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Thailand Renal Replacement Therapy Registry 2023: Epidemiological Insights Into Dialysis Trends and Challenges

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ABSTRACT

Introduction: The Thailand Renal Replacement Therapy (TRT) Registry is a vital database tracking patient demographics, treatment modalities, and outcomes across hemodialysis centers nationwide.

Methods: This study analyzes TRT Registry data from 2000 to 2023 to identify trends and challenges in managing end-stage kidney disease (ESKD).

Results: Among 152 827 patients, 129 113 received hemodialysis, and 23 714 underwent peritoneal dialysis. Diabetic nephropathy and hypertension accounted for over 80% of cases, with IgA nephropathy as the most common biopsy-confirmed glomerulonephritis. Most patients had a primary school education or lower. The Universal Coverage Scheme (46.2%) was the primary funding source. Thrice-weekly dialysis was the most common regimen (65.0%), while 34.3% of patients received twice-weekly dialysis. Key challenges included anemia, malnutrition, vascular access issues, and disparities in dialysis adequacy. Cardiac disease (34.7%), infections (19.7%), and cerebrovascular disease (7.7%) were the leading causes of death.

Conclusion: Thailand's growing ESKD burden demands improved renal replacement therapy (RRT) strategies. The TRT Registry offers essential insights to guide policy and healthcare improvements.

1 | Introduction

Dialysis care in Asia is influenced by government support, patient-centered policies, and efforts to improve access to quality kidney care services. Despite progress, disparities remain between affluent nations and lower-income countries, where economic constraints and healthcare infrastructure challenges limit access to adequate renal care [1–5]. In Thailand, a policy shift in renal replacement therapy (RRT) under the Universal Coverage Scheme (UCS), effective February 1, 2022, allows end-stage kidney disease (ESKD) patients to choose between hemodialysis and peritoneal dialysis, promoting a patient-centered approach [6]. This policy empowers patients with ESKD to select their preferred treatment modality either—hemodialysis or peritoneal dialysis fostering—more personalized care [7]. It reflects global trends toward patient

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empowerment and personalized healthcare, encouraging informed treatment decisions based on individual health needs and preferences [8].

Central to addressing these challenges is the Thailand Renal Replacement Therapy (TRT) Registry, a vital database tracking patient demographics, treatment modalities, and clinical outcomes across hemodialysis centers nationwide. By systematically collecting and analyzing data, the TRT Registry offers insights into current practices, identifies evolving trends, and highlights areas for improvement. This report analyzes TRT Registry data, focusing on trends, challenges, and opportunities in RRT delivery in Thailand. By interpreting registry findings, we aim to guide clinicians, policymakers, and researchers in enhancing care for ESKD patients and strengthening healthcare system capacity.

2 | Materials and Methods

We analyzed national registry data from the TRT program, covering dialysis services across all 77 provinces in 2023. Ethical approval was obtained from the Institutional Review Board of the Royal Thai Army Medical Department (IRBRTA 1445/2567), Bangkok, Thailand. The TRT program (version 3) integrates data from hospitals, dialysis centers, and nephrology units, ensuring consistency through standardized forms and electronic submissions. The dataset included all patients who initiated dialysis for ESKD between 2000 and 2023, with a primary focus on those starting treatment in 2023.

The study population included patients who initiated RRT in 2017, encompassing both hemodialysis and peritoneal dialysis. Inclusion criteria required complete medical records and confirmed initiation of dialysis. Data accuracy was ensured through automated cleaning algorithms, cross-referencing of patient records, and resolution of discrepancies in collaboration with reporting centers. In 2023, 1089 out of 1106 active dialysis centers (98.4%) participated in the registry. These 1106 facilities comprised 587 hemodialysis centers (53.1%) operated directly by in-house public hospitals, 208 centers (18.8%) providing outsourced dialysis services for public hospitals, and 311 centers (28.1%) functioning as private standalone clinics nationwide [9].

The collected variables included demographic details (age, sex, education, and region), clinical parameters (causes of ESKD, metabolic profiles, anemia status, vascular access), and treatment modalities. We analyzed dialysis reimbursement distribution across Thailand's three main public health insurance schemes—the Universal Coverage Scheme (UCS), Civil Servant Medical Benefit Scheme (CSMBS), and Social Security Scheme (SSS)—to identify potential disparities in access and modality choice. Each scheme has distinct reimbursement policies that influence treatment decisions and outcomes. The UCS, covering 75% of the Thai population, initially limited reimbursement to peritoneal dialysis (CAPD) but later expanded to include hemodialysis under specific conditions. The CSMBS (8% of the Thai population) and SSS (16%) provide full reimbursement for both peritoneal dialysis and hemodialysis, allowing unrestricted modality choice. By comparing utilization patterns across these schemes, we aimed to assess the impact of healthcare financing on dialysis access, modality distribution, and equity of care within the Thai healthcare system.

