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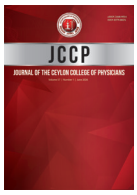

Audit

Audit of peritonitis rates, microbiological profiles, and outcomes among peritoneal dialysis patients in a nephrology unit at a tertiary care hospital in Sri Lanka

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ABSTRACT

Background: Peritonitis remains a major complication of peritoneal dialysis (PD) and is linked to technique failure, catheter loss, and mortality. The International Society for Peritoneal Dialysis (ISPD) 2022 recommends keeping peritonitis rates at ≤ 0.40 episodes per patient-year and culture-negative rates below 15%. Clinical audit is essential for assessing adherence to these standards and identifying areas for quality improvement.
Methods: This retrospective clinical audit included all adult patients receiving PD in Nephrology Unit 3 at the National Hospital of Sri Lanka from 01 January 2025 to 31 December 2025. Peritonitis episodes were identified from clinical and microbiological records. Patient-years were calculated based on PD exposure during the audit period. Outcomes assessed included organism distribution, relapse frequency, catheter removal, fungal peritonitis, insertion-related peritonitis, mortality, and the proportion of patients remaining peritonitis-free. Findings were compared with ISPD 2022 guideline targets and international registry benchmarks.
Results: Twelve patients (7 females, 5 males; mean age 54.8 years) contributed 7.24 patient-years at risk. Thirteen episodes of peritonitis were recorded, corresponding to a peritonitis rate of 1.80 episodes per patient-year, substantially exceeding ISPD 2022 recommendations. Culture-negative peritonitis accounted for 30.8% of episodes. Coliform organisms and Corynebacterium species each accounted for 23.1% of infections, followed by Pseudomonas spp. (15.4%) and Acinetobacter (7.7%). No cases of fungal peritonitis were observed.
Three episodes met ISPD 2022 criteria for relapse (23.1%). Catheter removal occurred in two episodes (15.4%), and one death was associated with peritonitis. Five patients (41.7%) remained peritonitis-free during the audit period. Two episodes (22.2% of catheter insertions) were classified as catheter insertion-related peritonitis.
Conclusion: This clinical audit found that peritonitis and culture-negative rates substantially exceeded ISPD 2022 targets, with relapse rates above registry benchmarks and a low proportion of peritonitis-free patients. These findings highlight the need for targeted infection-prevention strategies and optimisation of microbiological practices. However, the small cohort size and limited patient-years at risk mean that the calculated rates should be interpreted cautiously. A structured quality-improvement initiative, followed by re-audit, is planned.

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Introduction

Peritoneal dialysis (PD) is an established modality of kidney replacement therapy and is widely used for its advantages, including preservation of residual renal function, improved patient autonomy, and avoidance of vascular access complications. Despite these benefits, peritonitis remains a serious complication of PD and continues to be a leading cause of technique failure, catheter removal, hospitalisation, and mortality.

Peritonitis in PD patients is defined by the International Society for Peritoneal Dialysis (ISPD) 2022 criteria as the presence of at least two of the following: clinical features consistent with peritonitis, such as abdominal pain or cloudy dialysate; a dialysate white blood cell count greater than 100 cells/μL with more than 50% polymorphonuclear cells; and a positive dialysate culture. Monitoring peritonitis rates and associated outcomes is essential for evaluating the quality of PD programmes and for ensuring adherence to international standards.

The International Society for Peritoneal Dialysis (ISPD) 2022 guidelines recommend that peritoneal dialysis programmes maintain peritonitis rates at or below 0.40 episodes per patient-year, keep culture-negative peritonitis rates below 15%, and ensure that more than 80% of patients remain peritonitis-free annually. In addition, catheter insertion–related peritonitis, defined as peritonitis occurring within 30 days of catheter placement, should account for less than 5% of catheter insertions. These indicators serve as key quality benchmarks for evaluating the effectiveness and safety of PD programmes.[1]

In addition to guideline targets, international registry data provide valuable real-world benchmarks for peritonitis-related outcomes. Registry reports, including those from the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA), indicate relapse rates of approximately 10–15% and catheter removal rates of approximately 10–20% of peritonitis episodes. Monitoring these parameters is essential for assessing technique survival and overall PD programme performance.[1,2]

Our unit provides a comprehensive peritoneal dialysis programme. Patients undergo standardised training in the aseptic exchange technique prior to initiation of PD. Routine follow-up is conducted in dedicated nephrology clinics, and suspected peritonitis is promptly evaluated and managed in accordance with established protocols, including microbiological assessment and guideline-directed therapy.

