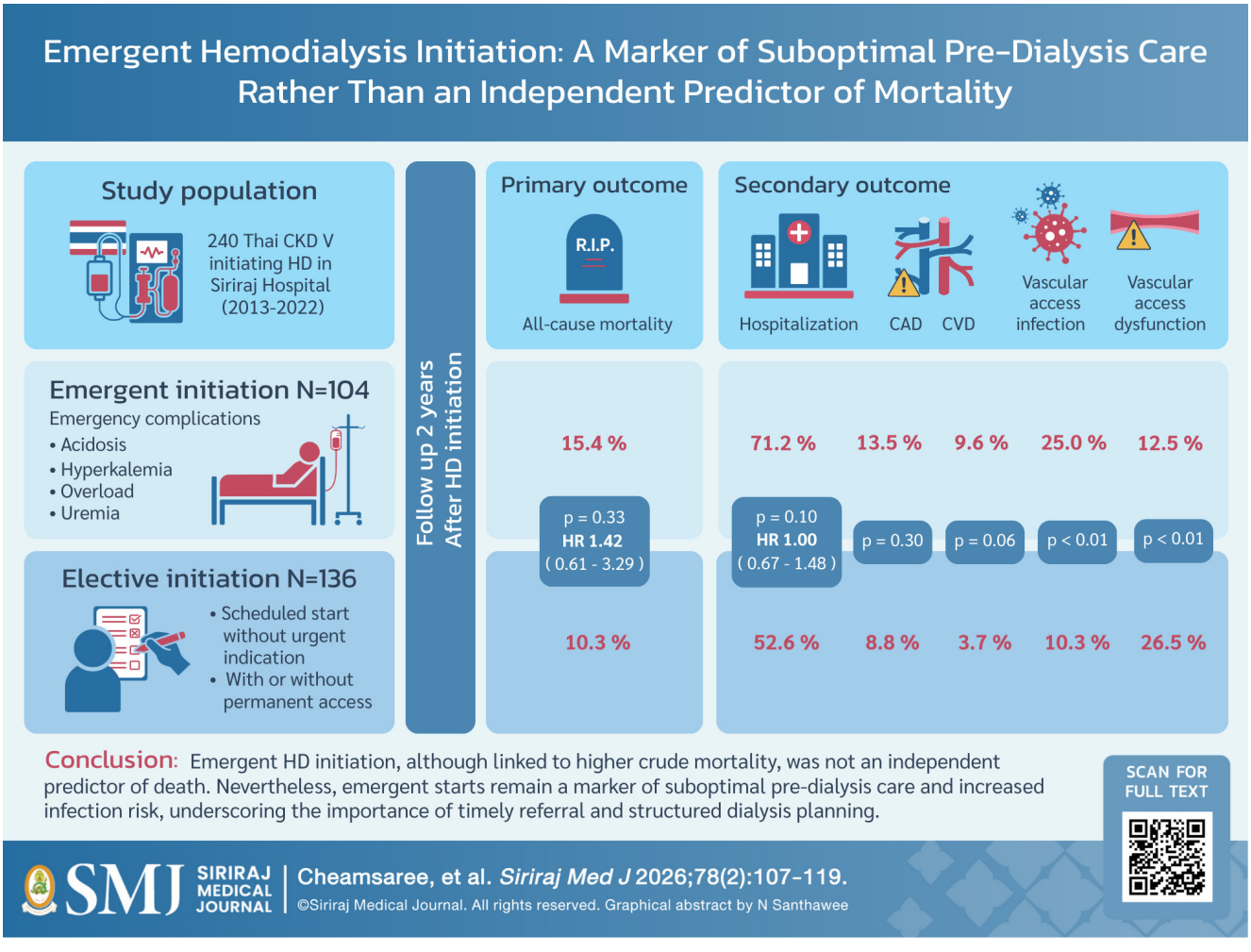
Emergent Hemodialysis Initiation: A Marker of Suboptimal Pre-Dialysis Care Rather Than an Independent Predictor of Mortality

Kemmawat Cheamsaree, M.D.[1], Luddawan Upekkhawong, M.Sc.[2], Kornchanok Vareesangthip, M.D.[2,*]

[1]Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand, [2]Renal Division, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.



*Corresponding author: Kornchanok Vareesangthip
E-mail: Kornchanok.var@mahidol.ac.th
Received 14 October 2025 Revised 26 November 2025 Accepted 29 November 2025
ORCID ID:http://orcid.org/0000-0003-2071-1996
https://doi.org/10.33192/smj.v78i2.278277

All material is licensed under terms of the Creative Commons Attribution 4.0 International (CC-BY-NC-ND 4.0) license unless otherwise stated.

ABSTRACT

Objective: Emergent hemodialysis (HD) initiation has been consistently linked to higher mortality in prior studies, but evidence from Thailand is limited. This study evaluated the impact of elective versus emergent HD initiation in a tertiary-care setting.

Materials and Methods: This retrospective cohort study included adults with stage 5 chronic kidney disease who initiated HD at Siriraj Hospital between 2013 and 2022. Emergent initiation was defined as HD started for urgent indications without permanent vascular access; elective initiation was nephrologist-scheduled HD without acute complications. The primary outcomes were two-year all-cause mortality, cardiovascular events, hospitalizations, and vascular-access complications.

Results: Among 240 patients, 104 (43.3%) initiated HD emergently. These patients had higher rates of diabetes, poorer nutritional and metabolic profiles, less pre-dialysis care, and greater catheter use. Crude mortality was higher in the emergent group (15.4% vs. 10.3%), but after adjustment for comorbidities, functional status, and laboratory parameters, emergent initiation was not independently associated with mortality (adjusted HR 1.42, 95% CI 0.61–3.29). Infection-related deaths and vascular access infections were more frequent with emergent initiation, while vascular access dysfunction occurred more often in the elective group. Median hospitalization-free survival was shorter in the emergent group.

Conclusion: Emergent HD initiation was not an independent predictor of mortality, suggesting that excess risk observed in prior cohorts may reflect comorbidity and nutritional status rather than initiation type itself. Nevertheless, emergent initiation remained a marker of suboptimal pre-dialysis care and higher infection risk. Strengthening early nephrology referral, structured pre-dialysis planning, and infection prevention remains essential for optimizing ESRD outcomes.