Additional data included mortality rates, treatment adequacy, and laboratory parameters related to anemia, mineral metabolism, and nutrition. For anemia and metabolic control targets, we applied criteria from the 2021 Clinical Practice Guideline for the Management of Anemia in Chronic Kidney Disease and the 2022 Thailand Chronic Kidney Disease–Mineral and Bone Disorder (CKD-MBD) Guideline. Hemoglobin targets were set at 10–11.5 g/dL, while acceptable ranges for calcium, phosphate, and intact parathyroid hormone in ESKD followed the recommended range of up to 2–9 times the upper limit of normal for intact parathyroid hormone [10]. This dataset provided valuable insights into dialysis trends, resource allocation, and the association between treatment modalities and clinical outcomes, thereby supporting evidence-based healthcare policy development.

We utilized data from a nationwide registry in Thailand, which records causes of death based on clinician diagnoses documented in medical records or death certificates. The definitions of clinical conditions—including cardiac disease, infectious disease, cerebrovascular disease, kidney disease including withdrawal from dialysis, uremic encephalopathy or other uremic complications, malignancy, and liver disease—were derived from the primary diagnosis reported by the treating clinician at the time of death. These diagnoses were not adjudicated using standardized or uniform clinical criteria across all centers.

2.1 | Statistical Analysis

Descriptive statistics were used to summarize the dataset. Continuous variables were reported as mean ± standard deviation (SD) or as median and interquartile range (IQR), while categorical variables were presented as frequencies and percentages. Patient characteristics, anemia status, metabolic profiles, and clinical outcomes were compared across treatment groups. Differences in means and proportions between groups were analyzed using independent *t*-tests and chi-square tests, respectively. Time-series methods were employed to evaluate yearly trends in dialysis initiation, while descriptive statistics were used to assess metabolic abnormalities, anemia management, and vascular access patterns.

3 | Results

3.1 | Yearly Prevalence Trend of Dialysis Patients (2000–2023)

The incidence of RRT, which includes both hemodialysis and peritoneal dialysis, has shown a steady increase from 2000 to 2023 (Figure 1). By 2023, data revealed a notable rise in new cases. Specifically, 13 045 new patients began hemodialysis, which represented a rate similar to that of the 2020–2021 period. The prevalence of RRT via peritoneal dialysis and hemodialysis

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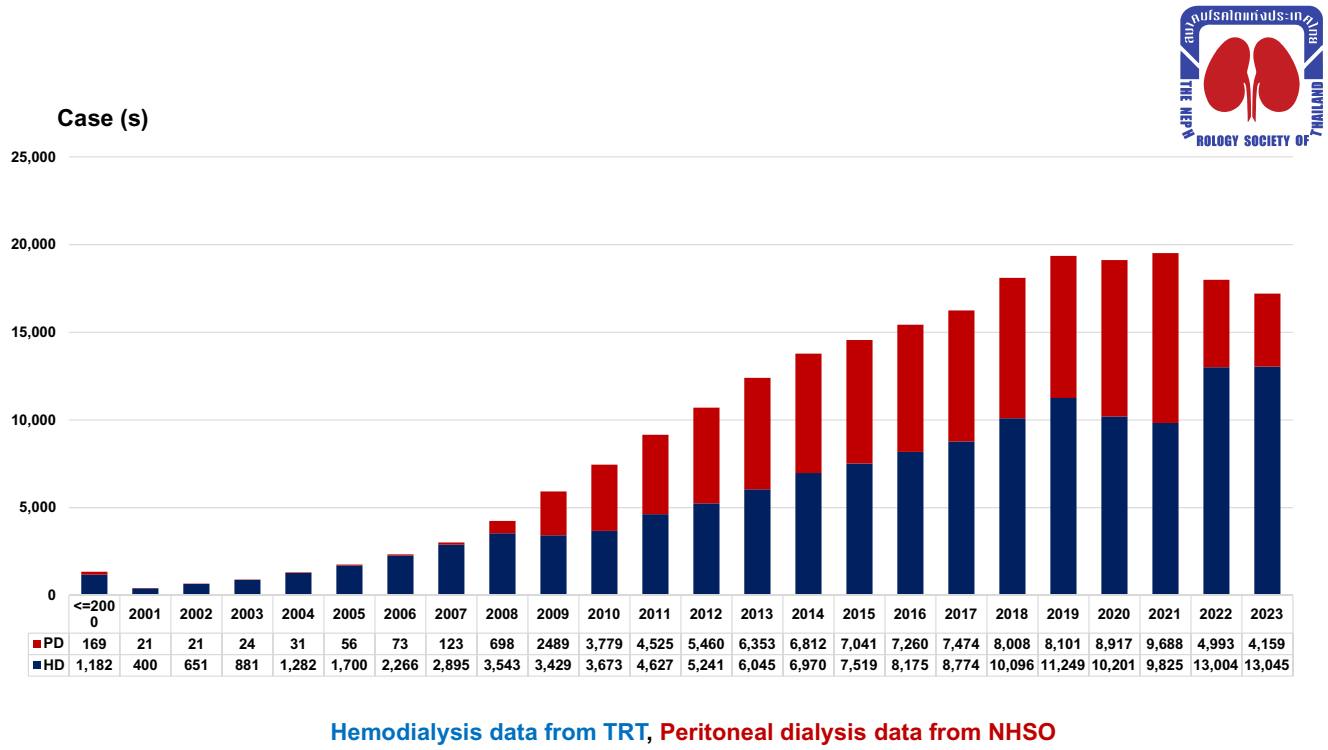

