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The Impact of Pediatric Nurses' Clinical Performance and Infection Control Practices on Peritoneal Dialysis Outcome

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Abstract

Objective*: The study aims to evaluate pediatric nurses' performance and infection control practices on peritoneal dialysis outcomes.*

Methodology: *This descriptive study utilized the International Society for Peritoneal Dialysis guidelines to evaluate the clinical practice of nurses in peritoneal dialysis. 37 nurses from Al-Najaf Teaching Hospital and the Middle Euphrates Peritoneal Dialysis Center. Assessed nurses' performance using a checklist across three observations (two observations) by a researcher, and a co-observer performed one. It is used to design evaluations from multiple perspectives or across different contexts, ensuring a comprehensive understanding of skills. Also, the final part to evaluate the outcomes of children.*

Result: *The clinical performance and infection control procedures of pediatric nurses have a major impact on the results of peritoneal dialysis. Their skillful practices were connected to lower chances of problems such as catheter displacement (OR = 0.933), exit site infections (OR = 0.561), leakage (OR = 0.551), and catheter obstruction (OR = 0.278). Furthermore, these activities lessened the chance of hospitalization (OR = 0.909), fluid/nutrition imbalance (OR = 0.462), and poor appetite (OR = 0.371). Higher odds ratios for respiratory trouble (OR = 1.517), hypotension (OR = 1.333), and peritonitis (OR = 1.786).*

Conclusions and recommendations: *Nursing performance was linked to an increase in complications such as peritonitis, abdominal pain, respiratory distress, and growth problems. These findings underscore the need for targeted interventions to address persistent complications and highlight the crucial role of nursing care in enhancing patient outcomes.*

Keywords: Impact; Infection Control, Nurses' Performance, Pediatric Peritoneal Dialysis

INTRODUCTION

Peritoneal dialysis is recommended for children with acute kidney failure, which is associated with increased infant mortality and commonly used to treat pediatric patients with hemolytic uremic syndrome, sepsis, and acute kidney damage resulting from severe diarrhea (Al Saedi J A., et al, 2025).

There are two primary modalities of PD: continuous ambulatory peritoneal dialysis (CAPD) and automated peritoneal dialysis (APD). While CAPD allows manual exchanges throughout the day, APD provides greater flexibility by automating fluid exchange during nighttime hours, thereby enhancing patient adherence and reducing the burden on daily routines. Although APD may be associated with lower peritonitis rates and decreased intraperitoneal pressure, it also carries drawbacks such as higher costs, potential for inadequate sodium removal, and sleep disturbances. A recent systematic review found no significant difference in patient survival between CAPD and APD, suggesting that modality choice should be individualized (Thavorncharoensap et al., 2025).

Nurses play a critical role in the management of PD, particularly in patient education, adherence promotion, and infection prevention. Infection control practices during peritoneal dialysis (PD) are crucial because they directly influence patient safety and treatment outcomes. Given that, PD involves a direct entry point into the body (the catheter), stringent infection control minimizes the risk of peritonitis and exit site infections. These complications can lead to hospitalization, technique failure, and even death. Therefore, robust infection control is paramount to optimize patient well-being, ensure the longevity of PD as a viable treatment, and reduce healthcare burdens (Bennett et al., 2025). One of the most important global strategies to optimize PD outcomes is comprehensive patient training, which remains a challenging but vital task. Therefore, nursing staff must be adequately trained not only in the technical aspects of PD but also in effective teaching strategies to ensure patients and caregivers can perform home-based dialysis safely (Khader & Alfaki, 2022) .

It is important to consider caregiver stress when making medical decisions for children with end-stage renal disease (Wightman A, 2019).Inadequate knowledge or non-compliance with infection control measures among healthcare providers can lead to increased morbidity and unplanned hospitalizations.

Thus, assessing and enhancing nursing performance is essential to identify knowledge gaps, reinforce best practices, and ensure optimal outcomes for pediatric patients undergoing PD (Allawi Khalaf et al., 2024). A particular strength is child empowerment, a process that allows patients to take greater control of their health and life and involves acquiring the knowledge and skills necessary for person-centered care (Baumgart A., et al., 2020).

