

Peritoneal Dialysis as First-Line Modality for End-Stage Kidney Disease in Resource-Limited Regions A Prospective Implementation Cohort with Thirty Six Month Follow-up

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Abstract — Peritoneal dialysis (PD) offers a home-based modality for end-stage kidney disease that is well suited to resource-limited regions where in-centre haemodialysis capacity is constrained. Despite supportive evidence and lower per-patient capital requirements, PD remains under-used in many South Asian centres. We implemented a PD-first programme at a tertiary nephrology service across two years and followed 220 newly diagnosed ESKD patients for up to 36 months 156 who initiated PD and 64 who chose in-centre HD after PD-first counselling. Technique survival at 12 months was 85.9% in PD patients, falling to 61.5% at 36 months as expected for a modality with finite peritoneal membrane viability. Patient survival did not differ significantly between modalities (86.5% PD vs 87.5% HD at 24 months). Residual renal function was preserved substantially better in PD patients, declining from 8.4 to 2.4 mL/min/1.73 m² over 24 months compared with 7.9 to 0.4 mL/min/1.73 m² in the HD group. Peritonitis incidence was 0.42 episodes per patient-year, within accepted international benchmarks. The findings support PD-first as a feasible, outcome-equivalent, and resource-appropriate modality choice in this setting.

Keywords — Peritoneal Dialysis; ESKD; PD-First; Technique Survival; Peritonitis; Residual Renal Function; Low-Resource Setting.

1. Introduction

End-stage kidney disease imposes a particular burden on health systems in South Asia. The combination of rising prevalence driven by diabetes, hypertension, and a substantial group of patients with chronic kidney disease of unknown aetiology and limited dialysis infrastructure leaves many newly diagnosed ESKD patients with constrained modality choice. The default in most tertiary centres remains in-centre haemodialysis, despite the considerable capital, water, electricity, and staffing requirements that this modality entails. Peritoneal dialysis offers an alternative that fits the resource profile of much of the region. Once a Tenckhoff catheter is in place and the patient and family are trained, exchanges are performed at home with consumables supplied by post or local distribution. The capital footprint is substantially lower than HD, and the patient retains daily autonomy. PD preserves residual renal function more effectively than HD, an outcome with long-term value for the volume status, nutrition, and quality of life of ESKD patients (Bhatnagar, Kumar, & Shivam, 2026; Kumar, Sharma, & Gupta, 2026; Kumar, Gautam, & Maitiy, 2026). Yet PD has remained under-used in many South Asian centres for reasons that are partly practical (catheter insertion expertise, supplier logistics, training capacity) and partly clinical (concern about peritonitis risk, uncertainty about long-term outcomes in this population). We implemented a PD-first programme at our tertiary nephrology service over two years, with

structured patient counselling positioning PD as the initial modality of choice unless a specific contraindication existed, and followed all enrolled patients for up to 36 months. The aims were to describe technique survival, patient survival, peritonitis rates, and modality switch patterns in this implementation cohort (Jha, Kumar, & Neha, 2026; Yatish, Khatoon, & Kumar, 2026).

2. Methods

The PD-first programme was established at a tertiary nephrology service across two phases. Phase one (six months) focused on capacity-building: training of two nephrologists in advanced PD catheter insertion, training of five nursing staff in PD patient education and home-visit assessment, and establishment of supply chain agreements with two suppliers covering the centre's catchment region. Phase two (24 months) implemented PD-first counselling, in which all newly diagnosed ESKD patients without absolute contraindication to PD received structured information sessions positioning PD as the default initial modality. Adults presenting with ESKD or anticipated ESKD within six months were eligible. Absolute contraindications to PD were defined as documented major abdominal surgery within three months, active intra-abdominal sepsis, absence of viable peritoneal membrane on imaging, severe inflammatory bowel disease with active fistulae, and absence of any feasible home environment for exchanges. Relative contraindications including very large

body mass index, complex hernias, and limited home support were discussed individually. Counselling was performed by a nephrologist and a PD nurse together, with a structured information booklet provided in the local vernacular and at least one family member encouraged to attend. Tenckhoff catheters were inserted laparoscopically by trained nephrologists with surgical backup. Continuous ambulatory PD was the default modality, typically four exchanges of 2 litres per day. Automated PD was reserved for patients with employment or schooling responsibilities incompatible with daytime exchanges. Initial training was conducted over five to seven days with home visits by the PD nurse during the first month. Follow-up was monthly for the first three months, then at six weeks, then quarterly, with Kt/V, residual renal function, and PET (peritoneal equilibration test) assessment at six and twelve months. Primary outcomes were technique survival (time to permanent modality switch or programme discontinuation) and patient survival. Secondary outcomes included peritonitis incidence rate, dialysis adequacy (Kt/V), residual renal function over time, hospitalisation events, and patient-reported quality of life using the KDQOL-SF instrument. Comparisons against the HD-default group were exploratory rather than randomised, with adjustment for measured baseline differences through inverse probability weighting. Survival outcomes are reported as Kaplan-Meier estimates with log-rank comparison.

