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Evaluating Nurses' Knowledge Regarding Infection Control Standard Precautions in Dialysis Settings

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ABSTRACT

Background: Hemodialysis' patients and staff are particularly vulnerable to healthcare-associated infections due to repeated exposure to invasive procedures and potential contaminants. Infection control measures are essential in such high-risk settings, and nurses' knowledge plays a vital role in reducing infection transmission.

Objective: This study aimed to evaluate nurses' knowledge regarding infection control standard precautions in dialysis settings. **Subjects and Methods:** A pre-experimental one-group pre/posttest design was employed to accomplish this study. A convenience sample of 60 nurses who were involved in providing direct patient care were included in the study at the Hemodialysis Unit at Aswan University Hospital. **Tools:** Data were collected using an interview-based questionnaire, which included nurses' personal data and 10 open-ended questions assessing their knowledge of infection control standard precautions. Each question was scored from 0 to 2, with total knowledge categorized as good (≥75%), average (60–<75%), or poor (<60%). Descriptive statistics, paired t-tests, and Chi-square tests were applied for data analysis. **Results:** A statistically significant improvement was observed in the total mean knowledge scores of nurses following the implementation of the educational instruction guidelines. The mean score increased from 11.63±2.62 to 16.35±2.12 ($p < 0.001$). Prior to the intervention, only 13.3% of nurses demonstrated good knowledge, while 60% had poor knowledge. Following the instructional guidelines, 78.3% of nurses achieved good knowledge, and only 1.7% remained in the poor knowledge category. **Conclusion:** The educational instructional guidelines significantly enhanced nurses' knowledge regarding standard infection control precautions in the dialysis unit. **Recommendations**: Regular educational instructional guidelins are recommended to enhance infection prevention awareness among dialysis staff.

Keywords: Dialysis Settings, Infection Control Standard Precautions, Nurses' Knowledge.

INTRODUCTION

Chronic kidney disease (CKD) is considered a long-term condition that often begins without obvious signs but gradually leads to widespread inflammation in the body. Worldwide, the burden of CKD is steadily increasing, affecting nearly 850 million individuals and expected to become the fifth leading cause of death globally by the year 2040. In many cases, acute kidney injury (AKI) is a trigger for CKD development, and those who experience AKI are significantly more likely to progress to end-stage renal disease (ESRD) if proper care is not taken early on [(1)].

Among patients receiving dialysis, the risk of infection is especially high due to constant exposure to blood pathways, repeated access to central lines, and frequent interaction with healthcare environments. Factors like a weakened immune system, exposure to contaminated surfaces, and close contact with other patients and staff contribute to infection becoming the second most common cause of death in this group. Because of this elevated risk, strict infection control measures and standard precautions are crucial in dialysis settings [(2)]. Standard precautions are universal protocols designed to protect both patients and healthcare workers from infection exposure. These include safe handling of blood, body fluids, mucous membranes, and non-intact skin. They are supported globally by key organizations such as the CDC, WHO, APIC, and the European Best Practice Guidelines, and are considered essential for reducing healthcare-associated infections [(3)].

In hemodialysis units, surface disinfection must be carried out rigorously. Non-visible contamination requires wiping with low-level disinfectants, while visible blood spills demand more potent agents like tuberculocidal solutions or diluted household bleach [(4)]. Nurses in these units are the front-line defenders against spreading infection. Their knowledge and attitude directly influence the proper implementation of infection control guidelines in day-to-day clinical practice [(5)]. Nurses are responsible not only for technical tasks like administering dialysis but also for upholding safety standards that prevent disease transmission. This includes the following correct protocols to reduce the risk of spreading serious infections such as hepatitis C virus (HCV) among patients [(6)]. CKD is a growing global concern that disproportionately affects people in low- and middle-income countries (LMICs), where limited access to healthcare and environmental risks make prevention and treatment more difficult. Roughly 78% of those affected live in these under-resourced regions, where poverty and infections are common contributors to disease progression [(7-8)].

Educational programs targeting healthcare professionals have shown real promise in improving care for dialysis patients. By providing training in palliative approaches and infection control, nurses are better equipped to deliver quality care, support early

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symptom management, and improve the overall patient experience[9]. The intense treatment needs of ESRD patients often lower their quality of life. Caregivers, particularly nurses, have a significant influence on reducing hospitalizations and improving outcomes. Social support and consistent caregiver knowledge are vital elements in maintaining patient stability and promoting adherence to treatment regimens [10].