The aim of this clinical audit was to evaluate peritonitis rates, microbiological spectrum, and clinical outcomes among patients receiving peritoneal dialysis in our unit and to compare these findings against ISPD 2022 guideline targets and international registry benchmarks. The objectives of this clinical audit were to evaluate key peritonitis-related quality indicators, including the overall peritonitis rate, culture-negative peritonitis rate, microbiological profile, relapse rate, catheter removal rate, catheter insertion-related peritonitis rate, technique failure requiring conversion to haemodialysis, and the proportion of patients remaining peritonitis-free during the audit period.

This audit was undertaken as part of routine clinical quality assurance to evaluate peritonitis-related outcomes in our peritoneal dialysis programme. Although peritoneal dialysis services are established in our unit, a systematic evaluation of peritonitis rates and outcomes has not previously been conducted. In addition, variability in clinical outcomes and the need to align practice with the ISPD 2022 recommendations underscored the importance of formally assessing unit performance. Therefore, this study is a baseline audit intended to identify gaps in care, guide targeted quality improvement interventions, and inform future re-audit.

Methods

This retrospective clinical audit was conducted in our unit, Nephrology Unit 3, at the National Hospital of Sri Lanka, from 01 January 2025 to 31 December 2025 as part of routine clinical quality assurance. Episodes were identified by reviewing PD clinical records and microbiology laboratory databases and were defined according to the International Society for Peritoneal Dialysis (ISPD) 2022 criteria. Data were collected retrospectively from clinical records and microbiology databases using a standardised data extraction approach. No significant missing data were identified for the variables analysed in this audit. Peritoneal dialysate samples were collected under aseptic conditions and inoculated directly into blood culture bottles at the bedside before transport to the microbiology laboratory for processing and organism identification.

All adult patients receiving peritoneal dialysis during the audit period were included. Paediatric patients were not included as the unit manages only adult patients. All patients were on CAPD. A total of 12 patients were receiving peritoneal dialysis during the audit period, contributing 7.24 patient-years at risk.

Ethical approval for this clinical audit was obtained from the Institutional Ethics Review Committee of the National Hospital of Sri Lanka. The study was conducted in accordance with institutional and ethical standards for clinical audit.

Statistical Analysis

Data were analysed descriptively and presented as rates and percentages. The peritonitis rate was calculated as the total number of peritonitis episodes divided by the total patient-years at risk during the audit period, and expressed as episodes per patient-year, in accordance with ISPD 2022 recommendations. Patient-years at risk were calculated as the cumulative duration of peritoneal dialysis exposure for all patients during the audit period, with each patient contributing time from PD initiation (or the start of the audit period) until cessation of PD, death, or the end of the audit period, expressed in years.

The culture-negative peritonitis rate was calculated as the proportion of culture-negative episodes among all peritonitis episodes during the audit period. Organism-specific frequencies were reported as absolute counts and percentages.

Relapsing peritonitis is defined by ISPD 2022 as an episode occurring within four weeks of completion of therapy for a prior episode, caused by the same organism or a sterile episode following culture-negative peritonitis. Relapse rate was calculated as the proportion of peritonitis

episodes that relapsed among all peritonitis episodes. The catheter removal rate was calculated as the proportion of episodes that resulted in catheter removal. Catheter removal was defined as the removal of the peritoneal dialysis catheter due to peritonitis. Technique failure was defined as permanent transfer to haemodialysis due to peritonitis, resulting in discontinuation of peritoneal dialysis. The proportion of patients remaining peritonitis-free during the audit period was calculated as the number of patients who did not develop peritonitis divided by the total number of patients at risk.

