



EVALUATION OF RISK FACTORS, CLINICAL OUTCOMES, AND PHARMACOTHERAPEUTIC PATTERNS AMONG MAINTENANCE HEMODIALYSIS PATIENTS WITH CHRONIC KIDNEY DISEASE

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ABSTRACT

Background: The chronic kidney disease (CKD) is linked to significant morbidity and mortality, especially in those who need maintenance haemodialysis. Evaluation of prescribing patterns and clinical outcomes is crucial since complicated pharmacotherapy is required due to numerous comorbidities and consequences.

Aim: The purpose of this study is to assess the pharmacotherapeutic prescribing patterns, risk factors, and complications of patients with chronic renal disease receiving maintenance haemodialysis.

Methods: 128 patients undergoing maintenance haemodialysis at a tertiary care teaching hospital participated in a cross-sectional observational study. A standardised data collecting form was used to record demographics, comorbidities, clinical and laboratory parameters, complications, and medication use. WHO prescription indicators were used to assess prescribing trends, and statistical analysis was carried out to identify correlations between particular clinical factors.

Results: Males in their middle and older years were more likely to have CKD, and the most common comorbidities were diabetes mellitus and hypertension. The majority of patients had advanced renal failure, anaemia, and complications from haemodialysis. The most commonly given drugs included erythropoietin, loop diuretics, antibiotics, antihypertensives, alkalinising agents, and iron supplements. The WHO prescribing indicators showed an average of 6.7 drugs per prescription, indicating polypharmacy, whereas the high use of generic drugs (81%) and medicines from the National List of Essential Medicines (71%) reflects rational prescribing practices.

Conclusion: Patients on maintenance haemodialysis have a heavy burden of difficulties, comorbidities, and polypharmacy. Improving patient outcomes and quality of life requires early diagnosis, logical pharmacotherapy, clinical pharmacists' active participation, and a multidisciplinary approach.

KEYWORDS: Chronic Kidney Disease, Hemodialysis, Polypharmacy, Co-morbidities, Risk Factors, Pharmacotherapy, WHO Indicators.

Introduction

Chronic kidney disease (CKD) is a progressive and irreversible disorder characterized by the gradual loss of kidney function over time, resulting in significant morbidity, mortality, and healthcare expenditure worldwide[1,2]. It has emerged as a major global public health challenge, affecting approximately 10–13% of the adult population. As the disease progresses to end-stage renal disease (ESRD), maintenance hemodialysis becomes the most widely adopted renal replacement therapy, improving survival while imposing substantial physical, psychological, and economic burdens on patients[3,4,5,6].

Assessment of pharmacotherapeutic patterns provides valuable insights into current prescribing practices, medication utilization, adherence to evidence-based treatment guidelines, and opportunities for optimizing patient care[1,7]. Evaluating drug utilization among CKD patients receiving maintenance hemodialysis also helps identify irrational prescribing, supports antimicrobial stewardship, and facilitates the development of strategies to improve therapeutic outcomes while minimizing medication-related complications[8,9].

Although several studies have evaluated individual aspects of CKD management, comprehensive data simultaneously assessing risk factors, dialysis-related complications, and pharmacotherapeutic patterns among maintenance hemodialysis patients remain limited, particularly in tertiary care teaching hospitals[10,11]. Such information is essential for understanding the overall clinical profile of these patients and for developing targeted interventions to improve disease management[12]. The present cross-sectional observational study was undertaken to comprehensively evaluate the risk factors, complications, and pharmacotherapeutic patterns among chronic kidney disease patients undergoing maintenance hemodialysis at a tertiary care teaching hospital. The findings of this study are expected to provide evidence that supports rational prescribing practices, early identification of high-risk patients, optimization of clinical management, and improved quality of care for individuals receiving long-term hemodialysis.

Materials and Methodology

Study Design

A hospital-based, cross-sectional observational study was conducted to comprehensively evaluate the risk factors, clinical complications, and pharmacotherapeutic patterns among patients with CKD undergoing maintenance. Institutional Committee approval with IEC No: SPSP/2025-2026/PHD09 was obtained before initiation of the study. Written informed consent was obtained from all study participants, and confidentiality of patient information was maintained throughout the study.

Study Setting

The study was carried out in the Departments of General Medicine and Nephrology Units at Sri Venkateswara Ramnarayan Ruia Government General Hospital (SVRRGGH), a tertiary care teaching hospital in Tirupati, Andhra Pradesh, India.

