

Exit-Site Care Adherence in Peritoneal Dialysis: Real-World Practice and Outcomes

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ABSTRACT

Introduction: Peritoneal dialysis catheter-related infections represent a major source of morbidity, yet the optimal components of exit-site care and the role of patient adherence remain uncertain. This study evaluated real-world exit-site care practices, adherence, and exploratory associations with infection outcomes in a multicultural Australian peritoneal dialysis cohort.

Methods: A cross-sectional observational study was conducted within a metropolitan renal service. Adult patients attending routine follow-up completed a structured interviewer-administered survey capturing recalled training instructions, current practices, and reasons for non-adherence. Infection outcomes were obtained from registry and electronic medical record data, and adherence was assessed against both recalled instructions and local protocol.

Results: A total of 103 participants were included. Non-adherence to recalled training instructions was observed in 50% of participants, while 47% failed to meet at least one of the four minimum care requirements as defined by local protocol. Exit-site care practices varied substantially, particularly regarding antiseptic choice and cleansing frequency. Peritonitis and catheter-related infection rates were low (0.26 and 0.11 episodes per patient-year, respectively) and within guideline targets. No significant associations were identified between adherence measures or specific care practices and infection outcomes. Adverse reactions, most commonly related to antibacterial honey, were the leading reason for deviation from recalled instructions.

Conclusion: Marked variation in exit-site care practices was observed in this cohort, with exploratory analyses identifying no significant associations with infection outcomes. These findings support further evaluation of simplified exit-site care strategies that may improve sustainability and patient acceptability while maintaining acceptable infection control.

Keywords: Peritoneal Dialysis, Catheter-Related Infections, Exit-Site Infections, Peritonitis, Adherence, Anti-Infective Agents, Local, Self Care, Catheters, Indwelling

INTRODUCTION

Peritoneal dialysis (PD) provides a home-based alternative to centre-based haemodialysis (HD) for patients with kidney failure. Despite its advantages of autonomy and quality of life, PD can be complicated by infections, which can result in hospitalisations, transfer to HD or mortality.^{1,2,3} PD catheter-related infections (CRIs), which encompass exit-site infections (ESIs) and tunnel tract infections (TTIs), represent an important source of morbidity in PD, and have been recognised as a key concern by both patients and clinicians in the Standardised Outcomes in Nephrology - PD (SONG-PD) initiative.² As such, ensuring adequate care of the PD catheter exit-site among patients is crucial in reducing ESI risk and minimising disease burden.

Current evidence indicates that specific catheter care practices can influence the risk of CRIs in patients undergoing PD. In a multicentre cross-sectional study conducted in China, engagement in exit-site care practices such as antiseptic use, mask wearing, and routine exit-site observation were associated with lower rates of CRI.⁴ In addition, topical mupirocin has demonstrated efficacy in reducing *Staphylococcus aureus*-related ESIs in selected patient populations.^{5,6}

Despite recognition of exit-site care as an important preventative strategy, the optimal components of care remain unclear, with current International Society for Peritoneal Dialysis (ISPD) guideline recommendations based on relatively low-quality evidence.² This uncertainty is reflected in and likely contributes to the heterogeneity in exit-site care practices across Australian dialysis centres, as demonstrated in the Peritoneal Dialysis Outcomes and Practice Patterns Study (PDOPPS).⁷

Adherence to recommendations for catheter and exit-site care is a potentially modifiable behaviour. One systematic review reported non-adherence to prescribed dialysis exchanges in up to 53% of patients,⁸ while more than one-quarter of patients in another study completed fewer than half of their exchanges.⁹ These high rates likely reflect the substantial treatment burden experienced by patients, who must balance personal responsibilities with performing PD exchanges, conducting exit-site care, and adhering to prescribed medications.

However, there remains a notable gap in the literature examining adherence to exit-site care practices within an Australian context. Understanding how patients implement exit-site care in real-world settings and the reasons underlying deviations from recommended protocols may provide insights into potential future quality improvement initiatives and trials evaluating simplified care models.

