Thailand Renal Replacement Therapy Registry 2023: Epidemiology and Trends in Incident Dialysis Patients

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Abstract

This study examines data from the Thailand Renal Replacement Therapy (TRT) Registry, highlighting trends, challenges, and opportunities in managing End-Stage Kidney Disease (ESKD) and delivering renal replacement therapy (RRT) in Thailand. Between 2000 and 2023, the number of new patients initiating hemodialysis rose by 13,045 in 2023, while new peritoneal dialysis cases declined by nearly 50% compared to 2021. Diabetic nephropathy and hypertension remained the leading causes of ESKD, accounting for over 80% of cases. Despite the growing burden of ESKD, significant gaps in care persist, including challenges with vascular access and disparities in dialysis adequacy. Kidney transplantation rates remain low, with only a small percentage of patients on the waiting list. Additionally, the study highlights concerns about malnutrition and low vaccination coverage among dialysis patients. In 2023, the mortality rate among incident dialysis patients was 3.6%, with cardiac disease and infections as the leading causes of death. These findings emphasize the urgent need for targeted interventions in hypertension and diabetes management, infection prevention, and improved access to transplantation and vaccination. This analysis provides critical insights to inform policy development and enhance the quality of care for ESKD patients in Thailand.

Keywords: hemodialysis; peritoneal dialysis; end-stage kidney disease; renal replacement therapy

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Received: 26 February 2025; Revised: 4 April 2025; Accepted: 11 April 2025
https://doi.org/10.63555/jnst.2025.277563

รายงานข้อมูลประจำปี 2566 จากทะเบียนบำบัดทดแทนไตแห่งประเทศไทย: ระบาดวิทยาในผู้ป่วยบำบัดทดแทนไตรายใหม่

บัญชา สถิระพจน์, พิชญ ตันติยวรงค์, อนันต์ เชื้อสุวรรณ, อดิสรณ์ ลำเพาพงศ์, กวี ลิ่มบุตร, ไกรวิพร เกียรติสุนทร, คณิน ธรรมาวรานุคุปต์, ณัฏฐา ล้ำเลิศกุล, ปรมัตถ์ ธิมาไชย, พรพิมล เรียนถาวร, วัทธิกร พิชิตพร, วิจิตรา โชติมงคล, สุขฤทัย เลขยานนท์, สุวิกรานต์ วงศ์ประไพโรจน์, ชญาภา วรพิทยาภรณ์, นฤนาถ ศิรีวรรณ์, นันทนา ชปิลเลส, นิภา อัยยสานนท์, ปวีณา สิงห์ทิศ, ปิยาภรณ์ โทวันนัง, มณภิญญา ฉัตรทอง หอมจัน, สร้อยสะอาง สร้างสมวงษ์, สุนทรี เพิ่มพูลสวัสดิ์, อรอุมา เพ่งพินิจ, เถลิงศักดิ์ กาญจนบุษย์, วุฒิเดช โอภาศเจริญสุข

คณะอนุกรรมการการลงทะเบียนบำบัดทดแทนไต สมาคมโรคไตแห่งประเทศไทย

บทคัดย่อ

การศึกษานี้นำเสนอการวิเคราะห์ข้อมูลจากทะเบียนการรักษาทดแทนไตของประเทศไทย ซึ่งเน้นถึงแนวโน้ม ความท้าทาย และโอกาสในการจัดการโรคไตเรื้อรังระยะสุดท้าย และการให้บริการการรักษาทดแทนไตในประเทศไทย ตั้งแต่ปี พ.ศ. 2543 ถึง 2566 พบว่ามีการเพิ่มขึ้นของอัตราการรักษาด้วยการฟอกไต โดยในปี พ.ศ. 2566 มีผู้ป่วยใหม่เริ่มการฟอกเลือดจำนวน 13,045 ราย ในขณะที่การเริ่มต้นการฟอกไตทางช่องท้องลดลงประมาณครึ่งหนึ่งเมื่อเทียบกับปี พ.ศ. 2564 โรคไตจากเบาหวานและความดันโลหิตสูงเป็นสาเหตุหลักของโรคไตเรื้อรังระยะสุดท้าย ซึ่งคิดเป็นมากกว่าร้อยละ 80 ของผู้ป่วยทั้งหมด แม้ภาระโรคจะเพิ่มขึ้น แต่ยังมีช่องว่างที่สำคัญในการดูแล เช่น ปัญหาการเข้าถึงการเตรียมหลอดเลือดสำหรับฟอกไต ความไม่เพียงพอในการฟอกไต อัตราการปลูกถ่ายไตยังคงต่ำ โดยมีผู้ป่วยเพียงส่วนน้อยที่ลงทะเบียนในรายชื่อรอการปลูกถ่าย แนวโน้มการเกิดภาวะทุพโภชนาการ และอัตราการฉีดวัคซีนที่ต่ำในผู้ป่วยที่ฟอกไต อัตราการเสียชีวิตในผู้ป่วยที่เริ่มฟอกไตใหม่ในปี พ.ศ. 2566 อยู่ที่ร้อยละ 3.6 โดยโรคหัวใจและการติดเชื้อเป็นสาเหตุหลักของการเสียชีวิต การวิเคราะห์นี้เน้นย้ำถึงความจำเป็นเร่งด่วนในการดำเนินการแทรกแซงเฉพาะด้านในการจัดการความดันโลหิตสูง การควบคุมเบาหวาน และการป้องกันการติดเชื้อ รวมถึงการเพิ่มการเข้าถึงการปลูกถ่ายไตและการฉีดวัคซีน ผลการศึกษานี้ให้ข้อมูลสำคัญในการพัฒนาแนวทางนโยบายและการปรับปรุงคุณภาพการดูแลโรคไตเรื้อรังระยะสุดท้ายในประเทศไทย

คำสำคัญ: การฟอกเลือดด้วยเครื่องไตเทียม; การล้างไตทางช่องท้อง; ศูนย์ฟอกไต; การบำบัดทดแทนไต

Introduction

The incidence of treated end-stage kidney disease (ESKD) has remained stable in many high-income countries but has risen significantly in East and Southeast Asia.[1] This global increase is attributed to factors such as improved survival rates, demographic shifts, a growing prevalence

