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Original Article

ORIGINAL ARTICLE

Hospital readmission in children on maintenance dialysis: a multicentre, prospective cohort study

Yeşim Özdemir Atikel[1], Eszter Lévai[2], Claus Peter Schmitt[2], Shazia Adalat[3], Nadine Goodman[4], Ayşe Seda Pınarbaşı[5], İsmail Dursun[5], Burcu Yazıcıoğlu[6], Fabio Paglialonga[7], Karel Vondrak[8], Isabella Guzzo[9], Nikoleta Printza[10], Ilona Zagożdżon[11], Aleksandra Zurowska[11], Bahriye Atmış[12], Aysun Karabay Bayazıt[12], Marcin Tkaczyk[13], Maria do Sameiro Faria[14], Ariane Zaloszyc[15], Augustina Jankauskiene[16], Mesiha Ekim[17], Alberto Edefonti[7], Rukshana Shroff[4] and Sevcan A. Bakkaloğlu[6]

[1]Department of Pediatric Nephrology, Eskişehir Health Practice and Research Center, University of Health Sciences, Eskişehir, Türkiye, [2]Department of Pediatric Nephrology, Center for Pediatric and Adolescent Medicine, Heidelberg, Germany, [3]Department of Pediatric Nephrology, Evelina London Children's Hospital, London, UK, [4]Department of Pediatric Nephrology, Great Ormond Street Hospital for Children, London, UK, [5]Department of Pediatric Nephrology, Erciyes University Faculty of Medicine, Kayseri, Türkiye, [6]Department of Pediatric Nephrology, Gazi University Faculty of Medicine, Ankara, Türkiye, [7]Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, SC Nefrologia e Dialisi Pediatrica –Trapianti di Rene, Milan, Italy, [8]Department of Pediatrics, 2nd Faculty of Medicine and University Hospital Prague-Motol, Prague, Czech Republic, [9]Division of Nephrology, Dialysis and Renal Transplant Unit, Bambino Gesù Children's Hospital - IRCCS, Rome, Italy, [10]1st Pediatric Department, Unit of Pediatric Nephrology, Aristotle University, Thessaloniki, Greece, [11]Department of Pediatrics, Nephrology and Hypertension, Medical University of Gdansk, Gdansk, Poland, [12]Department of Pediatric Nephrology, Çukurova University Faculty of Medicine, Adana, Türkiye, [13]Department of Pediatric Nephrology, Instytut Centrum Zdrowia Matki Polki, Łódź, Poland, [14]Department of Pediatric Nephrology, Centro Materno-Infantil do Norte, Centro Hospitalar do Porto, Porto, Portugal, [15]Department of Pediatrics, University Hospital of Strasbourg, Strasbourg, France, [16]Institute of Clinical Medicine, Vilnius University, Vilnius, Lithuania and [17]Department of Pediatric Nephrology, Ankara University Faculty of Medicine, Ankara, Türkiye

Correspondence to: Yeşim Özdemir Atikel; E-mail: yesozdemir@gmail.com

ABSTRACT

Background. Limited data exist on rehospitalization in paediatric dialysis patients. The objective of this study was to identify indications, rates and risk factors for 30-day readmissions in this population.

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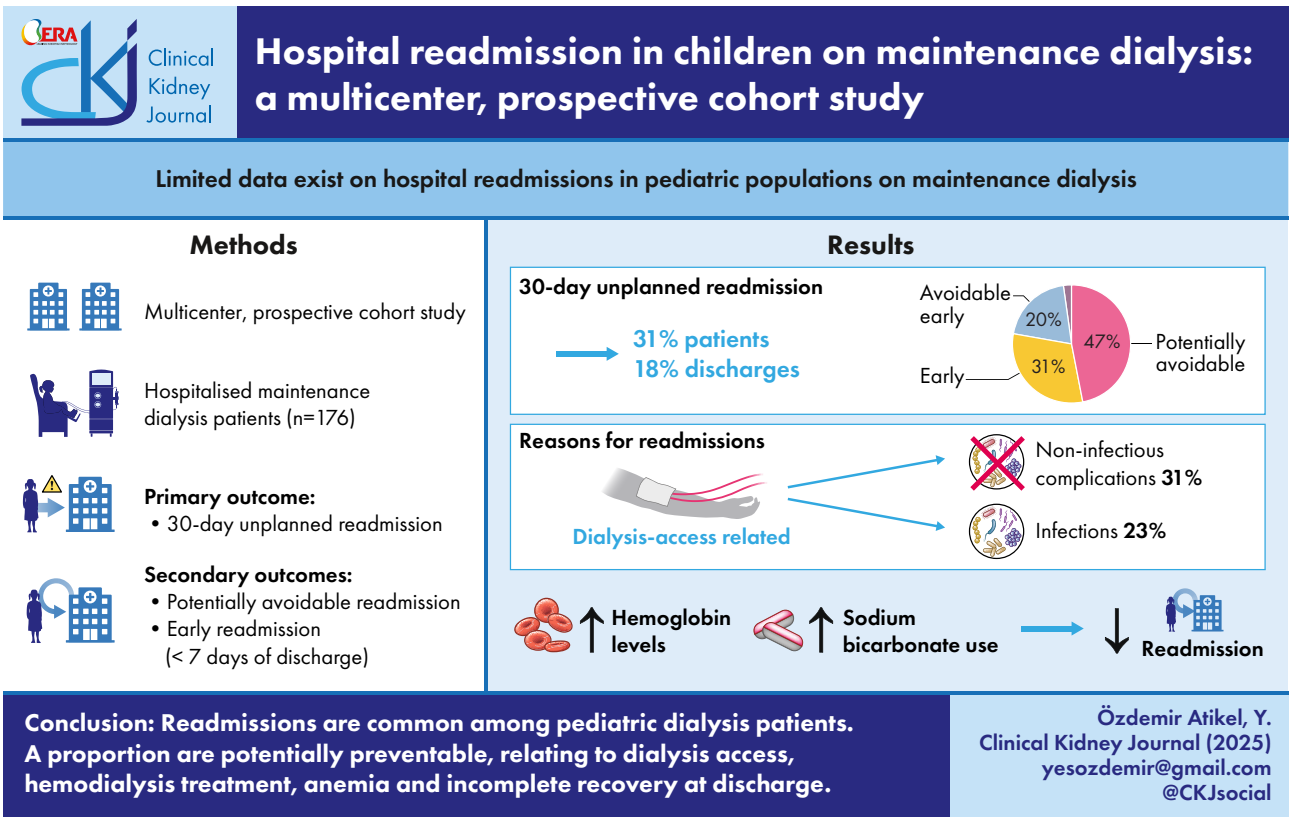
Methods. We used a prospective multinational, multicentre cohort study of haemodialysis (HD) and peritoneal dialysis (PD) patients discharged between July 2017 and July 2018. Readmission was identified as repeat hospitalization within 30 days of a prior (index) admission. Potentially preventable readmissions were clinically related to the initial admission. Early readmissions were those occurring within 7 days of discharge. The primary outcome was 30-day readmission. Secondary outcomes included potentially avoidable and early readmissions.