Keywords: Hemodialysis initiation; unplanned start; emergent start; mortality; Thailand; ESRD (Siriraj Med J 2026;78(2):107-119)

INTRODUCTION

Chronic kidney disease (CKD) affects approximately 17%–18% of Thai adults and imposes a substantial burden in terms of morbidity, mortality, and healthcare expenditure.[1-3] As CKD progresses to end-stage renal disease (ESRD), chronic hemodialysis (HD) remains the predominant renal replacement modality in Thailand.[4] Achieving optimal outcomes with HD requires advance preparation, including timely nephrology referral, structured patient education, modality counseling, and permanent vascular access creation, processes that often require 6–12 months of coordinated care. Emerging evidence suggests that artificial intelligence–assisted prediction and care coordination may help facilitate timely preparation for hemodialysis initiation and vascular access planning.[5]

In practice, many patients initiate HD in an emergent manner, often due to life-threatening complications and in the absence of permanent access. Outcomes for patients on HD are influenced by a range of factors, particularly comorbidities such as diabetes mellitus (DM) and hypertension (HT).[6,7] Nonetheless, several prior studies, including those from Asian cohorts, have consistently reported that unplanned or emergent dialysis initiation is associated with higher short-term mortality, increased infection risk, and greater hospitalization compared with planned dialysis initiation.[8-10] In contrast, elective dialysis initiation is typically accompanied by pre-dialysis care, which has been linked to lower mortality, fewer cardiovascular events, and reduced vascular access complications.[11-14] Emergent initiation, frequently undertaken to address urgent CKD complications such as hyperkalemia, metabolic acidosis, or volume overload, typically requires temporary catheter placement, a factor strongly linked to worse clinical outcomes.

Despite this growing body of evidence, real-world data from Thailand on the impact of elective versus emergent HD initiation remain limited. Such context-specific evidence is essential, as healthcare delivery models, dialysis access pathways, and referral practices vary across regions. To address this knowledge gap, we conducted a retrospective cohort study at Siriraj Hospital to compare clinical characteristics and 2-year outcomes between patients initiating HD in an elective versus emergent manner.

MATERIALS AND METHODS

Study design and setting

We conducted a retrospective cohort study of patients

with CKD stage 5 who initiated chronic HD at Siriraj Hospital, a tertiary referral center in Bangkok, Thailand, between December 2013 and December 2022.

Study population

Eligible participants were Thai adults (≥18 years) of Thai nationality who underwent their first session of chronic HD during the study period. Patients were excluded if they initiated HD following kidney graft failure, received HD solely for acute kidney injury during hospitalization, had insufficient clinical data to determine the date of HD initiation, or lacked at least 24 months of follow-up (unless censored earlier due to death or transplantation).

Case identification and data collection

Potential cases were identified through the hospital's electronic database using ICD-9/10 codes related to CKD, ESRD, dialysis dependence, and vascular access procedures (codes N18, N180, N184, N185, N188, N19, Z992, 3995, 389, 3893, 3895, 39, 3927, 3949, 3953, 394, 3942, 3943; details shown in Supplementary Table 1). Medical records of all identified patients were manually reviewed to confirm eligibility and extract data.

Definition of exposure groups

Emergent HD initiation was defined as an urgent, unscheduled first HD session prompted by refractory complications (metabolic acidosis, hyperkalemia, volume overload, or uremia), typically without permanent vascular access and usually initiated in the emergency department. This group also included patients who had partially planned HD initiation (e.g., an AVF/AVG already created) but declined or postponed starting dialysis and subsequently required emergency HD due to emergent complications.

Elective HD initiation was defined as a nephrologist-scheduled first HD session without urgent clinical indication, with or without permanent access at initiation. Patients who had no acute complications and remained non-uremic could be electively initiated when their eGFR declined to below 6 mL/min/1.73 m^2, primarily to allow sufficient time for AVF/AVG maturation.

Variables collected

For each eligible patient, we recorded demographics (age, sex, weight, height, body mass index), comorbidities (including diabetes mellitus, hypertension, coronary artery disease, cerebrovascular disease, peripheral arterial disease, arrhythmia, chronic respiratory disease, cirrhosis, autoimmune disease, and malignancy) and primary kidney disease (diabetic nephropathy, hypertensive nephropathy, glomerular disease, polycystic kidney disease, obstructive nephropathy, cancer-related, other or unknown). We captured elements of pre-dialysis care, namely timing of the first nephrology visits and CKD stage at that visit, number of nephrology clinic visits, receipt and date of renal replacement therapy counseling and the first modality chosen, as well as vascular surgery involvement (whether seen, timing of first visit, and number of visits). Laboratory values were recorded both at CKD stage 5 diagnosis and at HD initiation, including blood urea nitrogen, serum creatinine, estimated glomerular filtration rate, hemoglobin, hematocrit, albumin, bicarbonate, sodium, potassium, chloride, calcium, phosphorus, intact parathyroid hormone, and ferritin. Vascular access type at the first chronic HD session was classified as non-cuffed, non-tunneled catheter, tunneled cuffed catheter, arteriovenous fistula or arteriovenous graft (AVF/AVG).

Outcomes

The primary outcome was all-cause mortality within 24 months of chronic HD initiation. Secondary outcomes included major adverse cardiovascular events (coronary artery disease or cerebrovascular disease), time to first hospitalization for any cause (excluding admissions for elective surgical procedures such as AVF/AVG creation), vascular-access infection and vascular-access dysfunction requiring intervention, all assessed within the same 24-month window. Follow-up time was calculated from the date of HD initiation until the first occurrence of each outcome, with censoring at kidney transplantation, loss to follow-up, or completion of 24 months, whichever came first.

Ethical issues

The study protocol was reviewed and approved by the Human Research Protection Unit, Faculty of Medicine Siriraj Hospital, Mahidol University (SIRB Protocol no. 960/2565 (IRB4), COA no. Si 279/2023). The study was conducted in accordance with the Declaration of Helsinki. Informed consent was waived due to the retrospective nature of the study.

Statistical analysis

All analyses were performed using IBM SPSS Statistics version 29.0.2.0 (IBM Corp., Armonk, NY, USA). Baseline characteristics were summarized as mean ± standard deviation (SD) or median with interquartile range (IQR) for continuous variables, depending on distribution, and as frequencies with percentages for categorical variables. Between-group differences were assessed using Student's t-test for normally distributed

continuous variables, Mann–Whitney U test for skewed distributions, and the chi-square or Fisher's exact test for categorical variables, as appropriate.

Time-to-event analyses were conducted from the date of HD initiation to the event of interest, with censoring at 24 months, kidney transplantation or loss to follow-up. Kaplan–Meier survival curves were generated, and between-group differences were evaluated using the log-rank test. Cox proportional hazards regression models were used to estimate hazard ratios (HRs) with 95% confidence intervals (CIs) for 2-year all-cause mortality and first hospitalization. For model building, variables with a p-value < 0.05 in the univariable analysis were considered eligible for inclusion in the multivariable Cox models. In addition, emergent HD initiation—the primary exposure of interest—was prespecified and included in all multivariable models regardless of its univariable p-value. This approach ensured that the final models incorporated both statistically significant predictors and clinically relevant covariates. The proportional hazards assumption was assessed using log–log survival plots and time-dependent covariate tests and was satisfied for all Cox models. All statistical tests were two-tailed, with $p < 0.05$ considered statistically significant.

