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Factors Affecting Readmission in Hospitalized Patients with Chronic Kidney Disease: a Single Center Study

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ABSTRACT

Introduction

Chronic Kidney disease (CKD) in itself and the associated comorbidities together put the patients at increased risk of hospitalization. We aimed to study the factors associated with hospital readmission within 30 days of discharge in hospitalized patients with CKD.

Methods

This was a single center descriptive observational study conducted in Tribhuvan University Teaching Hospital (TUTH), Kathmandu. Hospitalized CKD patients were evaluated for sociodemographic parameters, clinical profile and laboratory parameters; they were asked over the phone after 30 days of discharge if they had repeat hospitalization. Readmission rates were calculated and factors at admission associated with repeat hospitalization were analyzed.

Results

Out of 337 CKD patients 307 could be contacted. Fifty patients (16.28%) needed readmission. Readmission rate was higher in patients older than 75 years and between ages 25 to 50. Patients who were undergoing dialysis at TUTH (OR 3.324 CI 1.239-8.917, p=0.017), who belonged to Newari community (OR 2.85 CI 1.17-6.9, p=0.020) and those from Kathmandu valley (1.94,CI 0.94-3.99) had higher odds of readmission. Hypertension, diabetes mellitus and tuberculosis as a comorbidity had increased odds of readmission of (1.51,CI 0.60-3.77), (1.48, CI 0.79-2.76), (1.569,CI 0.441-4.468) respectively. Hemoglobin less than 9 gm/dl and serum albumin less than 35 gm/l had higher odds of readmission of (1.109 95% CI 0.605-2.033) and (1.877,95%CI 0.869-4.054) respectively.

Conclusion

Overall 30 day readmission rate of Hospitalized CKD patients was 16.28%. Elderlies, those with medical comorbiditites, anemic and hypoalbuminemic patients tended to have increased odds of readmission.

Keywords
CKD, readmission, repeat hospitalization

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INTRODUCTION

Chronic Kidney disease (CKD) is a global public health problem. It ranks 11th among the most common cause of death worldwide according to the global burden of disease 2016.[1] The overall costs of care of CKD patients in the United States is $22,348/person/year, which is three times compared to patients without CKD.[2] CKD and the associated comorbidities lead to high risk of hospitalization, that is even higher in patients with end stage renal disease (ESRD) and those under maintenance hemodialysis.[3] Repeat hospitalization in CKD patients within 30 days of index admission are due to impaired immunity that predisposes them to recurrent infections, cardiovascular effects of CKD, vascular access related issues etc.[4-6]

The medical, emotional and economic impact of repeated hospitalizations is expected to be enormous. Though the hemodialysis service has been rendered free by the government of Nepal, the costs of medication and hospitalization has to be borne by the patients themselves.[7] Any intervention to reduce the rate of readmission in CKD patients is worthwhile.[8] We aimed to find the baseline data on rates of 30 day readmission in hospitalized patients of CKD stages 3, 4, 5 and 5D and then looked for factors that affected readmissions. The findings could potentially highlight specific areas for intervention to help reduce the rates of readmission of CKD patients, improve their health as well as reduce the overall national healthcare expenditure and formulate healthcare policy.

METHODS

This was a single center descriptive, observational study conducted in the Medical and Nephrology wards of Tribhuvan University Teaching Hospital (TUTH), Kathmandu between August 2018 and July 2019. Ethical clearance was taken from the Institutional Review Committee (IRC) of Institute of Medicine.

All the consenting adult patients above 16 years of age with CKD stages G3, 4, 5 and 5D admitted in the Medical and Nephrology wards of TUTH were included in the study. Similarly, patients who did not have accessibility to telephone for follow up phone calls, who left hospital against medical advice (LAMA),who were planned for renal transplant within 1 month, those planned for supportive care only without renal replacement therapy and those with very poor performance status with expected survival less than 1 month from the date of discharge were excluded from the study.

Prior written informed consent was taken from the patient or patient's relative/caregiver wherever appropriate. Data was recorded in predesigned proforma (available in appendix) via in person interview with the patient and/or the caregiver/ relative by the first author during the time of admission in the hospital. Investigation findings were recorded from the patient record in the same sitting. The patients were then followed up telephonically after 30 days of discharge from index hospitalization to find out about the readmission. Amongst those patients who could be contacted and were alive at the end of 30 days of discharge, the baseline sociodemographic, clinical and biochemical parameters were analyzed and compared as those readmitted and not readmitted.