Results. A total of 54 (31%) of 176 patients (102 PD, 74 HD) had at least one readmission; 84 (18%) discharges were followed by readmission. PD and HD patients had similar readmission rates {30.4% versus 31.1%; hazard ratio [HR] 1.06 [95% confidence interval (CI) 0.61–1.81]}. Compared with PD, HD patients had a significantly shorter time to readmission (8 versus 14 days; $P = .019$), higher early readmission rates (46% versus 18%; $P = .010$) and risk [odds ratio (OR) 3.87 (95% CI 1.35–11.11)]. Main readmission causes were dialysis access–related non-infectious complications (31%) and access infections (22.7%); 47% of readmissions were potentially avoidable. Lower haemoglobin levels were linked to readmission [HR 0.78 (95% CI 0.64–0.95)]. Bicarbonate use was associated with a 51% lower readmission risk [HR 0.49 (95% CI 0.24–0.99)]. Neurological comorbidity [OR 7.00 (95% CI 1.04–47.22)] and partial recovery [OR 56.45 (95% CI 3.02–1053.10)] were risk factors for avoidable readmission. Risk of avoidable and early readmission decreased with age [OR 0.98 (95% CI 0.97–0.99) and OR 0.99(95%CI 0.98–0.99), respectively].

Conclusions. Readmissions are common in paediatric dialysis patients, with a substantial proportion being potentially preventable. To reduce rehospitalizations, interventions should target modifiable factors such as access complications, anaemia and incomplete recovery at discharge, while recognizing non-modifiable risks like HD and younger age to identify high-risk patients.

GRAPHICAL ABSTRACT



Keywords: children, dialysis, hospitalization, readmission, risk factors

KEY LEARNING POINTS

What was known:

- There are limited data on rehospitalization in paediatric dialysis patients.

This study adds:

- We identified the indications, rates and risk factors for unplanned 30-day readmissions, potentially avoidable readmissions and early readmissions in this population.

Potential impact:

- Readmissions are common among paediatric dialysis patients but a significant proportion of readmissions are potentially avoidable.
- Dialysis access–related complications, haemodialysis treatment, anaemia and incomplete recovery at discharge are modifiable risk factors for readmission.

INTRODUCTION

Readmissions following hospital discharge are critical indicators of increased morbidity and mortality among patients with end-stage kidney disease (ESKD), impacting their quality of life and healthcare costs [1–6]. Specifically, 30-day readmission rates indicate the quality of care (QoC) received at the hospital, effectiveness of the discharge plan and coordination [7]. Early (within 7 days) [7, 8] and urgent (unplanned) hospital readmissions are mainly considered indicators of poor QoC [9–11], with early readmissions linked to a higher 1-year mortality [6]. Unplanned readmission has been viewed as a sign of care delivery failure, resulting in increased costs and potential harm [12]. The avoidable 30-day readmission rate is a critical metric for assessing the hospital QoC [13]. Therefore, it is crucial to distinguish between avoidable and unavoidable readmissions to effectively reduce readmissions and improve QoC [14].

ESKD patients have a 40% higher 30-day readmission rate than non-ESKD patients [15], with more than one-third of discharges resulting in readmission [3, 16]. While some unplanned hospital readmissions are not preventable, a proportion of conditions such as volume overload, electrolyte imbalance and vascular access infections can be preventable with proper transitional and outpatient care following initial (index) hospital discharge [4, 17]. Reducing readmissions is a significant priority for improving dialysis patients' overall health, quality of life and safety, as each hospitalization can have adverse consequences, including worsening of anaemia, hypoalbuminaemia, malnutrition, hospital-acquired infections and potentially increased in-hospital mortality [9, 18].

Since data on readmissions among children on maintenance dialysis are sparse, members of the European Paediatric Dialysis Working Group and European Society for Paediatric Nephrology Dialysis Working Group aimed to establish baseline 30-day unplanned readmission rates and identify risk factors for unplanned, potentially avoidable and early readmissions.

MATERIALS AND METHODS

Data source, design and study population

This multicentre, observational, prospective cohort study examined paediatric dialysis patients across 16 European university and tertiary care teaching hospitals from 1 July 2017 to 1 July 2018. The participants were <21 years of age with at least one hospital discharge during the study period. Hospitalization data were obtained from our previous study [19]. The collected sociodemographic and clinical information included age, sex, primary cause of ESKD, dialysis modality, vascular access type, comorbidities and nutrition. ESKD causes were classified as either glomerular (including primary glomerular diseases and haemolytic uraemic syndrome) or non-glomerular [including congenital anomalies of the kidney and urinary tract (CAKUT), familial/hereditary renal diseases (such as ciliopathies, hyperoxaluria and cystinosis), renovascular diseases, tubulopathies, tubulointerstitial nephritis and nephrolithiasis/nephrocalcinosis]. Chronic non-renal comorbid conditions (CMs) were categorized as cardiovascular, pulmonary, neurological, musculoskeletal, gastrointestinal, hepatobiliary, haemato-oncological, endocrinological ophthalmological, audiological (hearing impairment or deafness), genetic (a defined syndrome) and immunological disorders.

This study was conducted in accordance with the Declaration of Helsinki Ethical Principles and Good Clinical Practices and the study protocol was approved by the ethics committee of the coordinating centre (Gazi University Non-Interventional Clinical Research Ethics Committee).

Assessment of readmissions

A readmission event was identified as repeat hospitalization within 30 days of a prior (index) admission. Readmissions that met the inclusion criteria were also analysed as index admissions if they were followed by subsequent hospitalization, following the methodology of Springel *et al.* [20]. Early readmissions were defined as those occurring within 7 days of hospital discharge [7, 8].

We included admissions with complete clinical and discharge data. Patients were followed up until 30 July 2018, allowing 30 days of follow-up. Patients who were transferred to another hospital, transplant recipients or those who died during their initial hospital stay were excluded from the analysis because they had no opportunity to be readmitted. We also did not include admissions resulting in death, kidney transplantation or hospital transfer. In addition, admissions in which dialysis initiation was the primary reason for hospitalization were not considered eligible as index admissions, as these did not allow for prior discharge. Patients who initiated dialysis were only included if they had a subsequent hospitalization and discharge unrelated to dialysis initiation.

Readmissions were grouped as planned (scheduled) or unplanned (urgent), with unplanned being further subdivided into potentially avoidable (preventable) and unavoidable (unpreventable). Unplanned readmissions were due to acute illness, unforeseen circumstance or as part of the treatment