FIGURE 1 | Yearly incidence trend of dialysis patients from 2000 to 2023.

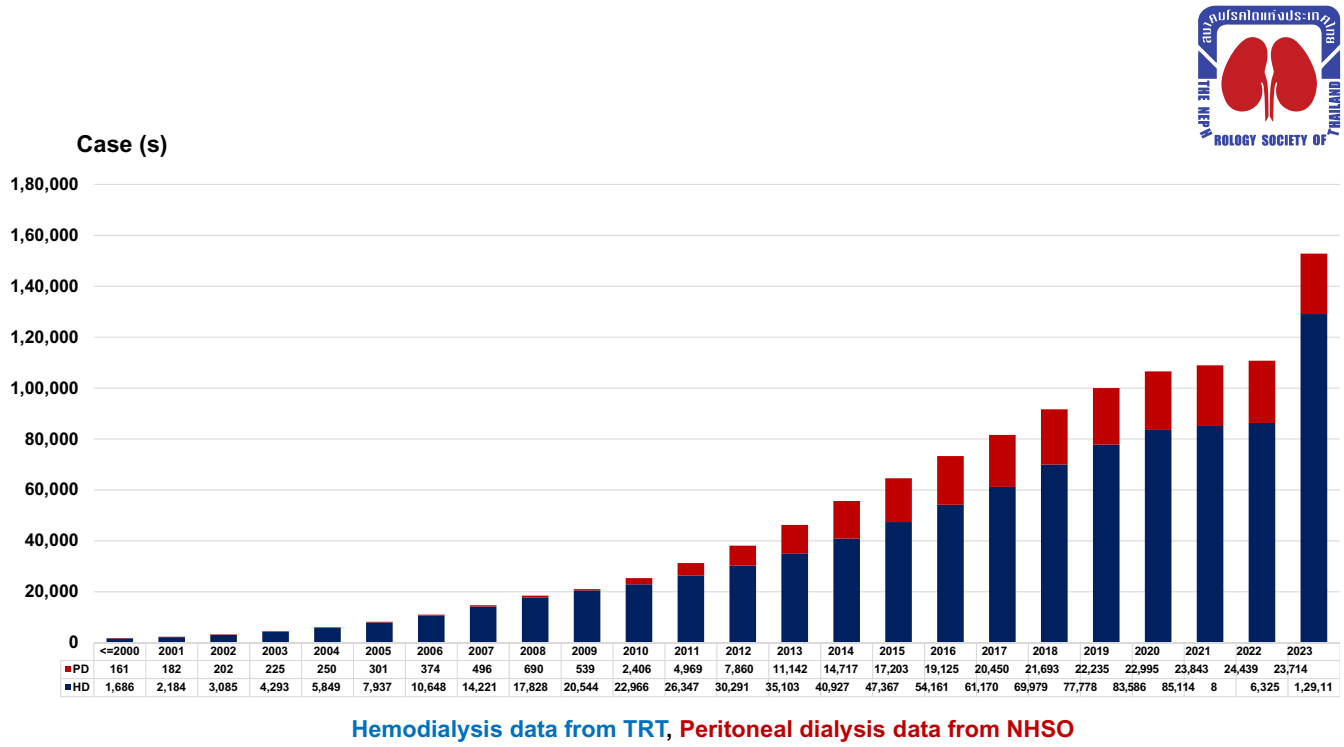

FIGURE 2 | Yearly prevalence trend of dialysis patients from 2000 to 2023.