Study Duration

The study was conducted over a period of six months, from October 2025 to March 2026.

Study Population

The study included adult patients diagnosed with chronic kidney disease who were receiving maintenance hemodialysis during the study period. A total of 128 patients fulfilling the eligibility criteria were enrolled using a convenient sampling technique.

Inclusion Criteria

- Patients aged 18 years or above, irrespective of gender.
- Diagnosed cases of chronic kidney disease receiving maintenance hemodialysis for more than one month.
- Patients willing to participate and providing written informed consent.
- Patients with associated comorbidities such as diabetes mellitus and/or hypertension.

Exclusion Criteria

- Patients diagnosed with acute kidney injury (AKI).
- Patients undergoing peritoneal dialysis or those with a history of renal transplantation.
- Critically ill patients unable to provide reliable clinical information.
- Patients who declined to participate in the study.

Study Materials

The following materials were used for data collection and analysis:

- Structured patient data collection form.
- Patient case records and medical charts.
- Laboratory investigation reports.
- Informed consent form.
- WHO Core Drug Prescribing Indicators.
- Lexicomp® and Drugs.com databases for drug information and assessment.

Data Collection Procedure

Eligible patients were identified after obtaining approval from the treating physician. Written informed consent was obtained from each participant before enrolment. Demographic details, clinical characteristics, medical history, duration and frequency of hemodialysis, lifestyle-related risk factors, comorbidities, laboratory investigations, dialysis-related complications, and prescribed medications

were collected using a structured data collection form from patient interviews, case records, and laboratory reports.

Risk factors including smoking, alcohol consumption, diabetes mellitus, hypertension, obesity, and other lifestyle factors were documented. Clinical complications were categorized as intradialytic and interdialytic complications. Pharmacotherapeutic patterns were evaluated by documenting all prescribed medications, therapeutic classes, frequency of prescribing, and the extent of polypharmacy. Drug utilization was evaluated using the World Health

Organization (WHO) Core Drug Prescribing Indicators. The collected data were entered into Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) software, Version 28.0 (IBM, New York, USA). Descriptive statistics were used to summarize demographic characteristics, clinical variables, complications, and prescribing patterns. Continuous variables were expressed as mean $\pm$ standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Associations between selected variables were analysed

Table 1: Baseline Characteristics, Clinical Profile, Risk Factors, and Hemodialysis Characteristics of the Study Population (N = 128)

Variable	Category	n (%)
Age (years)	18–29	4 (3.1)
	30–39	6 (15)
	40–49	31 (24.2)
	50–59	41 (32.0)
	60–69	29 (23.4)
	70–79	14(11)
	80–89	3(2)
Gender	Male	99 (77.3)
	Female	29 (22.7)
Body Mass Index (BMI)	Underweight	9 (7)
	Normal	77 (60)
	Overweight	33 (26)
	Obese	9 (7)
Major Risk Factors	Alcohol	36(28)
	Smoking	10(15)
	Poor compliance to medications	15(12)
	Obesity	6(5)
	NSAIDS Abuse	4(3)
Social Habits	Smoking	19 (15)
	Alcohol	2 (1)
	Smoking + Alcohol	19 (15)
	None	88 (69)
Hemoglobin (g/dL)	<10	94 (73.4)
	$\geq$ 10	34 (26.6)
eGFR (mL/min/1.73 m ²)	10–14	57 (44)
	5–9	43 (34)
	<5	28 (22)
Serum Creatinine (mg/dL)	<5	18 (14.1)
	5–10	64 (50.0)
	>10	46 (35.9)
Major Comorbidities	Hypertension	111 (87)
	Diabetes mellitus	77 (60.15)
	CAD	20 (16)
	Beri-Beri	3 (2.34)
	Thyroid	1(0.78)

using the Chi-square test. A *p*-value of <0.05 was considered statistically significant.

Results

A cross-sectional observational study was conducted for a period of 6 months from October 2025-March 2026 in the inpatient wards of Department of General Medicine and nephrology ward at SVRRGGH, Tirupati. A total of 128 patients with CKD undergoing maintenance hemodialysis were included in the study. The largest proportion of patients belonged to the 50–59 years age group (32%, *n*=41) and least number are recorded in 80–89 years (2.0%, *n* = 3). Male patients constituted the majority of the study population (77.3%, *n* = 99), whereas females accounted for 22.7% (*n* = 29).