Catheter insertion–related peritonitis rate was calculated as the number of peritonitis episodes occurring within 30 days of catheter insertion divided by the total number of catheter insertions during the audit period.

Given the small sample size and limited number of events, no statistical hypothesis tests or confidence intervals were calculated. All results are presented descriptively, and the calculated rates should be interpreted with caution.

Results

Clinical outcomes

The baseline characteristics of the study cohort are summarised in Table 1. Thirteen episodes were recorded, yielding a peritonitis rate of 1.80 episodes per patient-year, more than four times the ISPD 2022 recommended threshold. Five patients (41.7%) experienced no peritonitis during the audit period, well below the recommended target of >80%. Four patients experienced one episode of peritonitis, whereas three patients experienced multiple episodes. Notably, these three patients accounted for a disproportionate number of episodes, indicating that a small subset of patients contributed significantly to the overall peritonitis burden. The mean number of peritonitis episodes among affected patients was 1.86, indicating clustering of infections within a subset of patients.

A total of nine PD catheter insertions were performed during the audit period. Not all patients underwent catheter insertion during the audit period, as some were already established on peritoneal dialysis before the audit began. Two episodes (22.2% of catheter insertions) were classified as catheter insertion-related peritonitis, and the rate was calculated using the number of catheter insertions as the denominator. Given the small number of catheter insertions, this proportion should be interpreted cautiously, as it is subject to considerable statistical variability. These episodes accounted for 15.4% of all peritonitis episodes recorded during the audit period. Four episodes (30.8%) were culture-negative, substantially exceeding the recommended target. No episodes of fungal peritonitis were observed.

Three episodes met ISPD 2022 criteria for relapse (23.1%), exceeding registry-reported rates. Catheter removal occurred in two episodes (15.4%). One death occurred in association with peritonitis. One patient required permanent conversion to haemodialysis due to peritonitis-related technique failure during the audit period. Nine episodes (69.2%) resolved with continued peritoneal dialysis without requiring catheter removal or conversion to haemodialysis.

In this cohort of CAPD patients, culture-negative infections were the most common, accounting for 30.8% of episodes (Table 2). Culture-negative refers to episodes in which no organism was identified despite standard microbiological processing. Among culture-positive cases, coliform organisms and *Corynebacterium* species were equally frequent, each contributing 23.1% of infections, while *Acinetobacter* accounted for the smallest proportion at 7.7%.

Table 1
Baseline characteristics of patients included in the audit.

Variable	Value
Number of patients	12
Age, mean (range), years	54.8 (44–66)
Female, n (%)	7 (58.3)
Male, n (%)	5 (41.7)
Total patient-years at risk	7.24
PD modality	CAPD

Table 2
Microbiological profile of peritonitis episodes during the audit period.

Organism	Episodes	Episodes (%)
Culture-negative	4	30.8
Coliform	3	23.1
Corynebacterium	3	23.1
Pseudomonas spp.	2	15.4
Acinetobacter	1	7.7

Values are presented as number of episodes and percentage of total peritonitis episodes (n = 13).

Discussion

This clinical audit found a peritonitis rate of 1.80 episodes per patient-year, which substantially exceeds the International Society for Peritoneal Dialysis (ISPD) 2022 recommended target of ≤0.40 episodes per patient-year.[1] This finding indicates a significant infection burden in our peritoneal dialysis programme. The proportion of patients remaining peritonitis-free during the audit period was also lower than the recommended benchmark of greater than 80% annually, further emphasising the need to strengthen infection prevention strategies.[1]

Compared with international registry data, the peritonitis rate observed in our unit is higher than that reported in large registry cohorts such as the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA), which reports an overall peritonitis rate of approximately 0.37 episodes per patient-year, with modest variation across centres.[2] Studies from India have reported peritonitis rates ranging from 0.39 to 0.74 episodes per patient-year.[3,4]