steadily increased from 2000 to 2023, indicating a rising burden of ESKD (Figure 2). By 2023, 129 113 patients underwent hemodialysis, and 23 714 received peritoneal dialysis. This rise underscores the growing public health challenge posed by ESKD, driven by increasing incidences of hypertension and diabetes. Data on peritoneal dialysis were sourced from Thailand's National Health Security Office (NHSO), tracking nationwide dialysis modality utilization.

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TABLE 1 | Underlying causes of end-stage kidney disease (ESKD).

Causes of end-stage kidney disease (ESKD)	Total ($N = 142938$)	Percentage (%)
Diabetic nephropathy	48659	34.0
Hypertensive nephropathy	39914	27.9
Chronic tubulointerstitial disease	7758	5.4
Glomerulonephritis	4261	2.9
Others	3495	2.4
Obstructive nephropathy	2340	1.6
Polycystic kidney disease	1694	1.2
Unknown	6931	4.8
Missing data	27816	19.5
Biopsy-proven glomerulonephritis resulting in end-stage kidney disease (ESKD)	**Total ($N = 836$)**	**Percentage (%)**
IgA Nephropathy	245	29.3
Membranoproliferative glomerulonephritis (MPGN)	218	26.1
Membranous nephropathy	86	10.2
Focal segmental glomerulosclerosis (FSGS)	80	9.6
Chronic allograft nephropathy	19	2.3
Mesangial proliferative glomerulonephritis	16	1.5
Crescentic glomerulonephritis	12	1.9
Amyloidosis	7	0.8
Unknown	86	10.2
Others	67	8.0

3.2 | Underlying Causes of ESKD

Among dialysis patients, diabetic nephropathy and hypertension were the primary causes of ESKD, collectively accounting for over 60% of cases. Diabetes led with 34%, followed closely by hypertension at 27.9%, as shown in Table 1. Chronic tubulointerstitial diseases, including chronic urate nephropathy, analgesic nephropathy, and chronic pyelonephritis, constituted 5.4% of cases. Glomerulonephritis, particularly lupus nephritis ($N = 1091$), represented 2.9% of cases, highlighting chronic conditions' pivotal role in ESKD prevalence.

3.3 | Biopsy-Proven Glomerulonephritis Leading to ESKD

Among 836 biopsy-confirmed cases of glomerulonephritis leading to ESKD by 2023, IgA nephropathy predominated at 29.3%. Membranoproliferative glomerulonephritis (MPGN), membranous nephropathy, and focal segmental glomerulosclerosis (FSGS) followed at 26.1%, 10.2%, and 9.6%, respectively, as shown in Table 1. In 10.2% of cases, the cause remained unidentified, necessitating further diagnostic exploration.

3.4 | Age, Gender, and Education of Dialysis Patients

The dialysis population had a mean age of 61.9 ± 16.7 years, with 52.1% male and 46.3% female. Age and sex distribution were similar between hemodialysis and peritoneal dialysis groups. Regarding education, 32.9% (47321 patients) had a primary school education or lower, with a higher prevalence among peritoneal dialysis patients (55.5%) compared to hemodialysis patients (30.3%). Conversely, 13.8% of hemodialysis patients held a bachelor's degree or higher, compared to 5.1% of peritoneal dialysis patients, as shown in Table 2. This disparity suggests socio-economic and accessibility factors may influence dialysis modality choice and health outcomes.

3.5 | Distribution of Dialysis Patients Across Reimbursement Schemes

Thailand's reimbursement schemes ensure access to RRT for ESKD patients, as shown in Table 2. The UCS covered the largest proportion (46.2%), followed by the CSMBS at 21.2% and the SSS at 16.3%. While all schemes primarily support hemodialysis, UCS had a higher proportion of peritoneal dialysis patients, likely due to differences in dialysis availability, patient preferences, and provider recommendations.

3.6 | Vascular Access in Hemodialysis Patients

The primary vascular access types were arteriovenous fistula (AVF, 38.9%), double lumen catheter (DLC, 22.8%), and permanent catheter (18.8%). The high reliance on DLC for long-term dialysis raises concerns, as it is associated with higher complication rates compared to AVF, indicating potential challenges in achieving optimal vascular access.