The aim of this study was to characterise real-world PD exit-site care practices, adherence patterns and patient-reported barriers in a large prevalent PD population, while exploring associations with infection outcomes.

METHODS

Study Design and Setting

A cross-sectional observational study was conducted within Western Renal Services (WRS), Sydney Australia, which serves a multicultural population of 1.4 million people in Western Sydney and Nepean-Blue Mountains Local Health Districts and includes a large peritoneal dialysis service of 322 patients.¹⁰ Data was collected between August 2024 and October 2025 and the study protocol was approved by the Western Sydney Local Health District Human Research Ethics Committee (HREC 2023/ETH02881).

Participants

Eligible participants were adult patients (≥ 18 years) receiving PD who had completed training at WRS and were attending the PD clinic for routine follow-up care. Inclusion criteria required patients to have been on PD for at least three months and to be capable of providing informed consent. Exclusion criteria included inability to provide informed consent. Participation was voluntary, and written informed consent was obtained prior to survey commencement.

Data Collection

Data reported by patients were collected through a structured interviewer-administered survey developed by the investigators (Supplementary Material). Interviews were conducted in a private room during routine clinic appointments by one of two investigators (JRY, JT) who were not involved in the participants' clinical care, to minimise potential interviewer and social desirability bias. Each session lasted approximately 10 minutes, and was conducted in English or with interpreter assistance, as required.

The survey captured demographic data including language spoken at home and carer involvement in exit-site care. The patient was asked to recall training instructions taught by PD nursing staff and describe their current exit-site care routine. For patients whose practice deviated from their initial training instructions, additional questions were asked regarding the reason for non-adherence and potential barriers to adherence. The patient was also asked to recall their CRI history.

Clinical information regarding CRIs and infection outcomes was retrieved from electronic medical records (eMR) and the Renal Information System and Coordination (RISC) database, which records all dialysis-related care within the PD service. Patient-reported ESIs were reviewed and cross-checked against eMR and RISC documentation. Reported infections with features consistent with ISPD-defined ESIs but no corresponding record were classified as true ESIs.

Local Policy for Catheter Care

Local policy on PD exit-site care within WRS recommends that the dressing remain intact for the first postoperative week following catheter insertion. Thereafter, daily application of povidone-iodine is advised for the subsequent 6-8 weeks to

promote exit-site healing. Beyond this period, patients are advised to cleanse the exit-site daily with either saline or soap and water, in addition to application of either povidone-iodine or Medihoney (Comvita MEDIHONEY, Comvita, Te Puke, New Zealand), and covering the exit-site with a clean dressing afterwards. Topical mupirocin is not used due to concerns of emergence of antibiotic resistance and potential damage to polyurethane catheters.

Variables and Definitions

Adherence to recalled instructions was defined as consistency between a patient's current exit-site care practices and the routine they reported being taught during initial training. It was possible that patients recalled instructions that did not align with the protocol taught.

Adherence to the WRS exit-site care protocol was defined as meeting the minimum recommended standard across four care components:

- (1) daily cleansing
- (2) cleansing the exit-site with either normal saline or soap and water
- (3) application of either povidone-iodine or Medihoney
- (4) application of a dressing

Congruity between recalled training instructions and the WRS protocol was assessed using the same criteria, whereby patients were considered aligned with the protocol if the instructions they recalled reflected all four core components.

For adherence to recalled instructions, the extent of deviation was quantified using a degree of variation framework, categorised as no variation, minor variation and major variation, with the latter two representing discrepancies in 1 or >1 instruction respectively.

Outcomes

The primary outcome of interest was adherence status, defined as concordance between instructed and actual exit-site care practices. Secondary outcomes included infection history and reasons for non-adherence.