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of risk factors, and better access to renal replacement therapy (RRT) in emerging economies. Thailand is currently among the top eight Asian countries with the highest incidence of treated ESKD.[2] This significant burden raises concerns regarding the sustainability of healthcare financing and the capacity of healthcare systems to provide adequate services.[3]

ESKD poses a considerable public health challenge in Thailand, with the number of patients requiring RRT steadily increasing over the past decade.[4] A retrospective cohort study involving 855 hemodialysis centers in Thailand reported a high mortality rate among ESKD patients undergoing hemodialysis, with survival rates of 93.5%, 69.7%, and 41.2% at 1, 3, and 5 years, respectively.[5] During the 30 months of the COVID-19 pandemic, ESRD patients in Thailand experienced an excess mortality rate of 5.7% above expected deaths (95% CI: 1.7%, 10.0%), highlighting their increased vulnerability to pandemic-related mortality compared to the general population.[6] However, dialysis treatment was associated with a significant survival benefit for elderly Thai patients, including those aged ≥80 years, who showed improved outcomes with hemodialysis or peritoneal dialysis compared to comprehensive conservative care.[7] These findings emphasize the urgent need for targeted interventions to reduce risks faced by ESKD patients, particularly among vulnerable groups.

RRT is pivotal in managing ESKD and providing life-sustaining treatment to patients worldwide. In Thailand, the increasing prevalence of ESKD is driven by an aging population and the rising incidence of diabetes and hypertension—two primary causes of kidney failure.[8-10] This growing burden necessitates a robust healthcare response, including comprehensive data collection and analysis, to inform policy decisions and improve patient outcomes. To address this, Thailand updated its hemodialysis policy under the Universal Coverage Scheme (UCS) on February 1, 2022. This policy change allows patients to choose hemodialysis as a treatment option, promoting patient-centered care. Nevertheless, concerns persist regarding the healthcare system's ability to accommodate the expected surge in demand for hemodialysis services.

The Thailand Renal Replacement Therapy (TRT) Registry is crucial in monitoring and evaluating RRT delivery nationwide. By collecting data on treatment modalities such as hemodialysis and peritoneal dialysis, the registry provides valuable insights into patient demographics, treatment outcomes, and emerging trends. These data are essential for identifying gaps in care, optimizing resource allocation, and improving the overall quality of care for ESKD patients.

Despite significant progress in making RRT accessible and affordable through Thailand's UCS scheme, disparities in service availability and patient outcomes persist. Factors such as geographic location, socioeconomic status, and healthcare infrastructure significantly affect patient experiences and outcomes. The TRT Registry offers a unique opportunity to examine these disparities and provides evidence to support equitable healthcare improvements.

This report analyzes the TRT Registry data, highlighting key trends, challenges, and opportunities in the delivery of RRT in Thailand. By reviewing the registry's findings, this work aims to guide clinicians, policymakers, and researchers in developing strategies to improve care for ESKD patients and enhance the healthcare system's ability to effectively meet their needs.

Methods

We conducted a detailed analysis of national registry data collected through the TRT program. This nationwide registry provides comprehensive information on dialysis services and resources across all 77 provinces of Thailand for 2023. The dataset encompassed a broad range of demographic, clinical, and treatment-related variables for Incident Dialysis patients. Ethical approval for this study was obtained from the Institutional Review Board of the Royal Thai Army Medical Department (Approval number: IRBRTA 1445/2567), Bangkok, Thailand.

The analysis utilized data from the TRT program (version 3), a robust system integrating information from hospitals, dialysis centers, and nephrology units nationwide. Data consistency was ensured through the use of standardized forms and electronic submissions, which captured patient demographics, treatment modalities, and clinical outcomes. 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 consisted of all patients who began RRT in 2023, encompassing hemodialysis, peritoneal dialysis, and kidney transplantation. Inclusion criteria required complete medical records and verified initiation of dialysis during the study period. Automated data-cleaning algorithms embedded within the TRT system systematically addressed duplicate entries and incomplete records. Accuracy was further enhanced by cross-referencing patient information from multiple healthcare facilities to eliminate errors. Anomalies or inconsistencies in the dataset were flagged for review, and reporting centers were contacted to resolve missing or unclear data.

The variables collected in this study encompassed a wide range of data, including demographic details such as age, sex, education level, and geographic distribution, as well as clinical parameters like the underlying causes of ESKD, metabolic and electrolyte profiles, anemia status, and types of vascular access. Treatment modalities included hemodialysis, peritoneal dialysis, and kidney transplantation, while the distribution of patients across reimbursement schemes—namely the UCS, Civil Servant Medical Benefit Scheme (CSMBS), and Social Security Scheme (SSS)—was analyzed to identify access patterns and potential disparities. Additionally, vaccination and serology data covering hepatitis, human immunodeficiency virus (HIV), and other infectious diseases were included, alongside clinical outcomes such as mortality rates, treatment adequacy, and laboratory parameters related to anemia management, mineral metabolism, and protein intake. This comprehensive dataset facilitated an in-depth evaluation of dialysis care dynamics, including trends in the initiation of dialysis and kidney transplantation, disparities in access and resource allocation across geographic regions and reimbursement schemes, and associations between treatment modalities and clinical outcomes, such as treatment adequacy, metabolic control, and nutritional status. The methodological approach provided critical insights into the infrastructure and quality of dialysis care in Thailand, offering a robust foundation for evidence-based policy-making and healthcare improvement.