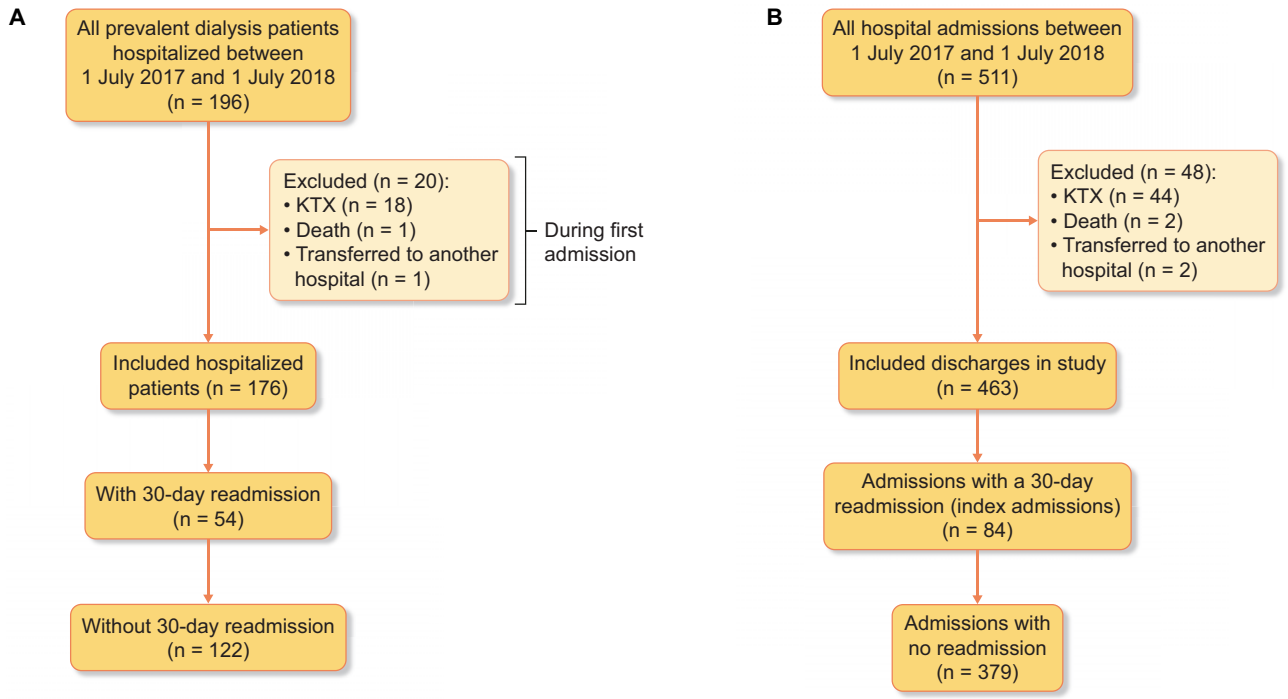


Figure 1: Flow diagram of the **(a)** patients needing rehospitalization and **(b)** events of hospital discharges included in the study.

plan at the index discharge time. These classifications were in line with prior studies [4, 8, 10, 14, 17, 21, 22]. Planned admissions included scheduled procedures, such as catheter revision, elective surgery or radiodiagnostic testing. A potentially preventable readmission is a readmission that is clinically related to the initial hospital admission, while clinically related is defined as a requirement that the underlying reason for readmission is plausibly related to the care rendered during or immediately following a prior hospital admission [22]. For instance, if a patient is discharged from the hospital after a diagnosis of non-infectious complications (NIC) of access and then readmitted within 30 days with respiratory infection, this readmission is considered unavoidable. If the same patient was discharged after an NIC of dialysis access and readmitted again with an NIC or IC of the access, this is considered a potentially avoidable readmission.

We focused primarily on unplanned 30-day readmissions and excluded scheduled readmissions. Readmission rates were presented as readmissions per patient year at risk (PYAR), calculated by dividing the total number of readmissions during the observation period by the total number of patient days at risk multiplied by 365. Clinical findings, laboratory values and medications on the day of admission were recorded. Complete recovery was defined as full clinical and laboratory resolution of the condition that led to the index admission. Incomplete recovery was defined as the persistence of clinical or laboratory abnormalities related to the index admission at the time of discharge (e.g. ongoing fluid overload, unresolved infection or continued electrolyte abnormalities).

Statistical analysis

The data were analysed using SPSS version 29 (IBM, Armonk, NY, USA). Statistical significance was set at $P < .05$. Values were presented as n (%), mean ± standard deviation (SD; normal distribution) or median [interquartile range (IQR); non-normal distribution]. The Student's t-test or Mann–Whitney U test was used to compare continuous variables between two independent groups and the chi-squared or Fisher's exact test analysed categorical variables, as appropriate. Covariates were initially compared between patients with and without 30-day unplanned readmissions as well as between admissions with and without subsequent readmission. Univariable analysis was followed by a multivariable logistic regression model to assess the relationships between potential explanatory factors and outcomes, identifying the risk factors for 30-day unplanned readmissions, avoidable readmission and early readmission. Cox regression analysis was used to assess time to readmission. Variables with P-values <.20 in univariate analysis were included in the multivariable model. Both biochemical parameters and treatment variables were eligible for inclusion, based solely on their univariate association with the outcome of interest. Using Kaplan–Meier analysis, we assessed readmission-free survival within the 30-day observation window following each hospital discharge. Patients were right-censored at day 30, or earlier in cases of kidney transplantation, loss to follow-up, death or study termination, whichever occurred earlier. Kaplan–Meier curves and logrank tests were used to compare 30-day readmission-free survival between PD and HD patients. The logrank P-value and hazard ratio (HR) were calculated based on events within this prespecified 30-day period.

RESULTS

Rehospitalization rates

A total of 176 patients on maintenance dialysis (102 PD, 74 HD) were analysed. Following discharge from their index hospitalization, 54 patients (31%) had one or more unplanned readmissions within 30 days (Fig. 1a). Among the 463 discharges, 84 (18%;

46 PD, 38 HD) were followed by 30-day unplanned readmissions (Fig. 1b). The readmission rate was calculated as 0.53/PYAR (0.48 for PD and 0.59 for HD). Kaplan–Meier survival analysis, limited to the 30-day observation window following each hospital discharge, showed that PD and HD patients had similar readmission rates (Supplementary Fig. 1), corresponding to an unadjusted HR of 1.06 (95% CI 0.61–1.81; $P = .83$).

Baseline characteristics of patients with and without 30-day unplanned readmissions

Readmitted patients had a median age of 9.5 years (IQR 3.8–13), with 57.4% being male. The proportions of readmitted HD and PD patients were similar (31.1% versus 30.4%; $P = .92$). A comparison of readmitted and non-readmitted children (Table 1) showed no significant differences in age at the start of the survey, age at the initiation of dialysis, dialysis vintage, weight and height standard deviation score (SDS), body mass index (BMI) and BMI SDS, primary kidney disease, presence of hypertension (HTN), use of antihypertensive drugs and other medications, oral versus enteral tube feeding and urine output. A total of 36% of patients with any CM ($n = 37$) and 32% ($n = 17$) with no CM experienced at least one unplanned readmission ($P = .08$). The frequency of each CM was similar in both groups. Laboratory values were similar between groups, except calcium, which was higher in readmitted patients (9.6 ± 0.7 versus 9.4 ± 0.7 mg/dl; $P = .04$).

Baseline characteristics of admissions that did or did not require readmission

We also compared index hospital admissions and examined the risk factors for readmission. Table 1 shows admission baseline characteristics. Both groups had similar ages, primary kidney disease, CMs, medications and laboratory values.

Of the 463 hospitalizations, 286 were unplanned and 177 were scheduled. Unplanned admissions led to more readmissions [$n = 65$ (22.7%)] than scheduled admissions [$n = 19$ (10.7%); $P = .001$]. Overall, of 84 index admissions, 65 (77.4%) were unplanned. The length of stay (LOS) was longer for index admissions than for admissions that did not result in readmission, but this was not significant ($P = .16$). An intensive care unit (ICU) stay during the index hospital admission did not correlate with readmissions. An ICU stay occurred in 4.8% ($n = 4$) of index hospitalizations and 3.4% ($n = 13$) of admissions without readmission ($P = .52$). Among hospital admissions that resulted in partial recovery, the readmission rate was 28.3% ($n = 15/53$). This rate was lower, although not significant, at 16.8% ($n = 69/410$) in hospitalizations that resulted in complete recovery ($P = .06$).

Time to readmission

The median time to readmission was 11.5 days (IQR 6.25–19.75), which was significantly shorter for HD patients [8 days (IQR 5–17)] than for PD patients [14 days (IQR 8.5–22.5); $P = .019$]. A total of 50% of the readmissions occurred within 11 days, with 63% occurring within the first 14 days post-discharge. Early readmissions (within 7 days) accounted for 31% ($n = 26$) of cases and was more frequent in HD patients (46%) than PD patients (18%) ($P = .010$).

Outcomes of readmissions

Among the 84 readmission episodes, 15 (17.9%) resulted in incomplete recovery at discharge, while the remaining 69 (82.1%) were classified as complete recovery. These outcomes were based on the clinical assessments at the time of discharge from the readmission episode. These classifications were determined by the treating physician, documented in the discharge summary and reported to the study team by the local investigator. No mortality was observed during any of the 30-day readmissions.