Sample size of the study was calculated using the formula $n= z^2p(1-p)/d^2$, where n=sample size, z=z statistic for the level of significance (for 95% confidence interval Z=1.96), p=expected prevalence (21.4% readmission rate) and d=precision (0.05). Hence, the sample size =329. Assuming 10% of patients do not respond to phone call (attrition rate) the estimated sample size was 367.

Continuous data were shown as mean ± standard deviation. Categorical data were shown in terms of frequency and percentage. Comparison of means of continuous parameters between readmitted vs not readmitted was done using independent sample t-test. Bivariate logistic regression was applied to findout factors affecting readmission. Odds ratio was calculated from the same to find out relative odds of readmission. A p-value of <0.05 was considered significant. The statistical analysis was performed using SPSS version 23 (IBM corp).

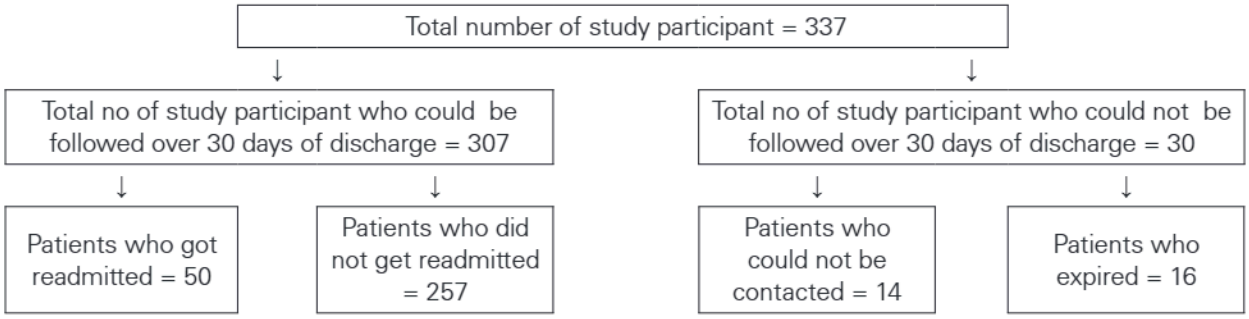

Figure 1. Diagrammatic representation of outcome of study

RESULTS

A total of 337 patients were included in the study. At the end of 30 days, only 307 patients (91.09%) could be contacted while 14 patients (4.1%) could not be traced and 16 (4.7%) passed away. Out of 307 patients, 50 (16.28%) got readmitted while 257 patients (83.7%) did not need readmission as represented in Figure 1 and Table 3.

Table 1. Sociodemographic and clinical profile of CKD patients

Characteristics	Number (%)
Ethnicity	
Brahmin	93 (27.6)
Chhetri	50 (14.8)
Newar	44 (13.1)
Tamang+Gurung	68 (20.2)
Others	82 (24.3)
CKD Stage	
Stage 3	4 (1.2)
Stage 4	39 (11.6)
Stage 5	84 (24.9)
Stage 5D	210 (62.3)
Causes of CKD	
Diabetes Mellitus	115 (34.1
Hypertension	110 (32.6)
Chronic glomerulonephritis	99 (29.4)
ADPKD	2 (0.6)
Obstructive Uropathy	11 (3.3)
Principal diagnosis	
Volume overload	133 (39.5)
Infection	75 (22.3)
Uremic Gastritis	46 (13.6)
Uremic encephalopathy	10 (3)
Obstructive nephropathy	8 (2.4)
Tuberculosis	24 (7.1)
Fistula related	5 (1.5)
CAD	5 (1.5)
Others	31 (9.1)

Table 2. Laboratory parameters of CKD patients

Variables	Mean±SD
Age (years)	49.75±17.05
Length of hospital stay (days)	11.65±6.91
Hemoglobin level (gm/dl)	9.05±1.64
Platelets (/mm3)	214849±114731
Urea (mmol/l)	22.96±12.64
Creatinine (µmol/l)	694.99±369.60
Sodium (mEq/l)	134.63±4.90
Potassium (mEq/l)	4.29±2.01
Albumin (gm/l)	34.11±5.76
Calcium (mmol/l)	1.88±0.27
Phosphorous (mg/dl)	5.49±2.05
Vitamin D(nmol/l)	25.08±17.96
iPTH (pg/ml)	395.43±461.97

Out of 337 studied participants, 221 (65.6%) were male and 116 (34.4%) were female. Fifteen (4.5%) patients were migrant workers who had recently returned to Nepal. Two hundred and eighty (83.1%) patients came from outside the Kathmandu Valley (Table 4).

