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Evaluation of the medication prescribing trends for individuals with mild to severe chronic renal disease at a tertiary care hospital.

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BSTRACT

Introduction: Chronic kidney disease (CKD), which is marked by a gradual fall in glomerular filtration rate (GFR), is a significant global public health concern that is linked to high rates of morbidity and death.

Methodology: Prospective observational research was conducted for six months. 151 patients' demographics, risk factors, phases, GFR, and medication prescription patterns were gathered using a proforma that was specifically created for this purpose.

Results: 151 instances in all were evaluated for the research, with a prevalence of 28.3% female and 72.2% male. The WHO's drug prescribing indicators show that, on average, 12.45 percent of encounters were prescribed; 63.35% of drugs were prescribed by generic name; 86.75% of encounters involved the prescription of an antibiotic; 100% of encounters involved the prescription of an injection; and 73.9% of drugs came from the EML.

Conclusion: The study highlights the necessity of focused interventions in CKD patient prescription practices, with an emphasis on utilising cost-effective strategies and managing risk factors. Patient outcomes might be greatly enhanced, and healthcare expenses could be decreased by using customised prescription guidelines and continuous evaluation models.

Key words: Chronic kidney disease, glomerular filtration rate, risk factors, prescribing patterns.

INTRODUCTION

The kidneys are the primary organ responsible for preserving fluid and electrolyte equilibrium. They are also crucial in the metabolism of numerous medications. The removal of drugs by the kidneys and other pharmacokinetic processes related to drug disposition are impacted by chronic kidney disease (CKD).[1]

Classification:

CKD is categorized into three stages based on albuminuria level and five stages based on glomerular filtration rate (GFR), as illustrated in the tables below.

Table 1: Classification of Chronic Kidney Disease (CKD) according to GFR.

Stages	**GFR value ml/min/1.73m2**	**Risk**
Stage I	>90	Normal
Stage II	60-89	Mild
Stage III A	49-59	Mild to moderate
Stage III B	30-44	Moderate to severe
Stage IV	15-29	Severe
Stage V	<15	Fatal

Table 2: Classification of Chronic Kidney Disease according to Albuminuria, A/C ratio (albumin/creatinine ratio)

Category	**24-Hour Albuminuria mg/24 h**	**A/C ratio (Mg/g)**	**Classification**
A-1	<30	<30	Normal
A-2	30-300	30-300	Moderate
A-3	>300	>300	Severe

The staging system provided above assists healthcare providers in selecting the appropriate approach and level of patient monitoring for individuals with chronic kidney disease (CKD). Developing risk prediction tools based on this staging system can enhance risk assessment for individual patients. In evaluating prognosis, factors such as the underlying cause of kidney

disease, demographics (age, gender, race), cholesterol levels, smoking history, and others should also be considered alongside GFR and albuminuria levels. [2]

Risk factors:[3], [4]

Table 3: Classification of risk factors with examples

Risk Factors	Examples
Genetic & phenotypic factors	Older age
	Low birth weight
	Family history of kidney disease
Lifestyle factors	Smoking
	Obesity
	Alcohol consumption
Medical conditions	Hypertension
	Diabetes mellitus
	Exposure to heavy metals
	Use of analgesics
Other health conditions	Acute kidney injury
	Cardiovascular disease
	Hyperlipidemia
	Metabolic syndrome
	Hepatitis – c virus infection
	HIV infection
	Malignancy
Screening methods	Serum creatinine levels

Clinical Manifestations: Early stages of chronic kidney disease (CKD) typically lack noticeable symptoms, with manifestations usually appearing in stages 4 or 5. Detection commonly occurs through routine blood or urine testing. Symptoms and signs that may arise during these advanced stages of CKD include:

- Nausea.
- Vomiting.
- Loss of appetite.

- Fatigue and weakness.
- Disturbed sleep.
- Decreased mental acuity.
- Muscle twitches and cramps.
- Swelling in the feet and ankles.
- Persistent itching.
- Chest pain due to uremic pericarditis.
- Shortness of breath due to pulmonary edema from fluid accumulation.
- Difficult-to-control hypertension.

Physical examination may not yield definitive findings, but patients may exhibit:

- Skin pigmentation changes.
- Scratch marks from itching.
- Pericardial friction rubs from uremic pericarditis.
- Uremic frost, resulting from elevated BUN levels leading to urea in sweat.
- Hypertensive fundal changes indicating chronicity. [5]

Treatment:

Purpose of therapy

Treatment aims to slow down the course of CKD to reduce the onset or severity of related problems, such as cardiovascular disease. There are pharmacologic and nonpharmacologic therapies that can be used to reduce the incidence and prevalence of ESRD as well as delay the rate at which CKD progresses.