Reasons for 30-day unplanned and early readmissions and concordance between diagnosis of index admissions and readmissions

Supplementary Table 1 shows the similar principal diagnoses for index admissions and readmissions. The top five index admission diagnoses were NIC of dialysis access (23.8%), infectious complications (IC) of access (19.1%), other organ/system disorders (17.9%), fluid overload/electrolyte imbalances/hypertension (9.6%) and infections unrelated to dialysis (7.1%). The most common reasons for readmission were NIC of access (31%; 15 central venous catheter (CVC), 2 arteriovenous fistula (AVF), 9 PD catheter-related), access ICs (22.7%; 14 PD, 5 CVC), organ/system disorders (19.1%), infections (11.9%) and fluid/electrolyte issues/hypertension (14.4%). A total of 32% ($n = 27$) of readmissions had the same reason as the index admission and 15% ($n = 13$) were related to the previous diagnosis, all of which were therefore considered potentially avoidable (47%). The highest concordance was observed in index admissions for CVC-related complications [80.0% ($n = 12/15$)], PD access-related complications (ARCs) [70% ($n = 14/20$)], fluid/electrolyte imbalances/hypertension [63% ($n = 5/8$)] and gastrointestinal and hepatobiliary disorders [43% ($n = 3/7$)] (Supplementary Table 1).

Early readmissions were mainly due to CVC-related complications [n = 10 (38.5%)], infections [$n = 5$ (19%)] and PD ARCs [$n = 4$ (15.4%)]. Seventeen discharges resulted in both early and potentially avoidable readmissions (avoidable early readmission) stemming from CVC-related complications (5 NIC, 1 IC), complications related to PD/PD access (2 NIC, 1 IC), infections ($n = 3$), fluid/electrolyte imbalances/hypertension ($n = 3$), placement of a permanent CVC ($n = 1$) and neurological disorder ($n = 1$).

Unavoidable and potentially avoidable readmissions

Table 2 compares the index admissions followed by unavoidable and potentially avoidable readmissions. Children <2 years of age, patients with CMs (particularly neurological and cardiovascular) and those with higher serum potassium and C-reactive protein (CRP) levels showed a higher probability of experiencing potentially avoidable readmission. Conversely, unavoidable readmissions were more frequently associated with hypertension, higher office blood pressure (BP) values, increased antihypertensive medication use (including renin–angiotensin system blockers, calcium channel blockers and diuretics), oligoanuria and higher serum creatinine levels at index admission.

No significant differences were found in the LOS or ICU stay between index admissions, leading to unavoidable or potentially avoidable readmissions. Partial recovery was more common for index admissions followed by potentially avoidable readmissions than for those followed by unavoidable readmissions (30% versus 6.8%; $P = .013$). Notably, 41% (28/69) of index admissions resulting in complete recovery still led to avoidable readmissions.

Table 1: Baseline characteristics of the hospitalized patients at study entry by readmission status and characteristics of the admissions based on readmission status.

	Patients			Admission events		
Demographic and clinical variables	With no readmission ($n = 121$)	At least one readmission ($n = 55$)	P-value	With no readmission ($n = 379$)	Followed by a readmission ($n = 84$)	P-value
Age at study entry[a] (years), median (IQR)	11.2 (5–15)	9.5 (3.8–13)	.12	10.2 (4.4- 14)	7.5 (3.8–13.6)	.30
Time on dialysis (months), median (IQR)	16 (2.8–39)	16.5 (4.3–37.3)	.78	33 (14–72.5)	23.5 (10–66)	.75
Gender, *n* (%)			.65			.44
Male	76 (62.3)	31 (57.4)		245 (64.6)	58 (69)	
Female	46 (37.7)	23 (42.6)		134 (35.4)	26 (31)	
Dialysis modality, *n* (%)						.55
HD	51 (41.8)	23 (42.6)	.92	158 (41.7)	38 (45.2)	
PD	71 (58.2)	31 (57.4)		221 (58.3)	46 (54.8)	.36
Vascular access for HD[b], *n* (%)						
AVF	9 (17.6)	3 (13)	.74	24 (15.2)	3 (7.9)	
CVC	42 (82.4)	20 (87)		134 (84.8)	35 (92.1)	
Anthropometric data						
Weight SDS, median (IQR)	−1.64 (−2.7 to −0.72)	−1.79 (−3.14–0.54)	.74	−1.44 (−3.02–0.51)	−1.52 (−3.2–0.51)	.71
Height SDS, median (IQR)	−1.94 (−3.4 to −0.93)	−2.74 (−3.5–0.96)	.16	−2.18 (−3.5–1.12)	−2.26 (−3.5 to −1.12)	.53
BMI (kg/m^2), median (IQR)	16.2 (15.1–19.1)	16.5 (14.9–18.9)	.65	16.8 (15–19)	16.7 (15–18.6)	.78
BMI SDS, median (IQR)	−0.48 (−1.37–0.35)	−0.22 (−1.72–1.10)	.32	−0.16 (−1.28–0.63)	−0.06 (−1.43–0.74)	.62
Office SBP (mmHg), mean ± SD	111 ± 18	109 ± 21	.49	111 ± 22	107 ± 22	.14
Office DBP (mmHg), mean ± SD	70 ± 16	66 ± 17	.15	68 ± 18	64 ± 18	.10
Urine output, *n* (%)						
Oligo-anuric	71 (58.2)	34 (63)	.66	243 (64)	58 (69)	.39
Primary renal diagnosis, *n* (%)			.13			.28
Non-glomerular[c]	87 (71.3)	45 (83.3)		303 (79.9)	72 (85.7)	
Glomerular[d]	35 (28.7)	9 (16.7)		76 (20.1)	12 (14.3)	
Comorbidity, *n* (%)						
Any	65 (53.3)	37 (68.5)	.08	236 (62.3)	60 (71.4)	.11
Neurocognitive + motor	24 (19.7)	13 (24.1)	.64	88 (23)	24 (29)	.37
Cardiovascular	14 (11.5)	10 (18.5)	.30	66 (17)	22 (26)	.08
Gastrointestinal and hepatobiliary	14 (11.5)	7 (13)	.16	117 (31)	31 (37)	.28
Pulmonary	12 (9.8)	9 (16.7)	.30	60 (16)	17 (20)	.41
Musculoskeletal	13 (10.7)	5 (9.3)	.99	37 (9.8)	7 (8.3)	.84
Ocular	9 (7.4)	6 (11.1)	.39	34 (9)	10 (12)	.53
Genetic (a defined syndrome)	10 (8.2)	3 (5.6)	.75	32 (8.4)	4 (4.8)	.36
Haemato-oncological	8 (6.6)	4 (7.4)	1.000	23 (6.1)	5 (6)	1.000
Endocrinological	7 (5.7)	2 (3.7)	.72	12 (3.2)	2 (2.4)	1.000
Hearing impairment	4 (3.3)	1 (1.9)	1.000	19 (5)	3 (3.6)	.77
Multimorbidity	35 (28.7)	19 (35.2)	.49	133 (35)	32 (38)	.60
Hypertension	61 (50)	27 (50)	1.000	210 (55.4)	41 (48.8)	.27
Nutrition, *n* (%)			.20			.12
Only demand feeding	96 (78.7)	37 (68.5)		286 (75.5)	56 (66.7)	
Enteral feeding	26 (21.3)	17 (31.5)		93 (24.5)	28 (33.3)	
Medication, *n* (%)						
Anti-hypertensive	61 (50)	27 (50)	1.000	210 (55.4)	41 (48.8)	.27
ACE-I	31 (25.4)	13 (24.1)	1.000	111 (29)	21 (25)	.51
ARB	7 (5.7)	3 (5.6)	1.000	18 (4.7)	5 (6)	.58
CCB	24 (27.9)	18 (33.3)	.58	128 (33.8)	26 (31)	.62
Beta-blocker	21 (17.2)	11 (20.4)	.77	74 (19.5)	18 (21.4)	.80
Diuretics	18 (14.8)	5 (9.3)	.45	53 (14)	12 (14.3)	1.000
Sodium bicarbonate	53 (43.4)	15 (27.8)	.07	129 (35)	28 (33.7)	.83
Potassium binder	10 (8.2)	6 (11.1)	.57	53 (14.4)	9 (10.8)	.50
CCPB	79 (64.8)	32 (59.3)	.59	251 (69)	50 (61)	.15