The mean age of the study population was 49.75 years (±17.05) with range of 17 to 93 years. Average length of stay was 11.65 days (±6.91). The mean hemoglobin was 9.05gm/dl (±1.64). Our study population had mean albumin of 34.11gm/l (±5.76) (Table 2).

Ninety-three (27.6%) patients were brahmin, 50(14.8%) were chhetri, 44(13.1%) belonged to the Newari community, 68(20.2%) were either tamang or gurung and 82 patients (24.3%) belonged to other groups of ethnicities. Sixty two percent of the patients (210) belonged to Stage 5D, out of which 208 were under maintenance hemodialysis and 2 were on CAPD. CKD Stage 5 comprised of 84 (24.9%) patients followed by Stage 4 and Stage 3 which included 39(11.6%) and 4(1.6%) patients respectively (Table 1).

The most common cause of CKD in our study population was diabetes mellitus (34.1%), followed by hypertension (32.6%) and chronic glomerulonephritis (29.4%). Two hundred and eighty one (83.4%) patients had hypertension as the comorbidity and diabetes mellitus was present among 115 patients (20.91%). Both diabetes mellitus and hypertension were present

Table 3. Outcome of readmission of patients with CKD

Outcome	Number (%)
Readmitted	50 (14.8)
Not readmitted	257 (76.3)
Not contact	14 (4.2)
Expired	16 (4.7)

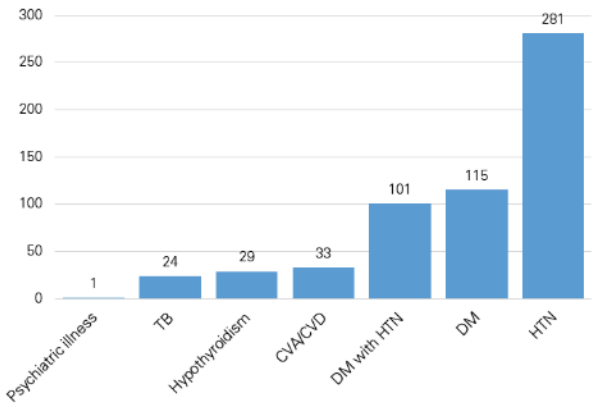

Figure 2. Frequency distribution of comorbidities among CKD patients

among 101 patients(17.60%) (Figure 2). The other comorbidities were hypothyroidism in 29 (5.05%), Tuberculosis(TB) in 24 (7.1%) and psychiatric issue in one patient. A total of 134 patients (39.8%) had atleast 2 comorbidities.

Volume overload was the major complaint during index hospitalization seen in 133 patients (39.5%) followed by infectious complications and uremia in 75 patients (22.3%), and 56 patients (16.6%) respectively. Twenty four patients (7.1%) had tuberculosis in any form as the principal cause of index hospitalization. Among 294 patients in CKD stage 5 or 5D, 208 were on maintenance hemodialysis and 2 patients were under CAPD. We found 72 patients in CKD 5 without vascular access (Figure 3).

There was no statistical significant difference in readmission rates based on gender, mean age and mean length of hospital stay. Compared with the overall readmission rates of 16.28%, 19.44% of patients in CKD 4 and 16.32% of patients with CKD

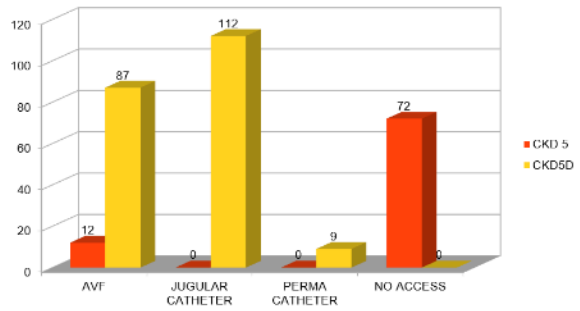

Figure 3. Access distribution among CKD patients

5D were readmitted. Among diabetics, 18.44% patients were readmitted. Twenty two percent of patients with tuberculosis and 20.28% of patients with infection as the diagnosis during index hospital admission were readmitted (Table 4). The mean hemoglobin of index admission among the readmitted group of patients was (8.59±1.47) gm/dl which was lower compared to (9.09±1.65)gm/dl

Table 4. Comparision of the sociodemographic and clinical profile among readmitted vs not readmitted CKD patients (n=307).