Assessment of body mass index (BMI) showed that 60% (*n* = 77) of the patients had a normal BMI, while 26% (*n* = 33) were overweight. Underweight and obese individuals each constituted 7% (*n* = 9) of the study population. Among the major risk factors identified, alcohol consumption was the most common (28%, *n* = 36), followed by smoking (15%, *n* = 10), poor compliance with medications (12%, *n* = 15), obesity (5%, *n* = 6), and NSAID abuse (3%, *n* = 4). With respect to social habits, 69% (*n* = 88) of the patients reported no history of smoking or alcohol use, whereas 15% (*n* = 19) were smokers, 15% (*n* = 19) reported both smoking and alcohol consumption, and only 1% (*n* = 2) consumed alcohol alone.

Laboratory evaluation revealed that 73.4% (*n* = 94) of the patients had hemoglobin levels below 10 g/dL, indicating a high prevalence of anemia, while 26.6% (*n* = 34) had

hemoglobin levels of 10 g/dL or higher. Based on estimated glomerular filtration rate (eGFR), 44% (*n* = 57) of the patients had values between 10–14 mL/min/1.73 m², 34% (*n* = 43) had values between 5–9 mL/min/1.73 m², and 22% (*n* = 28) had an eGFR of <5 mL/min/1.73 m². Serum creatinine levels were 5–10 mg/dL in 50.0% (*n* = 64) of the patients, while 35.9% (*n* = 46) had levels >10 mg/dL and 14.1% (*n* = 18) had levels <5 mg/dL.

Hypertension was the most prevalent comorbidity, affecting 87% (*n* = 111) of the patients, followed by diabetes mellitus (60.15%, *n* = 77) and coronary artery disease (CAD) (16%, *n* = 20). Less frequently observed comorbidities included beri-beri (2.34%, *n* = 3) and thyroid disorders (0.78%, *n* = 1).

The frequency distribution of intradialytic and interdialytic complications among the 128 patients undergoing maintenance hemodialysis is presented in Table 2. Among the intradialytic complications, shortness of breath was the most frequently reported complication, affecting 76 (59%) patients, followed by muscle cramps in 29 (23%), nausea and vomiting in 24 (19%), headache in 23 (18%), and chest pain in 19 (15%) patients. Altered sensorium was the least common intradialytic complication, observed in 4 (3%) patients. Among the interdialytic complications, pedal edema was the most prevalent complication, reported in 43 (34%) patients, followed by lower limb swelling in 34 (27%), decreased urine output in 28 (22%), anemia in 22 (17%), electrolyte imbalance in 20 (16%), and facial puffiness in 19 (15%) patients. Vascular access-related complications and loss of appetite were observed in 10 (8%) and 7 (5%) patients, respectively.

Table 2: Prevalence of Intradialytic and Interdialytic Complications Among Maintenance Hemodialysis Patients (N = 128)

Type of Complication	Complication	No. of Patients (n = 128)	Percentage (%)
Intradialytic Complications	Shortness of breath	76	59
	Muscle cramps	29	23
	Nausea & vomiting	24	19
	Headache	23	18
	Chest pain	19	15
	Altered sensorium	4	3
Interdialytic Complications	Pedal edema	43	34
	Lower limb swelling	34	27
	Decreased urine output	28	22
	Anemia	22	17
	Electrolyte imbalance	20	16
	Facial puffiness	19	15
	Vascular access complications	10	8
	Loss of appetite	7	5

Table 3: WHO drug prescribing indicators

S. No	Prescribing Indicators	Average/ Percentage
1	Average Number of Drugs Per Encounter	6.7
2	Percentage of Drugs Prescribed From NLEM	71%
3	Percentage of Drugs Prescribed by Generic Name	81%
4	Percentage of Encounters with An Injection Prescribed	72%
5	Percentage of Encounters with Antibiotic Prescribed	87%

Table 4: Association between selected variables among CKD patients

S. No	Variables Compared	X ² Value	df	P Value
1	Gender vs Hemoglobin Levels	0.387	3	0.943
2	Smoking vs eGFR Levels	3.404	2	0.182
3	BMI vs Hypertension	2.861	3	0.004
4	BMI vs Hypertension	3.617	2	0.016
5	Dialysis Frequency vs Complications	1.581	2	0.027

(Bold, P-Value < 0.05 = significant).