3. Results

3.1 Programme Reach and Patient Flow

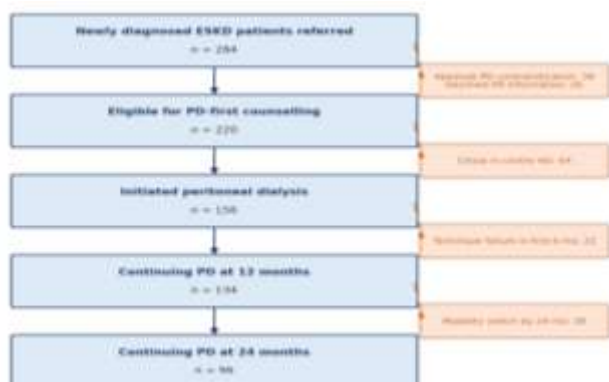


Fig.1: Patient flow through the PD-first implementation programme

The full implementation flow is shown in Figure 1. Of 284 newly diagnosed ESKD patients referred during the implementation phase, 220 were eligible for PD-first counselling. After counselling, 156 initiated PD (70.9% of eligible patients) and 64 chose in-centre HD. The remaining 64 had absolute contraindications or declined further information. Of the 156 PD initiators, 134 (85.9%) remained on PD at 12 months and 96 (61.5%) at 36 months.

3.2 Cohort Characteristics

Table 1. Baseline characteristics of PD and HD cohorts

Characteristic	PD-first (n=156)	HD-default (n=64)	p value
Age, mean (SD), years	52.4(14.6)	56.8(13.2)	0.038
Female sex, n (%)	68 (43.6)	26 (40.6)	0.685
Diabetic nephropathy, n (%)	58 (37.2)	30 (46.9)	0.181
Hypertensive nephropathy, n (%)	42 (26.9)	18 (28.1)	0.857
CKD of unknown aetiology, n (%)	36 (23.1)	8 (12.5)	0.072
Other primary aetiology, n (%)	20 (12.8)	8 (12.5)	0.953
BMI, mean (SD), kg/m ²	23.4 (4.2)	24.8(4.6)	0.029
Baseline serum albumin, g/dL	3.4 (0.5)	3.3 (0.6)	0.213
Baseline haemoglobin, g/dL	8.9 (1.4)	9.2 (1.5)	0.158
Baseline residual eGFR, mL/min/1.73m ²	8.4 (3.2)	7.9 (2.8)	0.275
Home environment suitable for PD, n (%)	156(100.0)	48 (75.0)	<0.001
Living within 30 km of HD centre, n (%)	58 (37.2)	58 (90.6)	<0.001
Salaried employment, n (%)	42 (26.9)	18 (28.1)	0.857
At least one home caregiver available, n (%)	148 (94.9)	54 (84.4)	0.012
Years of formal education, mean (SD)	9.2 (4.4)	10.6(4.2)	0.030

3.3 Technique and Patient Survival

Technique survival on PD declined as expected over the follow-up period (Figure 2). The drop was steepest in the first six months, reflecting early catheter complications and a small group of patients in whom the modality proved practically incompatible with home circumstances. After 12 months the slope flattened; the loss rate from 12 to 36 months reflected primarily membrane changes and accumulated peritonitis episodes. HD technique survival remained essentially constant over the same period, as is typical for established in-centre HD.