Statistical Analysis

Continuous data were reported as mean $\pm$ standard deviation or median (interquartile range) as appropriate, whereas categorical data were presented as frequency (%). Data were analysed using SPSS version 22. Associations between infection outcomes (CRIs, peritonitis) and categorical variables were analysed using the Chi-square test or Fisher's Exact Test as appropriate. For significant associations identified, post-hoc analyses were performed, with Bonferroni correction applied to adjust for multiple comparisons. Peritonitis and catheter-related infection rates were calculated by dividing the total number of infection episodes recorded across the cohort by the cumulative time at risk on PD, expressed in patient-years. Time at risk was defined as the interval from PD commencement to the date of data extraction for each participant. Continuous variables were analysed using

one-way ANOVA. Binary logistic regression was performed to evaluate the independent association between infection outcomes and selected risk factors. A p value of < 0.05 was considered statistically significant.

Sample size estimation was performed a priori. Based on previous studies, non-adherence was expected to occur in approximately 30% of patients,^{11,12} and a baseline CRI rate of 0.30 was assumed.^{2,13} As no prior studies had evaluated the effect of exit-site care adherence on infection outcomes, we hypothesised that non-adherence would double this rate. Under these assumptions, a minimum of 97 evaluable participants was required to achieve 80% power using a two-sided significance level of 0.05.

RESULTS

Participant Characteristics

A total of 103 participants were included in the study (Table 1), with fewer than ten eligible patients estimated to have declined participation; reasons for non-participation were not systematically recorded. The mean age was 61.6 ± 14.9 years, with a median dialysis vintage of 710 days (range 52 - 4018 days). Most participants (62%) were male. The majority of participants performed exit-site care independently (73%), while the remainder relied on a carer. English was the most commonly reported primary language, followed by Arabic and Chinese. Primary kidney disease was most frequently attributed to diabetes and glomerulonephritis.

Table 1. Baseline demographic and clinical characteristics of study participants.

Characteristic	Value ^{a,b}
Number of participants (<i>n</i>)	103
Age, years	61.6 ± 14.9
Sex, <i>n</i> (%)	
Male	64 (62%)
Female	39 (38%)
Dialysis vintage, days	710 (1063.5)
Language spoken, <i>n</i> (%)	
English	47 (46%)
Arabic	10 (10%)
Chinese	10 (10%)
Pasifika	1 (1%)
Other	35 (34%)
Person performing exit-site care, <i>n</i> (%)	
Patient	75 (73%)
Carer	28 (27%)

Characteristic	Value ^{a,b}
Diabetes, n (%)	51 (50%)
Coronary artery disease, n (%)	24 (23%)
Primary cause of kidney disease, n (%)	
Diabetes mellitus	34 (33%)
Autosomal dominant polycystic kidney disease	2 (2%)
Glomerulonephritis	26 (25%)
Hypertension	18 (17%)
Congenital abnormalities of the kidneys and urinary tract	4 (4%)
Other	19 (18%)

^aValues presented as mean $\pm$ standard deviation, median (interquartile range), or frequency (%).

^bPercentages may not total 100% due to rounding

Exit-Site Care Practices and Adherence

Half of the participants were considered adherent to their recalled training instructions (n = 51, 50%), while the remaining participants demonstrated deviation in at least one of the four components of the routine they believed they had been taught (n = 52, 50%). Among non-adherent individuals, variation was minor in 28 (54%) cases and major in 24 (46%).

Analysis of recall accuracy demonstrated that most participants correctly remembered the training instructions provided by nursing staff (n = 75, 73%), but 28 (27%) 'recalled' instructions that differed from the WRS PD exit-site care protocol.

When assessing adherence against the WRS PD exit-site care protocol, 55 (53%) participants met the minimum required standard, whereas 48 (47%) failed to perform at least one aspect. Notably, 15 (15%) participants were adherent to their recalled instructions yet did not meet the WRS protocol requirements as they did not recall certain aspects of exit-site care. Conversely, 11 (11%) were non-adherent to their recalled instructions but still met the minimum standard of WRS local policy due to their recalled instructions being more stringent than WRS protocol.

Antiseptic choice varied widely, with the majority of patients using povidone-iodine solution only (n = 57, 55%), followed by those using both povidone-iodine and Medihoney (n = 29, 28%) (Figure 1).