3.7 | Hemodialysis Adequacy

The adequacy of dialysis treatment is commonly evaluated using parameters, such as spKt/V and the urea reduction ratio (URR), which assess the efficiency of dialysis by quantifying urea clearance, a key indicator of waste removal during the procedure, as shown in Table 3. Thrice-weekly dialysis was the most common regimen (65.0%), while 34.3% of patients received twice-weekly dialysis. Mean spKt/V was 1.71 ± 0.34 for twice-weekly dialysis and 1.64 ± 0.33 for thrice-weekly dialysis. Notably, 62.1% of twice-weekly patients had suboptimal spKt/V (< 1.8), compared

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TABLE 2 | Characteristics of dialysis patients.

Category	Hemodialysis ($N=129113$)	Peritoneal dialysis ($N=14779$)	p	Total ($N=143892$)
Gender (male/female %)	52.3/46.1	50.8/48.2	< 0.001	52.1/46.3
Age (years)	62.3 ± 17.05	59.9 ± 15.4	< 0.001	61.9 ± 16.7
Age groups (*N*, %)				
< 18 years	2998 (2.5%)	240 (1.7%)	< 0.001	3238 (2.4%)
18–40 years	10326 (8.5%)	1369 (9.6%)		11695 (8.6%)
41–60 years	35808 (29.4%)	4696 (33.0%)		40504 (29.8%)
> 60 years	72584 (59.6%)	7928 (55.7%)		80512 (59.2%)
Education levels (*N*, %)				
Primary school or lower	39116 (30.3%)	8205 (55.5%)	< 0.001	47321 (32.9%)
Secondary school	28870 (22.4%)	2844 (19.2%)		31714 (22.0%)
High school	12769 (9.9%)	1190 (8.1%)		13959 (9.7%)
Vocational/high vocational certificate	10402 (8.1%)	740 (5.0%)		11142 (7.7%)
Bachelor's degree or higher	17816 (13.8%)	760 (5.1%)		18576 (12.9%)
Unknown	20140 (15.6%)	1040 (7.0%)		21180 (14.7%)
Distribution of dialysis patients across reimbursement schemes (*N*, %)				
Universal Coverage Scheme (UCS)	50115 (41.8%)	12018 (82.5%)	< 0.001	62133 (46.2%)
Civil Servant Medical Benefit Scheme (CSMBS)	27517 (22.9%)	941 (6.5%)		28458 (21.2%)
Social Security Scheme (SSS)	21396 (17.9%)	535 (3.7%)		21931 (16.3%)
Self-payment	13217 (11.0%)	137 (0.9%)		13354 (9.9%)
Others	7648 (6.4%)	930 (6.4%)		8578 (6.4%)

Note: The data is presented as mean ± SD and percentages. An independent t-test and chi-square test were used to compare means and percentages between groups.

to 7.6% of thrice-weekly patients falling below the target (1.2). This highlights the challenge of maintaining adequate dialysis with less frequent sessions.

The mean normalized protein catabolic rate (nPCR) was 1.20 ± 0.25 g/kg/day for twice-weekly dialysis and 1.09 ± 0.23 g/kg/day for thrice-weekly dialysis, suggesting lower protein intake in the latter group. Alarmingly, 23.0% of twice-weekly and 37.7% of thrice-weekly patients had an nPCR < 1.0 g/kg/day, indicating inadequate protein intake, which is critical for preventing muscle loss and malnutrition in dialysis patients.

3.8 | Mineral and Bone Parameters

Table 3 provides a comprehensive overview of the mineral, bone, and serum albumin levels in the dialysis population. Corrected serum calcium averaged 9.2 ± 1.1 mg/dL, with 21.6% showing hypocalcemia (< 8.6 mg/dL) and 6.1% hypercalcemia (> 10.3 mg/dL). Hyperphosphatemia (> 4.5 mg/dL) affected 48.4%, while 6.4% had hypophosphatemia (< 2.7 mg/dL). The median iPTH was 315.6 pg/mL (IQR 169–542.3), with 59.1% within the recommended 135–585 pg/mL range, while 18.8% had low levels (< 135 pg/mL), and 22.1% had elevated levels (> 585 pg/mL), indicating potential secondary hyperparathyroidism.

Finally, the mean serum albumin level was 3.8 ± 0.5 g/dL, with the IQR ranging from 3.6 to 4.1 g/dL. Low serum albumin levels are often associated with malnutrition, inflammation, and poor health outcomes. A worrisome 21.0% of patients had hypoalbuminemia (serum albumin < 3.5 g/dL), a strong indicator of nutritional deficits and inflammatory states, both of which are prevalent in dialysis patients. Hypoalbuminemia is a well-known risk factor for increased morbidity, mortality, and poor dialysis outcomes, making it a critical parameter to monitor.