In total population, the majority of patients had a CKD duration of <2 years (82, 64%), followed by 2–5 years (36, 28%), while only 10 (8%) patients had CKD for >5 years. The duration of hemodialysis among study population is documented, the majority of patients had been undergoing maintenance hemodialysis for <6 months (69, 54%), followed by 6–12 months (31, 24%), while 28 (22%) patients had been on hemodialysis for >12 months. The frequency of hemodialysis among study population, the majority of patients underwent maintenance hemodialysis three times per week (79, 61.7%), followed by two sessions per week (40, 31.2%), while only 9 (7%) patients received hemodialysis once weekly.

Among the total drug class distribution, the antibiotics were prescribed in 115 (89.8%), loop diuretics in 110 (85.9%), alkalinizing agents in 102 (79.6%), antihypertensives in 101 (78.9%), iron supplements in 97 (75.7%), vitamin D/calcium supplements in 95 (74.2%), erythropoietin in 65 (50.7%), phosphate binders in 69 (53.9%), antidiabetics in 50 (39%), and antiplatelets in 17 (13.2%). Among antibiotics, ceftriaxone was the most commonly prescribed in 93 (72.65%) patients. Among antihypertensives, cilnidipine was most frequently used in 70 (54.6%) patients, followed by prazosin in 13 (10.1%), metoprolol in 8 (6.25%), and clonidine in 7 (5.46%) patients. Insulin was the most commonly prescribed antidiabetic in 37 (28.90%) patients, followed by human mixtard in 11 (8.59%) and teneligliptin in 2 (1.56%) patients. Iron sucrose 49 (38.28%), iron folic acid 48 (37.5%), and erythropoietin 65 (50.78%) were commonly used for anemia management. Among phosphate binders, sevelamer carbonate was prescribed in 40 (31.25%) patients and sucroferric oxyhydroxide (Dynualta) in 29 (22.65%) patients. Clopidogrel was prescribed in 17 (13.28%) patients.

The prescribing indicators showed a high average number

of drugs per encounter (6.7), indicating polypharmacy. A majority of drugs were prescribed from the National List of Essential Medicines (71%), and 81% were prescribed by generic name, reflecting rational and cost-effective therapy. The percentage of encounters with injections was high (72%) due to the requirement for parenteral treatments. Additionally, antibiotics were prescribed in 87% of encounters, indicating frequent infection management (Table 3).

The association between selected clinical and lifestyle variables among CKD patients was analyzed using the Chi-square test. The findings revealed that there was no statistically significant association between gender and hemoglobin levels ($\chi^2 = 0.387$, $df = 3$, $p = 0.943$), indicating that anemia prevalence was similar across both males and females. Similarly, smoking status did not show a significant relationship with eGFR levels ($\chi^2 = 3.404$, $df = 2$, $p = 0.182$). However, a statistically significant association was observed between BMI and hypertension ($\chi^2 = 2.861$, $df = 3$, $p = 0.004$). CKD duration showed a significant association with anemia ($\chi^2 = 3.617$, $df = 2$, $p = 0.016$). Dialysis frequency was significantly associated with complications ($\chi^2 = 1.581$, $df = 2$, $p = 0.027$). Overall, the findings demonstrated a high burden of associated risk factors, comorbidities, and abnormal laboratory parameters among patients with chronic kidney disease undergoing maintenance hemodialysis and chronic liver disease, while the demographic characteristics, lifestyle factors, clinical profiles, and pharmacotherapeutic prescribing patterns collectively provide a comprehensive overview of the study population and establish the basis for subsequent discussion of their clinical implications.

Discussion

Kidney function declines irreversibly in chronic kidney disease (CKD), requires continuous medical care. According

to the current study, diabetes mellitus and hypertension are the two primary risk factors for CKD in patients receiving continuous haemodialysis. Cardiovascular illnesses and other comorbid problems worsen patient outcomes and lengthen the course of the illness. Electrolyte imbalances, fistulas, and anaemia are typical consequences that highlight the systemic character of CKD and its effects on several organ systems. These results emphasise the importance of early detection and effective management of modifiable risk factors to decrease the disease's course and reduce morbidity.

The age distribution in this cross-sectional observational study shows that CKD primarily affects middle-aged and older people, with the largest percentage of patients in the 50–59 age group (32%), followed by those in the 40–49 age group (24%) and the 60–69 age group (23%). This finding is in line with the progressive nature of CKD, in which long-term exposure to risk factors including diabetes mellitus and hypertension causes renal function to gradually decline over time. The comparatively smaller percentage of patients in younger age groups points to either delayed progression or early-stage illness. Higher mortality rates or a desire for conservative treatment may be the cause of the decline in the number of patients in the extremely elderly (>70 years). These findings are similar to Palikhey[1]et al., study.