RESULTS

A total of 756 patients were initially screened from the hospital database using ICD-9/10 codes. After exclusion of ineligible cases, including those with prior kidney transplant failure, dialysis for acute kidney injury, insufficient documentation, or inadequate follow-up, 240 patients with confirmed CKD stage 5 who initiated chronic HD between 2013 and 2022 were included in the final analysis (Fig 1). Of these, 104 patients (43.3%) initiated HD in an emergent manner, while 136 patients (56.7%) initiated HD in an elective manner.

Baseline demographic, clinical, and laboratory data are summarized in Table 1. The proportion of male patients was significantly lower in the emergent HD initiation group compared with the elective group (46.2% vs. 61.0%, $p = 0.02$). There were no statistically significant differences between groups in age at CKD stage 5 diagnosis, age at HD initiation, body weight, or body mass index.

Comorbidity profiles differed between groups. Diabetes mellitus was more common in the emergent group (72.1% vs. 56.6%, $p = 0.01$), as was peripheral arterial disease (4.8% vs. 1.5%, $p = 0.045$). Diabetic nephropathy was the most common underlying cause of CKD overall, but its prevalence was higher among emergent initiators (63.5% vs. 50.0%, $p = 0.04$). In contrast, glomerular disease was significantly more frequent in the elective group (20.6% vs. 6.7%, $p = 0.003$).

Pre-dialysis care also showed important differences. Four patients (3.8%) in the emergent group had never met a nephrologist before HD initiation. Moreover, a significantly greater proportion of emergently initiated patients had their first nephrology visit only after reaching CKD stage 5. In addition, the percentage of patients receiving vascular surgery care and the number of visits to a vascular surgeon before HD initiation were both markedly lower in the emergent group.

Marked contrasts were observed in vascular access type at initiation. Most emergently initiated patients

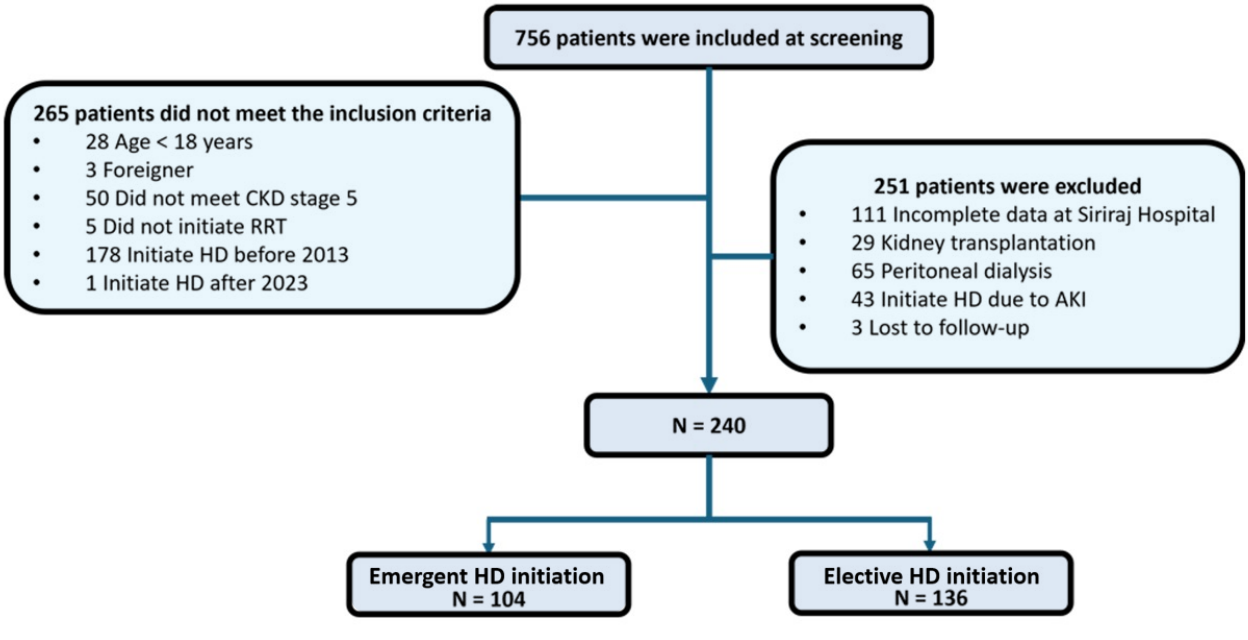


Fig 1. Flow diagram of study inclusion and exclusion criteria.

TABLE 1. Baseline characteristics.

Baseline Factors	Emergent HD initiation (N = 104)	Elective HD initiation (N = 136)	*p*-value
Male, N (%)	48 (46.2)	83 (61.0)	0.02
Age of CKD stage 5, y†	64±13	61±15	0.12
Age at HD initiation, y†	65±13	62±15	0.12
Body weight, kg†	63.1±15.7	63.8±13.8	0.73
Height, cm†	160.0±9.1	161.6±10.2	0.20
BMI, kg/m^{2}†	24.6±5.4	24.5±5.7	0.98
Co-morbidities, N (%)			
Diabetes mellitus	75 (72.1)	77 (56.6)	0.01
Hypertension	98 (94.2)	124 (91.2)	0.37
Dyslipidemia	58 (55.8)	81 (59.6)	0.56
Chronic respiratory disorder	5 (3.8)	3 (2.2)	0.27
Cirrhosis	4 (3.8)	5 (3.7)	0.95
Cerebrovascular disease	15 (14.4)	12 (8.8)	0.17
Coronary artery disease	22 (21.2)	25 (18.4)	0.59
Valvular heart disease	2 (1.9)	2 (1.5)	0.79
Arrhythmia	11 (10.6)	7 (5.1)	0.11
Peripheral arterial disease	5 (4.8)	2 (1.5)	0.04
Autoimmune disease	5 (4.8)	2 (1.5)	0.13
Cancer	10 (9.6)	8 (5.9)	0.28
Mobility status, N (%)			
Total dependent status	6 (5.8)	6 (4.4)	0.63
Need assistance	18 (17.3)	19 (14.0)	0.48
Independent status	80 (76.9)	111 (81.6)	0.37
Cause of CKD, N (%)			
Diabetic nephropathy	66 (63.5)	68 (50.0)	0.04
Hypertensive nephropathy	14 (13.5)	16 (11.8)	0.69
Glomerular disease	7 (6.7)	28 (20.6)	<0.01
Polycystic kidney disease	2 (1.9)	4 (2.9)	0.62
Obstructive nephropathy	5 (4.8)	2 (1.5)	0.13
Genitourinary cancer	0 (0)	1 (0.7)	0.38
Others	5 (4.8)	12 (8.8)	0.23
Unknown	5 (4.8)	5 (3.7)	0.75
Pre-dialysis care by nephrologist, N (%)	100 (96.2)	136 (100)	0.02
Stage of CKD at first visit nephrologist, N (%)			
Stage 2	2 (1.9)	3 (2.2)	0.88
Stage 3	14 (13.5)	32 (23.5)	0.05
Stage 4	43 (41.3)	68 (50.0)	0.18
Stage 5	41 (39.4)	33 (24.3)	0.01
No. of nephrologist visits†	4.5±1.3	4.9±0.5	<0.01