Statistical Analysis

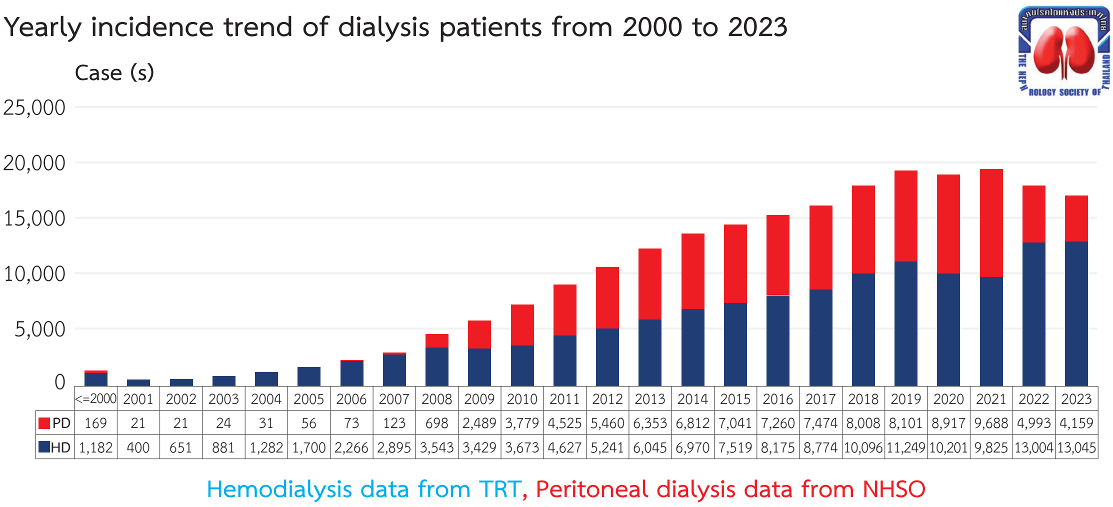
Descriptive statistics were employed to summarize the dataset comprehensively. Continuous variables, including age, laboratory parameters, and dialysis adequacy, were reported as mean ± standard deviation (SD) for normally distributed data or as interquartile range (IQR) for non-normal data. Categorical variables, such as reimbursement schemes, vascular access types, and treatment modalities, were presented as frequencies and percentages.

Patient characteristics, anemia status, metabolic and electrolyte profiles, and clinical outcomes were compared across treatment groups using means, medians, IQRs, and percentages. Yearly trends in the initiation of dialysis and kidney transplantation were analyzed through time-series methods, while descriptive statistics evaluated the prevalence of metabolic and mineral abnormalities, anemia management practices, and vascular access types.

Results

Yearly Incidence Trend of Dialysis Patients in 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 (**Figure 2**). In contrast, 4,159 new patients initiated peritoneal dialysis, reflecting a significant decline of approximately 2.0 times compared to 2021 (**Figure 3**). Meanwhile, 986 patients underwent kidney transplantation as their primary RRT modality, showing a modest upward trend (**Figure 4**).



	<=2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
PD	169	21	21	24	31	56	73	123	698	2,489	3,779	4,525	5,460	6,353	6,812	7,041	7,260	7,474	8,008	8,101	8,917	9,688	4,993	4,159
HD	1,182	400	651	881	1,282	1,700	2,266	2,895	3,543	3,429	3,673	4,627	5,241	6,045	6,970	7,519	8,175	8,774	10,096	11,249	10,201	9,825	13,004	13,045

Figure 1 Yearly incidence trend of dialysis patients from 2000 to 2023

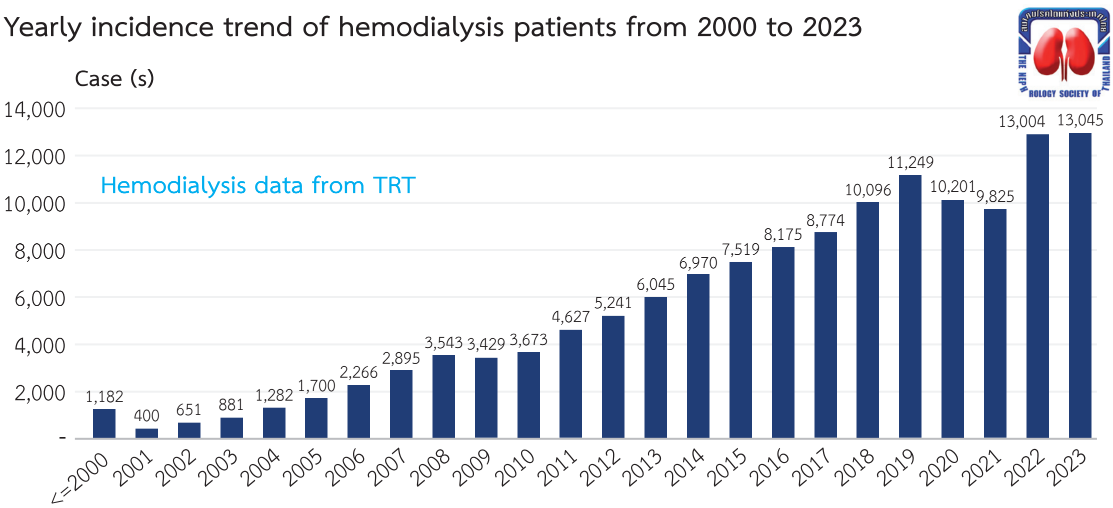


Figure 2 Yearly incidence trend of hemodialysis patients from 2000 to 2023

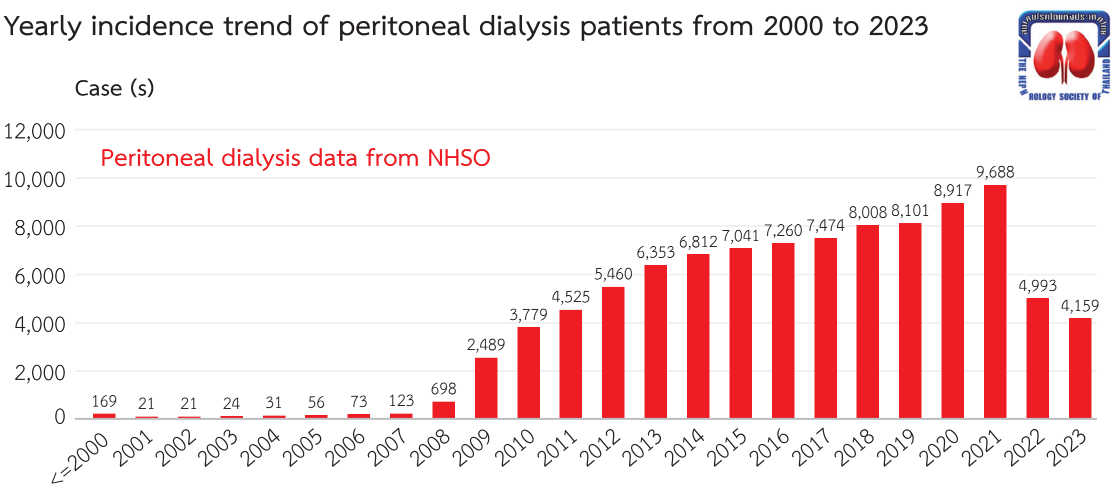


Figure 3 Yearly incidence trend of peritoneal dialysis patients from 2000 to 2023