Published data on peritoneal dialysis–associated peritonitis from Sri Lanka remain limited. An early study by Perera et al. described microbiological characteristics of peritonitis in Sri Lankan PD patients, although the cohort size was small, limiting broader interpretation.[5] More recently, Herath et al. reported a peritonitis rate of 0.53 episodes per patient-year in a Sri Lankan CAPD cohort studied between July 2020 and April 2022, with culture positivity in 80% of episodes and fungal peritonitis in 10% of cases; seven patients required permanent conversion to haemodialysis due to peritonitis-related complications.[6] Similarly, Ratnapala et al. reported an overall peritonitis rate of 0.4 episodes per patient-year in a Sri Lankan CAPD programme.[7] Compared with these national data, the peritonitis rate observed in our audit is higher, although the absence of fungal peritonitis in our cohort represents a favourable finding.

The reasons for this discrepancy are likely multifactorial. First, differences in patient populations, including comorbidity burden and patient selection, may influence the risk of peritonitis. Second, variations in training protocols, retraining frequency, and adherence to aseptic technique may contribute to differing infection rates between centres. Importantly, the small cohort size in our study may have led to an overestimation of the peritonitis rate, as even a small number of additional episodes can significantly affect calculated rates. Finally, differences in centre experience, infrastructure, and staffing resources across units may also contribute to variability in outcomes.

The culture-negative peritonitis rate observed in our audit exceeded the ISPD 2022-recommended threshold of less than 15%.[1] Elevated culture-negative rates may reflect challenges in specimen collection, transport delays, or suboptimal microbiological processing. Prompt inoculation of dialysate samples into blood culture bottles and improved coordination with microbiology services are essential for enhancing organism identification and guiding appropriate antimicrobial therapy.[1,8]

The microbiological profile in this audit showed a predominance of coliforms and Corynebacterium species. The identification of Corynebacterium species as a relatively frequent isolate is notable, as these organisms are commonly associated with touch contamination during dialysis exchanges.[9] However, in the absence of detailed patient-level data, it is not possible to definitively attribute these infections to lapses in aseptic technique. The observed clustering of peritonitis episodes among a subset of patients suggests that patient-specific factors, including technique, training retention, or environmental conditions during exchanges, may have contributed.

In contrast, the presence of coliform organisms indicates possible environmental or enteric sources of infection, which may reflect different risk factors such as hygiene practices or contamination during handling.

Relapsing peritonitis was observed in a proportion of cases, which may reflect persistent infection, catheter biofilm formation, or incomplete eradication of the initial infection. The procedural catheter insertion-related peritonitis rate was 22.2%, exceeding the ISPD 2022 recommended benchmark of less than 5% and representing a critical and potentially preventable finding. This finding requires urgent corrective action through targeted quality improvement measures.[10,11] The ISPD 2022 guidelines recommend peri-procedural antibiotic prophylaxis, strict adherence to aseptic technique during catheter placement, and appropriate post-insertion care to reduce the risk of early peritonitis.[1]

The elevated rate observed in this audit may reflect gaps in one or more of these areas, including variability in insertion technique, inconsistent antibiotic prophylaxis, or suboptimal early catheter care.[10,11] Given the small number of catheter insertions, this proportion should be interpreted with caution, as it is subject to considerable statistical variability.

Permanent conversion to haemodialysis occurred in one patient due to peritonitis-related technique failure, highlighting the potential impact of infection on long-term PD viability. Temporary haemodialysis was required for selected patients during the management of acute infections, consistent with standard clinical practice.

No episodes of fungal peritonitis were observed in this cohort, which is a favourable finding. Several factors may explain this observation. Fungal peritonitis is often associated with prior or prolonged antibiotic exposure, recent bacterial peritonitis, or delayed catheter removal in the setting of refractory bacterial peritonitis.[1,12] The absence of fungal infections in this audit may reflect limited antibiotic exposure and timely management of bacterial peritonitis.