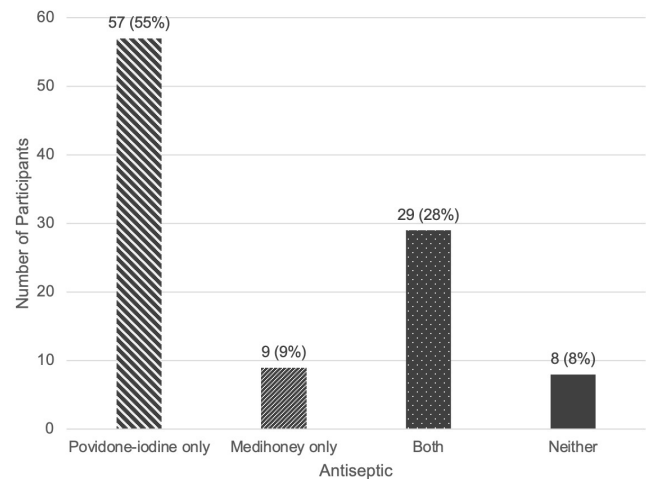


Figure 1. Distribution of antiseptic choice reported by participants for exit-site care. Categories include povidone-iodine only, Medihoney only, both agents, or neither antiseptic. Bars represent the number of participants; counts and percentages are shown above each bar.

Most participants (n = 81, 79%) reported cleaning their exit site daily, while the remaining participants cleaned 0–2 (n = 4), 3–4 (n = 12), and 5–6 (n = 6) times weekly.

Infection Outcomes

In this study, the peritonitis rate was 0.26 episodes per patient-year, while the incidence of catheter-related infection was 0.11 episodes per patient-year. Both rates were well within the ISPD target thresholds of fewer than 0.4 episodes per patient-year.^{1,14}

Overall, 43 participants (42%) had experienced at least one CRI since commencing PD, and 40 (39%) had experienced at least one episode of peritonitis. Eight participants (8%) reported an ESI that was not documented in electronic or registry records.

Factors Associated with Infection Outcomes

All categorical variables that were assessed, including adherence to recalled instructions, degree of variation, adherence to WRS protocol, antiseptic choice, frequency of cleaning, cleansing with soap and water, dressing application, sex, primary language, carer involvement, CAD, and diabetes, showed no statistically significant association with either CRI or peritonitis (Table 2).

For continuous variables, there was a statistically significant association between dialysis vintage and adherence to WRS protocol (p = 0.04). No significant associations were found between dialysis vintage and either adherence to recalled instructions (p = 0.2) or concordance between patients' recalled instructions and the WRS protocol (p = 0.055).

No independent predictors of CRI were identified in multivariable logistic regression analysis (Table 3). Longer dialysis vintage was associated with an increased risk of peritonitis in the multivariable model (p=0.007), while no significant associations were observed with antiseptic choice, CAD or diabetes in the multivariable

model (Table 3). Both logistic regression models demonstrated modest overall explanatory power ($R^2 = 0.128$ for CRI and 0.227 for peritonitis).

Barriers to Adherence and Reasons for Non-Adherence

While various barriers to adherence were cited by patients, the majority of non-adherent patients did not report any barriers ($n = 45$, 87%). Among those who did, inability to afford supplies was the most common hindrance, although it was only reported by 3 patients. Insufficient time was cited by 1 participant, while 2 participants reported other barriers, including visual impairment and recurrent skin overgrowth.

The most common reasons for non-adherence were adverse reactions to antiseptic or dressing ($n = 23$, 44%), perceiving care as unnecessary ($n = 18$, 35%), and lack of motivation ($n = 9$, 17%). Six participants (12%) provided no explicit reason (Figure 2).