TABLE 1. Baseline characteristics. (Continue)

Baseline Factors	Emergent HD initiation (N = 104)	Elective HD initiation (N = 136)	*p*-value
eGFR at first nephrologist visit (mL/min/1.73 m²)‡	17.7 [12.0, 25.8]	22.2 [15.0, 30.5]	<0.01
Pre-dialysis care by vascular surgeon, N (%)	32 (30.8)	98 (72.1)	<0.01
No. of vascular surgeon visits‡	0 [0, 2]	3 [0, 5]	<0.01
RRT counseling, N (%)	96 (96.0)	136 (100)	0.02
First RRT mode chosen, N (%)			
Hemodialysis	75 (78.1)	119 (87.5)	0.06
Peritoneal dialysis	20 (20.8)	10 (7.4)	<0.01
Kidney transplant	1 (1.0)	7 (5.1)	0.09
Indication for dialysis initiation, N (%)			
GFR < 6 mL/min/1.73 m²	0 (0)	95 (69.9)	<0.01
Volume overload	67 (64.4)	15 (11.0)	<0.01
Hyperkalemia	5 (4.8)	1 (0.7)	0.04
Uremia	31 (29.8)	25 (18.4)	0.04
Acidosis	1 (1.0)	0 (0)	0.25
Vascular access at date of HD initiation, N (%)			
Non-cuffed, non-tunneled catheter	79 (76.0)	22 (16.3)	<0.01
Tunneled cuffed catheter	16 (15.4)	46 (34.1)	<0.01
AVF/AVG	9 (8.7)	67 (49.6)	<0.01
Laboratory data at HD initiation			
BUN (mg/dL)†	92.7±32.5	90.4±31.1	0.58
Creatinine (mg/dL)†	9.9±4.5	10.3±4.1	0.49
eGFR (mL/min/1.73 m²)‡	5.1 [3.6, 6.8]	4.9 [3.7, 6.6]	0.94
Sodium (mmol/L)†	135.4±5.7	135.7±5.3	0.65
Potassium (mmol/L)†	4.5±1.1	4.1±0.8	<0.01
Chloride (mmol/L)†	96.9±7.4	95.8±7.3	0.31
Bicarbonate (mmol/L)†	18.5±5.3	20.6±4.1	<0.01
Albumin (mg/dL)†	3.3±0.6	3.7±0.7	<0.01
Calcium (mg/dL)†	8.3±1.2	8.6±1.1	0.03
Phosphorus (mg/dL)†	6.1±2.6	5.8±1.7	0.47
iPTH (pg/mL)†	281.6±171.7	332.7±240.5	0.32
Hemoglobin (g/dL)†	8.7±1.9	9.5±1.6	<0.01
Hematocrit (%)†	26.9±5.8	28.9±5.0	<0.01
Ferritin (ng/mL)†	976.0±1189.5	612.5±449.3	0.07

†Presented as mean ± standard deviation

‡Presented as median (interquartile range)

Abbreviations: CKD; chronic kidney disease, HD; hemodialysis, BMI; body mass index, eGFR; estimated glomerular filtration rate, RRT; renal replacement therapy, AVF; arteriovenous fistula, AVG; arteriovenous graft, BUN; blood urea nitrogen, iPTH; intact parathyroid hormone

began HD with a non-cuffed, non-tunneled catheter (76.0% vs. 16.3%, $p < 0.001$). Conversely, use of AVF/AVG was significantly higher among elective initiators (49.6% vs. 8.7%, $p < 0.001$). Notably, the small proportion of elective patients who still initiated with a non-cuffed catheter did so mainly due to delayed AVF maturation (often > 6 months) or reimbursement-related delays.

Although eGFR at HD initiation did not differ significantly between groups, emergent initiation was associated with significantly worse biochemical markers, including lower serum albumin, hemoglobin, hematocrit, and bicarbonate levels. Detailed laboratory data at the time of renal replacement therapy counseling, CKD stage 5 diagnosis, and HD initiation are provided in the Supplementary Table 2.

Outcomes

Two-year outcomes by initiation type are summarized in Table 2. Overall mortality did not differ significantly between emergent and elective groups (15.4% vs. 10.3%, $p = 0.33$). Among those who died, infection was the leading cause in both groups, accounting for 81.3% of deaths in the emergent group and 71.4% in the elective group. Cancer and cardiovascular disease were less frequent causes of death and did not differ significantly between groups.

Hospitalization was common in both cohorts, with a numerically higher rate in the emergent group (71.2% vs. 52.6%, $p = 0.10$). Importantly, the median time to first hospitalization was significantly shorter in the emergent group (7.2 months [IQR 3.6 - 10.8]) compared with the elective group (16.4 months [IQR 10.6 - 22.2], $p = 0.03$). Rates of major adverse cardiovascular events were low in both groups and showed no significant differences.

Clear differences were observed in vascular access–related outcomes. Vascular access infection was significantly more common in the emergent group (25.0% vs. 10.3%, $p = 0.003$), consistent with greater reliance on temporary catheters. In contrast, vascular access dysfunction was more frequent in the elective group (26.5% vs. 12.5%, $p = 0.008$), likely reflecting the longer duration of AVF/AVG use.

In summary, while overall mortality did not differ by initiation type, unplanned initiation was associated with a shorter hospitalization-free interval and higher risk of vascular access infection, whereas planned initiation was linked to greater vascular access dysfunction over time.

TABLE 2. Comparative outcomes between emergent and elective HD initiation group.