Table 1: Continued

Demographic and clinical variables	Patients			Admission events		
	With no readmission ($n = 121$)	At least one readmission ($n = 55$)	*P*-value	With no readmission ($n = 379$)	Followed by a readmission ($n = 84$)	*P*-value
Sevelamer	30 (24.6)	12 (22.2)	.88	85 (23.4)	17 (20.7)	.70
25-hydroxy vitamin D	51 (41.8)	18 (33.3)	.37	132 (37.4)	33 (40.7)	.57
Active vitamin D	75 (61.5)	39 (72.2)	.22	258 (73.1)	61 (75.3)	.78
Iron	85 (69.7)	37 (68.5)	1.000	261 (75.2)	67 (84.8)	.09
ESA	87 (71.3)	42 (77.8)	.47	299 (86.4)	71 (89.9)	.52
Biochemical parameters at study entry						
Haemoglobin (g/dl), mean ± SD	10.83 ± 1.97	10.29 ± 1.55	.07	10.59 ± 1.89	10.46 ± 1.97	.57
BUN (mg/dl), median (IQR)	50.8 (35.5–61)	49.8 (39–68.5)	.74	49.2 (37.2–63.7)	49.1 (37.6–63.6)	.79
Creatinine (mg/dl), median (IQR)	5.8 (4.3–8.6)	6.1 (4–7.9)	.80	6.4(4.5–8.8)	5.8 (4–8.5)	.10
GFR (ml/min/1.73 m^2), median (IQR)	7.6 (6.1–11.2)	7.9 (6.3–10.5)	.66	7.1(5.5–10.7)	7.7 (6.1–11.2)	.26
Uric acid (mg/dl), mean ± SD	6.3 ± 1.6	5.9 ± 1.4	.23	5.9 ± 1.8	6.1 ± 1.9	.48
Sodium (mmol/l), mean ± SD	138 ± 3.8	138 ± 3.1	.90	138.3 ± 3.9	137.5 ± 4.1	.11
Potassium (mmol/l), mean ± SD	4.64 ± 0.72	4.64 ± 0.77	.95	4.72 ± 0.89	4.79 ± 0.96	.57
Calcium (mg/dl), mean ± SD	9.4 ± 0.7	9.6 ± 0.7	.044	9.55 ± 0.95	9.34 ± 1.06	.08
Phosphorus (mg/dl), mean ± SD	5.5 ± 1.5	5.4 ± 1.6	.94	5.66 ± 1.64	5.21 ± 1.78	.052
Albumin (g/dl), mean ± SD	3.7 ± 0.6	3.8 ± 0.5	.32	3.75 ± 0.62	3.72 ± 0.69	.68
Sodium bicarbonate (mEq/l), mean ± SD	23.1 ± .1	23.9 ± 4.3	.27	23.9 ± .3	23.3 ± 3.7	.23
Alkaline phosphatase (IU/l), median (IQR)	206 (121–398)	256 (185–428)	.14	232 (129–371)	240 (164–313)	.62
Ferritin (µg/l), median (IQR)	149 (88–381)	191 (94–409)	.70	197 (104–361)	247 (123–383)	.37
Parathormone (pg/ml), median (IQR)	259 (128–535)	233 (77–850)	.81	261 (104–725)	172 (91–626)	.23

ACE-I: angiotensin-converting enzyme inhibitor; ARB: angiotensin receptor blocker; AVF: arteriovenous fistula; BMI: body mass index; BUN: blood urea nitrogen; CCB: calcium channel blocker; CCPB: calcium-containing phosphate binder; ESA: erythropoiesis-stimulating agent; GFR: glomerular filtration rate; SDS: standard deviation score.

[a]Age at the admission for hospitalization.

[b]The percentages here reflect the analysis results within HD patients only.

[c]Including congenital anomalies of the kidney and urinary tract (CAKUT) and urologic problems (including vesicoureteral reflux and obstructive uropathies); familial/hereditary renal diseases (including ciliopathies, hyperoxaluria, cystinosis); renovascular diseases; tubulopathies, tubulointerstitial nephritis, nephrolithiasis/nephrocalcinosis, perinatal asphyxia, metabolic, cardiac and haemato-oncological diseases; unidentified/aetiology uncertain.

[d]Including primary glomerular diseases and haemolytic uraemic syndrome.

Percentages may not be exactly 100% because of rounding.

Factors associated with 30-day unplanned readmission, potentially avoidable readmission and early readmission

In the multivariable logistic regression analysis, the haemoglobin level emerged as a significant risk factor for readmission. Patients with lower haemoglobin values were more commonly readmitted compared with those who were not readmitted [odds ratio (OR) 0.74 (95% CI 0.57–0.97)] (Table 3). Multivariable Cox regression analysis revealed that higher haemoglobin levels [HR 0.78 (95% CI 0.64–0.95)] and the use of sodium bicarbonate [HR 0.49 (95% CI 0.24–0.99)] significantly reduced the readmission risk (Table 4). The presence of neurological CM [OR 7.00 (95% CI 1.04–47.22)] and hospitalization resulting in partial recovery [OR 56.45 (95% CI 3.02–1053.10)] increased the risk of potentially avoidable readmission, whereas each month increase in age decreased the risk [OR 0.98 (95% CI 0.97–0.99)].

Being on HD was found to be a risk factor for early readmission based on readmission characteristics [OR 3.87 (95% CI 1.35–11.11)]. In a separate model based on index admission characteristics, early readmission risk exhibited a significant decreasing trend with increasing age at index admission [OR 0.990 (95% CI 0.982–0.999)] (Table 3). Other variables such as anaemia, serum calcium and chronic calcium channel blocker (CCB) use were included in the multivariable analysis based on a univariate *P*-value <.20, but it did not retain statistical significance. Gender was borderline significant in univariate analysis ($P = .016$) but did not remain significant in multivariable modelling. All candidate determinants with a univariate *P*-value <.20 are presented in Table 3 and included in the regression models.

DISCUSSION

The results of this comprehensive 1-year prospective cohort study offer insights into the readmission rates of paediatric

Table 2: Comparison of index admissions followed by unavoidable and potentially avoidable unplanned readmissions.