Variables	Characteristics	Outcome		p-value
		Readmitted (n=50)	Not Readmitted (n=257)	
Gender	Male	31	171	0.55
	Female	19	86	
Age(years)	<25	2	27	0.20
	25-50	23	99	
	50-75	22	119	
	>75	3	12	
Hospital stay (days)	-	11.20	11.53	0.76
Address	Kathmandu	13	40	0.08
	Outside Kathmandu	37	217	
Migrant	Yes	0	15	0.09
	No	50	242	
Diagnosis (Primary reason for admission at index hospitalisation)	Infection	14 (20.28%)	55	0.10
	Volume Overload	5 (12.9%)	108	
	Uremia	5 (10%)	45	
	Tuberculosis	5 (22.72%)	17	
	Obstructive	1 (14.2%)	6	
	CAD	1 (100%)	1	
	Fistula related	0 (0)	4	
	Others	8 (27.58%)	21	
Comorbidities	Less than 2	28	155	0.57
	More than 2	22	102	
Stage of CKD	Stage 3	0(0)	4	0.76
	Stage 4	7(19.44%)	29	
	Stage 5	11(15.49%)	60	
	Stage 5D	32(16.32%)	164	
Dialysis Facility (n=194)	TUTH	5	12	0.02
	Outside	26	151	

among the group that was not readmitted (Table 2).

Bivariate logistic regression was carried out taking readmission as the dependent variable (Table 5). Patients who had TUTH as the primary dialysis center were found to have higher odds of readmission compared to other centers, (OR 3.384 95%CI 1.229-9.40,p=0.019). Patients who belonged to Newari community had higher odds of readmission compared to other communities (OR 2.85 95% CI 1.17-6.9,p=0.02).

Bivariate logistic regression analysis did not show any significant association between other factors as mentioned in the table above. However, patients with age more than 75 years (OR 7.353 95% CI 0.788-68.634) and those between 25 to 50 years (OR 6.053 95% CI 0.779-47.017) tended to have increased odds of readmission. Similarly, presence of hypertension as the comorbidity increased the odds of readmission (OR1.49 95% CI 0.59-3.72) so did having other comorbidities like diabetes mellitus (OR1.56 95%CI 0.83-2.91) and tuberculosis (OR 1.569 95%CI 0.441-4.468).

CKD patients with hemoglobin lower than 9 gm/dl appeared to have increased risk of readmission (OR 1.653 95% CI 0.869-4.054) compared to those with hemoglobin more than 9gm/dl. It was also observed that serum sodium less than 130 (OR 1.64 95% CI 0.64-4.19), potassium more than 4.5 (OR 1.38 95% CI 0.67-2.86) and having central venous catheter as opposed to AV fistula as the route of hemodialysis were seen to increase the risks of readmission, though not statistically significant.

Patients who had arteriovenous fistula (AVF) as the access had lower odds of readmission compared to those without access, similarly people who had central venous access as the route of hemodialysis had higher odds of readmission (Table 5).

Table 5. Bivariate logistic regression for Socio-demographic characteristics and clinical parameters of readmitted vs not readmitted patients (n=307). *[Table continued on next page]*

Variables	Characteristics	Readmission		Bivariate analysis cOR (95% CI)	p-value
		Readmitted	Not readmitted		
Dialysis facility center (n=196)	TUTH	7	12	3.384 (1.229-9.40)	0.02
	Others	26	151	Ref	
Ethnicity (n=307)	Brahmin	13	77	Ref	0.50
	Chhetri	8	40	1.26 (0.47-3.35)	0.63
	Newar	13	27	2.85 (1.17-6.9)	0.02
	Tamang+Gurung	7	54	0.767 (0.287-2.05)	0.59
	Others	9	59	1 (0.39-2.53)	1.00
Age (years) (n=307)	<25	2	27	Ref	
	25-50	23	99	6.053 (0.779-47.017)	0.09
	50-75	22	119	4.375 (0.562-34.047)	0.16
	>75	3	12	7.353 (0.788-68.634)	0.08
Sex (n=307)	Female	19	86	Ref	0.49
	Male	31	171	0.79 (0.42-1.50)	
Address (n=307)	Kathmandu	13	40	Ref	0.08
	Outside Kathmandu	37	216	0.527 (0.25-1.07)	
Hypothyroid (n=307)	Yes	6	24	1.37 (0.52-3.58)	0.51
	No	44	233	Ref	
Tuberculosis (n=307)	Yes	5	17	1.569 (0.551-4.441)	0.34
	No	45	240	Ref	
DM (n=307)	Yes	22	83	1.56 (0.89-2.96)	0.16
	No	28	166	Ref	
HTN (n=307)	Yes	44	211	1.49 (0.59-3.72)	0.38
	No	6	43	Ref	
CVA or CVD (n=307)	Yes	5	24	1.07(0.38-2.95)	0.90
	No	45	233	Ref	
DM with HTN (n=307)	Yes	20	81	1.58 (0.54-4.66)	0.40
	No	30	176	Ref	