SIGNIFICANCE OF THE STUDY

CKD is a growing global concern that disproportionately affects people in low- and middle-income countries (LMICs), where limited access to healthcare and environmental risks make prevention and treatment more difficult. Roughly 78% of those affected live in these under-resourced regions, where poverty and infections are common contributors to disease progression [7-8].

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AIM OF THE STUDY

This study aimed to assess nurses' knowledge of standard infection control precautions in dialysis settings.

Research Hypothesis: H1: Mean knowledge score of study groups would be higher following instructional guidelines.

SUBJECTS AND METHODS

A pre-experimental one-group pretest/posttest design was employed to accomplish this study. A convenience sample of 60 nurses who were involved in providing direct patient care were included in the study at the Hemodialysis Unit at Aswan University Hospital.

Tools: Data were collected using an interview-based questionnaire, which included nurses' personal data and 10 open-ended questions assessing their knowledge of infection control standard precautions.

All participants in the study were willing volunteers who were required to be available throughout the study period and actively involved in patient care within the unit.

Data Collection Tools:

Tool (I): An interview- based questionnaire:

It was developed by researchers following an extensive review of the related literature to ensure their relevance and accuracy. It was divided into two parts.

Part (1): Personal characteristics of the studied nurses: It focused on gathering personal data from the participants. This included variables such as age, gender, marital status, educational background, years of experience both in dialysis and outside of it, and previous attendance in training programs related to infection control.

Part (2): Pre/ post knowledge questionnaire: It assessed the nurses' knowledge about infection control standard precautions. This section consisted of 10 open-ended questions that aimed to evaluate their understanding of infection control concepts, transmission routes, hand hygiene techniques, the steps involved in proper handwashing, and the correct use of personal protective equipment (PPE). Additionally, questions were included to assess their knowledge on how to handle contaminated linen, blood spills, and medical waste.

Scoring System

The participants' answers were checked against a pre-made model key. The following was the scoring system for the answers: 2 points for right, 1 point for partially right, and 0 points for wrong or "do not know." On the knowledge evaluation, a maximum of 20 points could be achieved. There were three groups based on the participants' knowledge levels: "Good" for 75% to 100%, "Average" for 60% to 74%, and "Poor" for less than 60%.

Content validity and reliability:

The tool and the instructional guidelines booklet were reviewed and validated by a panel of five academic experts. This panel included three experts from the Faculty of Nursing and two from the Faculty of Medicine at Aswan University. Testing reliability of the developed tools was done statistically through Cronbach's alpha test that was 0.860 for knowledge.

Pilot study:

It was conducted on a small sample representing 10% of the total sample size (n=6) to test the clarity, relevance, and time management of the tools. The data obtained from the pilot study were excluded from the final results, and modifications were made based on the feedback received. These revisions were incorporated before proceeding with the final implementation of the study.

Fieldwork :(Data collection)

From the start of November to the end of April, a total of six months were devoted to conducting fieldwork. There were five distinct stages to the research process: pre-study, assessment, planning, implementation, and evaluation.

Phase one: Preparatory Phase:

In order to build the tools for data collecting, the preparatory step involved analyzing the existing literature, which includes books and papers from the past and present. The administration and Faculty of Nursing at Aswan University Hospital gave their

official approval. Furthermore, approval was granted by the director of the hemodialysis unit to conduct the research within their facility.

Phase two: Assessment phase:
Researchers assessed the unit's environmental design, such as numbers of rooms, beds and spaces between it, and numbers of machines. After nurses were informed about the goal of the study, their verbal consent was subsequently obtained. At this stage, the researcher spoke with each nurse individually to get a feel for their demographics and their level of familiarity with infection control protocols.

Phase three: planning phase:
Designing the instructional guidelines was the first step in this process. The researcher developed guidelines to address the needs of the nurses after receiving feedback from the study participants and reviewing a large body of relevant literature. To achieve the goals of the study, we made sure that all the nurses were taught the same intervention content using the same methodologies. This included creating specialized teaching aids. English was used to construct a structured colored booklet that is accompanied by illustrations.

Phase four: Implementation phase:
The researchers met all available nurses under study 3 days a week in a sessions. The interview took place in the dialysis unit (nurses' office) during nurses' break. Two to four nurses were taken daily. Then the researcher explained the booklet. The interview took between 45 and 60 minutes to complete the questionnaires plus 15 minutes for feedback from the nurses. At the end of the session, the nurses took the booklet from the researcher.