Outcomes	Emergent HD initiation (N = 104)	Elective HD initiation (N = 136)	*p*-value
Overall death, N (%)	16 (15.4)	14 (10.3)	0.33
Cause of death, N (%)			
Infection	13 (81.3)	10 (71.4)	0.53
Cancer	3 (18.2)	2 (14.4)	0.74
Coronary artery disease	0 (0)	1 (7.1)	0.28
Hospitalization, N (%)	74 (71.2)	82 (52.6)	0.10
Median time to first hospitalization, months‡	7.2 [3.6, 10.8]	16.4 [10.6, 22.2]	0.03
Coronary artery disease, N (%)	14 (13.5)	12 (8.8)	0.30
Cerebrovascular disease, N (%)	10 (9.6)	5 (3.7)	0.06
Vascular access infection, N (%)	26 (25.0)	14 (10.3)	<0.01
Vascular access dysfunction, N (%)	13 (12.5)	36 (26.5)	<0.01

‡Presented as median (interquartile range)
Abbreviation: HD; hemodialysis

Survival analysis and predictors of two-year mortality

Overall cumulative survival for the cohort was 95% at 12 months and 87% at 24 months following HD initiation. Survival was numerically lower among patients with emergent initiations at both time points (12 months: 92% vs. 98%; 24 months: 85% vs. 89%), although differences between groups appeared modest on visual inspection of Kaplan–Meier curves (Fig 2a).

In univariate Cox analysis, emergent initiation was associated with a nonsignificant trend toward higher mortality (HR 1.58, 95% CI 0.77 -3.23; $p = 0.21$). After multivariable adjustment for demographic, clinical, and laboratory covariates, emergent initiation was not independently associated with mortality (adjusted HR 1.42, 95% CI 0.61 - 3.29; $p = 0.42$). Independent predictors of mortality included older age at HD initiation, non-dependent functional status (protective effect of independence) and lower serum albumin levels at initiation. Other comorbidities (e.g., diabetes, coronary artery disease, prior cerebrovascular disease) and initiation with AVF/AVG were not significant in the adjusted model (Table 3).

Hospitalization

Hospitalization was frequent in both groups, with a clearly shorter hospitalization-free interval among emergent HD initiators. The Kaplan–Meier curves (Fig 2b) show earlier divergence in the emergent group, consistent with a higher hospitalization burden.

In Cox models (Table 4), emergent initiation was associated with a higher risk of first hospitalization in univariate analysis (HR 1.60, 95% CI 1.17 -2.19; $p = 0.004$) but this association was no longer significant after multivariable adjustment (adjusted HR 1.00, 95% CI 0.67 - 1.48; $p = 0.98$). Several factors were linked to hospitalization in univariate analyses: diabetes mellitus, coronary artery disease, and lower serum albumin were associated with higher risk, while initiation with AVF/AVG and pre-dialysis nephrology care appeared protective. In the multivariable model, higher eGFR at HD initiation remained independently associated with an increased risk of hospitalization (adjusted HR 1.09 per mL/min/1.73 m^2, 95% CI 1.03 -1.15; $p < 0.01$), whereas initiation with AVF/AVG and higher albumin showed borderline protective trends. These findings indicate that the excess hospitalization observed with emergent starts is largely explained by case-mix and baseline clinical status rather than the initiation pathway per se.

Subgroup analysis by vascular access

This sensitivity analysis was performed to address potential misclassification of patients who initiated with a non-cuffed, non-tunneled catheter but were categorized as elective. To disentangle the initiation pathway from the access type, we stratified outcomes by vascular access used at first HD and then compared elective vs. emergent initiation within each access subgroup. Among patients starting with a non-cuffed, non-tunneled catheter, emergent initiation was not associated with higher two-year mortality or shorter hospitalization-free survival. Results were likewise nonsignificant within the tunneled cuffed catheter and AVF/AVG groups (data provided in the Supplementary Table 3). Overall, these findings indicate that inclusion of some non-cuffed, non-tunneled catheter cases within the elective initiation group does not explain the absence of an independent mortality effect of unplanned initiation. Rather, the null association appears consistent across access types, though interpretation is limited by wide confidence intervals in smaller subgroups.

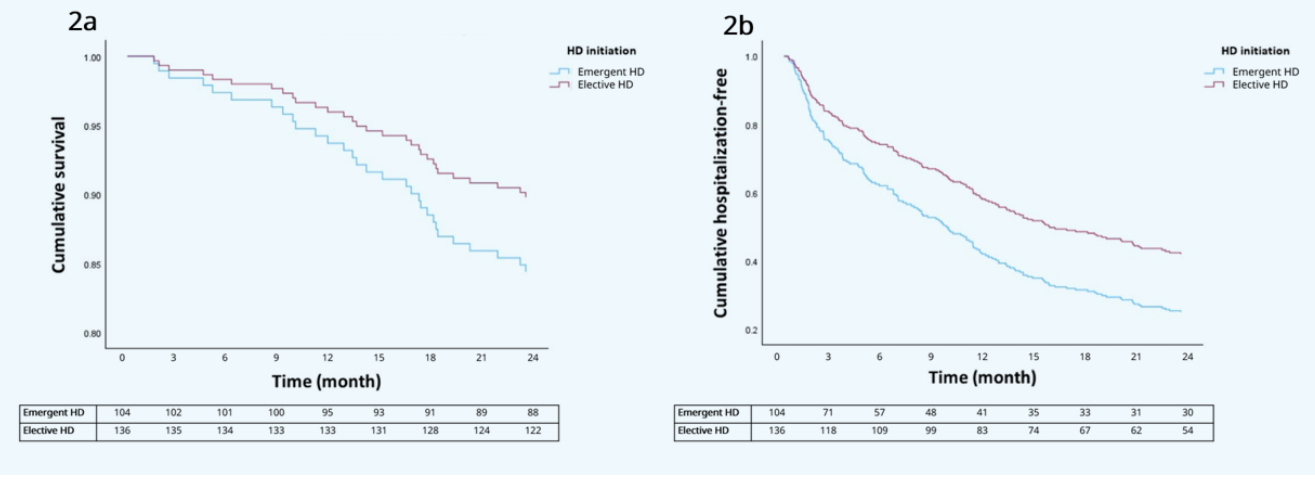


Fig 2. **(A)** Patient survival in emergent and elective HD initiation groups. **(B)** Hospitalization-free survival in emergent and elective HD initiation groups.

TABLE 3. Cox regression analysis of factors associated with patient survival.