Variations in Aspects of Exit-Site Care

The most frequently omitted or altered aspects of care were use of Medihoney ($n = 40$) and cleansing frequency ($n = 15$). In contrast, changes to povidone-iodine use ($n = 10$), cleansing with saline or soap and water ($n = 10$), and dressing application ($n = 5$) were less commonly reported. The vast majority of reported adverse effects were related to Medihoney ($n = 21$), most commonly attributed to local discomfort due to excessive moisture or stickiness at the exit-site, with significantly fewer issues reported for dressing materials ($n = 4$) and povidone-iodine ($n = 1$).

DISCUSSION

This study characterised exit-site care practices in a multicultural Australian PD cohort, focusing on adherence and factors contributing to non-adherence. Approximately half of participants deviated from the prescribed exit-site care protocol, and a similar proportion deviated from their personally recalled training instructions. No associations were observed between infection outcomes and either form of non-adherence – an exploratory finding which requires further confirmation.

Despite receiving structured education during initial PD training, a large proportion of participants demonstrated non-adherence to both local protocol and their recalled training instructions. These deviations in practice were not correlated with poorer infection outcomes, even after stratification according to the degree of variation. This is consistent with Ding et al.'s multicentre study, which reported marked variability in adherence across various self-care domains.⁴ Notably, non-adherence in aspects comparable to those examined in our study, including cleansing frequency and dressing use, was not associated with increased infection risk. Collectively, these findings suggest that some aspects of local exit-site care protocols could be simplified, although prospective studies are needed to confirm comparable infection outcomes.

No antiseptic regimen demonstrated superiority in this study, in keeping with ISPD recommendations.² Several studies have also noted no significant difference in infection outcomes between tested agents, such as the HONEYPOT randomised controlled trial (RCT) comparing Medihoney with intranasal mupirocin.¹³ Conversely, other studies have reported advantages for regimens based on specific antiseptic agents, including Medihoney, povidone-iodine, and chlorhexidine, compared with the alternative regimens evaluated in those studies.^{15,16,17}

Tolerability emerged as a key differentiating factor between antiseptics, with the majority of reported adverse reactions attributed to Medihoney. Despite its theoretical antimicrobial properties,¹⁸ these tolerability issues likely limit its practical utility. By comparison, povidone-iodine was associated with far fewer reported reactions and more consistent use, thereby potentially representing a more acceptable option.

The majority of participants performed daily exit-site cleansing, likely reflecting both local protocol recommendations and regional hygiene practices, with daily showering being common in Australia.¹⁹ However, no significant difference in infection outcomes was observed between daily and less frequent routines. This is in keeping with ISPD guideline recommendations of cleansing at least twice weekly,² which is informed by Ding et al.'s study.⁴ Our findings support further evaluation of less intensive cleansing schedules that may reduce treatment burden while maintaining acceptable infection outcomes.

Similarly, dressing application also exhibited no association with infection risk in this cohort, consistent with findings from Mushahar et al.'s pilot RCT.²⁰ One cohort study reported higher rates of ESIs and peritonitis among patients using dressings compared with the control.²¹ Overall, the existing literature and findings of the present study are in alignment with current ISPD guidance, which does not mandate dressing use.² Most cases of dressing-related non-adherence in our study were largely attributed to local irritation or discomfort ($n = 4$, 80%), suggesting that alternative low-irritant materials may improve acceptability.

The multivariable models of our study demonstrated limited overall explanatory power. The CRI model accounted for only a small proportion of outcome variability ($R^2 = 0.128$), with no independent predictors identified, suggesting that unmeasured factors are likely to play a larger role in infection susceptibility. The peritonitis model demonstrated slightly greater explanatory capacity ($R^2 = 0.227$), with longer dialysis vintage emerging as a significant predictor, likely reflecting cumulative exposure risk over time rather than a direct effect of dialysis duration itself.

Table 2. Summary of chi-square analyses for infection outcomes.