Phase five: Evaluation phase:
The researcher reassessed or evaluated nurses' knowledge after 3 months using tool I part 2. Then a comparison was done between the collected data before intervention and collected data at the end of the study for determination of the effect of applying the instructional guidelines.

Ethical consideration:
This study was ethically approved by Aswan University's Research Ethics Committee. Written informed consent of all the participants was obtained. The nurses were assured that their information would remain confidential and be used solely for research purposes, following an explanation of the study's objective. They were informed that participation was entirely voluntary, and they could withdraw from the study at any time without providing a reason. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human testing.

Statistical analysis
After data collection, the data were organized and analyzed using SPSS version 24. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used, with qualitative variables compared using the chi-square test. Paired sample t-tests were used for quantitative comparisons, and Spearman correlation assessed relationships between variables. Data were presented in bar and pie charts. A p-value ≤ 0.05 was considered statistically significant, and $p \leq 0.001$ was highly significant.

RESULTS

Part I: Personal Characteristics of the Studied Nurses:

Table (1) shows that most nurses (45%) were aged between 30 and 39 years, and all participants were female. Most of the nurses (73.3%) were married. In terms of educational background, 81.7% held an associate degree from a technical health institute, while 16.7% had a diploma. Only 1.7% of the participants held a bachelor's degree in nursing. Regarding work experience, 81.7% had experience working within the dialysis unit, while 18.3% had worked outside of it. Nearly half (46.7%) of the nurses who received training in infection control, with the majority (82.1%) having attended just one course.

Table (1): Distribution of the studied nurses regarding their personal data (n=60)

Item	No	%
Age (years):		
20-<30 years	19	31.7
30-<40 years	27	**45**
40-50 years	14	23.3
50- 60 years	0	0
Gender:		
Male	0	0
Female	60	**100**
Marital status:		
Married	44	**73.3**
Un married	16	26.7
ducational qualification		
Bachelor of nursing science	1	1.7
Associated degree of technical health institute	49	**81.7**
Diploma of secondary technical nursing school	10	16.7
ate of employment:		
Years of experience inside dialysis unit	49	**81.7**
Years of experience outside dialysis unit	11	18.3
ave training courses:		
Yes	28	**46.7**
No	32	53.3
Numbers of training courses: (n=28)		
One	23	**82.1**
Two or more	5	17.9

Figure 1 showed that 38% of the participants had between 5 and 10 years of total nursing experience, while **Figure 2** indicated that 60% of the nurses worked the morning shift.

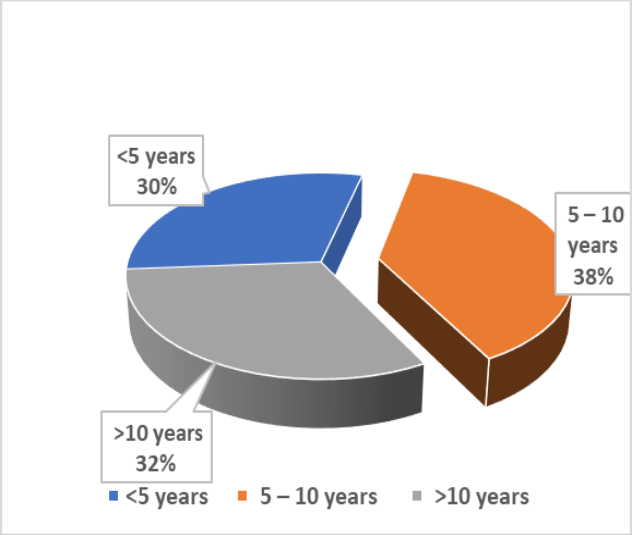

Figure (1): Shows that more than one third (38%) of the studied nurses have 5-10 years of experiences.