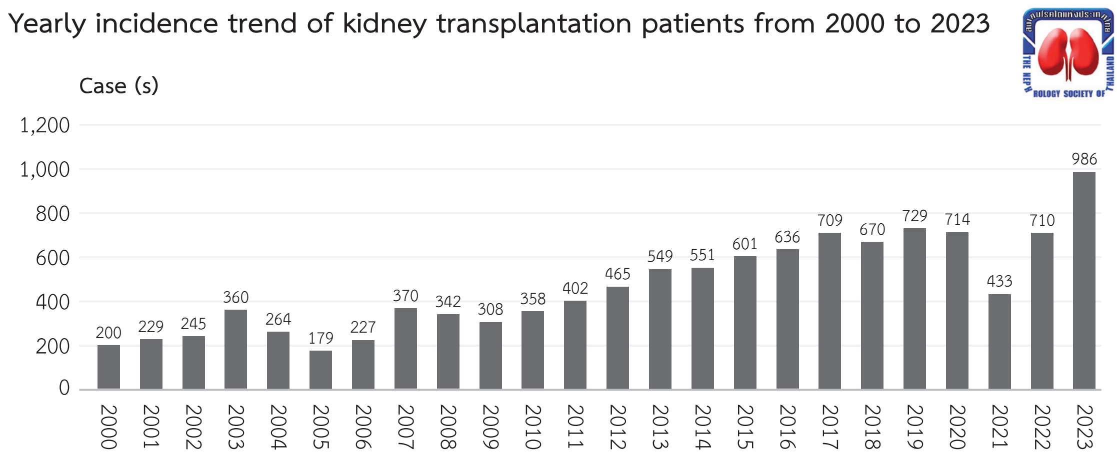


Figure 4 Yearly incidence trend of kidney transplantation patients from 2000 to 2023

Underlying Causes of End-Stage Kidney Disease (ESKD)

In 2023, the underlying causes of ESKD among incident dialysis patients were primarily attributed to diabetic nephropathy and hypertension, which together accounted for over 80% of cases. Diabetes was the most common cause, responsible for 41.8% of cases, followed closely by hypertension at 39.1%, as detailed in **Table 1**. Cases with an unknown etiology represented 10.8%, suggesting the need for further investigation into these origins. Glomerulonephritis, although less common, accounted for 3.0% of the total cases. These findings underscore the critical role of chronic conditions, particularly hypertension and diabetes, in driving the increasing prevalence of ESKD. Moreover, they emphasize the importance of targeted preventive strategies, early diagnosis, and effective management of these conditions to mitigate the burden of ESKD in the population.

Table 1 Underlying Causes of End-Stage Kidney Disease

Etiology	Total (N=13,844)	Percentage (%)
Diabetic nephropathy	5,787	41.8
Hypertensive nephropathy	5,422	39.1
Unknown	1,492	10.8
Chronic glomerulonephritis	421	3.0
Obstructive nephropathy	135	1.0
Polycystic kidney disease	105	0.8
Chronic tubulointerstitial disease	71	0.5

Underlying Glomerulonephritis Confirmed by Biopsy Resulting in End-Stage Kidney Disease

The causes of glomerulonephritis leading to ESKD in 56 incident dialysis patients in 2023, as confirmed by kidney biopsy, were diverse, as shown in **Table 2**. The most common cause was IgA nephropathy, which accounted for 32.3% of the cases, highlighting its significant role in the progression to ESKD. The second and third most common causes were focal segmental glomerulosclerosis (FSGS) and crescentic glomerulonephritis, making up 6.1%

and 4.6% of the cases, respectively. These conditions are known for their aggressive nature and poor renal outcomes. Additionally, the cause of kidney damage was unknown in 35.4% of the cases, indicating the need for further investigation into this group.

Table 2 Underlying Glomerulonephritis Confirmed by Biopsy Resulting in End-Stage Kidney Disease

Glomerulonephritis Confirmed by Biopsy	Percentage (%)
IgA nephropathy	32.3
Focal segmental glomerulosclerosis	6.1
Crescentic glomerulonephritis	4.6
Membranous nephropathy	3.0
Mesangial proliferative glomerulonephritis	1.5
Membranoproliferative glomerulonephritis	1.5
Unknown	35.4

Age, Sex, and Education of Dialysis Patients

The dialysis population had a mean age of 60.9±13.9 years, with a sex distribution of 53.3% male and 46.7% female. When this population was divided into two groups based on the type of dialysis—hemodialysis and peritoneal dialysis—the age and sex distribution remained similar across both groups. Specifically, the mean age in both the hemodialysis and peritoneal dialysis cohorts was comparable, reflecting a balanced representation of both sexes in each treatment modality. This consistency suggests that age and sex were not significant differentiators between the two groups in the study population, as shown in **Table 3**.

The majority of dialysis patients had an education level of primary school or lower, comprising 53.7% (7,436 individuals). The group receiving peritoneal dialysis had a higher percentage of individuals with this educational background (66.6%) compared to hemodialysis (53.0%). In contrast, hemodialysis patients had a higher percentage of individuals with a bachelor's degree or higher (11.0%) compared to peritoneal dialysis (8.3%), as shown in **Table 3**.

Kidney Transplantation Waiting List Among Dialysis Patients

The data showing that only 2.8% of hemodialysis patients and 2.9% of peritoneal dialysis patients are registered on the kidney transplant waiting list highlight significant challenges related to accessibility and awareness of kidney transplantation. This low registration rate is particularly concerning among younger patients, with only 5.2% of individuals under 60 and 4.2% of those under 65 included on the list, as shown in **Table 4**.