Pharmacologic therapy in addition to mild dietary protein restriction (as a nondrug therapy) is typically beneficial for patients with chronic kidney disease (CKD). The major goal of pharmacologic therapy is to manage the underlying diseases, such as diabetes mellitus and hypertension, that caused the kidney impairment to stop the kidneys from declining further in function. It is usually necessary for patients to receive a multimodality therapy strategy, regardless of the reason behind their renal disease. [6]

Drug dosing in CKD patients:

Medications requiring dose reductions are

-Antibiotics

-Direct oral anticoagulants

-Gabapentin and Pregabalin

-Oral hypoglycemic agents

-Insulin

-Chemotherapeutic agents

-Opiates. [7]

Drug Utilization studies:

Due to variances over time, among doctors, in various disease stages, and among populations, ongoing monitoring of medication use in chronic kidney disease (CKD) is crucial. Examining how drugs are used by people with chronic kidney disease (CKD) might offer light on prescription behavior, which is important because these patients need lifelong care.[8]

With more than a billion people living in India and an increasing CKD prevalence, the country's economy and healthcare system are expected to face difficulties. Therefore, it is essential to know the medication utilization patterns in persons with renal failure as to identify frequent comorbidities associated with CKD, understand current prescribing trends, and evaluate the long-term effects of these patterns on overall health outcomes. [9]

Drug Utilization Studies (DUS) are investigations conducted by the WHO to examine the many aspects of drug marketing, distribution, prescription, and consumption within a community. These studies focus on the resulting impacts on health, society, and the economy. Encouraging the prudent use of pharmaceuticals is the main goal of research on drug utilization. Comprehending the drug usage patterns of patients is imperative to enhance the quality of prescription procedures. Drug Utilization Study (DUR) is a sanctioned, methodical, continuous investigation of prescription prescribing, distribution, and consumption. Its main objective is to encourage the prudent use of pharmaceuticals, an essential component of institutional healthcare decision-making. The World Health Organization (WHO) estimates that CKD causes more than 850,000 deaths yearly. These individuals are more vulnerable to negative drug responses because of their restricted lifestyle and several prescription regimens.[10] Patients with chronic kidney disease (CKD) may have many concomitant conditions, including infections, DM, HTN, and CAD. They frequently need a wide range of prescriptions, some of which may have an impact on the development or reduction of renal function. Reasonably prescribing becomes difficult since patients with chronic kidney disease (CKD) require complex prescription regimens and frequent monitoring, which increases the risk of drug-related problems. When choosing drugs for CKD therapy, factors including cost, adherence, and effectiveness are carefully considered because these patients frequently experience polypharmacy and are more likely to experience adverse reactions and drug-drug interactions. Selecting the right medications is essential to minimizing side effects and achieving the best possible results for patients. Consequences, such as hypertension, anemia,

and cardiovascular problems, are needed for specialized care strategies. These can be difficult to control and further impair kidney function, which can negatively affect patients' quality of life. Examining existing prescribing procedures to CKD patients, proposing tactics to encourage prudent drug usage, decrease medication mistakes, and improve therapeutic results were the goals of this study. In addition to evaluating antihypertensive drug interactions and interactions with other medications, the study also sought to evaluate the average number of prescriptions written, the distribution of drug classes, the analysis of individual antihypertensive agents, the examination of monotherapy, dual therapy, multiple therapy, and combination therapy, the assessment of drug severity and side effects, and adverse drug reactions. Treatment recommendations for hypertension are many worldwide; the most recent JNC-VIII guideline suggests diuretics as first-line treatment. The more incidence of HTN and to long-term pharmaceutical usage make the accompanying treatment costs a major health economics concern.[8] Deficits in hypertension treatment may be found by looking at antihypertensive drug use patterns and evaluating blood pressure control in relation to current standards, which will eventually help lower mortality and morbidity. The use of antihypertensive medications in South India has not been extensively studied. Regularly carrying out Drug Utilization Studies (DUS) has several advantages. First, it offers a comprehensive picture of the real drug use trends for a particular illness over time within a particular demographic. Second, it helps identify excessive drug usage early on.[11]

WHO Prescribing Indicators:

1. Average number of drugs per encounter.
2. Percentage of drugs prescribed by generic name.
3. Percentage of encounters with an antibiotic prescribed.
4. Percentage of encounters with injections prescribed.
5. Percentage of drugs prescribed from essential drug list or formulary.[13]

I. Average number of drugs for encounter = total no of drugs/ total no of prescription

II. Percentage of drugs prescribed by generic name = no of drugs prescribed by generic name/ total no of prescription x 100

III. Percentage of encounter with an antibiotic prescribed = no of prescriptions by antibiotics / total no of prescription x 100

IV. Percentage of encounter with an injection prescribed = no of injections by prescriptions / total no of prescription X 100

V. Percentage of drug prescribed from the essential medication list of formularies (WHO

essential medicine list) = no of drugs prescribed from WHO EML / total no of drugs x 100.[14],[15]