3.9 | Metabolic and Electrolyte Profiles

The mean total cholesterol level was 164.1 ± 42.4 mg/dL, while LDL-C averaged 93.4 ± 33.5 mg/dL, with variability suggesting potential cardiovascular risk in some patients.

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TABLE 3 | Hemodialysis adequacy, mineral and bone parameters, albuminuric and anemic status in patients on hemodialysis.

Variables	Total	Percentage
Dialysis frequency		
Two times a week hemodialysis	35372	34.3%
Three times a week hemodialysis	67034	65.0%
Four times a week hemodialysis	493	0.5%
Two times a week hemodialysis		
spKt/V	1.71 ± 0.34	
spKt/V < 1.8 (*N*, %)	20586	62.1%
Urea reduction ratio (URR) (%)	74.8 ± 7.3	
URR < 65 (*N*, %)	3096	9.3%
Normalized protein catabolic rate (nPCR)	1.20 ± 0.25	
nPCR < 1 (*N*, %)	7644	23.0%
Three times a week hemodialysis		
spKt/V	1.64 ± 0.33	
spKt/V < 1.2 (*N*, %)	4889	7.6%
Urea reduction ratio (URR) (%)	73.1 ± 7.3	
URR < 65 (*N*, %)	8245	12.7%
Normalized protein catabolic rate (nPCR)	1.09 ± 0.23	
nPCR < 1 (*N*, %)	24236	37.7%
Corrected serum calcium (mg/dL)	9.2 ± 1.1	
8.6–10.3	61884	72.3%
< 8.6	18493	21.6%
> 10.3	5253	6.1%
Serum phosphate (mg/dL)	4.6 ± 1.4	
2.7–4.5	39940	45.3%
< 2.7	5600	6.4%
> 4.5	42715	48.4%
Serum intact-PTH (pg/mL)	315.6 (IQR 169, 542.3)	
135–585	43173	59.1%
< 135	13753	18.8%
> 585	16136	22.1%
Serum albumin (g/dL)	3.8 ± 0.5	
≥ 3.5	68342	79.1%
< 3.5	18058	21.0%
Hemoglobin (g/dL)	9.8 ± 1.5	
10–11.5	34042	37.9%
< 10	46537	51.8%
> 11.5–13	8245	9.2%
> 13	1063	1.2%

Note: The data is presented as mean ± SD, median with IQR and percentages. It was analyzed by averaging the laboratory results for each patient and then classifying them into respective category groups. Corrected calcium (mg/dL) = measured total calcium (mg/dL) + 0.8*(4 − measured albumin (g/dL)).

Electrolyte imbalances were notable: 21.3% had hyponatremia (< 135 mEq/L), 2.3% had hyperkalemia (> 5.5 mEq/L), and 6.5% had hypokalemia (< 3.5 mEq/L). Hypochloremia (< 96 mEq/L) affected 20.7%, while 1.7% had hyperchloremia (> 106 mEq/L). Metabolic acidosis (bicarbonate < 22 mEq/L) was present in 20.4% of patients, while 20.8% had metabolic alkalosis (> 26 mEq/L), indicating frequent acid–base disturbances. Mean serum albumin was 3.8 ± 0.5 g/dL, with 21.0% having hypoalbuminemia (< 3.5 g/dL), reflecting malnutrition and inflammation risks.

3.10 | Anemia and Erythropoiesis-Stimulating Agents (ESA) Use

The mean hemoglobin was 9.8 ± 1.5 g/dL, with only 37.9% achieving the target range (10–11.5 g/dL). A significant proportion (51.8%) had hemoglobin levels below 10.0 g/dL, while 10.4% exceeded the target range, as shown in Table 3. Anemia management varied across reimbursement schemes: 55.1% of CSMBS patients, 38.8% of SSS patients, and 36.9% of self-paying patients reached the target range, compared to just 29.7% of patients under the UCS. This suggests that reimbursement schemes may influence the effectiveness of anemia management.

The median transferrin saturation was 27.5% (IQR 21.5%–35.0%), and the median ferritin level was 410.2 ng/mL (IQR 217.3–681.7 ng/mL). Iron deficiency was common, with 19.7% of patients having transferrin saturation < 20%, and 39.8% having levels between 20% and 29%. Additionally, 22.6% had ferritin levels < 200 ng/mL, indicating iron depletion. Conversely, 15.1% had transferrin saturation > 40%, suggesting potential iron overload, while 40.2% had ferritin levels > 500 ng/mL, also indicative of iron overload.