Factors	Univariate analysis		Multivariate analysis	
	HR (95% CI)	*p*-value	HR (95% CI)	*p*-value
Female	1.58 (0.77-3.25)	0.22		
Age at HD initiation	1.07 (1.03-1.11)	<0.01	1.06 (1.02-1.11)	<0.01
BMI	0.99 (0.92-1.06)	0.72		
Co-morbidities				
Diabetes mellitus	1.40 (0.64-3.05)	0.40		
Hypertension	1.17 (0.28-4.91)	0.83		
Dyslipidemia	0.95 (0.46-1.95)	0.88		
Chronic respiratory disorder	1.07 (0.15-7.85)	0.95		
Cirrhosis	5.30 (1.85-15.20)	<0.01	3.19 (0.78-12.96)	0.11
Cerebrovascular disease	1.28 (0.44-3.63)	0.66		
Coronary artery disease	1.82 (0.83-3.98)	0.13		
Valvular heart disease	2.24 (0.31-16.44)	0.43		
Arrhythmia	3.46 (1.41-8.47)	<0.01	2.19 (0.76-6.34)	0.15
Peripheral arterial disease	0.05 (0.00-957.55)	0.55		
Autoimmune disease	1.08 (0.15-7.93)	0.94		
Cancer	3.65 (1.49-8.95)	<0.01	0.63 (0.17-2.34)	0.49
Totally independent status	0.20 (0.10-0.40)	<0.01	0.31 (0.13-0.76)	0.01
Pre-dialysis nephrologist care	20.64 (0.00-3703933.93)	0.62		
eGFR at first nephrologist visit	0.99 (0.96-1.02)	0.51		
Pre-dialysis nephrologist visit no.	1.16 (0.71-1.90)	0.56		
Pre-dialysis RRT counseling	0.40 (0.06-2.96)	0.37		
Pre-dialysis vascular surgeon visit	0.35 (0.16-0.76)	<0.01	1.21 (0.15-9.99)	0.86
Pre-dialysis vascular surgeon visit no.	0.76 (0.62-0.94)	<0.01	0.80 (0.42-1.53)	0.49
Emergent HD initiation	1.58 (0.77-3.23)	0.21	1.42 (0.61-3.29)	0.42
HD initiation with AVF/AVG	0.14 (0.03-0.60)	<0.01	0.31 (0.03-3.05)	0.31
Laboratory at HD initiation				
Albumin	0.39 (0.22-0.70)	<0.01	0.44 (0.20-0.96)	0.04
Hematocrit	0.97 (0.90-1.03)	0.28		
eGFR	1.10 (1.02-1.19)	0.02	1.03 (0.91-1.17)	0.67

Abbreviations: HD; hemodialysis, BMI; body mass index, eGFR; estimated glomerular filtration rate, RRT; renal replacement therapy, AVF; arteriovenous fistula, AVG; arteriovenous graft

TABLE 4. Cox regression analysis of factors associated with time to first hospitalization.

Factors	Univariate analysis		Multivariate analysis	
	HR (95% CI)	*p*-value	HR (95% CI)	*p*-value
Female	1.14 (0.83-1.56)	0.42		
Age at HD initiation	1.01 (1.00-1.02)	0.04	1.01 (0.99-1.02)	0.28
BMI	1.01 (0.99-1.04)	0.38		
Co-morbidities				
• Diabetes mellitus	1.56 (1.11-2.18)	0.01	1.08 (0.72-1.62)	0.73
• Hypertension	1.26 (0.67-2.40)	0.47		
• Dyslipidemia	1.15 (0.83-1.58)	0.41		
• Chronic respiratory disorder	0.64 (0.24-1.73)	0.38		
• Cirrhosis	1.65 (0.77-3.52)	0.20		
• Cerebrovascular disease	1.29 (0.80-2.09)	0.30		
• Coronary artery disease	1.57 (1.09-2.27)	0.02	1.44 (0.92-2.23)	0.11
• Valvular heart disease	2.23 (0.85-6.33)	0.10		
• Arrhythmia	1.66 (0.99-2.78)	0.06		
• Peripheral arterial disease	1.83 (0.75-4.46)	0.19		
• Autoimmune disease	1.55 (0.64-3.78)	0.34		
• Cancer	1.52 (0.88-2.64)	0.13		
Totally independent status	0.79 (0.54-1.15)	0.22		
Pre-dialysis nephrologist care	0.36 (0.13-0.98)	0.04	0.54 (0.13-2.25)	0.40
eGFR at first nephrologist visit	1.00 (0.99-1.01)	0.90		
Pre-dialysis nephrologist visit no.	0.89 (0.76-1.04)	0.14		
Pre-dialysis RRT counseling	1.56 (0.39-6.29)	0.53		
Pre-dialysis vascular surgeon visit	0.88 (0.64-1.21)	0.43		
Pre-dialysis vascular surgeon visit no.	0.96 (0.89-1.03)	0.26		
Emergent HD initiation	1.60 (1.17-2.19)	<0.01	1.00 (0.67-1.48)	0.98
HD initiation with AVF/AVG	0.55 (0.38-0.80)	<0.01	0.63 (0.39-1.03)	0.07
Lab at HD initiation				
• Albumin	0.64 (0.49-0.83)	<0.01	0.76 (0.55-1.05)	0.09
• Hematocrit	0.99 (0.96-1.02)	0.39		
• eGFR	1.10 (1.05-1.15)	<0.01	1.09 (1.03-1.15)	<0.01

Abbreviations: HD; hemodialysis, BMI; body mass index, eGFR; estimated glomerular filtration rate, RRT; renal replacement therapy, AVF; arteriovenous fistula, AVG; arteriovenous graft

DISCUSSION

In this single-center Thai cohort, emergent HD initiation was associated with poorer baseline nutritional and metabolic status, greater catheter use, a shorter hospitalization-free interval, and higher rates of vascular access infection. However, it was not an independent predictor of two-year all-cause mortality after adjustment. Instead, survival was influenced by age, functional dependence, and hypoalbuminemia at initiation. These results suggest that emergent initiation serves more as a marker of case-mix and clinical frailty than as a direct causal factor for mortality in this setting.

Although 96% of patients who initiated HD emergently had received pre-dialysis nephrology care, their CKD stage at first nephrology visit was substantially more advanced, and they had significantly fewer nephrology visits compared with the elective group. These factors likely limited opportunities for timely education, access planning, and preparation. Additional contributors may include patient refusal or postponement of planned dialysis and rapid acute deterioration. Together, these findings highlight that mere nephrology contact does not ensure planned initiation, underscoring the need for earlier referral and more structured, frequent pre-dialysis follow-up.

Earlier work links late referral or unplanned/emergency starts to worse outcomes, including higher mortality, longer hospital stays, and less optimal access preparation.[11,15-18] A recent systematic review and meta-analysis also confirmed a lower risk of mortality, shorter lengths of initial hospitalization and better preparations for renal replacement therapy among patients referred early to nephrologists.[19] Previous Thai data also suggested better survival among patients who accepted renal replacement therapy after counseling.[20]

Conversely, studies focused specifically on emergency or urgent dialysis starts, such as the French REIN registry analysis,[9] a Taiwanese cohort stratifying planned elective vs planned/unplanned urgent starts,[10] and a Japanese retrospective cohort,[21] generally reported higher mortality with emergency/unplanned pathways. Another study in a Thai population also showed an increased mortality in patients initiating HD with a catheter compared to AVF/AVG.[22]

Our adjusted null association contrasts with those reports, but the direction of crude effects in our data (higher unadjusted mortality and infection with emergent starts) is consistent with the prior signal. Several contextual and methodological factors likely explain the discrepancy. Firstly, the definitions of initial pathways used were different. We used manual chart review to classify initiation, whereas many prior studies relied on administrative definitions (e.g., very short referral intervals, first dialysis within 24 h of a nephrology visit, or access type as a proxy). Administrative approaches may pool heterogeneous patients and overestimate the risk of emergent status. Manual review likely reduced misclassification and better captured clinical context.