Worldwide, delivery of healthcare is significantly reliant on medications. The public's trust in the healthcare system and the morale of medical staff are directly impacted by their availability. Fraser emphasizes that the prescribing of medications is viewed by patients and medical professionals as a critical result of doctor appointments. The quality of care given to patients and the community is reflected not just in the availability of pharmaceuticals but also in the way that they are prescribed. Medications used appropriately have the potential to drastically lower morbidity and death rates worldwide. Regretfully, WHO almost half of all medications were improperly given, filled; this problem is particularly common in the global South. Because a sizable amount of global healthcare spending is devoted to prescription drugs, this abuse has an impact on healthcare expenditures. Improving the way people use medications is seen to be a critical first step in making the most of the little health resources available and raising the standard of treatment. The World Health Organization (WHO) has been gathering and disseminating data on pharmaceutical consumption through its World Medicines Situation Reports since 1988 to highlight the significance of addressing medicine usage. Additionally, in the early 1990s, the WHO developed a collection of "essential use of drugs indicators." with INRUD. These metrics assess success in patient care, prescription processes, and aspects unique to the hospital. They function as unbiased metrics to characterize the state of drug use at different healthcare service levels. Reason for message is to give an idea of prescribing indicators, highlighting their importance, advantages, and disadvantages.[14]

A useful tool for assessing prescription behaviors in healthcare delivery systems is the prescribing indicator. Nevertheless, the comprehensiveness of prescriptions—which includes standard compliance and the inclusion of patient, medication, prescriber, and dispenser-related data—is not sufficiently evaluated by these basic indicators. To predict drug consumption trends to track and analyze drug utilization on, it is critical to routinely analyze the prescribing practices of healthcare facilities.[15]

ATC Classification of drugs:[12]

Currently, the most frequently accepted medication categorization system ATC, which has been approved by WHO. Drugs are grouped according to this system's therapeutic and chemical properties, as well as the organ or system they target. When researching drug use and categorizing pharmaceuticals according to their many uses, therapeutic qualities, and chemical and pharmacological characteristics, the ATC classification is quite helpful. A

concerted effort has been made to understand this complex categorization system. Gurulingappa et al. presented a novel approach that makes use of information extraction and machine learning approaches to investigate the ATC categorization system. Their methodology is restricted to the identification of medicinal compounds belonging to the 'Cardiovascular System' class, which is one of the 14 primary ATC classes. An opportunity to perform a thorough investigation of the ATC categorization system is presented by this abundance of data. With the goal of creating a reliable technique to identify drug compounds within all 14 potential main classes of the ATC classification system, the current study builds on the successes of using machine learning and data mining methods to address complex issues in various biological fields. First, to successfully train and evaluate the predictor, it is important to create or choose a legitimate benchmark dataset. Second, a mathematical expression precisely reflecting the samples' inherent correlation with the goal to be forecasted should be used to formulate them. Thirdly, to carry out the prediction process, a strong algorithm or engine must be created. Lastly, to assess the predictor's predicted accuracy with objectivity, cross-validation tests must be carried out. We'll go into more detail about each of these actions separately below. [16] A multitude of medical problems require the administration of several drugs to manage symptoms, prevent the progression of the disease, or prevent more illnesses. However, alongside their intended effects, drugs can also trigger sickness and mortality because of adverse drug responses or drug abuse. Adverse drug responses are defined by the World Health Organization (WHO) as "undesirable and unintended reactions to medications that typically occur at doses used for disease prevention, diagnosis, therapy, or modification of physiological functions in humans."(17)

Materials and Methods

Study site - General medicine wards within Sri Venkateswara Ramnarayan Ruia Government General Hospital (SVRRGGH)

Research methodology – Prospective observational research. Duration of study

- Six months {September 2023 – February 2024}

Research population - 151 participants

Study Materials:

1. Patient data collection form.
2. Consent form with informed consent.
3. WHO prescribing indicators.

Micromedex Drug Interactions Checker & Stockley’s drug interactions 12th edition.

4. **Inclusion criteria:** All patients diagnosed with CKD in General medicine wards of Sri Venkateswara Ramnarayan Ruia Government General Hospital. (SVRRGGH).

Exclusion criteria:

1. Patients below age of 18years.
2. Patients who declined participation.
3. Patients with psychiatric disorders.
4. Special populations such as pregnant or lactating women.
5. Cases involving tumours or trauma.
6. Surgical conditions like kidney stones and kidney transplants.
7. Exclusion of incomplete and illegible information

Method of data collection: Following approval from the educational institute Sri Padmavathi School of Pharmacy, individuals attending Sri Venkateswara Ramnarayan Ruia Government General Hospital. (SVRRGGH) and diagnosed with CKD were enrolled in the study upon providing written consent. The research was performed in the General Medicine wards of Ruia Hospital in Tirupati, following the acquisition of informed consent from patients. Individuals with CKD were identified, and their data was retrieved from patient case records.