Males were found to be significantly more prevalent (77%) than females (23%). This result is consistent with the Chakraborty[2]et al., study, and it may be because men are more likely to be exposed to lifestyle-related risk factors such alcohol and tobacco use, in addition to potential gender disparities in healthcare access and health-seeking behaviour. According to the BMI distribution, 60% of patients had a normal BMI, 26% were overweight, and 7% were both underweight and obese. According to risk factor analysis, smoking (15%) and alcohol intake (28%) were significant contributions, as was poor medication adherence (12%). This implies that although lifestyle factors play a part in the development of CKD, non-lifestyle factors like diabetes and hypertension are more important. These findings are consistent with the studies conducted by Kaur[9] et al., and Chen[10]et al., on risk factors in CKD patients.

The high prevalence of anaemia among CKD patients is a noteworthy finding of our investigation. 42% of patients had haemoglobin levels between 7 and 9.9 g/dl, whereas 35% had severe anaemia (below than 7 g/dl). This is in line with the pathophysiology of chronic kidney disease (CKD), where anaemia is caused by iron shortage, reduced erythropoietin production, and persistent inflammation. The need for efficient anaemia therapy is highlighted by the small proportion of patients with normal haemoglobin levels. Zhang[4]et al., investigation on the connection between anaemia and CKD reports similar findings.

The majority of patients had end-stage renal disease with eGFR values between 10–14 ml/min/1.73 m² (44%),

followed by 5–9 ml/min (34%) and <5 ml/min (22%). Serum creatinine values >6 mg/dl were also present in 63% of patients, indicating significant renal impairment. In a population receiving haemodialysis, these results are anticipated. According to a comorbidity analysis, the most common illnesses were diabetes mellitus (60%) and hypertension (87%). These are recognised as the main causes of CKD and play a major role in the illness's advancement. Shortness of breath (59%) was the most prevalent intradialytic consequence, followed by muscle cramps (23%), nausea and vomiting (19%), and headache (18%). Rapid fluid changes, electrolyte imbalances, and haemodynamic instability during dialysis sessions are probably the causes of these issues. Pedal oedema (34%), lower limb swelling (27%), and decreased urine output (22%) were all common interdialytic consequences, suggesting persistent fluid overload and insufficient clearance in between sessions. In accordance with normal treatment recommendations, the majority of patients (59%) received haemodialysis three times a week. These findings are consistent with Kaur[9]et al., study.

The present study highlights the complex pharmacotherapeutic management of patients with chronic kidney disease (CKD) undergoing maintenance haemodialysis, who frequently present with multiple comorbidities and complications. The high utilization of antibiotics (86.7%), loop diuretics (85.9%), alkalinizing agents (79.6%), and antihypertensive drugs (78.9%) reflects the need to manage infections, fluid overload, metabolic acidosis, and hypertension, respectively. Iron supplements (71%) and erythropoietin (53.1%) were commonly prescribed for CKD-associated anemia, while vitamin D, calcium supplements, and phosphate binders were used to manage CKD-mineral and bone disorder. The WHO prescribing indicators showed an average of 6.7 drugs per prescription, indicating polypharmacy, whereas the high use of generic drugs (81%) and medicines from the National List of Essential Medicines (71%) reflects rational prescribing practices. Statistical analysis revealed significant associations between BMI and hypertension, CKD duration and anemia, and dialysis frequency and complications, while gender and smoking showed no significant association with hemoglobin levels and eGFR, respectively. These findings, consistent with Palikhey[1] et al., emphasize the importance of early risk factor management, regular monitoring, and evidence-based pharmacotherapy to improve clinical outcomes and quality of life in maintenance haemodialysis patients.

Conclusion

The present study demonstrated that patients with chronic kidney disease undergoing maintenance haemodialysis have a high burden of comorbidities, complications, advanced renal impairment, and polypharmacy, with hypertension and diabetes mellitus being the predominant comorbidities, highlighting the complexity of disease management despite

largely rational pharmacotherapeutic prescribing practices. Early detection, effective management of risk factors, rational drug therapy, active involvement of clinical pharmacists, and a multidisciplinary approach are essential to improve clinical outcomes and enhance the quality of life of patients undergoing maintenance haemodialysis.

Conflict of Interest

The authors do not have any conflicts of interest.

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