Distribution of New Dialysis Patients Across Different Reimbursement Schemes

In 2023, the distribution of incident dialysis patients in Thailand across various reimbursement schemes reflects the country's commitment to providing access to RRT for individuals with ESKD, as shown in **Table 5**. Most incident dialysis patients were covered by the UCS (65%), followed by the SSS (13.2%) and the CSMBS (12.3%).

The UCS's broad coverage is key in managing the growing ESKD burden. While all schemes predominantly favored hemodialysis, the UCS showed a higher proportion of patients receiving peritoneal dialysis than the other schemes. This variation may be due to differences in dialysis availability, patient preferences, and healthcare provider recommendations.

Table 3 Characteristics of Dialysis Patients: Age, Sex, and Education Level

Category	Hemodialysis (N= 13,045)	Peritoneal Dialysis (N= 743)	Total (N= 13,844)
Male/Female (%)	53.5 / 46.5	50.3 / 49.7	53.3 / 46.7
Age (years)	60.8±13.9	61.3±14.6	60.9±13.9
Age groups (N, %)			
<18 years	26 (0.2)	12 (1.6)	38 (0.3)
18–40 years	1,213 (9.4)	47 (6.4)	1,263 (9.2)
41–60 years	4,335 (33.5)	229 (31.1)	4,584 (33.3)
>60 years	7,387 (56.9)	449 (60.9)	7,870 (57.2)
Education levels (N, %)			
Primary school or lower	6,918 (53.0)	495 (66.6)	7,436 (53.7)
Secondary school	1,312 (10.1)	69 (9.3)	1,387 (10.0)
High school	1,596 (12.2)	47 (6.3)	1,646 (11.9)
Vocational/High vocational certificate	822 (6.3)	34 (4.6)	863 (6.2)
Bachelor's degrees or higher	1,434 (11.0)	62 (8.3)	1,505 (10.9)
Unknown	963 (7.4)	36 (4.9)	1,008 (7.3)

Table 4 Kidney Transplantation Waiting List Among Dialysis Patients

Category	Hemodialysis (N= 13,045)	Peritoneal Dialysis (N= 743)	Total (N=13,844)
Waiting list for kidney transplantation	359 (2.8 %)	22 (2.9 %)	383 (2.8%)
Age (years)			
<60 years	294 (5.2%)	18 (6.1%)	312 (5.2%)
<65 years	318 (4.2%)	20 (4.8%)	338 (4.2%)
<70 years	332 (3.5%)	22 (4.1%)	355 (3.5%)
<75 years	341 (3.0%)	22 (3.4%)	364 (3.1%)

Table 5 Distribution of Reimbursement Schemes for New Dialysis Patients

Category	Hemodialysis (N= 13,045)	Peritoneal Dialysis (N= 743)	Total (N=13,844)
Universal Coverage Scheme (UCS)	8,482 (65.0%)	554 (74.6%)	9,067 (65.5%)
Social Security Scheme (SSS)	1,720 (13.2%)	94 (12.7%)	1,824 (13.2%)
Civil Servant Medical Benefit Scheme (CSMBS)	1,640 (12.6%)	44 (5.9%)	1,694 (12.3%)
Self-payment	325 (2.5%)	7 (0.9%)	335 (2.4%)
Others	878 (6.7%)	44 (5.9%)	925 (6.7%)

Type of Vascular Access in New Hemodialysis Patients

The primary vascular access in the new patients was arteriovenous fistula (AVF) (35.9%), double lumen catheter (34.4%), and permanent catheter (22.3%), as shown in **Table 6**. The data revealed a notably high prevalence of patients relying on double-lumen catheters, highlighting the significant role in long-term dialysis treatment. This finding highlights the challenges in achieving optimal vascular access, as the double-lumen catheter is often considered a less ideal choice than AVF due to higher risks of complications.

Table 6 Types of Vascular Access in New Hemodialysis Patients

Type of Vascular Access	Total (N=13,045)	Percentage (%)
Arteriovenous Fistula	4,850	35.9
Double Lumen Catheter	4,657	34.4
Permanent Catheter	3,014	22.3
Arteriovenous Graft	302	2.2

Hemodialysis Adequacy in Twice-Weekly and Thrice-Weekly Schedules

The frequency of hemodialysis treatments varies based on patient needs, healthcare access, and specific medical guidelines. Among patients with ESKD, the most common dialysis regimens are twice-weekly dialysis (48.1%) and thrice-weekly dialysis (51.3%).

The adequacy of these treatment regimens is often evaluated using spKt/V and the Urea Reduction Ratio (URR), which quantify dialysis efficiency by measuring urea clearance—a marker of waste removal during dialysis, as shown in **Table 7**. For twice-weekly hemodialysis, the mean spKt/V was 1.67±0.37, and the mean URR was 73.7± 8.3%. For thrice-weekly hemodialysis, the mean spKt/V was 1.60±0.34, and the mean URR was 72.4± 8.0%. Among patients undergoing twice-weekly dialysis, 65.8% face challenges in achieving the optimal spKt/V value of 1.8 with this schedule, whereas only 11.0% of patients on thrice-weekly dialysis fail to reach the optimal spKt/V value of 1.2.[11]

Achieving adequate Normalized Protein Catabolic Rate (nPCR) is essential to ensure that patients receive sufficient protein to prevent malnutrition and maintain muscle mass. For twice-weekly hemodialysis, the mean nPCR was 1.16±0.27 g/kg/day, while for thrice-weekly hemodialysis, the mean nPCR was 1.06±0.25 g/kg/day. Moreover, approximately 30-40% of patients in both groups had an nPCR of less than 1 g/kg/day. This range is considered suboptimal for maintaining muscle mass and overall protein balance, which is particularly important for dialysis patients. According to KDOQI guidelines, a dietary protein intake of 1.0–1.2 g/kg/day is recommended to maintain stable nutritional status.[12]

Metabolic and Electrolyte Profiles of Incident Dialysis Patients

A comprehensive assessment of incident dialysis patients' metabolic and electrolyte profiles has become increasingly important, particularly as these factors significantly impact patient outcomes. This analysis focuses on key electrolytes and metabolic parameters crucial for managing dialysis patients, as shown in Table 8.