The following information was gathered from the case records:

1. Patient demographics
2. Risk factors
3. Laboratory results
4. Prescribed medications

Prescribed drugs were categorized by ATC classification system and analyzed, then investigate prescribing trends in CKD patients, focusing on the following indicators:

1. The median number of medications per occurrence is calculated by dividing the total quantity of drugs by the total number of prescriptions.
2. The proportion of pharmaceuticals given by their common name is calculated by dividing the quantity of medications given by their common name by the overall number of prescriptions, and then multiplying the result by 10.
3. The proportion of encounters with a given antibiotic may be calculated by dividing the quantity of medications for antibiotics by the total quantity of prescriptions, and then multiplying the result by 100.
4. The proportion of encounters with a given injection is calculated by dividing the quantity of injections given by the total quantity of prescriptions, and then multiplying the result by 100.

5. The proportion of pharmaceuticals given from the WHO's Essential Medicine List, which is included in the formulary, may be calculated by dividing the quantity of medications given from the WHO EML with the total quantity of drugs and multiplying the result by 100.

Ethics Permission: The study was approved by institutional ethical committee with proposal no: SPSP/2023-2024/PD04

Statistical analysis: Microsoft Excel was also utilized, and results were presented through pie charts, bar graphs, column and tabular forms.

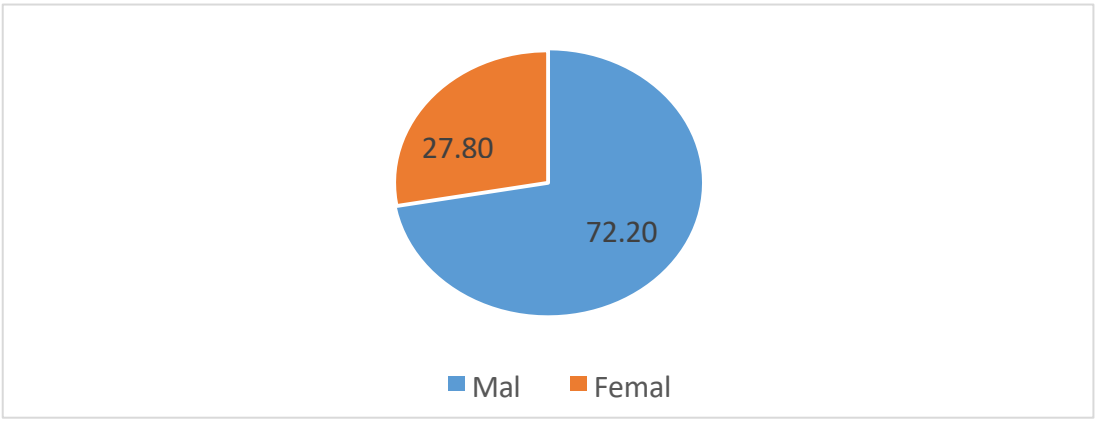
RESULTS

Among 151 case studies, the observed outcomes are as follows:

Gender wise distribution of CKD patients:

Table 4: Gender wise distribution of patients

Gender	No. of patients (n=151)	Percentage (%)
Males	109	72.2
Females	42	27.8



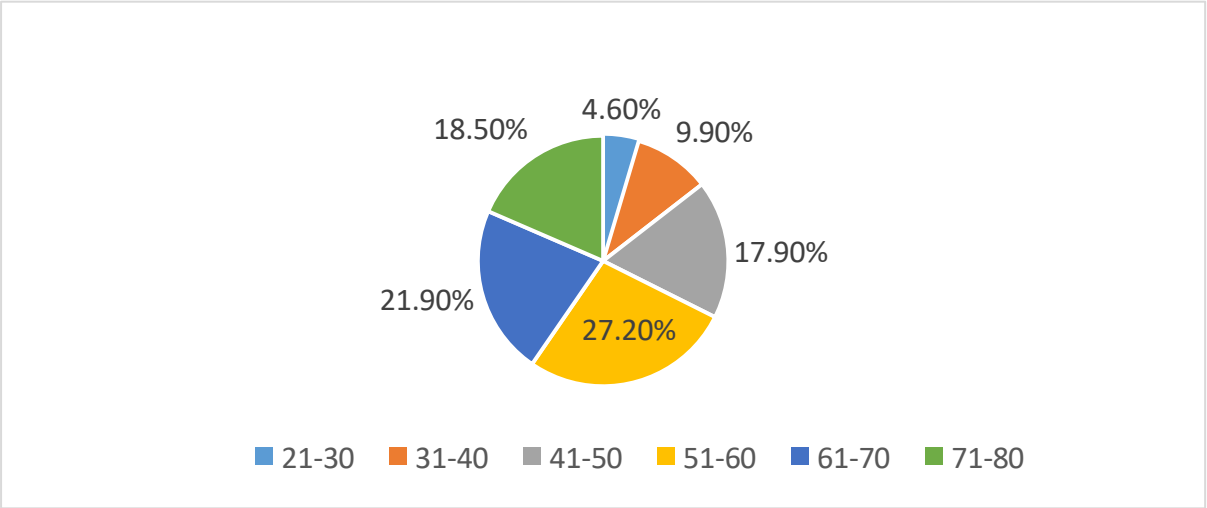
"Figure 1: Gender wise distribution of CKD patients"

Among the 151 patients, 72.2% are males while 27.8% are female.