Despite the recognized importance of infection control in peritoneal dialysis, there is a lack of empirical studies that directly examine the relationship between nurses' clinical performance and infection-related complications in pediatric peritoneal dialysis, particularly in Iraq, Al-Najaf City. Most existing literature focuses on general nursing practices or adult populations, leaving a critical gap in understanding how pediatric nurses' infection control practices influence clinical outcomes.

METHODOLOGY

In the present study, a descriptive design was employed to evaluate the clinical practice of nurses in peritoneal dialysis. The study utilized the standards and recommendations provided by the International Society for Peritoneal Dialysis (ISPD). The ISPD offers evidence-based clinical practice guidelines, standards for infection control, catheter management, and nursing care, as well as professional development through training and conferences (Morelle J., et al, 2021). Impact on pediatric peritoneal dialysis outcomes was evaluated in alignment with the Standardized Outcomes in Nephrology – Peritoneal Dialysis (SONG-PD) initiative. This approach aims to establish core outcome sets that reflect what matters most to patients, caregivers, and clinicians. The SONG-PD framework follows established international methods from the OMERACT (Outcome Measures in Rheumatology) initiative, which has been endorsed by the World Health Organization (WHO) as a valid strategy for developing consensus-based outcome measures (Manera E K., et al, 2018). The questionnaire was sent to 17 experts from different specialties, and they have ten or more years of experience in their field of specialization. After a face-to-face discussion with experts, some items are excluded, others are included, and the instrument is measured as valid after considering all the remarks and recommendations for the validity. The reliability of the study tool was examined by the internal consistency (Alpha) technique to determine the stability and consistency of the questionnaire over time. The obtained value was (r = 0.79) for the performance instrument. Ethical approval is an important step in conducting a research study in terms of ensuring there is no harm or discomfort for the participants. The purpose is to protect the researcher and participants' rights. Hence, the researcher provided a printed copy of the information on nurses' performance and its effect on pediatric outcome, and gave a brief explanation about the method of data collection and procedure to conduct the study. The research ethical committee reviewed all materials and provided their permission to carry out this study at 2024\10\2 referance MEC-61from (Head of Ethical Committee for Clinical Study Kufa Faculty of Medicine \University of Kufa) . Interviews with nurses and children caregivers before starting data collection and an explanation for them about the purpose of the study were done to ensure their participation in the study and agreements from nurses and families, were informed about the privacy of their information, the nature of the study, their right to withdraw, and the confidentiality of the subject data. The sample was 37 nurses in total sample, who worked in peritoneal dialysis centers, and 51 children ongoing peritoneal dialysis. The researcher developed a questionnaire format to reach the intended study objectives. Part one: Socio-demographic variables for nurses: This part includes (age, sex, education level, total years of experience, years of experience in peritoneal dialysis, and number of training sessions). B Socio-Demographic characteristics of the children include (age, sex, level of education, residence, family monthly income).

C-Clinical data: This part includes (number of peritoneal dialysis sessions, type of peritoneal dialysis, who is the caregiver at home).Part two: Nurse Performance. It contains 43 questions for assessing the nurses' performance by checklist, three observations in different periods to avoid bias. Part three: Child Outcome contains 18 questions for assessing the complications of peritoneal dialysis. The data collection process has been performed from November 25th, 2024, to January 23rd, 2025.

Odds Ratio (OR): The OR quantifies the strength of the association between the predictor variable and the outcome. An OR < 1 (e.g., 0.933, 0.561) indicates that an increase in the predictor variable (e.g., better nursing performance/infection control) is associated with a lower likelihood or odds of the outcome (e.g., fewer complications). This suggests a protective or beneficial effect. An OR > 1 (e.g., 1.517, 1.786) indicates that an increase in the predictor variable is associated with a higher likelihood or odds of the outcome. This suggests an increased risk. An OR = (1) no association between the predictor and the outcome. By calculating ORs for various complications about nurses' practices, the study can

statistically determine which aspects of performance significantly reduce or increase the risk of adverse outcomes in pediatric PD patients.