Table 7 Hemodialysis Adequacy in Patients on Twice-Weekly and Thrice-Weekly Schedules

Hemodialysis adequacy	Percentage	
Frequency	**%**	
Twice per week	48.1%	
Three times per week	51.3%	
Four times per week	0.2%	
Twice per week	**Mean ± SD**	**Mean ± SD Median (IQR)**
spKt/V	1.67±0.37	1.65 (1.42, 1.88)
spKT/V<1.8 (N, %)	2,889	65.8%
Urea Reduction Ratio (URR) (%)	73.7±8.3	74.9 (69.2, 79.4)
Urea Reduction Ratio (URR) <65% (N, %)	582	13.0%
Normalized Protein Catabolic Rate (nPCR)	1.16±0.27	1.14 (0.96, 1.33)
Normalized Protein Catabolic Rate (nPCR)< 1 (N, %)	1,314	30.1%
Three times per week		
spKt/V	1.60±0.34	1.58 (1.37, 1.82)
spKT/V<1.2 (N, %)	578	11.0%
Urea Reduction Ratio (URR) (%)	72.4±8.0	73.2 (67.8, 77.9)
Urea Reduction Ratio (URR) <65% (N, %)	854	16.1%
Normalized Protein Catabolic Rate (nPCR)	1.06±0.25	1.04 (0.89, 1.21)
Normalized Protein Catabolic Rate (nPCR)< 1 (N, %)	2,230	42.7%

Table 8 Metabolic and Electrolytes Profiles of Incident Dialysis Patients

Parameters	Mean ± SD	Median (IQR)
Fasting plasma glucose (mg/dL)	136.7±72.2	114 (94, 153)
Hemoglobin A1C (%)	6.9±1.7	6.3 (5.6, 7.7)
Total cholesterol (mg/dL)	166.5±48.7	160 (134, 191)
HDL-cholesterol (mg/dL)	46.6±16.3	44 (36, 55)
LDL-cholesterol (mg/dL)	96.1±39.0	90 (68, 117)
Triglycerides (mg/dL)	136.7±84.5	116 (83, 166)
Serum uric acid (mg/dL) (N, %)	7.1±2.2	7 (5.6, 8.4)
3.5-7.2	2,898 (51.3%)	
<3.5	182 (3.2%)	
>7.2	2,567 (45.5%)	

Table 8 Metabolic and Electrolytes Profiles of Incident Dialysis Patients (continued)

Parameters	Mean ± SD	Median (IQR)
Serum sodium (mEq/L) (N, %)	136.2±3.8	137 (134, 139)
135-145	8,239 (68.9%)	
<135	3,681 (30.8%)	
>145	42 (0.4%)	
Serum potassium (mEq/L) (N, %)	4.2±0.6	4.23 (3.9, 4.7)
3.5-5.5	10,448 (87.2%)	
<3.5	1,184 (9.9%)	
>5.5	351 (2.9%)	
Serum chloride (mEq/L) (N, %)	99.0±4.6	99 (97, 102)
96 to 106	8,862 (74.8%)	
<96	2,439 (20.6%)	
>106	548 (4.6%)	
Serum bicarbonate (mEq/L) (N, %)	23.4±3.7	24 (22, 26)
22-26	6,185 (52.0%)	
<22	3,497 (29.4%)	
>26	2,212 (18.6%)	

*The data was analyzed using the average laboratory results for each patient and then classified into each category group.

The mean hemoglobin A1C (HbA1c) was 6.9±1.7%, which aligns with the recommended target for diabetes management and suggests that many patients have optimal glucose control. This could potentially improve long-term cardiovascular outcomes. The mean total cholesterol level was 166.5 ± 48.7 mg/dL, within the typical range for dialysis patients; however, this relatively low level may also signal malnutrition, a common issue in this population. Additionally, the mean LDL-cholesterol (LDL-C) level was 96.1±39.0 mg/dL, showing considerable variability across patients. Interestingly, higher LDL levels have been paradoxically associated with better survival rates in some cases, suggesting that elevated LDL may be linked to increased cardiovascular risk in certain individuals.[13]

Dyselectrolytemia encompasses a range of dialysis-related complications that have both immediate and long-term consequences, contributing to an increased mortality rate among hemodialysis patients, particularly due to cardiovascular complications.[14] Elevated serum uric acid levels are associated with impaired renal function and the progression of kidney disease[15], and a U-shaped relationship between serum uric acid levels and all-cause mortality has been observed in dialysis patients.[16] In this population, the mean serum uric acid level was 7.1 ± 2.2 mg/dL. The mean, median, and interquartile range (IQR) values for key electrolytes (sodium, potassium, chloride, and bicarbonate) generally fell within the normal range; however, a significant proportion of patients exhibited abnormalities in these parameters. Specifically, 30.8% had hyponatremia (serum sodium < 135 mEq/L), 2.9% had hyperkalemia, and 9.9% had hypokalemia.

Additionally, 29.4% had metabolic acidosis (serum bicarbonate < 22 mEq/L), while 18.6% had metabolic alkalosis (serum bicarbonate > 26 mEq/L). These findings underscore the high prevalence of electrolyte disturbances and acid-base imbalances in dialysis patients, highlighting the need for close monitoring and appropriate management to prevent complications.

Mineral Metabolites and Hormone and Serum Albumin

Table 9 presents the mineral metabolites, PTH, and serum albumin levels in the 2023 dialysis population. The mean serum calcium and phosphate levels were 8.8 ± 1.3 mg/dL and 4.6 ± 1.6 mg/dL, respectively, with a median intact parathyroid hormone (iPTH) level of 254.6 (IQR 133.5 to 443.6) pg/mL. While most mineral and bone parameters were within normal ranges, significant abnormalities were observed: 3.9% of patients had hypercalcemia, 46.1% had hyperphosphatemia, and 9.2% had hypophosphatemia.