Age wise distribution of CKD patients:

Table 5: Age wise distribution of patients

Age groups (years)	No. of patients (n=151)	Percentage (%)
21-30	07	4.6
31-40	15	9.9
41-50	27	17.9
51-60	41	27.2
61-70	33	21.9
71-80	28	18.5



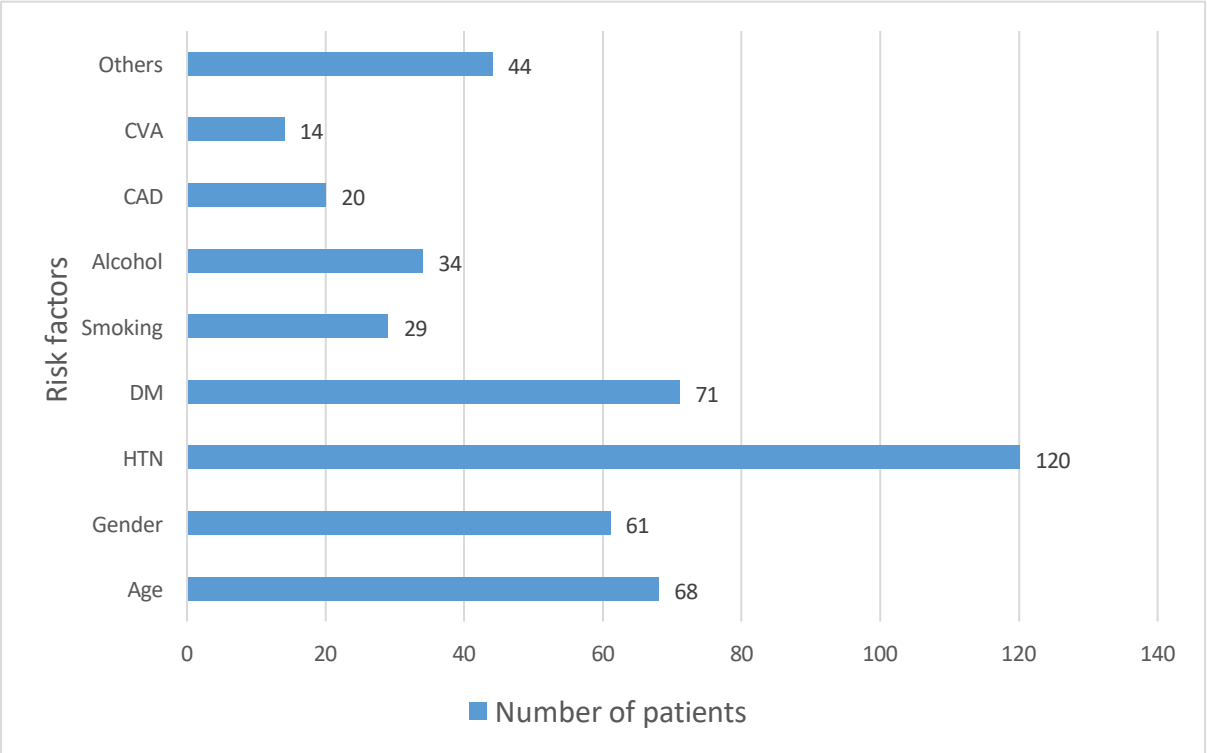
"Figure 2: Age wise distribution of CKD patients"

Among the 151 patients, the highest number of patients were under the age group of 51-60 years, accounting for 27.2% of the total. The next age category was 61-70 years, with 21.9%, followed by 71-80 with 18.5%, 41-50 with 17.9%, 31-40 with 9.9% and 21-30 with 4.6%.

Categorization of risk factors in the study population:

Table 6: Categorization of risk factors in patients

Risk factors	**Frequency**	**Percentage (%)**
Age	68	45
Gender	61	40.4
HTN	120	79.5
DM	71	47
Smoking	29	19.2
Alcohol	34	22.5
CAD	20	13.2
CVA	14	9.3
Others	44	29.1