The majority of ESAs were administered intravenously (77.1%), with recombinant human erythropoietin (Epoetin Alfa) being the most commonly used (97.3%). Epoetin Beta accounted for only 2.0% of ESA prescriptions.

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TABLE 4 | Causes of death in dialysis patients.

Cause of death	Total ($N=46075$)	Hemodialysis ($N=38828$)	Peritoneal dialysis ($N=7247$)
Cardiac disease	15672 (34.7%)	14364 (37.8%)	1308 (18.3%)
Infectious disease	8889 (19.7%)	7195 (18.9%)	1694 (23.7%)
Uncertain	5987 (13.3%)	4938 (13.0%)	1049 (14.7%)
Cerebrovascular disease	3469 (7.7%)	2946 (7.7%)	523 (7.3%)
Kidney disease	1231 (2.7%)	1144 (3.0%)	87 (1.2%)
Malignancy	1537 (3.4%)	1447 (3.8%)	90 (1.3%)
Liver disease	520 (1.2%)	493 (1.3%)	27 (0.4%)
Accident	525 (1.2%)	495 (1.3%)	30 (0.4%)
Suicide	112 (0.3%)	86 (0.2%)	26 (0.4%)
Other	7130 (15.8%)	4826 (12.7%)	2304 (32.2%)
Missing	878 (1.9%)	784 (2.0%)	94 (1.3%)
Overall mortality rate	46075/143892 (32.0%)	38828/129113 (30.1%)	7247/14779 (49.0%)

3.11 | Clinical Outcomes

Between 2017 and 2023, the mortality rate among dialysis patients was 32.0%, with higher mortality in peritoneal dialysis (49.0%) than hemodialysis (30.0%) in Table 4. Leading causes of death were cardiac disease (34.7%), infections (19.7%), and cerebrovascular disease (7.7%). Cardiac-related deaths were more frequent in hemodialysis patients (37.8%), while infections were more common in peritoneal dialysis patients (23.7%), underscoring modality-specific risks. This difference suggests that infection risk may be more pronounced in patients undergoing peritoneal dialysis, likely due to the nature of the treatment itself, which requires frequent catheter use and direct exposure of the peritoneal cavity.

4 | Discussion

Data from the TRT Registry highlight key trends and challenges in ESKD management from 2000 to 2023. Dialysis prevalence has steadily increased, reflecting a growing ESKD burden largely driven by diabetes and hypertension. Although peritoneal dialysis gained traction following the launch of the "PD First" policy in 2008—initially balancing the ratio of new hemodialysis-to-peritoneal dialysis cases at 1:1—this trend reversed over time. After the policy shift to a "Free Choice" model in 2022, the hemodialysis-to-peritoneal dialysis initiation ratio rose to 3:1, indicating a growing preference for or systemic bias toward hemodialysis. While the prevalence of both modalities increased, the incidence of peritoneal dialysis remained stable, whereas hemodialysis incidence continued to rise. These trends underscore the need for stronger preventive strategies targeting metabolic and cardiovascular risk factors. Enhancing early CKD detection and management is essential to mitigate the rising ESKD burden and ensure sustainable dialysis care in Thailand.

While the policy shift under the UCS in February 2022 allowed patients to choose between hemodialysis and peritoneal dialysis—moving away from the CAPD-first policy—the effect on dialysis modality distribution appears modest in the short term. As shown in Figure 1, the incidence of peritoneal dialysis significantly declined from approximately 9600 new cases in 2021 to 4100 in 2023, reflecting a clear shift in modality preference or access. However, the prevalence of peritoneal dialysis remained stable at 23714 in 2023, while the prevalence of hemodialysis increased markedly to 129113 patients. This suggests that although the use of incident peritoneal dialysis declined, existing peritoneal dialysis patients remained on therapy, balancing out the prevalence figures between 2022 and 2023. There are several possible explanations for these findings. First, the policy change was implemented gradually across provinces, and the infrastructure or staffing needed to support increased hemodialysis uptake may have lagged in some areas. Second, some patients may have continued to prefer peritoneal dialysis due to convenience, prior counseling, or geographic constraints. Third, clinical inertia and provider familiarity with peritoneal dialysis from the previous CAPD-first policy may have slowed the immediate transition to hemodialysis.