Regarding iPTH, 59.2% of patients had levels within the target range (135–585 pg/mL), but 25.4% had levels below 135 pg/mL, and 15.4% had levels above 585 pg/mL. The mean serum albumin level was 3.7 ± 0.5 g/dL, with 30.6% of patients exhibiting hypoalbuminemia, indicating widespread protein malnutrition or inflammation, which can negatively impact health and treatment outcomes.

Table 9 Mineral Metabolites and Hormone and Serum Albumin in Incident Dialysis Patients

Parameters (n, %)	Mean ± SD	Median (IQR)
Serum calcium (mg/dL) (N, %)	8.8±1.3	8.8 (8.3, 9.3)
8.6-10.3	6,600 (58.7%)	
<8.6	4,192 (37.3%)	
>10.3	444 (3.9%)	
Serum phosphate (mg/dL) (N, %)	4.6±1.6	4.4 (3.5, 5.4)
2.7-4.5	5,009 (44.7%)	
<2.7	1,026 (9.2%)	
>4.5	5,169 (46.1%)	
Serum intact-PTH (pg/mL) (N, %)	357.6±412.9	254.6 (133.5, 443.6)
135-585	4,281 (59.2%)	
<135	1,839 (25.4%)	
>585	1,114 (15.4%)	
Serum albumin (g/dL) (N, %)	3.7±0.5	3.75 (3.5, 4.1)
≥3.5	7,419 (69.4%)	
<3.5	3,267 (30.6%)	

*The data was analyzed using the average laboratory results for each patient and then classified into each category group.

Anemia and the Use of Erythropoiesis-Stimulating Agents in Incident Dialysis Patients

Table 10 presents data on anemia status and the use of erythropoiesis-stimulating agents (ESAs) in incident dialysis patients in 2023. The mean hemoglobin level was 9.2 ± 1.5 g/dL, with 25.4% of patients reaching the recommended target range of 10–11.5 g/dL. A significant proportion, 68.5%, had hemoglobin levels below 10.0 g/dL, while 6.1% exceeded the target.

Anemia management varied by reimbursement scheme: 35.5% of CSMBS patients and 33.1% of self-paying patients reached the target range, compared to 28.3% under the SSS and 22.1% under the UCS. This suggests that reimbursement schemes may impact anemia management.

The median transferrin saturation was 25.6% (IQR 18.6 to 34.8%), and the median ferritin level was 373 ng/mL (IQR 188 to 690 ng/mL). Iron depletion was common, with 29.9% of patients having transferrin saturation <20%, and 34.1% having levels between 20% and 29%. Additionally, 26.7% had ferritin <200 ng/mL. On the other hand, 16.4% had transferrin saturation >40%, indicating possible iron overload, while 37.3% had ferritin >500 ng/mL, suggesting iron overload.

Most ESAs were administered intravenously (88.9%), with recombinant human erythropoietin (Epoetin Alfa) being the most commonly used (97.5%), while Epoetin Beta accounted for only 1.8%.

Table 10 Anemia and the Use of Erythropoiesis-Stimulating Agents in Incident Dialysis Patients

Parameters	Mean ± SD	Median (IQR)
Hemoglobin (g/dL) (N, %)	9.2±1.5	9.24 (8.2, 10.3)
10-11.5	3,089 (25.4%)	
<10	8,314 (68.5%)	
>11.5-13	626 (5.2%)	
>13	112 (0.9%)	
Hemoglobin (g/dL) in Universal Coverage Scheme (N, %)	9.0±1.5	9.06 (8.1, 10.0)
10-11.5	1,764 (22.1%)	
<10	5,885 (73.9%)	
>11.5-13	264 (3.3%)	
>13	53 (0.7%)	
Hemoglobin (g/dL) in Social Security Scheme (N, %)	9.5±1.6	9.48 (8.3, 10.6)
10-11.5	426 (28.3%)	
<10	924 (61.4%)	
>11.5-13	134 (8.9%)	
>13	21 (1.4%)	
Hemoglobin (g/dL) in Civil Servant Medical Benefit Scheme (N, %)	9.8±1.5	9.82 (8.8, 10.8)
10-11.5	582 (35.5%)	
<10	870 (53.1%)	
>11.5-13	159 (9.7%)	
>13	29 (1.8%)	

Table 10 Anemia and the Use of Erythropoiesis-Stimulating Agents in Incident Dialysis Patients (continued)

Parameters	Mean ± SD	Median (IQR)
Hemoglobin (g/dL) in self-payment (N, %)	9.5±1.5	9.63 (8.7, 10.6)
10-11.5	96 (33.1%)	
<10	170 (58.6%)	
>11.5-13	21 (7.3%)	
>13	3 (1.0%)	
Transferrin saturation (%) (N, %)	28.7±15.0	25.56 (18.6, 34.8)
30-40	1,441 (19.6%)	
<20	2,196 (29.9%)	
20-29	2,502 (34.1%)	
>40	1,206 (16.4%)	
Ferritin (ng/mL) (N, %)	539.4±558.5	373 (188, 690)
200-500	2,878 (35.9%)	
<200	2,137 (26.7%)	
>500	2,986 (37.3%)	
Erythropoietin stimulating agents (N, %)		
Intravenous route	10,208	88.9%
Subcutaneous route	1,263	11.0%
Missing	2,373	0.1%
Types of erythropoietin stimulating agents (N, %)		
Recombinant Human Erythropoietin (Epoetin Alfa)	11,001	97.5%
Recombinant Human Erythropoietin (Epoetin Beta)	197	1.8%
Darbepoetin Alfa	51	0.5%
Methoxy Polyethylene Glycol-Epoetin Beta	32	0.3%

*The data was analyzed using the average laboratory results for each patient and then classified into each category group.

Hepatitis & HIV Serology and Vaccination in Incident Dialysis Patients

Data on viral hepatitis and HIV serology were significantly missing (55%–60%). Among the available data, only 1.9% of dialysis patients tested positive for hepatitis B antigen, 1.3% for anti-HCV antibodies, and 0.4% for HIV antibodies (**Table 11**).

Vaccination rates were low: 6.9% of patients received the COVID-19 vaccine, 26.8% received the influenza vaccine, and 65.5% were vaccinated for hepatitis B. Alarmingly, only 0.9% had received the pneumococcal vaccine, highlighting a significant gap in vaccination coverage for this vulnerable population.