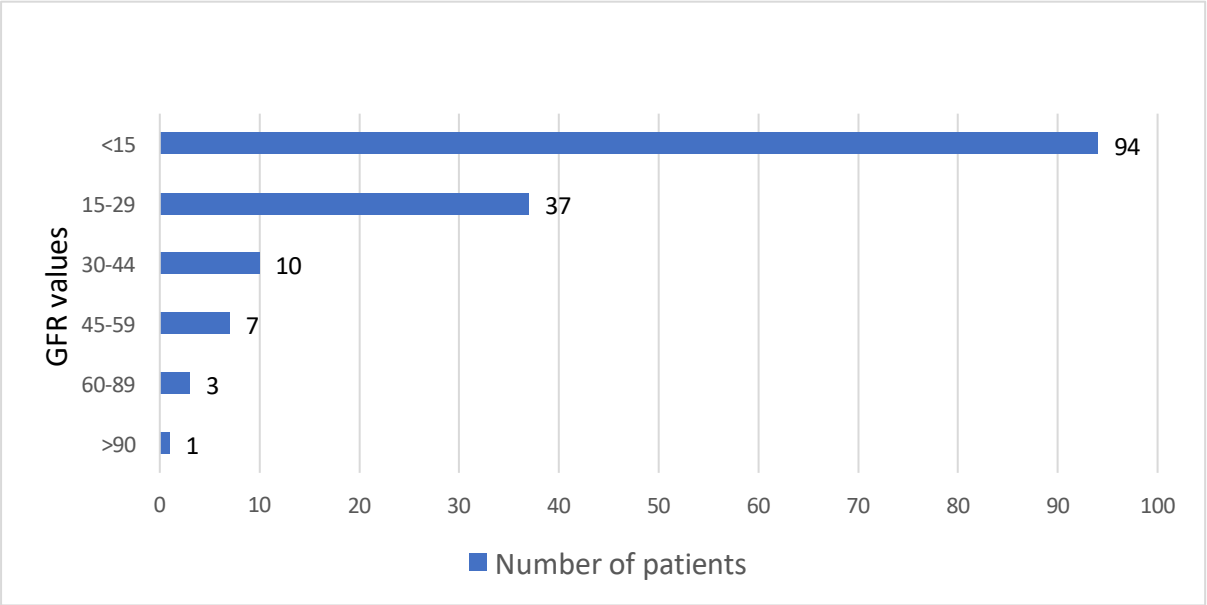
"Figure 3: Categorization of risk factors in CKD patients"

Among the 151 patients, the risk factor that affects the majority of patients is HTN (79.5%), followed by DM (47%), Age (45%), Gender (40.4%), others (29.1%), Alcohol (22.5%), Smoking (19.2%), CAD (13.2%) and CVA (9.3%).

Categorization of eGFR values in study populations:

Table 7: Classification of eGFR values

GFR values	Number of patients	Percentage (%)
>90	1	0.66
60-89	3	1.9
45-59	7	4.6
30-44	10	6.60
15-29	37	23.80
<15	94	62.30



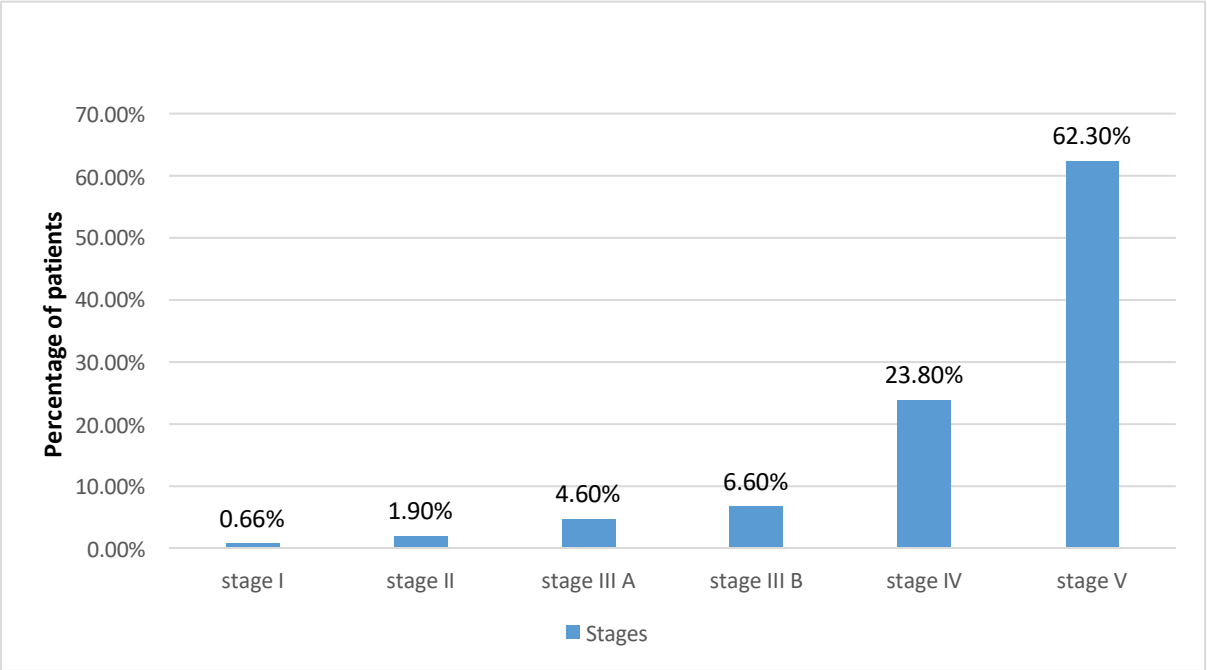
"Figure 4: eGFR values in CKD patients"

Among the 151 patients, the majority had eGFR value below 15, followed by 15-29, 30-44, 45-59, 60-89, and over 90, with 94, 37, 10, 7, 3, and 1 individual respectively.