RESULTS AND FINDINGS:

Table 1: Socio-Demographic Characteristics for Studied Nurses

Demographic Data of the Nurses	Rating and Intervals	F.	%
Age Groups (Years)	<= 25	9	24.3
	26 - 30	16	43.2
	31 and More	12	32.4
	Mean ± SD (Min-Max)	28.76 ± 3.76 (23-37)	
Sex	Males	15	40.5
	Females	22	59.5
level of education	School Nursing	1	2.7
	Institution of Nursing	18	48.6
	College of Nursing	17	45.9
	Postgraduate	1	2.7
Experience Years (total)	<= 5	18	48.6
	> 5	19	51.4
	Mean ± SD (Min-Max)	6.49 ± 3.7 (1-14)	
Years of experience in peritoneal dialysis	<= 5	27	73.0
	> 5	10	27.0
	Mean ± SD (Min-Max)	4.22 ± 2.56 (1-10)	
Training courses	No	0	.0
	Yes	37	100.0
Number of training sessions	1	15	40.5
	2	10	27.0
	3	11	29.7
	4	1	2.7
Total		37	100%

%= percentage, F. = frequency, SD=Standard deviation, Min=Minimum, Max=Maximum.

Table (1) analyzes the demographics of the 37 nurse participants. The female (59.5%) and male (43.2%). education levels were nursing institution (48.6%), nursing college (45.9%), and postgraduate (2.7%). Experience: >5 years (51.4%), ≤5 years in peritoneal dialysis (73%). All attended training courses: one session (40.5%), two (27%), three sessions (29.7%), and four sessions (2.7%).

Table (2): Socio-Demographic Characteristics for Studied Children (N=51).

Demographic Data of the Children	Rating and Intervals	F.	%
Age groups of children (Years)	<= 5	12	23.5
	6 - 10	18	35.3
	11 and More	21	41.2
	Mean ± SD (Min-Max)	9.24 ± 4.22 (2-17)	
Sex	Males	28	54.9
	Females	23	45.1
Level of Education	Not Read and Write	29	56.9
	Able to Read and Write	16	31.4
	Primary School Graduate	6	11.8

	Secondary School Graduate	0	.0
Residence	Urban	27	52.9
	Rural	24	47.1
Family-Monthly Income	< 300	23	45.1
	300 - 600	10	19.6
	601 - 900	16	31.4
	> 900	2	3.9
Total		51	100%

%= percentage, F. = frequency, SD=Standard deviation, Min=Minimum, Max=Maximum.

Table (2) provides the socio-demographic characteristics of 51 children in this study. Ages ranged from 2–17 years, with most (41.2%) aged 11 and older. 35.3% were 6-10 years old, and 23.5% were 5 or younger. males (54.9%) and females (45.1%). (56.9%) not able to read and write, 31.4% could read/write, and 11.8% completed primary school. Children lived in urban (52.9%) and rural areas (47.1%). Most families earned less than IQD 300 (45.1%), with 19.6% earning IQD 300-600, 31.4% earning IQD 601-900, and 3.9% earning over IQD 900 monthly.

Table (3): Clinical Characteristics for Studied Children.

Clinical data	Rating and Intervals	F.	%
Peritoneal Dialysis Sessions \ day	<= 5	47	92.2
	> 5	4	7.8
	Mean ± SD (Min-Max)	4.10 ± 0.78 (3-6)	
Type of Peritoneal Dialysis	CAPD	51	100.0
	APD	0	0
Who is the caregiver at home	Mother	46	90.2
	Father	5	9.8
Total		51	100%

%= percentage, F. = frequency, SD=Standard deviation, Min=Minimum, Max=Maximum.

Table 3 presents the clinical characteristics of the 51 studied children undergoing peritoneal dialysis. The majority (92.2%) receive five or fewer dialysis sessions per day, ranging from 3 to 6 sessions daily. All children (100%) undergo Continuous Ambulatory Peritoneal Dialysis (CAPD), while none receive Automated Peritoneal Dialysis. Regarding caregiving, mothers are the primary caregivers for most children (90.2%), while fathers assume this role for only 9.8% of the cases.