Table 5. Bivariate logistic regression for Socio-demographic characteristics and clinical parameters of readmitted vs not readmitted patients (n=307). [Continued from previous page]

Variables	Characteristics	Readmission		Bivariate analysis cOR (95% CI)	p-value
		Readmitted	Not readmitted		
IV iron received (n=307)	Received	5	21	Ref	0.68
	Not received	45	236	0.80 (0.28-2.25)	
Erythropoietin (n=307)	Received	19	102	1.07 (0.57-2.00)	0.83
	Not received	31	155	Ref	
Access (n=307)	AVF	18	72	0.747(0.36-1.553)	0.81
	Jugular catheter	14	87	1.161(0.54-2.497)	
	Permanent Catheter	1	6	1.121(0.127-9.910)	
	CAPD	0	1		
	No Access	17	91		
Anemia level (n=307)	≤ 9	41	182	1.877(0.869-4.054)	0.11
	> 9	9	75	Ref	
Platelets (n=307)	<1 lakh	5	23	0.90(0.29-2.80)	0.92
	1-1.5 lakh	13	60	1.13(0.55-2.29)	0.73
	>1.5 lakh	32	174	Ref	
Sodium (n=307)	<130	18	33	1.64(0.64-4.19)	0.30
	130-135	21	138	Ref	
	>135	11	86	0.55(0.25-1.22)	0.15
Potassium (n=307)	<3.5	6	28	0.66(0.18-2.39)	0.53
	3.5-4.5	29	169	Ref	
	>4.6	15	60	1.38(0.67-2.86)	0.38
Albumin (n=307)	<35	26	127	1.109(0.605-2.033)	0.29
	>35	24	130	Ref	
Vitamin D (n=298)	≤8	4	27	0.84(0.26-2.68)	0.77
	8-30	19	108	Ref	
	>30	25	115	1.23(0.64-2.37)	0.52
Phosphorous (n=247)	<2.5	4	10	1.54(0.42-5.66)	0.51
	2.5-4.5	14	54	Ref	
	>4.5	23	142	0.62(0.29-1.30)	0.21
iPTH (n=298)	<50	1	17	0.28(0.03-2.20)	0.23
	50-450	37	179	Ref	
	>450	10	54	0.89(0.41-1.91)	0.78
Diastolic dysfunction (n=307)	Yes	7	30	1.23(0.50-2.98)	0.60
	No	43	227	Ref	
Systolic dysfunction (n=307)	Yes	6	30	1.03(0.41-2.71)	0.90
	No	44	227	Ref	

DISCUSSION

CKD, a global epidemic ranks 11th on the cause of global death and has also contributed significantly to the overall healthcare costs.[1]

The mean age of the study population was 49.54 years (±17.05) showing that this is the disease of productive age group in Nepal with mean length of hospital stay of 11.45 days (±6.91) the cause of which could be multifactorial and is contributing to increased healthcare costs.

We found 16.28% of our study population needing readmission within 30 days of index hospital discharge. The rate of readmission was 16.28% among those with CKD5 and CKD 5D combined and the rate of 16.32% among those under maintenance hemodialysis. These rates are lower compared to those reported by United States Renal Data System(USRDS) which reported rehospitalization rate of 21.4% among CKD patients, 34.6% among those with ESRD and 36.6 % among those under hemodialysis.[3,9] The lower rates we saw could be due to poor access to healthcare outside the Kathmandu valley since the majority of our

study population came from outside Kathmandu. Additionally, 16 patients had expired during our follow up period, this mortality could have been prevented had they received better health service in a better health care system.