The elevated peritonitis rate observed in this audit likely reflects a combination of patient-related, procedural, and system-level factors. At the patient level, inadequate adherence to aseptic exchange technique and variability in retention of initial training may have contributed to the risk of infection. This may reflect gaps in reinforcement of training and challenges in maintaining long-term adherence to correct exchange practices. In addition, environmental factors in the home dialysis setting, including suboptimal conditions during exchanges, may have also played a role.[1,13]

At the procedural level, the very high catheter insertion-related peritonitis rate (22.2%) suggests deficiencies in catheter insertion practices. Potential contributors include variability in operator technique and inconsistency in the use of peri-procedural antibiotic prophylaxis.[14,15] System-level factors should also be considered. These

include potential delays in microbiological processing, infrastructure limitations, and staffing constraints within the PD programme, which may affect both patient training and infection surveillance.[15] In addition, as a relatively small PD unit, limited case volume may affect the consistency of training and experience among healthcare providers.

Based on the findings of this audit, a structured quality improvement plan will be implemented. Patient-level interventions will include reinforcement of aseptic exchange technique, implementation of structured retraining programmes at regular intervals, and periodic competency assessments. Procedural interventions will focus on standardising catheter insertion practices, ensuring consistent use of peri-procedural antibiotic prophylaxis, and reviewing post-insertion care protocols. Microbiological interventions will include strict adherence to bedside inoculation of dialysate into blood culture bottles and containers, and optimisation of specimen transport and laboratory processing pathways. System-level interventions will involve regular audit feedback sessions, strengthening infection surveillance, and improving coordination between clinical and microbiology teams.

Rates derived from small PD programmes should be interpreted cautiously, as a limited number of events can disproportionately influence calculated performance metrics. Nevertheless, this audit has identified key areas for quality improvement and provides a foundation for targeted interventions. Continuous surveillance of peritonitis indicators remains essential to maintain high-quality peritoneal dialysis care. A re-audit is planned after the implementation of corrective measures to evaluate their effectiveness and complete the audit cycle.

Although this study does not describe novel organisms or previously unreported treatment outcomes, its value lies in providing real-world data from a single-centre peritoneal dialysis programme in the local context. Such data are essential for benchmarking performance against international standards and for comparison with regional and national outcomes. This audit contributes to the limited published data on peritoneal dialysis-related peritonitis in Sri Lanka and may serve as a reference for future quality improvement initiatives within the national nephrology programme.

Limitations

The small cohort size (n = 12) and limited patient-years at risk mean that the calculated peritonitis rates and related outcomes are inherently unstable and may be disproportionately affected by a small number of events. As a result, the findings should be interpreted with caution, and direct comparisons with larger registry datasets should be made carefully. In addition, this was a single-centre audit, which may limit generalisability to other peritoneal dialysis programmes.

Conclusion

This clinical audit shows a substantially elevated peritonitis rate in the unit compared with ISPD 2022 recommendations, with associated concerns including high culture-negative rates and increased relapse frequency. However, the small cohort size and limited patient-years at risk mean that the calculated rates are inherently unstable and should be interpreted cautiously. Despite this limitation, these findings indicate gaps in infection-prevention practices and highlight the need for targeted quality-improvement interventions, particularly in patient training, microbiological processes, and catheter-insertion protocols.

As a baseline audit, these results provide a framework for implementing corrective measures and for monitoring their impact. A re-audit is planned 12 months after the implementation of these interventions to evaluate the effectiveness of quality improvement measures and to ensure completion of the audit cycle.

Author declaration

Ethical Approval

Ethical approval for this clinical audit was obtained from the Institutional Ethics Review Committee of the National Hospital of Sri Lanka.

Conflicts of Interest

The authors declare no conflicts of interest.

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Author Contributions

MT: study conception, design, data collection, data interpretation, manuscript preparation, and approval of the final manuscript. MS: study conception, design, data interpretation, manuscript preparation, and approval of the final manuscript.

Data Availability

Data are available from the corresponding author upon reasonable request.

Abbreviations

PD – Peritoneal Dialysis
ISPD – International Society for Peritoneal Dialysis
CAPD – Continuous Ambulatory Peritoneal Dialysis
APD – Automated Peritoneal Dialysis
ANZDATA – Australia and New Zealand Dialysis and Transplant Registry

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