Table (4): Distribution of three views and Total of Nurses' Performance overall items regarding Peritoneal Dialysis.

Overall Items		First View					Second View					Third View					Total View				
		F.	%	X	SD	ASS	F.	%	X	SD	ASS	F.	%	X	SD	ASS	F.	%	X	SD	ASS
Nurses Performance	Poor	15	40.54	1.71	.15	Moderate	19	51.35	1.68	.11	Moderate	25	67.57	1.64	.13	Poor	19	51.35	1.67	.09	Moderate
	Moderate	22	59.46				18	48.65				12	32.43				18	48.65			
	Good	0	.00				0	.00				0	.00				0	.00			

%= percentage, F. = frequency, SD= standard deviation, Mean <=1.66: Poor, 1.67-2.33: moderate, 2.34 and more: Good, Ass. Assessment.

Table 4 shows the overall evaluation of nurses' performance in Peritoneal Dialysis, showing a predominant "Moderate" assessment, with no instances of "Good" performance across all views. The percentage of nurses rated as "Poor" increased from the first view (40.54%) to the third view (67.57%),

indicating a decline in performance over time. However, the total view maintained a "Moderate" assessment (mean score 1.67), suggesting the need for ongoing training and skill enhancement to improve the quality of nursing care in peritoneal dialysis.

Table (5): Outcome Characteristics for Studied Children (N=51).

Outcome data	Rating and Intervals	F.	%
The child outcomes	Itching	6	4.7
	Catheter displacement	10	7.8
	Catheter blockage	6	4.7
	Leakage at the exit site	4	3.1
	Peritonitis	11	8.5
	Exit site infections	18	14.0
	Patient discomfort	10	7.8
	Abdominal pain	33	25.6
	Cramping	31	24.0
	Respiratory difficulty	17	7.7
	Leakage of peritoneal fluid	10	4.5
	Hypotension	11	5.0
	Hospitalization	22	10.0
	Facilitating a normal lifestyle, including school attendance and social activities	22	10.0
	Ensuring adequate nutrition and fluid balance	22	10.0
	Monitoring and addressing growth-related issues	49	22.3
	Better appetite	26	11.8

Table (5) shows the distribution of outcome characteristics among studied children undergoing peritoneal dialysis. Abdominal pain (25.6%) and cramping (24.0%) were most common, followed by exit site infections (14.0%) and peritonitis (8.5%). Growth issues (22.3%), also frequent. Hospitalization, lifestyle maintenance, nutrition, and fluid balance each occurred in 10% of cases. These results highlight discomfort, infections, and growth as key concerns in pediatric peritoneal dialysis.

Table (6): Odd Ratio for Children's Outcome Characteristics and Nurses' Performance regarding Peritoneal Dialysis.

Outcome Characteristics for Studied Children	Odds Ratio
Itching	.588
Catheter displacement	.933
Catheter blockage	.278
Leakage at the exit site	.551
Peritonitis	1.786
Exit site infections	.561
Patient discomfort	1.333
Abdominal pain	1.524
Cramping	.529
Respiratory difficulty	1.517
Leakage of peritoneal fluid	.488
Hypotension	1.333
Hospitalization	.909

Facilitating a normal lifestyle, including school attendance and social activities	**1.719**
Ensuring adequate nutrition and fluid balance	**.462**
Monitoring and addressing growth-related issues	**.381**
Better appetite	**.371**

Table (6) presents the odds ratios for various outcomes associated with peritoneal dialysis in children, relative to moderate nursing performance. Lower ORs for catheter displacement (0.933), exit site infections (0.561), leakage (0.551), cramping (0.529), and particularly catheter blockage (0.278) suggest that improved nursing care may significantly reduce the likelihood of these complications. Similarly, reduced odds were observed for hospitalization (0.909), fluid/nutrition imbalance (0.462), growth issues (0.381), and poor appetite (0.371), indicating the positive role of nursing in overall patient management. Conversely, higher ORs for respiratory difficulty (1.517), hypotension (1.333), and peritonitis (1.786) indicate these complications may persist related to moderate nursing performance. Persistent risks of peritonitis and abdominal pain (OR 1.524) highlight challenges in infection control that may stem from patient-specific or procedural variables.