The steady expansion of both hemodialysis and peritoneal dialysis suggests improved RRT access. However, socioeconomic and reimbursement factors appear to influence modality selection. The higher prevalence of peritoneal dialysis among patients with lower education levels may indicate barriers to hemodialysis such as geographic and financial constraints. Optimizing modality selection based on patient suitability rather than systemic limitations remains a priority.

The high use of DLC for long-term dialysis raises concerns due to its associated risks. Increasing AVF placement through early referral and patient education could improve vascular access outcomes. Additionally, inadequate dialysis remains an

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issue, particularly among twice-weekly hemodialysis patients. Expanding access to thrice-weekly sessions may be necessary to enhance treatment adequacy and reduce complications.

Malnutrition is a concern, with many patients exhibiting low nPCR and hypoalbuminemia, both linked to poor outcomes. Improved dietary counseling and nutritional support are essential [11]. Metabolic abnormalities, including electrolyte imbalances, dyslipidemia, and mineral-bone disorders, highlight the need for better phosphate control, acid–base management, and cardiovascular risk reduction.

A significant proportion of patients fail to meet target hemoglobin levels, with disparities in anemia management across reimbursement schemes. UCS patients achieve lower hemoglobin targets than those under CSMBS and SSS, indicating possible inequalities in ESA and iron therapy access. Standardized treatment protocols and equitable resource distribution could improve anemia outcomes.

The overall mortality rate of 32.0% highlights the urgent need to enhance the quality of dialysis care in Thailand. Patients on peritoneal dialysis experienced higher mortality, primarily from cardiovascular disease and infections. However, this elevated risk is multifactorial. Under Thailand's PD-first policy, peritoneal dialysis patients often present with a higher baseline comorbidity burden, including older age, diabetes, and poor overall health status. Additional contributing factors include limited access to specialist care, delays in transitioning to hemodialysis, and elevated cardiovascular risk. Poorer survival was also associated with female gender, older age at peritoneal dialysis initiation, lower educational attainment, diabetes, and enrollment under the CSMBS [12]. While cardiovascular disease remained the leading cause of death in both hemodialysis and peritoneal dialysis groups, peritoneal dialysis patients showed a higher proportion of deaths due to infections and other causes. This may be partly explained by peritonitis, a serious and common complication in peritoneal dialysis [13], as well as less frequent healthcare contact in peritoneal dialysis compared to in-center hemodialysis, potentially delaying the diagnosis and management of infections. Patient selection and underlying comorbidities further contribute to these observed disparities. Taken together, these findings underscore the need for improved cardiovascular risk management—including better control of blood pressure, anemia, and lipid levels—as well as strengthened infection prevention strategies, particularly among peritoneal dialysis patients [14, 15].

This study has several limitations. Although it provides valuable nationwide insights, the TRT Registry is observational in nature, which limits the ability to draw causal inferences regarding treatment outcomes. Data completeness and accuracy depend on reporting from individual dialysis centers, which may introduce variability and reporting bias. Notably, advanced dialysis modalities such as hemodiafiltration were used in fewer than 1% of patients, and high-frequency hemodialysis (> 3 sessions per week) in less than 0.5%, limiting the analysis of these potentially beneficial strategies. These low utilization rates likely reflect resource constraints and policy limitations rather than clinical appropriateness, which may affect the generalizability of findings related to dialysis adequacy. Additionally, data on residual kidney function, medication use, and long-term quality of life were not consistently captured, limiting a more comprehensive evaluation of patient outcomes. Furthermore, clinical condition definitions—including those for cardiac disease, infections, cerebrovascular disease, kidney disease, malignancy, and liver disease—were based on the primary diagnosis reported by the treating clinician at the time of death and were not adjudicated using standardized criteria across all centers. Moreover, the category of "uncertain death" accounted for 14.7% of the population, which likely reflects a lack of clear documentation at the time of death, the absence of autopsies, or deaths occurring outside of hospital settings. Finally, while socioeconomic and geographic disparities were observed, further investigation using linked datasets is necessary to fully understand their impact on access to care and patient survival.

5 | Conclusion

The growing ESKD burden in Thailand calls for comprehensive strategies to improve RRT delivery. While the UHC scheme has enhanced dialysis accessibility, challenges remain in resource allocation, geographic disparities, and chronic disease management. The TRT Registry provides valuable insights into patient demographics, treatment trends, and outcomes, guiding policy development and healthcare optimization.

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Ethics Statement

This study adhered to the Declaration of Helsinki and received ethical review and approval from the Institutional Review Board, Royal Thai Army Medical Department (IRBRTA 1445/2567), approved on November 5, 2024 (code: S078h/67).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon request.

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