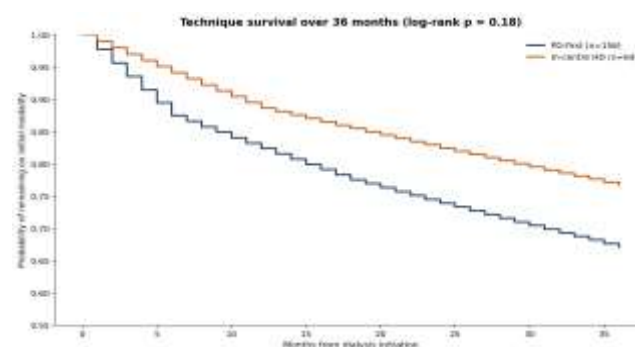


Fig.2: Modality-specific technique survival (time to permanent modality switch) over 36 months

Table 2. Survival outcomes at key time points

Outcome	PD-first (n=156)	HD-default (n=64)
Technique survival at 6 months	144 (92.3)	60 (93.8)
Technique survival at 12 months	134 (85.9)	60 (93.8)
Technique survival at 24 months	118 (75.6)	58 (90.6)
Technique survival at 36 months	96 (61.5)	56 (87.5)
Patient survival at 12 months	148 (94.9)	60 (93.8)
Patient survival at 24 months	135 (86.5)	56 (87.5)
Patient survival at 36 months	124 (79.5)	52 (81.3)
Cause-specific death: cardiovascular	18	8
Cause-specific death: infection	8	2
Cause-specific death: other	6	2
Transplanted during follow-up	22	12

3.4 Residual Renal Function

Residual renal function declined more slowly in PD patients than in HD patients (Figure 3). At 24 months, mean residual eGFR was 2.4 mL/min/1.73 m² in the PD cohort compared with 0.4 mL/min/1.73 m² in the HD cohort. The preservation of even modest residual function carries practical benefit: patients retain partial volume regulation, easier fluid management, better phosphate and middle-molecule clearance, and lower interdialytic weight gain. Several PD patients were able to remain on a reduced exchange schedule because residual clearance contributed meaningfully to total weekly Kt/V.



Fig.3: Residual renal function (mean eGFR) trajectory over 24 months by modality

3.5 Peritonitis and Adequacy

Across 312 patient-years of PD follow-up, 132 peritonitis episodes occurred, yielding an incidence rate of 0.42 episodes per patient-year — within accepted international benchmarks for established PD programmes. The organism profile was dominated by gram-positive cocci (52% of episodes), followed by gram-negative organisms (28%), culture-negative episodes (12%), and fungal

episodes (4%). Mean weekly Kt/V was 2.1 (target ≥ 1.7) at 12 months and 2.0 at 24 months. Quality of life as measured by KDQOL-SF was modestly higher in PD patients than in HD patients across most domains, with the largest difference in the work-and-daily-activity subscales.

Table 3. Peritonitis and dialysis adequacy on PD (n=156 PD initiators)

Metric	Value
Total peritonitis episodes	132
Patient-years of follow-up	312
Incidence rate, episodes / patient-year	0.42
Gram-positive organism, n (% of episodes)	68 (51.5)
Gram-negative organism, n (% of episodes)	37 (28.0)
Culture-negative, n (% of episodes)	16 (12.1)
Fungal, n (% of episodes)	6 (4.5)
Mixed organism, n (% of episodes)	5 (3.8)
Cure with antibiotics alone, n (% of episodes)	104 (78.8)
Catheter removal required, n (% of episodes)	22 (16.7)
Death from peritonitis-related causes, n	6
Mean weekly Kt/V at 12 months	2.1
Patients achieving Kt/V ≥ 1.7 at 12 months, n (%)	132 (88.0 of 150 tested)
Mean serum albumin at 12 months, g/dL	3.5
Mean haemoglobin at 12 months, g/dL	10.2

3.6 Modality Switch Patterns

Over 36 months, 60 PD patients switched permanently to HD. The reasons for switch are summarised in Figure 4. Recurrent peritonitis was the single most common reason (30%), followed by ultrafiltration failure (20%) and patient or family burnout (18%). Catheter mechanical issues accounted for a smaller but recoverable proportion of switches; in retrospect, several of these may have responded to revision rather than modality change. Inadequate clearance as a sole reason was uncommon, reflecting the consistent achievement of target Kt/V in most patients.