Categorization of CKD patients based on stages:

Table 8: Stages of CKD in study population

Stage of disease	**No. of patients**	**Percentage (%)**
Stage I	1	0.66
Stage II	3	1.9
Stage III A	7	4.6
Stage III B	10	6.60
Stage IV	37	23.80
Stage V	94	62.30



"Figure 5: Stage of disease in study population"

Among the 151 patients, the largest proportion of patients were classified as stage V, followed by stage IV, III B, III A, II, and I, with percentages of 62.30% and 23.80%, respectively. The percentages are as follows: 6.60%, 4.6%, 1.9%, and 0.66% accordingly.

Categorization of drugs used in CKD patients:

Table 9: ATC Classification of drugs

ATC code	**Drug class**	**Number of drugs (n=1880)**	**Percentage (%)**
A	Alimentary tract and metabolism	662	35.21
B	Blood and blood forming agents	278	14.78
C	Cardiovascular system	426	22.65
D	Dermatologics	1	0.05
G	Genito urinary system and sex hormones	3	0.15
H	Systemic hormonal preparations	4	0.05
J	Anti-infectives for systemic use	236	12.55

L	Antineoplastic and immunomodulating agents	1	0.05
M	Musculoskeletal system	3	0.15
N	Nervous system	45	5.05
P	Antiparasitic products, insecticides, and repellents	6	0.31
R	Respiratory system	49	2.60
S	Sensory organs	0	0
V	Various	116	6.17

Based on the ATC categorization, medications belonging to the alimentary tract and metabolism class were the most highly recommended, accounting for 35.21% of the total. They were followed by cardiovascular compounds at 22.65% and blood formation agents at 14.78%, respectively.

Classification of drugs prescribed:

Table 10: Different groups of drugs prescribed

Drug class and ATC code	**No. of drugs (n=1880)**	**Percentage (%)**
Antihypertensive drugs	370	19.68
Diuretics - C03CA [Furosemide - C03CA01, spironolactone]	145	7.71
Beta Blockers - C07AB [Propranolol, metoprolol, atenolol - CO7AB03, labetalol - C07AG01, clonidine - CO2ACO]	80	2.65
ACE Inhibitors - C09AA [Enalapril - C09AA02]	7	0.37
Calcium channel blockers - C08CA [Amlodipine - COBCA01, nifedipine - COBCA05, cilnidipine]	114	6.06
Alpha Blockers - C02CA [Prazosin - C02CA01]	32	1.70
Angiotensin Receptor Blockers - C09CA	11	0.58

[Telmisartan - C09CA07]		
Miscellaneous	11	0.58
Drugs for GIT	142	7.55
Proton Pump Inhibitors - A02BC [Pantoprazole - A02BC02]	48	2.55
H2 Blockers - A02BA [Ranitidine - A02BA02]	94	5
Anti Diabetic drugs	77	4.09
Insulins - A10A	59	3.13
Oral Hypoglycemics - A10B [Metformin - A10BA02, glimepiride]	18	0.95
Haemopoietic drugs **[**Folic acid - B03BD01, Erythropoietin - B03XA01, Iron Sucrose]	199	10.58
Phosphate Binders [Sevelamer - V03AE02]	114	6.22
Calcium - A02AA04	6	0.31
Anti Platelet drugs - B01A3 [Clopidogrel - B01AC04, heparin - B01AB01]	65	3.45
Antibacterial - J01 [Ceftriaxone, metronidazole, cefotaxime, Cefsulbactum]	222	11.80
Anti Emetics [Ondansetron]	45	2.39
Vitamins and Minerals	204	10.85
Alkalinizing Agents	124	6.59
Analgesics	77	4.09
Others	298	12.65

In our study, a total of 1880 prescribed drugs were analyzed. Among these, the most frequently used medications were antihypertensives, accounting for 370 drugs (19.68%) sub categorizing mostly diuretics with 145 drugs (7.7%), calcium channel blockers with 114 drugs (6.06%). This was followed by antibacterial agents with 222

drugs (11.80%), vitamins and minerals with 204 drugs (10.85%), haemopoietic agents with 199 drugs (10.58%), secretory agents with 142 drugs (7.55%), alkalinizing agents with 124 drugs (6.59%), phosphate binders with 117 drugs (6.22%), antidiabetic drugs with 74 drugs (4.09%), analgesics with 77 drugs (4.09%), antiplatelet with 65 drugs (3.45%), and antiemetics is 45 drugs (2.39%).while the percentage of other medications is 12.65% (235).