Infection Outcome	Independent Variable	X ² /Z	p-value
Catheter-related infection	Adherence with recalled instructions	0.014	0.907
	Degree of variation (actual practice versus recalled instructions)	0.241	0.886
	Adherence with WRS protocol	0.667	0.414
	Antiseptic choice	6.796	0.078*
	Frequency of cleaning (daily versus non-daily)	0.008	0.928
	Cleansing with soap and water	0.363	0.547
	Dressing application	1.627	0.232*
	Sex	1.254	0.263
	Primary language (English vs non-English)	0.503	0.478
	Carer involvement	0.096	0.757
	Coronary artery disease	1.985	0.159
	Diabetes	0.080	0.777
Peritonitis	Adherence with recalled instructions	0.106	0.745
	Degree of variation (actual practice versus recalled instructions)	0.663	0.718
	Adherence with WRS Protocol	0.914	0.339
	Antiseptic choice	7.460	0.060*
	Frequency of cleaning (daily versus non-daily)	0.051	0.822
	Cleansing with soap and water	0.071	0.790
	Dressing application	0.081	1.000*
	Sex	1.719	0.190
	Primary language (English vs non-English)	0.092	0.762
	Carer involvement	0.158	0.691
	Coronary artery disease	1.642	0.200
	Diabetes	0.533	0.465

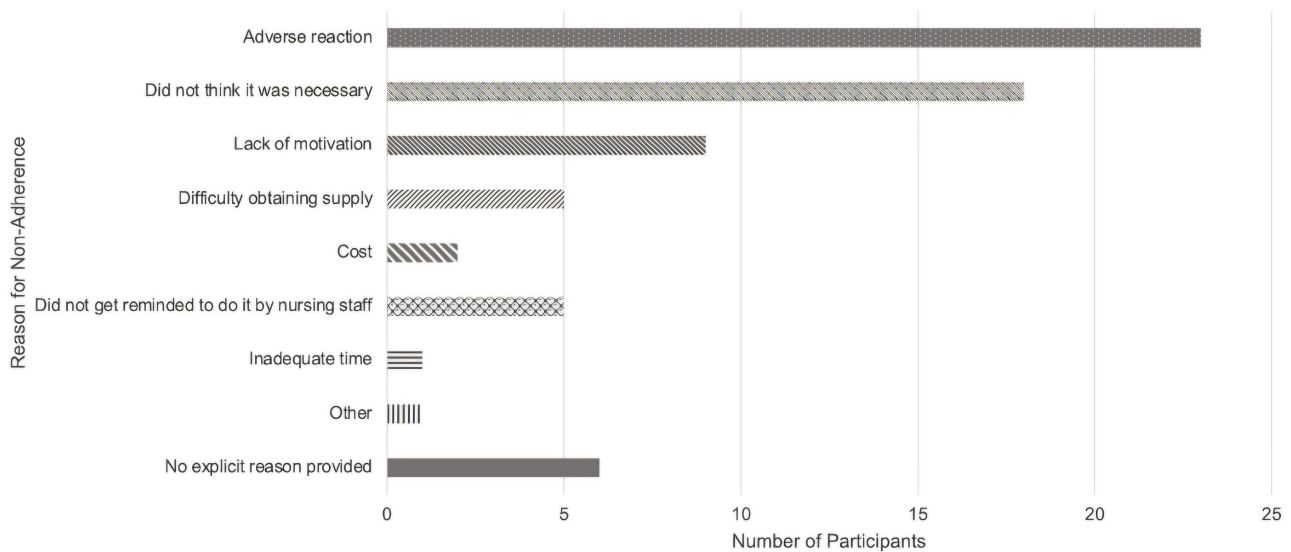
WRS Western Renal Services

*Chi-square assumption of expected cell counts not met (>20% of cells with expected counts <5). Therefore, Fisher's exact test was applied.

Few barriers to adherence were reported, suggesting that systemic challenges such as access or time were not major contributors within this population. Instead, non-adherence was more commonly attributed to personal factors such as adverse reactions, predominantly to Medihoney, as well as a perceived lack of necessity and limited motivation. These observations suggest that future educational programmes may benefit from emphasising the rationale for individual components of exit-site care to improve adherence.

Table 3. Multivariable logistic regression analysis for infection outcomes.