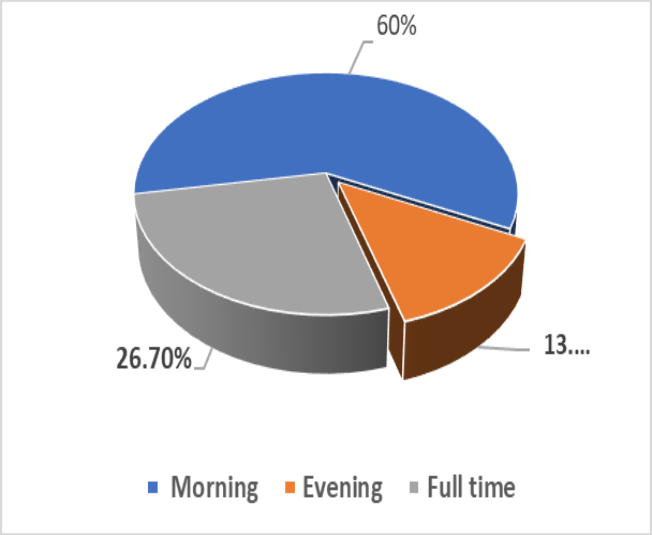

Figure (2): Illustrates that three fifth (60%) of the studied nurses have morning shift.

Part II: Nurses' Knowledge about Infection Control Practices (Pre and Post Instructional guidelines)

Table 2 reveals significant improvements in nurses' knowledge after the educational program. For example, only 25% of nurses could correctly identify the steps of handwashing before the intervention, but this increased to 76.7% afterward. Knowledge of the five moments for handwashing rose from 8.3% to 60%. Furthermore, only 10% could explain the infection cycle prior to the training, which increased to 81.7% after the intervention.

Table (2): Distribution of the studied nurses regarding their knowledge toward infection control standard precautions in dialysis unit pre and post instructional guidelines (n=60):

Items		Complete Correct		Incomplete Correct		Don't know		Significant test	
		No.	%	No.	%	No.	%	X^2	P-value
Definition of standard precaution	**Pre**	24	40	34	56.7	2	3.3	46.14	**0.000****
	Post	35	58.3	23	38.3	2	3.3		
Correct steps of hand washing	**Pre**	15	**25.0**	45	75.0	0	0	100.7	**0.000****
	Post	46	**76.7**	23.3		0	0		
Five moment of hand washing	**Pre**	5	**8.3**	31	51.7	24	40.0	85	**0.000****
	Post	36	**60.0**	7	11.7	17	28.3		
Correct steps of wearing personal protective equipment	**Pre**	26	43.3	34	56.7	0	0	57.6	**0.000****
	Post	35	58.3	25	41.7	0	0		
Description of infection cycle	**Pre**	6	**10.0**	46	76.7	8	13.3	35.3	**0.000****
	Post	49	**81.7**	6	10.0	5	8.3		

(**) highly statistically significant at p<0.01.

Table 3 shows additional significant gains in other areas of infection control knowledge. Recognition of infection transmission modes increased from 13.3% to 63.3%, understanding patient risk factors improved from 20% to 85%, and competence in managing contamination (e.g., waste and blood) increased from 21.7% to 80%.

Table (3): Distribution of the studied nurses regarding their knowledge toward infection control standard precautions in dialysis unit pre and post instructional guidelines (n=60):

Items		Complete Correct		Incomplete Correct		Don't know		Significant test	
		No.	%	No.	%	No.	%	X^2	P-value
Infection modes of transmission in dialysis unit	**Pre**	8	**13.3**	32	53.3	20	33.3	91.3	**0.000****
	Post	38	**63.3**	10	16.7	12	20.0		
How to prevent infection in dialysis unit	**Pre**	23	38.3	37	61.7	0	0	100.2	**0.000****
	Post	39	65.0	21	35.0	0	0		
Why are dialysis patients at risk of infection	**Pre**	12	**20.0**	48	80.0	0	0	117.8	**0.000****
	Post	51	**85.0**	9	15.0	0	0		
How does dialysis nurse deal with, waste, blood spots……..etc.	**Pre**	13	**21.7**	47	78.3	0	0	71.4	**0.000****
	Post	48	**80.0**	12	20	0	0		
Role of nurse in dialysis unit	**Pre**	20	33.3	40	66.7	0	0	97.6	**0.000****
	Post	40	66.7	20	33.3	0	0		

(**) highly statistically significant at p<0.01.

Table 4 shows the comparison of the total mean knowledge scores before and after the program, revealing a significant increase from 11.63 ± 2.62 to 16.35 ± 2.12, representing a 45% improvement (p < 0.001).

Table (4): Comparison between total mean scores of the studied nurses' knowledge toward infection control standard precautions in dialysis unit pre and post instructional guidelines (n=60):

	Pre program	Post program	t	P -value
Total knowledge				
Mean ±S. D	11.63 ± 2.62	16.35 ± 2.123	-9.133-	**0.000****
Min-Max	8-19	11-20		
Percentage of change	45%			

(**) highly statistically significant at p<0.01. t= Paired sample t test.

