as moderate, with stronger performance in clinical recognition, patient monitoring, and selected dietary/fluid-management areas, but weaker or more variable knowledge in technical, machine-related, infection-control, and sharps-safety areas.

Discussion

The present study evaluated undergraduate nursing students' knowledge regarding hemodialysis care and identified an uneven pattern of knowledge. Students appeared comparatively stronger in recognizing clinical complications and managing patient-related issues, whereas technical procedures and infection-control practices showed greater variability. This pattern supports the concern expressed in the research project that conceptual knowledge may not automatically translate into mastery of

technology-dependent dialysis procedures. Knowledge of dialysis complications was one of the stronger areas. More than two-thirds of students selected the reported responses for dialysis disequilibrium syndrome symptoms and early termination of dialysis, and 65.8% identified fluid overload in the described clinical presentation. The discussion in the source project suggests that routine emphasis on patient assessment, vital-sign monitoring, and recognition of deterioration may contribute to this relative strength. Technical knowledge was less consistent. Responses concerning tubing, ultrafiltration, blood-flow factors, and machine-related procedures were often near or below two-thirds. The source discussion proposes that dialysis machines are frequently managed by specialized staff and that students may observe rather than independently perform technical procedures. Consequently, structured simulation and competency-focused assessment may be necessary to consolidate technical learning.

Infection-control and occupational-safety findings are particularly important because dialysis involves repeated exposure to blood and blood-borne pathogens. The relatively low proportions selecting the reported responses for hepatitis C screening and puncture-proof sharps disposal indicate a need for repeated teaching and assessment of universal precautions, sharps safety, equipment decontamination, and blood-borne infection prevention. The study's implications are consistent with the source project's recommendations: undergraduate curricula should integrate simulation-based dialysis training, standardize clinical orientation in dialysis units, strengthen infection-control education, and use objective skills-based assessments such as OSCEs where appropriate. The source project also recommends multi-site and longitudinal research to improve generalizability and evaluate development of knowledge and clinical skills over time.

Limitations

The study was conducted at a single nursing institution, which limits generalizability to other nursing schools and clinical settings. The reported results are primarily descriptive and do not include completed inferential correlation analyses despite Pearson's correlation being specified in the analysis plan. The questionnaire was self-administered, which may introduce response bias and may not reflect actual clinical competence. In addition, several complex competency areas were represented by individual knowledge items, which may limit measurement precision. Finally, the cross-sectional design cannot establish causation or track changes in knowledge over time.

Conclusion

This study found a moderate overall pattern of hemodialysis-care knowledge among 228 undergraduate nursing students at the Lahore School of Nursing. Students demonstrated relatively stronger knowledge in recognizing dialysis complications, patient monitoring, and selected dietary and fluid-management concepts. However, technical knowledge, machine-related procedures, infection-control measures, and occupational safety showed important inconsistencies. The findings support strengthening undergraduate dialysis education through simulation-based learning, standardized clinical orientation, repeated infection-control teaching, and competency-focused assessment. Such measures may improve students' preparedness for safe and effective care of patients receiving hemodialysis.

Conflict of Interest

No conflict of interest was reported in the supplied research project.

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Author Contributions

Muhammad Chand Fazal conducted the research project, data collection, analysis, and manuscript preparation. Madiha Mukhtar supervised the research process, provided academic guidance, and reviewed the work.

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