Secondly, pre-dialysis exposure in emergently initiated patients may be of significance. A notable proportion of patients labeled emergent in our cohort had some prior nephrology contact, medication optimization, and elements of education, all of which are features that could attenuate risk relative to emergency-start cohorts in other settings.

Thirdly, the timing of dialysis initiation in our cohort was at a lower eGFR than some Western datasets, potentially narrowing differences in early hazard between groups. If both elective and emergent initiation occur late (biochemically), residual between-group mortality differences may be muted.

Fourthly, the health-system capacity at Siriraj Hospital, a tertiary care center, may provide rapid stabilization and infection control that blunts early excess risk associated with emergent starts, especially when temporary catheters are promptly converted or rigorously managed. In addition, post-initiation factors may further influence outcomes. Differences in dialysis adequacy and prescription adjustments can have an effect, these include electrolytes and clearance.[23,24] Although evidence shows that modern dialyzers achieve adequate delivered dose even at lower dialysate flow rates and with reuse, suggesting that adequacy depends more on appropriate prescription than intensity alone.[25] Fluid management is another key determinant, as subclinical volume overload—better detected by lung ultrasound than routine examination—has been associated with higher hospitalization and mortality.[26] Patient-level factors such as biological aging and metabolic burden may also increase morbidity.[27-29] Together, these considerations highlight that outcomes after HD initiation are shaped not only by the mode of start but also by ongoing adequacy, volume control, and individualized treatment adjustments.

Lastly, access-based misclassification was addressed. Since some elective patients began HD with a non-cuffed, non-tunneled catheter (e.g., delayed AVF maturation, reimbursement delays), we performed access-stratified analyses. Within each access subgroup, emergent initiation was not associated with mortality or hospitalization, suggesting that the null association was not due to misclassification.

The excess vascular-access infection observed in

emergent starts aligns with the biological risk conferred by catheter dependence and is consistent with literature linking catheters to infectious complications and adverse outcomes.[30,31] Conversely, the higher access dysfunction in elective starters likely reflects their greater and longer exposure to AVF/AVG, with complications occurring over time rather than early catastrophic events. Recurrent stenosis is a major driver of access failure, hospitalization, and subsequent catheter use, underscoring the importance of durable access function. Prior studies further suggest that drug-coated balloon angioplasty offers superior primary patency compared with plain balloon angioplasty, highlighting the potential to mitigate long-term restenosis.[32] Together, these findings support a model in which catheter-related infection and patient frailty drive near-term events, while long-term access maintenance dominates later morbidity.

The strengths of our study include detailed manual classification of initiation type, accurate characterization of pre-dialysis care, and adjustment for functional and biochemical status. Limitations include the retrospective, single-center design, potential residual confounding, and limited statistical power for subgroup analyses (as evidenced by wide CIs, especially in the AVF/AVG subgroup). We also did not assess patient-reported outcomes of quality of life, which may differ between initiation pathways despite similar mortality.

CONCLUSION

Our study challenges the assumption that emergent HD initiation inevitably leads to worse survival, showing instead that mortality risk is more strongly influenced by patient comorbidity and nutritional status. However, emergent initiation remains a marker of suboptimal pre-dialysis care and higher infection risk. Improving early referral, structured education, and multidisciplinary planning remain essential for ESRD care.

Data Availability Statement

The data that support the findings of this study are not publicly available due to their containing information that could compromise the privacy of research participants but are available from the corresponding author (K.V.) upon reasonable request.

ACKNOWLEDGEMENT

None.

DECLARATIONS

Grants and Funding Information

This research did not receive any specific funding.

Conflict of Interest

The authors declare that they have no competing interests.

Registration Number of Clinical Trial

Not applicable.

Authors' Contributions

Conceptualization and methodology, K.V. and K.C.; Investigation, K.V., K.C. and L.U.; Formal analysis, K.V. and K.C.; Visualization and writing – original draft, K.V., K.C. and L.U.; Writing – review and editing, K.V. and L.U., Supervision, K.V. All authors have read and agreed to the final version of the manuscript.

Use of Artificial Intelligence

This research did not use any artificial intelligence in any of the processes.

IRB Approval

The study protocol was reviewed and approved by the Human Research Protection Unit, Faculty of Medicine Siriraj Hospital, Mahidol University (SIRB Protocol no. 960/2565 (IRB4), COA no. Si 279/2023) and was conducted according to the principles of the Declaration of Helsinki. Informed consent was waived due to the retrospective nature of the study.

REFERENCES

1. Ingsathit A, Thakkinstian A, Chaiprasert A, Sangthawan P, Gojaseni P, Kiattisunthorn K, et al. Prevalence and risk factors of chronic kidney disease in the Thai adult population: Thai SEEK study. Nephrol Dial Transplant. 2010;25(5):1567-75.
2. Ong-Ajyooth L, Vareesangthip K, Khonputsa P, Aekplakorn W. Prevalence of chronic kidney disease in Thai adults: a national health survey. BMC Nephrol. 2009;10:35.
3. Perkovic V, Cass A, Patel AA, Suriyawongpaisal P, Barzi F, Chadban S, et al. High prevalence of chronic kidney disease in Thailand. Kidney Int. 2008;73(4):473-9.
4. Thai Renal Replacement Therapy (TRT) Registry 2023 Annual Data Report: The Subcommittee of the Thai Renal Replacement Therapy (TRT) Registry 2024, The Nephrology Society of Thailand; March 2025 [cited 2025 Apr 21]. Available from: https://www.nephrothai.org/wp-content/uploads/2025/03/Ebook-TRT-book-2023-10-Mar-2025Final.pdf.
5. Alnaser RI, Abed MN, Alassaf FA, Alsaaty MH. Integrating Artificial Intelligence into Chronic Kidney Disease Care: Enhancing Hemodialysis Scheduling, Comorbidity Management, and Diagnostic Capabilities. Siriraj Med J. 2025;77(7):543-52.
6. Mori K, Nishide K, Okuno S, Shoji T, Emoto M, Tsuda A, et al. Impact of diabetes on sarcopenia and mortality in patients undergoing hemodialysis. BMC Nephrol. 2019;20(1):105.
7. Couchoud C, Moranne O, Frimat L, Labeeuw M, Allot V, Stengel B. Associations between comorbidities, treatment choice and outcome in the elderly with end-stage renal disease.