Characteristics	Admission followed by a potentially avoidable readmission ($n = 40$)	Admission followed by an unavoidable readmission ($n = 44$)	P-value
Age at hospitalization (years), median (IQR)	7.4 (2.1–14)	10.5 (5.4–13.4)	.09
≤24 months, *n* (%)	10 (25)	3 (6.8)	.046
Time on dialysis (months), median (IQR)	21.3 (14–33)	25 (12.5–45.5)	.28
Male, *n* (%)	31 (77.5)	27 (61.4)	.17
Anthropometric data			
Weight SDS, median (IQR)	−1.10 (−2.85 to −0.53)	−2.14(−3.21 to −0.51)	.57
Height SDS, median (IQR)	−1.83(−3.43 to −0.86)	−2.69(−3.58 to −1.19)	.28
Body mass index (BMI), median (IQR)	16.8 (15.2–18.1)	16.6 (15–18.7)	.93
BMI SDS, median (IQR)	−0.11 (−1.11–0.82)	−0.10 (−1.77–0.74)	.61
Systolic BP (mmHg), mean ± SD	101 ± 22	112 ± 20	.010
Diastolic BP (mmHg)	57 ± 18	70 ± 16	<0.001
Urine output, *n* (%)			
Oligo-anuric	21 (52.5)	37 (84.1)	.004
Dialysis modality, *n* (%)			1.000
PD	22 (55)	24 (54.5)	
HD	18 (45)	20 (45.5)	
Primary renal disease, *n* (%)			.89
Glomerular	5 (12.5)	7 (15.9)	
Non-glomerular	35 (87.5)	37 (84.1)	
Underlying comorbidity, *n* (%)	34 (85)	26 (59)	.017
Multiple comorbidity	16 (40)	16 (36.4)	.90
Neurological	19 (47.5)	5 (11.4)	.001
Cardiovascular	15 (37.5)	7 (15.9)	.046
Pulmonary	9 (22.5)	8 (18.2)	.82
Gastrointestinal + hepatobiliary	16 (40)	15 (34.1)	.45
Musculoskeletal	3 (7.5)	4 (9.1)	1.000
Genetic	1 (2.5)	3 (6.8)	.61
Haemato-oncologic	2 (5)	3 (6.8)	1.000
Endocrinological	–	2 (4.5)	.49
Visual/ocular	4 (10)	6 (13.6)	.74
Number of comorbid conditions, median (IQR)	1 (1–3)	1 (0–2)	.041
Nutrition, *n* (%)			0.58
Only demand feeding	25 (62.5)	31 (70.5)	
Gastrostomy/tube feeding	15 (37.5)	13 (29.5)	
Hypertension, *n* (%)	14 (35)	27 (61.4)	.028
Number of antihypertensive drugs, median (IQR)	0 (0–1)	1 (0–2.75)	.023
>2 antihypertensive drugs, *n* (%)	3 (7.5)	11 (25)	.06
ACEI, *n* (%)	5 (12.5)	16 (36.4)	.023
ARB, *n* (%)	1 (2.5)	4 (9.1)	.36
CCB, *n* (%)	6 (15)	20 (45.5)	.005
Beta-blocker, *n* (%)	7 (17.5)	11 (25)	.56
Diuretics, *n* (%)	1 (2.5)	11 (25)	.009
Biochemical parameters			
Haemoglobin (g/dl), mean ± SD	10.35 ± 1.93	10.56 ± 2.02	.63
Anaemia[a], *n* (%)	27 (67.5)	27 (61.4)	.72
BUN (mg/dl), median (IQR)	48.7 (40.5–57.7)	50.2 (35.1–70.1)	.87
Creatinine (mg/dl), median (IQR)	4.5(3.51–7.08)	6.32(5.11–9.05)	.007
GFR (ml/min/1.73 m^2), median (IQR)	8.17 (6.71–11.33)	6.7 (5.2–10.8)	.059
Uric acid (mg/dl)	5.99 ± 2.18	6.24 ± 1.61	.66
Sodium (mmol/l)	137.13 ± 4.50	137.92 ± 3.72	.19
Potassium (mmol/l)	5 ± 1.02	4.60 ± 0.88	.032
Calcium (mg/dl)	9.19 ± 1.26	9.48 ± 0.84	.10
Phosphorus (mg/dl)	5.37 ± 1.91	5.06 ± 1.66	.21
Calcium × phosphorus ≥55, *n* (%)	17 (42.5)	13 (29.5)	.31
Alkaline phosphatase (IU/l)	250 (188–372.5)	299 (180–670)	.13
Parathyroid hormone (pg/ml)	120 (74.5–650)	277.9 (106–614.7)	.29
Albumin (g/dl)[a]	3.72 ± 0.80	3.71 ± 0.57	.47
Albumin <3.5 g/dl, *n* (%)	11 (27.5)	15 (34.9)	.62

Table 2: Continued

Characteristics	Admission followed by a potentially avoidable readmission ($n = 40$)	Admission followed by an unavoidable readmission ($n = 44$)	P-value
HCO_3 (mEq/l)	22.8 ± 4.2	23.8 ± 3.1	.12
HCO_3 <22 mEq/l, *n* (%)	14 (35.9)	11 (26.2)	.48
Ferritin (μg/l), median (IQR)	243 (98–361.5)	299 (180–670)	.29
Positive CRP, *n* (%)	19 (63.3)	9 (28.1)	.011
Medications, *n* (%)			
Sodium bicarbonate	14 (35)	14 (32.6)	.99
Potassium binder	5 (12.5)	4 (9.3)	.73
CCPB	23 (57.5)	27 (64.3)	.68
Sevelamer	5 (12.5)	12 (28.6)	.12
25 hydroxy vitamin D	17 (42.5)	16 (39)	.92
Active vitamin D	34 (85)	27 (65.9)	.082
Iron	31 (81.6)	36 (87.8)	.64
ESA	34 (89.5)	37 (90.2)	1.000
Type of admission, *n* (%)			
Unplanned	39 (97.5)	26 (59.1)	<.001
Length of stay (days), median (IQR)	4 (1.25–9)	3 (1–9)	.52
≥14 days, *n* (%)	4 (10)	7(16.3)	.60
ICU stay, *n* (%)	2 (5)	2 (4.5)	1.000
Outcome, *n* (%)			
Partial recovery	12 (30)	3 (6.8)	.013
New comorbidity	1 (2.5)	1 (2.3)	1.000

ACEI: angiotensin-converting enzyme inhibitor; ARB: angiotensin II receptor blocker; BUN: blood urea nitrogen; CCB: calcium channel blocker; CCPB: calcium containing phosphate binder; ESA: erythropoiesis stimulating agents; ESR: erythrocyte sedimentation rate; GFR: glomerular filtration rate; SDS: standard deviation score.
[a]According to KDIGO guideline for anaemia [23].
Percentages may not be total 100% because of rounding.

maintenance dialysis patients in Europe. One-third of hospitalized patients experienced at least one unplanned 30-day readmission. However, among all hospital discharges, 18% resulted in 30-day unplanned readmissions, which was lower than the 22–35% reported in US studies [3, 15, 20, 24].

The readmission rate was 0.53/PYAR, with similar rates between the PD and HD patients. However, HD patients had significantly shorter times to readmission than PD patients and 2.5 times higher early readmission rates. A previous study of US adult HD patients found that 36% of the readmitted patients were hospitalized within the first week [6]. These findings indicate that HD patients require more intensive monitoring and follow-up care. In another comprehensive study, the median time to readmission for paediatric HD and PD patients was 12 days [20], which was almost identical to our findings.

A key finding of this study was that more than three-quarters of the index admissions leading to readmission were unplanned, primarily due to NIC of dialysis access, followed by IC of access, other organ/system disorders, and less commonly by fluid/electrolyte imbalances/hypertension and non-dialysis infections. The most common reasons for readmissions were also similar. In Springel's cohort of paediatric dialysis patients, the rates of dialysis and dialysis ARCs were found to be lower (10.6% for PD and 7.9% for HD), infection-related readmission rates (10.5%) were similar to our study and the most common causes of readmission were found to be cardiovascular events (13%) [20]. Adult dialysis patients with CVCs have a higher risk of repeated admissions compared with those undergoing dialysis via an AVF [25]. Our study found that more than half of the readmissions were due to complications related to dialysis access, with only two associated with AVF. However, the vascular access type did not impact readmission. Notably, the number of patients undergoing HD via AVF was low.