Infection Outcome	Predictor	p-value	Exp(B)	95% Confidence Interval for Exp(B)		Nagelkerke R ²
				Lower	Upper	
Catheter-related infection	Constant	0.804	1.373			0.128
	Carer involvement	0.755	0.858	0.329	2.240	
	Dialysis vintage	0.703	1.000	0.999	1.000	
	Antiseptic choice	0.109				
	Coronary artery disease	0.139	2.231	0.772	6.452	
	Diabetes	0.605	0.789	0.321	1.937	
	Dressing application	0.308	0.384	0.061	2.415	
Peritonitis	Constant	0.847	0.824			0.227
	Dialysis vintage	0.007	1.001	1.000	1.001	
	Antiseptic choice	0.168				
	Coronary artery disease	0.567	0.724	0.239	2.193	
	Diabetes mellitus	0.403	0.666	0.257	1.727	

**Figure 2.** Reasons for non-adherence to recalled exit-site care instructions. Categories include adverse reactions, perceived lack of necessity, reduced motivation, difficulty obtaining supplies, cost, lack of reminders, inadequate time, other reasons, and no explicit reason provided. Bars indicate number of participants.

Unexpectedly, there was considerable discrepancy between patients' recalled training instructions and local protocol, suggesting that information delivered during one-off training may be insufficient in promoting knowledge retention. The TEACH-PD study emphasises the value of structured training approaches that incorporate reinforcement and assessment of understanding.²² Incorporating these principles into PD training

may enhance long-term skill retention and minimise unintentional non-adherence in our study population. Furthermore, periodic retraining may benefit patients established on PD, given the observed association between longer dialysis vintage and reduced adherence to local protocol.

Strengths of this study include collection of survey-related data by researchers with no involvement in the patients' clinical care, which may have encouraged more accurate disclosure of behaviours. The study also evaluated behavioural and practical factors contributing to non-adherence, which has largely been unexplored previously.

Limitations include the cross-sectional design, which prevents assessment of causality, and reliance on self-reported data, which may introduce recall bias. The study's sample size and single-service setting also limit generalisability, particularly for findings related to adherence. Furthermore, recruitment of patients attending routine clinic reviews who were willing to participate in research may result in over-representation of patients who are more engaged with their healthcare, suggesting that the observed non-adherence rates may represent a conservative estimate of real-world practice.

Future research efforts should include RCTs evaluating simplified exit-site care models and antiseptic-only versus antibiotic-based prophylaxis. The latter is particularly relevant given current ISPD guideline recommendations and concerns regarding emerging antimicrobial resistance.² Other components of catheter care, including routine line-change practices and adequate securing of the PD catheter, also warrant further investigation.

CONCLUSION

In this multicultural Australian cohort, substantial variability was observed in PD exit-site care practices, with 50% demonstrating non-adherence to recalled training instructions and a similar proportion failing to adhere to local protocol requirements. Exploratory analyses found no association between either non-adherence or antiseptic choice and infection risk. In contrast, tolerability emerged as a key determinant of adherence, with Medihoney associated with higher rates of adverse reactions. Together, these findings support further investigation of simplified exit-site care strategies designed to improve sustainability and patient acceptability.

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DECLARATION OF CONFLICTING INTEREST

JRY, JT, MD, and JWL report no conflicts of interest. LK reports serving as an ex officio member of the Board of the local health district as part of their role as elected Chair of the Medical Staff

Council. KS reports receiving a Western Sydney Local Health District REN Kick-starter Grant (2024) for the project "Reducing medication-related harm in people with chronic kidney disease during an acute illness", receiving speaker honoraria from Baxter Healthcare, and serving on committees of the Asia Pacific Society of Nephrology, the International Society of Peritoneal Dialysis, and the International Society of Nephrology. KC reports receiving honoraria from Vantive for educational presentations.

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SUPPLEMENTARY MATERIALS

The interviewer-administered survey instrument used in this study and the STROBE checklist are available as supplementary material.

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