DISCUSSION:

1. Nursing Performance

Analysis of the sociodemographic data revealed that less than half of the nurses were between 26 and 30 years old, and more than half were female. Around 48.6% had graduated from a nursing institute, and most had five years or less of experience. These results are consistent with Khalaf et al. (2024), who found similar age and gender distributions among nurses. Importantly, the study identified deficiencies in performance, as nurses scored only in the "average" range on competency assessments. No participant received a "good" rating, signaling a troubling gap in clinical effectiveness. These findings echo the results of Khalaf et al. (2024), who also reported poor knowledge and practice among dialysis nurses. A key factor contributing to suboptimal performance may be the lack of structured training. Although various sessions had been conducted, there was no standardization, underscoring the need for unified training based on ISPD guidelines. The TEACH-PD trial (Chow et al., 2023) supports a showing that a standardized curriculum can improve technical skills and reduce infection rates.

2. Pediatric Outcomes

The study examined multiple patient-related variables, revealing several critical findings. Among pediatric patients, over 41% were 11 years or older, and the sample was slightly male-dominated, contrasting somewhat with Mohajerzadeh et al. (2021), who reported near gender parity. Educational barriers were profound; more than half of the children were illiterate, limiting adherence to care protocols. Kamath et al. (2020) confirmed similar trends, linking school absence to prolonged dialysis. Socioeconomic limitations were also apparent, with 45.1% of families earning less than IQD 300 monthly, a factor likely affecting access to care. Despite these barriers, CAPD proved effective and feasible for managing ESRD in children, particularly in low-resource settings (Prasad et al., 2006; Keita et al., 2019). The study also found that higher nursing performance correlated with fewer complications such as catheter occlusion, site infections, and hospitalizations, consistent with previous evidence (Gunasekara et al., 2010; Nopsopon et al., 2022).

3. Caregiver Burden

The study emphasized the vital role of mothers in the daily management of pediatric PD. Mothers were responsible for administering dialysis, ensuring hygiene, managing medications, and providing emotional support. These findings align with studies by Kiliś-Pstrusińska et al. (2013), which illustrated how caregiving in chronic kidney disease is primarily a maternal responsibility, especially in traditional cultures. However, this role places immense strain on families. Wightman et al. (2019) noted that while some caregivers reported acceptance and personal growth, many experienced significant physical and emotional burdens. Fatima and Khouriati (2024) further confirmed that socioeconomic status and disease severity greatly influence caregiver stress. These findings call for psychosocial interventions and caregiver education to ease the burden and improve family functioning.

4. Infection Control Implications

Non-compliance with infection control practices among healthcare providers can increase morbidity and

unplanned hospitalizations in pediatric PD. This study revealed common complications including abdominal pain (25.6%), cramps (24%), exit site infections (14%), and peritonitis (8.5%). These underscore the need for strict hygiene protocols and better clinical training. Dubrofsky et al. (2020) emphasized the importance of using robust quality indicators to assess care, yet few provinces consistently monitored key metrics. The results of this study showed statistically significant associations between lower nursing performance and complications such as peritonitis, respiratory distress, and hypotension. (Paglialonga F & Edefonti A, (2009) The study emphasizes that assessment and management should include ensuring adequate energy and protein intake, optimal metabolic control, and, if necessary, prescribing specific medications. These findings highlight the critical need to enhance infection control measures and implement standardized education to mitigate preventable complications.

Infection Control Practices and ISPD Hygiene Protocols

The International Society for Peritoneal Dialysis (ISPD) has established clear hygiene protocols to prevent infectious complications in PD patients. These include strict hand hygiene before and after every exchange, the use of surgical masks, single-use of disposable items, proper exit site care, and maintenance of a sterile field throughout the PD process (ISPD, 2022). Adherence to these guidelines has been shown to significantly reduce the risk of peritonitis and exit-site infections, especially in pediatric populations (Chow et al., 2023).