Nephrol Dial Transplant. 2007;22(11):3246-54.
8. Anutrakulchai S, Mairiang P, Pongskul C, Thepsuthammarat K, Chan-On C, Thinkhamrop B. Mortality and treatment costs of hospitalized chronic kidney disease patients between the three major health insurance schemes in Thailand. BMC Health Serv Res. 2016;16(1):528.
9. Michel A, Pladys A, Bayat S, Couchoud C, Hannedouche T, Vigneau C. Deleterious effects of dialysis emergency start, insights from the French REIN registry. BMC Nephrol. 2018; 19(1):233.
10. Chen YM, Wang YC, Hwang SJ, Lin SH, Wu KD. Patterns of Dialysis Initiation Affect Outcomes of Incident Hemodialysis Patients. Nephron. 2016;132(1):33-42.
11. Stack AG. Impact of timing of nephrology referral and pre-ESRD care on mortality risk among new ESRD patients in the United States. Am J Kidney Dis. 2003;41(2):310-8.
12. Hwang SJ, Yang WC, Lin MY, Mau LW, Chen HC, Taiwan Society of N. Impact of the clinical conditions at dialysis initiation on mortality in incident haemodialysis patients: a national cohort study in Taiwan. Nephrol Dial Transplant. 2010;25(8): 2616-24.
13. Wu LC, Lin MY, Hsieh CC, Chiu HC, Mau LW, Chiu YW, et al. Planned creation of vascular access saves medical expenses for incident dialysis patients. Kaohsiung J Med Sci. 2009;25(10): 521-9.
14. Ethier J, Mendelssohn DC, Elder SJ, Hasegawa T, Akizawa T, Akiba T, et al. Vascular access use and outcomes: an international perspective from the Dialysis Outcomes and Practice Patterns Study. Nephrol Dial Transplant. 2008;23(10):3219-26.
15. Kazmi WH, Obrador GT, Khan SS, Pereira BJ, Kausz AT. Late nephrology referral and mortality among patients with end-stage renal disease: a propensity score analysis. Nephrol Dial Transplant. 2004;19(7):1808-14.
16. Pena JM, Logrono JM, Pernaute R, Laviades C, Virto R, Vicente de Vera C. Late nephrology referral influences on morbidity and mortality of hemodialysis patients. A provincial study. Nefrologia. 2006;26(1):84-97.
17. Gallego E, Lopez A, Lorenzo I, Lopez E, Llamas F, Illescas ML, et al. Influence of early or late referral to nephrologist over morbidity and mortality in hemodialysis. Nefrologia. 2003;23(3): 234-42.
18. Diegoli H, Silva MC, Machado DS, Cruz CE. Late nephrologist referral and mortality association in dialytic patients. J Bras Nefrol. 2015;37(1):32-7.
19. Cheng L, Hu N, Song D, Liu L, Chen Y. Early versus late nephrology referral and patient outcomes in chronic kidney disease: an updated systematic review and meta-analysis. BMC Nephrol. 2025;26(1):25.
20. Watcharotone N, Moolvong P, Matula K, Kosukhvivadhana D. Survival outcome after decision making for renal replacement therapy in chronic renal failure. Journal of the Nephrology Society of Thailand. 2022;28(1):68-76.
21. Shimizu Y, Nakata J, Yanagisawa N, Shirotani Y, Fukuzaki H, Nohara N, et al. Emergent initiation of dialysis is related to an increase in both mortality and medical costs. Sci Rep. 2020;10(1): 19638.
22. Wara-aswapati S, Chuasuwan A. Survival rate and associated factors of unplanned hemodialysis initiation among end stage kidney disease patients. Royal Thai Air Force Medical Gazette. 2022;68(1):10-20.
23. Vareesangthip K, Davenport A. Reducing the risk of intradialytic hypotension by altering the composition of the dialysate. Hemodial Int. 2020;24(3):276-81.
24. Vareesangthip K, Yincharoen P, Winijkul A, Chanchairujira T. Cardiac arrhythmia during early-week and mid-week dialysis in hemodialysis patients. Ther Apher Dial. 2021;25(6):890-8.
25. Srisuwan W, Charoensri S, Jantarakana K, Chanchairujira T. Increasing Dialysate Flow Rate over 500 ml/min for Reused High-Flux Dialyzers do not Increase Delivered Dialysis Dose: A Prospective Randomized Cross Over Study. Siriraj Med J. 2022; 74(3):152-60.
26. Vareesangthip K, Thanapattaraborisuth B, Chanchairujira K, Wonglaksanapimon S, Chanchairujira T. Assessment of Volume Status in Chronic Hemodialysis: Comparison of Lung Ultrasound to Clinical Practice and Bioimpedance. Siriraj Med J. 2023;75(3): 224-33.
27. Taesilapasathit C, Spanuchart I, Suppadungsuk S, Sutharattanapong N, Vipattawat K, Sethakarun S, et al. Accumulation of Advanced Glycation End Products Independently Increases the Risk of Hospitalization Among Hemodialysis Patients. Siriraj Med J. 2022;74(5):305-13.
28. Thaweethamcharoen T, Vasuvattakul S, Noparatayaporn P. Comparison of Utility Scores and Quality of Life Scores in Thai Patients between Twice and Thrice-Weekly Hemodialysis. Siriraj Med J. 2020;64(3):94-7.
29. Tangwonglert T, Vareesangthip K, Vongsanim S, Davenport A. Comparison of skin autofluorescence, a marker of tissue advanced glycation end-products in the fistula and non-fistula arms of patients treated by hemodialysis. Artif Organs. 2020; 44(11):1224-7.
30. Mohamed H, Ali A, Browne LD, O'Connell NH, Casserly L, Stack AG, et al. Determinants and outcomes of access-related blood-stream infections among Irish haemodialysis patients; a cohort study. BMC Nephrol. 2019;20(1):68.
31. Campos E, Cuevas-Budhart MA, Cedillo-Flores R, Candelario-Lopez J, Jimenez R, Flores-Almonte A, et al. Is central venous catheter in haemodialysis still the main factor of mortality after hospitalization? BMC Nephrol. 2024;25(1):90.
32. Chaivanit T, Chaivanit P, Bumrungrachapukdee P, Unprasert P, Wattanavaekin K, Benyakorn T. Comparison of Primary Patency Rate between Drug- Coated Balloon and Plain Balloon Angioplasty in Hemodialysis Access. Siriraj Med J. 2022;74(6): 388-94.