Figure 3 illustrated that only 13.3% of nurses had a good level of knowledge before the intervention, while 78.3% reached a good level of knowledge after the program. Conversely, the percentage of nurses with poor knowledge dropped from 60% to just 1.7%.

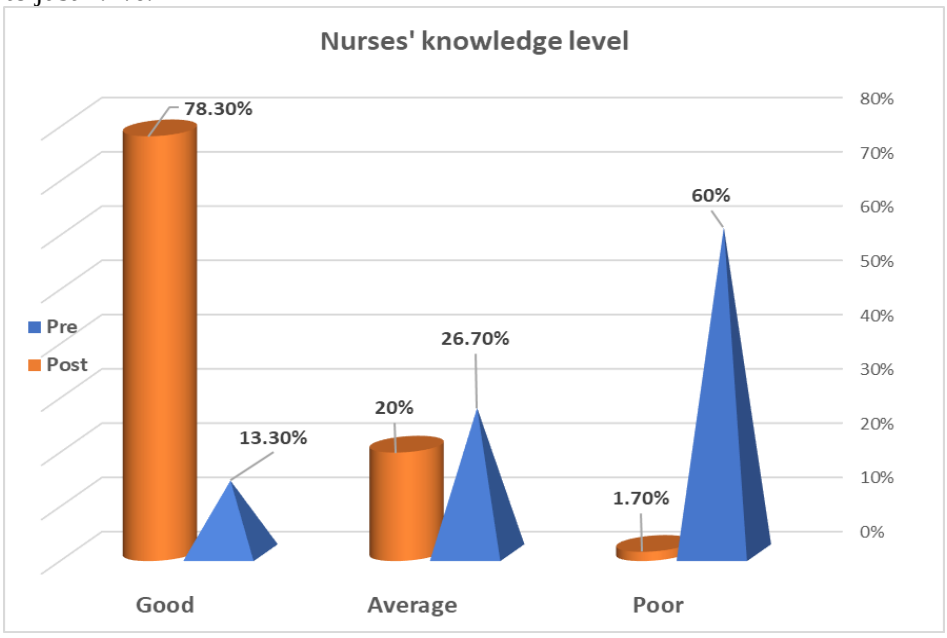

Figure (3): Total level of nurses' knowledge toward infection control standard precautions in dialysis unit pre and post instructional guidelines (n=60).

DISCUSSION

Patients undergoing hemodialysis, along with dialysis staff, are at increased risk of healthcare-associated infections due to frequent and prolonged exposure to potential contaminants within the dialysis environment. Consequently, strict infection control practices are strongly recommended in hemodialysis units to minimize the risk of transmission and prevent cross-contamination[11].

In this study, most participating nurses were between 30 and 40 years old; all were female, and nearly three-quarters were married. The majority held diplomas from technical health institutes rather than bachelor's degrees. Fewer than half had received prior training in infection control, and among those, most had attended only one training session. This demographic likely reflects the staffing structure at the study site, where diploma-level nurses were more prevalent, and the nursing workforce was predominantly female. Personal responsibilities, such as marriage, may influence shift preferences, which could explain the predominance of morning-shift workers in the sample.

These findings were consistent with those of **Elasrag *et al.*** [12], who reported that nearly half of the nurses in their study were aged 30–40 years, most were female and married, and held diplomas from technical institutes. Conversely, **Morkes *et al.*** [13] noted a younger age distribution and lower rates of prior infection control training among hemodialysis nurses, highlighting variability in staffing profiles and professional development across institutions.

Following the instructional guidelines, nurses' awareness of infection control standard precautions significantly improved. Before the intervention, only 25% could correctly identify the handwashing procedure, and even fewer understood the "five moments" of hand hygiene or the infection transmission cycle. After the intervention, these figures increased markedly, with over three-quarters of nurses answering correctly. This suggests the educational program was effective in addressing knowledge gaps, likely due to its structured content, visual aids, and reinforcement through printed materials and discussion.

Comparable improvements were observed by **Ahmed *et al.*** [14] who reported statistically significant gains in nurses' knowledge after an infection control education program in pediatric dialysis settings, particularly regarding hand hygiene and transmission precautions. However, **Arinze-Onyia *et al.*** [15] found that most healthcare workers already had high baseline knowledge about hand hygiene, potentially due to prior institutional training.