Earlier readmissions tend to be preventable and related to index hospitalization [21, 26]. A clinically related, potentially preventable readmission may result from inadequate care during the initial hospital stay or insufficient follow-up post-discharge rather than unrelated subsequent events [22]. According to our findings, around half of the readmissions were related to the index hospitalization cause and deemed potentially preventable, matching findings by Springel *et al.* [20]. Readmissions linked to previous diagnoses occurred most often after hospitalizations for CVC complications, fluid/electrolyte imbalances/hypertension and PD ARCs. One of the five index discharges resulted in avoidable early readmission. The main indications for index hospitalization were also CVC-related complications, complications related to PD/PD access and fluid/electrolyte imbalances/hypertension. These findings indicate that issues associated with dialysis access, fluid/electrolyte disorders and hypertension could not be completely resolved during the index hospital stay. The higher partial recovery rate observed in index admissions, leading to potentially avoidable readmissions, also supports this opinion. It is also noteworthy that although participating centres reported that most index admissions resulted in complete recovery, a significant proportion (41%) of the index admissions and readmissions were causally related. In line with this, we observed that 17.9% of all readmission episodes ended with partial recovery, while no mortality occurred during any readmission. These findings underscore the clinical significance of readmissions beyond their frequency. These results also underscore the importance of thorough follow-up and outpatient care, highlighting a potential area for improvement in patient care. Studies show closer monitoring of HD patients after hospitalization reduces readmission rates [16]. It was also shown that an additional visit by the nephrologist to patients receiving HD after a hospital

Table 3: Results of univariable and multivariable logistic regression analysis to determine the factors impacting 30-day readmission, potentially avoidable readmission and early readmission.

	Univariable			Multivariable		
Variables	B	OR (95% CI)	P-value	B	OR (95% CI)	P-value
Readmission (patient characteristics)						
Age at the start of the study (months)	−0.004	0.996 (0.991–1.001)	.11	−0.004	0.996 (0.990–1.002)	.33
Primary renal disease (glomerular)	−0.699	0.49 (0.22–1.12)	.09	−0.484	0.61 (0.22–1.71)	.35
Comorbidity	0.646	1.90 (0.97–3.75)	.06	0.333	1.39 (0.58–3.32)	.45
Haemoglobin (g/dl)	−0.171	0.84 (0.69–1.02)	.08	−0.294	0.74 (0.57–0.97)	.030
Serum calcium (mg/dl)	0.578	1.78 (1.00–3.15)	.047	0.555	1.74 (0.92–3.30)	.089
Sodium bicarbonate use	−0.692	0.50 (0.25–1.00)	.051	−0.785	0.45 (0.18–1.11)	.084
Potentially avoidable readmission risk for index admission (index admission characteristics)						
Age at the admission	−0.006	0.99 (0.98–1.00)	.08	−0.016	0.98 (0.97–0.99)	.033
Neurological comorbidity	1.954	7.05 (2.30–21.60)	<0.001	1.947	7.00 (1.04–47.22)	.045
Cardiovascular comorbidity	1.154	3.17 (1.13–8.89)	.028	0.912	2.49 (0.34–18.07)	.36
Serum potassium (mmol/l)	0.446	1.56 (0.96–2.52)	.06	0.430	1.53 (0.71–3.31)	.27
Positive CRP	0.148	4.41 (1.51–12.87)	.007	1.557	4.74 (0.96 -23.32)	.055
Partial recovery	1.768	5.85 (1.51–22.66)	.01	4.033	56.45 (3.02–1053.10)	.007
Early readmission (readmission characteristics)						
Dialysis modality (HD)	1.377	3.96 (1.47–10.67)	.006	1.354	3.87 (1.35–11.11)	.012
Age at the admission	−0.005	0.99 (0.98–1.00)	.17	−0.004	0.99 (0.98–1.00)	.33
Gender (male)	1.617	5.03 (1.35–18.73)	.016	1.283	3.60 (0.88–14.62)	.07
Early readmission (index admission characteristics)						
Dialysis modality (HD)	0.962	2.61(1.01–6.78)	.047	0.723	2.06 (0.69 -6.11)	.19
Age at the admission	−0.007	0.99 (0.98–1.00)	.06	−0.010	0.990 (0.982–0.999)	.027
Anaemia[a]	0.856	2.35 (0.82–6.73)	.11	1.522	1.79 (0.54–5.92)	.33
Serum calcium (mg/dl)	−0.421	0.65 (0.41–1.03)	.06	−0.235	0.79 (0.47–1.30)	.36
CCPB use	−1.141	0.32 (0.12–0.83)	.020	−0.978	0.42 (0.13–1.33)	.14
Potentially avoidable early readmission (index admission characteristics)						
Age at the admission	0.008	0.99 (0.98–1.00)	.06	−0.006	0.99 (0.98–1.00)	.25
Anaemia[a]	1.147	3.15 (0.82–12.01)	.09	1.276	3.58 (0.84–15.12)	.08
Serum calcium (mg/dl)	−0.510	0.60 (0.36–0.98)	.042	−0.368	0.69 (0.41–1.16)	.16
Antihypertensive use	−1.346	0.24 (0.07–0.84)	.026	−1.104	0.33 (0.07–1.40)	.13

CCPB: calcium containing phosphate binder; CRP: C-reactive protein; GFR: glomerular filtration rate; SDS: standard deviation score.
[a]According to KDIGO guideline for anaemia [23].

stay can decrease the 30-day hospital readmission rate by 3.5%, which could result in 31.370 fewer annual hospitalizations [27]. As HD patients are evaluated by a physician at the dialysis centre at least three times per week, special attention should be paid during these visits, particularly for issues related to the CVC. Interventions that aim to decrease peritonitis and PD catheter-related complications may also decrease readmission rates.

Weight changes during hospitalization in dialysis patients require monitoring and dry weight adjustment to prevent volume overload readmissions [4]. To reduce acute admission and readmission risk in dialysis patients, the existing literature suggests frequent nephrologist visits, multidisciplinary medication therapy, management of anaemia and electrolyte imbalances, nutritional assessment, achieving dry weight and BP control [28–30]. Promptly detecting and managing fluid overload, high BP and electrolyte issues through fluid and salt restrictions, proper ultrafiltration during dialysis and appropriate medical care may lower readmission risk. In our cohort, an increase in antihypertensive medications was associated with unavoidable readmissions. Although hypertension in children on dialysis is often volume dependent, there are cases with more complex and treatment-resistant hypertension. The readmission coding reflected the therapeutic action (i.e. medication escalation) rather than the underlying mechanism. This highlights the ongoing challenge of distinguishing between volume-driven hypertension and pharmacologically managed hypertensive states in high-risk paediatric dialysis patients.

Adult studies have identified several risk factors for hospital readmission in patients with ESKD, including younger age

Table 4: Cox regression analysis assessing time to first readmission from demographic and clinical characteristics at the time of study entry.