Patients older than 75 years of age and patients who were between 25 years and 50 years were at higher odds of readmission with readmission rate of 20% and 18.8% respectively. These findings were in contrast with the findings of Hickson et al[4] that showed patients with age 18-29 years with highest rate of readmission of 41%. In our study proportion of patients younger than 25 years were lower (9.5%).

We observed that having TUTH as the primary dialysis center was significantly associated with 30-day readmission (OR 3.324 95% CI 1.239-8.917,p=0.017). These findings are in contrast to the one reported by Flythe et al.[10] which showed outpatient dialysis at a non university affiliated dialysis facility at higher odds of readmission (OR 3.59 95% CI, 2.03 - 6.36). Earlier detection of the ailments due to in center dialysis facility could have contributed to the higher odds in this group of population.

We found out that majority of CKD patients belonged to Brahmin community (27.6%), however the relative odds of readmission was higher in the Janajatis that included Tamang, Gurung and Newar (OR 1.64 95% CI 0.75-3.59). On further analysis patients from Newari community had significantly higher odds of readmission (OR 2.85 95% CI 1.17-6.9,p=0.020). Though specific ethnic characteristics of the study population couldnot be explored, multiple factors could play role in getting illness and admissions. Genetic predisposition, socioeconomic and cultural background being few of them.

When diabetes mellitus was the cause of CKD, 18.44% of our patients got readmitted. The rate of readmission was 17.3% in patients with hypertension as the cause of CKD. These findings were consistent with various studies[4] that reported diabetes and hypertension as a cause of ESRD with the risk of hospitalization. Patients with tuberculosis as the cause of index hospital admission had readmission rate of 22.72% while 20.28% of patients with infection as the reason for admission were readmitted. We found patients with more than two comorbidities at increased odds of readmission compared to those with two or less comorbidities, similar findings was seen in study done by Di Napoli et al. that showed people with multimorbidities were at increased risk of hospitalization.[5,11]

People who were inside the Kathmandu valley were at higher odds of readmission compared to those outside Kathmandu . These findings could be attributed to easier access to the healthcare facility in the capital city. We found that having central venous access for dialysis was at higher odds of readmission compared to those with arteriovenous fistula. These findings were consistent with those reported by Hickson et al. and a retrospective study done in Saudi Arabia.[12] Higher rate of infections in those with indwelling catheter are the important factors associated with it.[13]

On evaluation of laboratory parameters we found hemoglobin less than 9gm/dl with higher odds of readmission (OR1.87 95%CI 0.86-4.05,p=0.105). These findings though not statistically significant were consistent with the observations by Xia et al, Di Napoli et al and Hickson et al.These studies reported lower hematocrit as risk factors for both hospitalization and readmission.[4,5,14]

Role of haemoglobin as a determinant of readmission was also highlighted by Chan et al that showed periodic haemoglobin monitoring and EPO dose adjustment associated with lower risk of readmission.[15] Serum albumin is another parameter known to affect readmission rate as reported in various studies[4,9] with serum albumin level less than 35gm/l having consistent associations with readmission. These findings are replicated in our study as well with level below 35gm/l having odds of 1.109 (95% CI 0.605-2.033). Having sodium less than 130 and potassium more than 4.5 were also at higher risks of readmission, these findings however were not statistically significant.

We lacked the information regarding reason for readmission in our study. Thirty patients either expired or were lost to follow up, this significant proportion of patients might have required hospitalization which if taken could potentially have affected the outcome of our study.

CONCLUSION

The thirty-day readmission rate was 16.28%. The rate of readmission was higher at 16.10% in patients with ESRD and the rate of 16.32% in patients under maintenance hemodialysis.

Patients being dialyzed at TUTH and those from Newari community had higher odds of readmission. Patients being dialyzed via AVF had lesser readmission rates compared to those being dialyzed via central venous catheters. Having comorbidities like hypertension, diabetes mellitus, tuberculosis increased the risk of readmission, with increased risk with those with more than two comorbidities. Anemia and hypoalbuminemia also increased the risk of rehospitalization.

We recommend targeted management of anemia and early preparation for renal replacement therapy with appropriate vascular access to prevent unnecessary readmissions in the future. Multidisciplinary approach for volume management of CKD patients along with vaccination and infection

prevention would be pivotal in reducing the 30-day hospital readmission.

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CONFLICT OF INTEREST

The author(s) declare that they do not have any conflict of interest with respect to the research, authorship, and/or publication of this article.

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