The present study also revealed significant improvements in nurses' understanding of infection transmission modes in dialysis settings, the high infection risks among dialysis patients, and proper handling of blood spills and contaminated materials. Prior to the program, fewer than one-quarter of participants demonstrated complete knowledge in these areas; post-intervention, this proportion rose to nearly two-thirds or more. From the researcher's perspective, this improvement may be attributed to the previous lack of emphasis on dialysis-specific infection risks in pre-service education—an area the intervention effectively addressed.

This result aligned with **Magor *et al.*** [16] who demonstrated that video-assisted training significantly enhanced nurses' ability to identify and respond to contamination risks during pediatric hemodialysis. In contrast, **Ahmed *et al.*** [17] reported persistently low awareness among dialysis nurses regarding the transmission of hepatitis viruses, despite regular exposure—suggesting variability in training effectiveness across institutions.

The current findings also revealed a significant increase in nurses' total mean knowledge scores following the implementation of the instructional guidelines. This supports the conclusion that structured educational programs were effective in enhancing dialysis nurses' conceptual understanding of infection control practices. The researchers believed this improvement was not only due to increased content exposure, but also to the engaging and interactive style of instructional delivery, which promoted better retention.

This finding was in line with **Yousef *et al.*** [18] who reported notable improvements in nurses' knowledge following an educational intervention on infection control in pediatric hemodialysis units. Similarly, **Osman *et al.*** [19] confirmed that a well-designed training program significantly raised knowledge scores both immediately and one month after the intervention. Collectively, these studies highlight the importance of continuous professional development in sustaining high safety standards in high-risk environments.

With respect to overall knowledge levels, the current study found that fewer than one-fifth of nurses demonstrated good knowledge before the intervention, while over three-fifths exhibited poor knowledge. Post-intervention, this pattern shifted significantly, with more than three-quarters achieving good knowledge and only a small minority remaining in the poor category. From the researcher's perspective, this improvement likely reflects the success of the intervention in addressing gaps in knowledge, particularly in areas that may have been neglected in everyday practice.

These results aligned with those of **Morkes *et al.*** [13] who reported similar improvements in knowledge scores among hemodialysis nurses following an educational program. **Mahran *et al.*** [20] also found that many nurses initially lacked sufficient knowledge of infection prevention, which improved notably after structured training. These results emphasize the need for ongoing education and support for dialysis unit staff

to enhance clinical competence and promote a culture of safety.

In the pre-intervention phase, this study identified a statistically significant association between nurses' total knowledge scores and variables such as age, years of experience, and prior training. Even after the intervention, experience and educational level remained predictive of better performance. This suggests that more experienced and better-educated nurses may have a stronger foundation for integrating new information and applying it in clinical settings.

These findings were consistent with those of **Elkholy *et al.*** [21] who reported that nurses' knowledge of safety protocols was significantly associated with age, educational attainment, and professional experience. On the other hand, **Fahim *et al.*** [22] found no significant correlation between demographic factors and infection control knowledge, implying that institutional factors might mediate these relationships. Nonetheless, the broader literature supports the positive influence of professional maturity and previous exposure on infection control competencies.

LIMITATIONS

Despite the valuable insights it offers, this study had several limitations. The single-group pre/post-test design limited our ability to control for confounding variables or attribute improvements solely to the intervention. Additionally, reliance on self-reported data introduces potential bias, such as social desirability or misinterpretation of questions. The findings may not be generalizable beyond this setting due to institutional factors such as staffing structure, resource availability, or organizational culture. Finally, while immediate post-intervention effects were measured, the study did not assess long-term knowledge retention.

CONCLUSION

It could be concluded that a structured instructional guideline significantly improved nurses' knowledge regarding infection control standard precautions in the dialysis unit. The post-intervention results reveal a marked increase in correct responses across all knowledge items and a significant positive shift in total knowledge scores. These outcomes highlight the value of continuous professional education and underscore the need for integrating regular training sessions into routine dialysis unit operations to ensure safer, evidence-based practices.

RECOMMENDATIONS

- The research' findings suggested that these educational instructional guidelines should be implemented as standard care in the dialysis unit and similar settings.
- Regular educational instructional guidelines are recommended to enhance infection prevention awareness among dialysis staff.

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