	Univariable			Multivariable		
Variables	B	Unadjusted HR (95% CI)	P-value	B	Adjusted HR (95% CI)	P-value
Age at the start of the study (months)	−0.004	0.996 (0.992–1.000)	.06	−0.004	0.996 (0.9921–1.000)	.06
Time on dialysis (months)	−0.001	0.999(0.991–1.007)	.75			
Sex (male)	−0.154	0.85 (0.50–1.47)	.57			
Weight SDS	0.007	1.00 (0.87–1.16)	.92			
Height SDS	−0.075	0.92 (0.80–1.06)	.29			
Dialysis modality (hemodialysis)	0.058	1.06 (0.61–1.81)	.83			
Primary renal disease (glomerular)	−0.611	0.54 (0.26–1.11)	.09	−0.279	0.75 (0.34–1.67)	.49
Comorbidity	0.515	1.67 (0.94–2.97)	.079	0.353	1.42 (0.71–2.85)	.32
Multicomorbidity	0.252	1.28 (0.73–2.24)	.37			
Neurological	0.223	1.24 (0.66–2.33)	.48			
Cardiovascular	0.465	1.59 (0.80–3.16)	.18			
Pulmonary	0.558	1.74 (0.85–3.57)	.12			
Gastrointestinal + hepatobiliary	0.466	1.59 (0.91–2.76)	.98			
Oligo-anuria	0.129	1.13 (0.65–1.97)	0.64			
Biochemical parameters at study entry						
Haemoglobin (g/dl)	−0.123	0.88 (0.75–1.03)	.118	−0.245	0.78 (0.64–0.95)	.016
BUN (mg/dL)	0.005	1.00 (0.99–1.01)	.47			
Creatinine (mg/dL)	−0.030	0.97 (0.881.06)	.53			
GFR (mL/min/1.73m^2)	−0.029	0.97 (0.91–1.03)	.33			
Uric acid (mg/dL)	−0.132	0.87 (0.68–1.11)	.28			
Sodium (mmol/L)	−0.002	0.99 (0.92–1.08)	.97			
Potassium (mmol/L)	−0.027	0.97 (0.65–1.45)	.89			
Calcium (mg/dL)	0.535	1.70 (1.04–2.78)	.032	0.456	1.57 (0.94–2.64)	.08
Phosphorus (mg/dL)	−0.017	0.98 (0.80–1.19)	.86			
Albumin (g/dL)	0.259	1.29 (0.80–2.09)	.29			
HCO_3 (mEq/L)	0.044	1.04 (0.97–1.12)	.24			
Positive CRP	0.244	1.27 (0.39–4.09)	.68			
Medications						
Sodium bicarbonate	−0.619	0.53 (0.29–0.97)	.042	−0.706	0.49 (0.24–0.99)	.048
Potassium binder	0.225	1.25 (0.53–2.92)	.60			
CCPB	−0.147	0.86 (0.50–1.48)	.59			
25-hydroxyvitamin D	−0.271	0.76 (0.43–1.34)	.34			
Active vitamin D	0.428	1.53 (0.84–2.78)	.15	−0.056	1.65 (0.80–3.37)	.16
Iron	−0.047	0.95 (0.53–1.69)	.87			
Erythropoiesis stimulating agent	0.289	1.33 (0.70–2.53)	.37			

BUN: blood urea nitrogen; CCPB: calcium containing phosphate binder; CRP: C-reactive protein; GFR: glomerular filtration rate; SDS: standard deviation score.

at dialysis initiation [31], longer dialysis duration [31], CVC use [32], comorbidities [33, 34], anaemia [16] and low serum albumin [32]. Post-discharge haemoglobin monitoring, erythropoietin dose adjustments and vitamin D administration lowered the readmission risk [16]. For paediatric dialysis patients, age <2 years, index hospital stays >14 days and HD use were linked to higher readmission risk [20]. According to our findings, low haemoglobin levels were associated with an increased risk of 30-day readmission, while oral sodium bicarbonate treatment was linked to a significantly lower risk. Anaemia has been shown to increase hospitalization risk in PD patients [35] but shows no correlation with readmissions in patients with CKD stages 3–5 [36]. Clinical trials have demonstrated that oral sodium bicarbonate supplementation can reduce interdialytic bicarbonate loss and potassium gain [37] while also improving nutritional status and shortening hospital stays in PD patients with mild acidosis [38]. These beneficial effects may partially explain the reduced readmission risk observed in our cohort. Although serum bicarbonate levels did not show a statistically significant association with readmission, oral sodium bicarbonate therapy may reflect a more sustained or clinically relevant acidosis burden. Treatment decisions often incorporate multiple observations and clinical judgment, offering a more stable proxy for underlying risk. Furthermore, the observed association between low haemoglobin levels and readmission may partially reflect the acuity or urgency of the index admission rather than a direct causal effect. This potential confounding mechanism warrants further investigation in future studies. In addition, these variables may also serve as indirect markers of overall patient stability or disease burden, reflecting broader care dynamics. Distinguishing between modifiable biological factors and clinical markers of favourable health status remains a challenge in paediatric dialysis care and merits further investigation.

We also identified younger age and neurological comorbidity in the index hospital stay as risk factors for potentially avoidable readmission, with younger age also a determinant of early readmission. In a study analysing recurrent readmissions within children's hospitals, neuromuscular CMs were the most prevalent disease group among frequently readmitted patients [39]. In another paediatric study evaluating 15-day readmissions, neurologic conditions increased the likelihood of readmission [26]. These findings emphasize the need for extra caution in younger patients and proper management of neurological CMs to reduce readmission risk.

The key strength of this prospective study lies in its comprehensive data collection of all dialysis patients hospitalized over a year. Its significance is heightened by the scarcity of research on paediatric dialysis patient readmissions, with only one previous retrospective study [20]. Our study provides more extensive data, enhancing its relevance in the field. One additional strength is the direct involvement of experienced paediatric nephrologists in both patient care and data collection. All readmission data were extracted from discharge documentation by these clinicians, using standardized definitions discussed in investigator meetings. This likely improved the accuracy and clinical relevance of the recorded data and reduced the potential for misclassification. However, due to the large amount of data we have, only selected outcomes and topics were addressed in this study, which can be considered a limitation. More detailed studies can be planned for each outcome. In particular, centre-level characteristics such as availability of dialysis modalities, vascular access practices and treatment protocols (e.g. haemodiafiltration, intensive HD) were not systematically analysed, which limits the interpretation of structural contributors to readmission. While data were collected separately from each centre, the current analysis was conducted at the patient level and did not stratify by centre volume or institutional characteristics. Additionally, reporting bias remains a possibility in any multicentre study; however, the involvement of experienced nephrologists at each site likely mitigated this risk. Moreover, as our primary goal was to evaluate risk factors for 30-day readmission events, we performed discharge-based analyses without adjusting for repeated events within individuals. While this approach has been applied in previous paediatric studies [20], we acknowledge that correlation between multiple discharges from the same patient may have influenced the results. In particular, repeated hospitalizations within the same child could lead to within-subject correlation that is not captured by conventional regression models. More advanced statistical methods, such as generalized estimating equations or shared frailty models, could be applied in future analyses to address this correlation and intercentre variability in care practices, which might otherwise introduce bias.

In conclusion, our study revealed that unplanned 30-day readmissions were common among paediatric dialysis patients, with a substantial proportion being potentially avoidable. Several modifiable risk factors emerged, including dialysis ARCs, haemodialysis treatment, anaemia and incomplete recovery at discharge. While our observational design did not evaluate specific interventions, these findings may help guide the identification of higher-risk patients and inform future studies. Clinical strategies, such as establishing dedicated access teams, fostering collaborative follow-up for dialysis access issues (particularly for HD patients), effectively managing anaemia and ensuring comprehensive discharge planning with an emphasis on complete recovery may represent promising avenues to reduce readmission risk and improve overall QoC for paediatric dialysis patients. Additionally, these comprehensive multicentre data provide valuable prognostic insights for clinicians and families seeking to anticipate outcomes following hospitalization in children with kidney failure.

SUPPLEMENTARY DATA

Supplementary data are available at *Clinical Kidney Journal* online.

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AUTHORS' CONTRIBUTIONS

Y.Ö.A. and S.A.B. were responsible for conceptualization, formal analysis, investigation, methodology, project administration, visualization and writing the original draft. All authors were responsible for data curation, resources, supervision and validation. Y.Ö.A., S.A.B., C.P.S., R.S. and A.E. were responsible for review and editing.

DATA AVAILIBILITY STATEMENT

The data underlying this article are available in the article and in its online supplementary material.

CONFLICT OF INTEREST STATEMENT

None declared.

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