However, in clinical practice—particularly in resource-limited settings—implementing these protocols faces considerable barriers. In the current study, despite moderate levels of nurse performance, infection-related outcomes such as peritonitis (8.5%) and exit-site infections (14%) remained high.

Qualitative observations revealed gaps such as interrupted sterile procedures due to environmental factors, inconsistent hand hygiene, and occasional reuse of materials during shortages. Similar implementation challenges were reported by Nopsopon et al. (2022) and Dubrofsky et al. (2020), who found that even when nurses were trained on ISPD protocols, systemic issues—like staffing limitations, workload, lack of continuous supervision, and inconsistent supply chains—undermined effective practice. Therefore, infection control should not be viewed solely as an individual nursing competency, but as a systemic outcome requiring institutional commitment to staff training, regular monitoring, resource availability, and caregiver education. Integrating ISPD guidelines into routine audits and reinforcing them through simulation-based refresher training—as encouraged by TEACH-PD (Chow et al., 2023)—could improve compliance and reduce infection rates more effectively. This indicates that, because peritonitis is an extremely sensitive complication that can arise from even small, temporary breaches in sterility or technique, the risk of developing it remains stubbornly high even when nurses are performing at a moderate to good level in general infection control. Even with adequate training, this ongoing risk may be increased by elements like innate patient vulnerability, environmental contamination, or minute, hard-to-detect procedural variances that cause contamination during bag swaps. This highlights that whereas nursing performance greatly lowers many risks, some serious consequences, such as peritonitis, provide a complicated problem that calls for multifaceted interventions that go beyond accepted infection control procedures.

LIMITATION

The study has a few limitations, such as a small sample size of PD nurses and children who meet the inclusion criteria, which could potentially affect the findings; limitations of previous studies; and the three views in different periods for each nurse.

CONCLUSIONS:

The findings of this study underscore the urgent need for targeted interventions to improve the quality of pediatric peritoneal dialysis (PD) care. The predominance of moderate performance among nurses highlights significant gaps in technical proficiency, infection control, and holistic patient management. These deficiencies directly contribute to persistent complications such as catheter displacement, exit site infections, peritonitis, and growth problems—issues that continue to threaten the well-being of pediatric patients.Addressing these challenges requires a multifaceted approach. Implementing standardized, evidence-based training programs will elevate nursing competencies and enhance clinical outcomes. Simultaneously, redesigning the physical environment of PD units can mitigate infection risks and promote safer, more efficient care practices. Equally important is the provision of structured support for caregivers and the removal of socioeconomic barriers that hinder equitable access to quality care.By recognizing and acting upon these interconnected factors, healthcare systems can significantly reduce preventable complications, improve the quality of life for children undergoing PD, and move toward a

more equitable and effective model of pediatric nephrology care. This call to action is not only a clinical imperative but also a moral one—ensuring that every child, regardless of background, receives the highest standard of care possible.

RECOMMENDATION

Immediate implementation of structured, evidence-based training programs for pediatric peritoneal dialysis (PD) nurses is essential to enhance their technical skills, ensure adherence to infection control protocols, improve patient education, and provide psychosocial support. This is especially critical given the high risk of complications such as peritonitis and catheter-related infections, despite the moderate performance levels currently observed among nursing staff.In addition to training, peritoneal dialysis units urgently need to be redesigned to promote sterile practices, safeguard patient privacy, and minimize infection risks. Environmental limitations have been identified as significant barriers to effective infection control, and improving the physical and clinical setup of PD units can help increase compliance with International Society for Peritoneal Dialysis (ISPD) guidelines.Moreover, it is vital to strengthen caregiver support and address socioeconomic barriers that impact the quality of care. Providing comprehensive caregiver training, emotional counseling, and financial assistance can help alleviate the burden on families. At the policy level, developing health strategies that address educational, social, and economic disparities will ensure more equitable access to high-quality PD care for all pediatric patients.

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