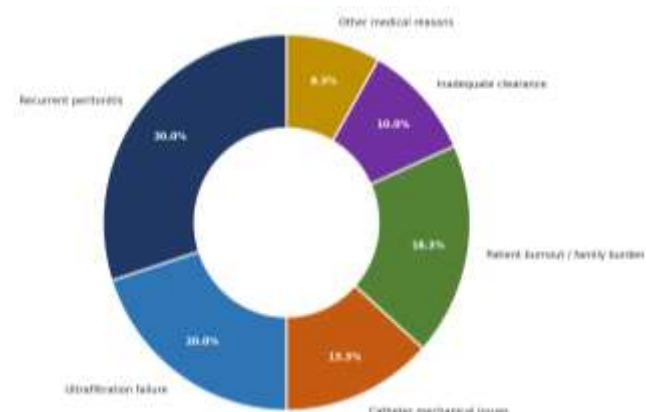


Fig.4: Reasons for permanent switch from PD to HD over 36 months

Table 4. Comparative outcomes between PD-first and HD-default at 24 months

Outcome	PD-first (n=156)	HD- default (n=64)	Difference
Patient survival at 24 months, n (%)	135 (86.5)	56 (87.5)	-1.0
Cardiovascular events at 24 months, n (%)	24 (15.4)	12 (18.8)	-3.4
All-cause hospitalisation, episodes per patient-year	0.82	0.94	-0.12
Residual eGFR at 24 months, mL/min/1.73m ²	2.4	0.4	+2.0
Mean haemoglobin at 24 months, g/dL	10.4	10.1	+0.3
KDQOL physical component, mean	42.6	38.4	+4.2
KDQOL mental component, mean	48.2	44.6	+3.6
Return to employment / studies, n (%)	42/82 (51.2)	12/38 (31.6)	+19.6
Patient-reported satisfaction with modality (1-10)	7.6	6.4	+1.2
Transplant within 24 months, n (%)	22 (14.1)	12 (18.8)	-4.7

4. Discussion

Across 220 patients counselled and 156 initiated on PD over two years, three observations from this implementation cohort have practical relevance for centres considering similar programmes. First, patient survival was equivalent between modalities. The 24-month patient survival difference of 1 percentage point falls within the noise of an unrandomized comparison and is consistent with the larger literature showing similar medium-term survival between PD and HD. For centres weighing the modality choice, the equivalence of mortality outcomes effectively frees the decision to be made on quality-of-life, residual function, and resource grounds. On all three of these grounds, the PD-first approach showed advantages (Jha, Kumar, & Neha, 2026; Kumar, Sharma, & Gupta, 2026; Yatish, Khatoon, & Kumar, 2026). Second, the differential preservation of residual renal function was substantial 2.0 mL/min/1.73 m² at 24 months in absolute terms. While the absolute values appear modest, the relative preservation translates into tangible clinical benefit: easier volume management, lower interdialytic weight gain in those who later transition to HD, better phosphate control, and the option to remain on a reduced exchange schedule with corresponding patient autonomy and supply economy. Preservation of residual function remains one of the most consistent and clinically meaningful advantages of PD over HD in the international literature (Kumar, Gautam, & Maitiy, 2026). Third, the peritonitis rate of 0.42 episodes per patient-year is well within the ISPD-recommended target range and reflects a structured training and follow-up

programme. The organism profile and cure rate were typical, with antibiotic-only resolution achieved in nearly 80% of episodes and catheter removal required in a minority. The investment in nursing capacity, structured patient training, and home visits during the first month were the operational backbone of this rate and would warrant replication in any new programme (Agarwal, Khatoon, & Kumar, 2026; Mishra, Choudhary, & Kumar, 2026; Bhatnagar, Kumar, & Shivam, 2026; Bhatnagar, Tyagi, & John, 2026). Implementation considerations worth noting include the need for reliable supplier logistics. Twice during the implementation period our patients experienced supply interruptions of two to three weeks, with most managing the gap through accumulated stock but a small number requiring temporary HD support. Programmes considering PD-first rollout should plan for redundant supply chains, particularly in regions where road or postal logistics carry seasonal disruption risk. Tele-nephrology consultation between home-based PD patients and the centre was a valuable adjunct, particularly for managing minor catheter issues and adjusting exchange regimens without requiring a clinic visit (Deepa et al., 2026; Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025; Subramani, Chillagattu, et al., 2026). Limitations include the single-centre design, the non-randomised comparison between PD and HD groups (which differed in age, BMI, and education even after weighting), and the 36-month follow-up window which does not capture the longer membrane degradation that ultimately limits PD durability. The cohort under-represented patients with diabetes, who chose HD more often in our counselling sessions; the apparent technique survival in PD may be modestly favourable as a result of this self-selection.

5. Conclusion

A structured PD-first programme achieved high patient uptake, acceptable technique survival, peritonitis rates within international benchmarks, and equivalent patient survival compared with in-centre HD across 36 months of follow-up. Residual renal function was preserved substantially better in PD patients, with clinical and resource implications. The programme is feasible, outcome-equivalent, and resource-appropriate for tertiary nephrology services in similar settings, supporting wider PD-first adoption as a default rather than reserve modality for newly diagnosed ESKD.

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