Table 11 Hepatitis and HIV Serology Status, Vaccination Rates and Coverage among Incident Dialysis Patients

Serology	Positive (N, %)	Missing (N, %)
HBs antigen	474 (1.9%)	3,028 (55.1%)
Anti-HBs antibody	3,936 (16.3%)	3,258 (55.1%)
Anti-HCV antibody	312 (1.3%)	4,347 (60.2%)
HIV status	87 (0.4%)	4,580 (61.2%)
Vaccination (N = 9,094)		
COVID-19 vaccine	275 (6.9%)	
Hepatitis-B vaccine	2,572 (65.0%)	
Influenza vaccine	1,058 (26.8%)	
Pneumococcal vaccine	34 (0.9%)	

Clinical Outcomes

Previous data from Thailand (2018 to 2022) indicated a mortality rate ranging from approximately 6% to 10%. In 2023, the mortality rate among newly initiated dialysis patients was 3.6%. Analyzing the causes of death within this population, the major contributors were cardiac disease (32.1%) and infectious diseases (20.6%), as shown in **Table 12**. This suggests that improving patient outcomes should focus on better management of cardiovascular health and infection prevention, two of the most significant risks for dialysis patients. Enhanced clinical care, regular monitoring, and implementing preventive measures for these conditions could potentially reduce mortality rates in the future.

Table 12 Causes of Death Among Incident Dialysis Patients

Cause of Death	Number (N)	Percentage (%)
Cardiac Disease	162	32.1
Infectious Disease	104	20.6
Cerebrovascular Disease	37	7.3
Malignancy	20	3.9
Liver Disease	10	2.0
Kidney Disease	7	1.4
Accident	6	1.2
Suicide	3	0.6
Uncertain	61	12.1
Total	**504**	**3.6**

Discussion

This study offers a comprehensive analysis of the national registry data on Incident Dialysis patients in Thailand in 2023, providing valuable insights into the management of ESKD. The substantial increase in hemodialysis patients reflects the growing burden of ESKD[3], with diabetic nephropathy and hypertension as the primary contributors.[17] These findings underscore the need for focused interventions aimed at early diagnosis, prevention, and effective management of these chronic conditions to mitigate the long-term healthcare burden.

A key observation from the data is the significant variation in access to different treatment modalities. Notably, the higher proportion of patients on peritoneal dialysis under the UCS compared to other schemes suggests potential differences in resource allocation or healthcare provider recommendations. This calls for a closer examination of how treatment access is distributed across different patient groups and healthcare settings.

The study also highlights challenges related to anemia management and dialysis adequacy. Despite the availability of erythropoiesis-stimulating agents, many patients, particularly those under the UCS, had suboptimal hemoglobin levels, with many exhibiting concentrations below 9 g/dL. This condition is associated with poorer health outcomes, as higher hemoglobin levels are linked to better clinical outcomes, including reduced mortality and hospitalization rates.[18] These findings suggest a need for improved anemia management strategies and may indicate disparities in access to treatment, potentially influenced by reimbursement schemes.

Furthermore, the study reveals that many patients receiving twice-weekly dialysis fail to achieve optimal dialysis adequacy[11], as indicated by suboptimal spKt/V values. More frequent dialysis regimens may be crucial to achieving adequate treatment levels and improving patient outcomes.[19, 20] Although this study provides data on vascular access methods, it offers limited exploration of the reasons behind preferences for certain access types. The high reliance on double-lumen catheters for chronic hemodialysis raises concerns, as these devices are associated with complications such as blockage and infections.[21] Further research into the underlying causes of these challenges could provide insights into improving vascular access strategies and patient outcomes.

Several limitations must be considered when interpreting the findings. Missing data on hepatitis and HIV serology, as well as incomplete vaccination records, may impact the reliability of some conclusions. The low vaccination rates, particularly for pneumococcal vaccines, suggest gaps in preventive care, although the absence of complete data limits definitive conclusions on vaccination practices in this population. Additionally, the low percentage of patients on the kidney transplant waiting list raises concerns about access to transplantation services and patient awareness. However, the study does not explore the reasons behind these low registration rates, warranting further investigation into potential barriers.

The analysis also reveals a notable reduction in mortality rates among newly initiated dialysis patients in 2023 (3.6%) compared to previous years, suggesting that recent healthcare interventions may have positively impacted patient outcomes. However, the leading causes of death—cardiac disease and infectious diseases—highlight the critical need to address these risks.[22] A multifaceted approach to managing cardiovascular health, including better control of hypertension, diabetes, dyslipidemia, and other risk factors, is essential. Furthermore, infection prevention strategies, timely access to healthcare, and enhanced patient education on infection control are crucial in reducing mortality.

Despite the registry's comprehensive nature, the study is limited by missing data, particularly for peritoneal dialysis cases, and potential reporting biases, especially in rural or underserved areas. Regional disparities in healthcare infrastructure, socioeconomic status, and access to healthcare may also limit the generalizability of the findings. Moreover, while this study provides valuable insights into dialysis care in Thailand, a comparative analysis with other countries would help identify best practices and inform improvements in the Thai healthcare system.

In conclusion, the increasing burden of ESKD in

Thailand underscores the urgent need for comprehensive healthcare strategies to manage the growing number of patients requiring RRT. The findings from the TRT Registry offer essential insights into patient demographics, treatment modalities, and clinical outcomes, which can inform policy development and healthcare optimization. To address the challenges identified, further research should focus on long-term patient follow-up, improving data completeness, and exploring regional disparities in access to care and transplantation. Targeted interventions to enhance anemia management, dialysis adequacy, and vaccination coverage could significantly improve outcomes for dialysis patients in Thailand.

Acknowledgements

The Subcommittee on the Thailand Renal Replacement Therapy (TRT) Registry of the Nephrology Society of Thailand extends its gratitude to all nephrologists and staff members of the dialysis and transplant centers for their contributions, as well as the Thai Renal Replacement Therapy staff officers—Supaporn Namkaew, Nanthika Tathong, and Prayuth Damrongsuwat.

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