Potential drug interactions in CKD patients:

Table 11: Severity of potential drug interactions in patients

Severity of drug interactions	No. of drug interactions in patients
Major	187
Moderate	153
Minor	28
None	46

Out of 151 patients, 368 potential drug interactions were identified and mostly were of major severity, followed by moderate, minor and some patients were found with no drug interactions i.e., 187, 153, 28 patients respectively.

Identified potential drug interactions:

Table 12: Major potential drug interactions

S. No	**Drug Interactions**	**Severity and Frequency (n)**	**Effect**
1	Furosemide x Insulin	Major (n=27)	Increased risk of hyperglycemia and increased insulin requirement.
2	Amlodipine x Clopidogrel	Major (n=24)	Reduced effectiveness of preventing platelet aggregation and heightened likelihood of thrombotic events.
3	Clopidogrel x Aspirin	Major (n=21)	Increased risk of bleeding.
4	Furosemide x Aspirin	Major (n=20)	Increased risk of salicylate toxicity and decreased diuretic effectiveness and possible nephrotoxicity.
5	Metronidazole x Ondansetron	Major (n=9)	Increase the risk of irregular heart rhythm.

6	Enalapril x Furosemide	Major (n=7)	Increased risk of salicylate toxicity and decreased diuretic effectiveness and possible nephrotoxicity.
7	Ranitidine x Tramadol	Major (n=6)	Increased risk of tramadol exposure and increased risk of respiratory depression.
8	Azithromycin x Ondansetron	Major (n=5)	Increased risk of QT interval prolongation.
9	Aspirin x Heparin	Major (n=4)	Increased risk of bleeding.
10	Azithromycin x Metronidazole	Major (n=3)	Increase the risk of irregular heart rhythm.
11	Furosemide x Glimepiride	Major (n=3)	Increased risk of hyperglycemia and increased insulin requirement.

Table 13: Moderate potential drug interactions

S. No	**Drug Interaction**	**Severity and Frequency (n)**	**Effect**
1	Atorvastatin x Clopidogrel	Moderate (n=30)	Decreased formation of clopidogrel active metabolite resulting in high on treatment platelet reactivity.
2	Iron sucrose x Pantoprazole	Moderate (n=11)	Decreased iron bioavailability.
3	Telmisartan x Furosemide	Moderate (n=9)	Severe hypotension and deterioration in renal function including renal failure.
4	Metoprolol x Prazosin	Moderate (n=7)	Exaggerated hypotensive response to first dose of alpha blockers.
5	Aspirin x Metoprolol	Moderate (n=6)	Decreased anti-hypertensive effect.
6	Amlodipine x Metformin	Moderate (n=4)	Decrease the effect of metformin by pharmacodynamic antagonism.
7	Furosemide x Hydrocortisone	Moderate (n=4)	May result in hypokalemia.

8	Aspirin x Insulin	Moderate (n=4)	Increased risk of hypoglycemia.
9	Atorvastatin x Azithromycin	Moderate (n=3)	Increased risk of rhabdomyolysis.
10	Furosemide x Metformin	Moderate (n=3)	Increased risk of hyperglycemia and potential loss of glycemic control.

Table 14: Minor potential drug interactions

S. No	**Drug Interactions**	**Severity and Frequency (n)**	**Effect**
1	Aspirin x Ranitidine	Minor (n=9)	Ranitidine reduces anti platelet effect of aspirin.
2	Calcium gluconate x Iron sucrose	Minor (n=7)	Decreased iron effectiveness.
3	Iron sucrose x Sodium bicarbonate	Minor (n=4)	Decreased absorption and efficacy of iron sucrose.
4	Furosemide x Sucralfate	Minor (n=3)	Decreases the effect of sucralfate.
5	Insulin x Metformin	Minor (n=3)	Increased risk of hypoglycemia.

Among 368 identified potential drug interactions,

- The most predominant major potential drug interaction was observed between Furosemide x Insulin (n=27).
- Atorvastatin x Clopidogrel (n=30) was highly observed among moderate potential drug interactions.
- The minor potential drug interaction was mostly observed between Ranitidine x Aspirin (n=9).

Who prescribing indicators:

Table 15: WHO prescribing indicators

WHO prescribing indicators	**Report**
Average number of drugs per encounter	12.45
Percentage of drugs prescribed by Generic name	63.35%
Percentage of encounters with an antibiotic prescribed	86.75%
Percentage of encounters with injections prescribed	100%

Percentage of drugs prescribed from essential drugs list or formulary	73.9%

The WHO indicators reveal that the average number of drugs per encounter is 12.45. Additionally, 63.35% of drugs are prescribed using their generic names, 86.75% of encounters involve the prescription of antibiotics, and 100% of encounters involve the prescription of injections. Furthermore, 73.9% of drugs prescribed are from the essential medication list.

DISCUSSION:

The examination of medication prescription patterns for patients with mild to severe chronic renal disease was the focus of the current investigation. The eGFR, stages of CKD, risk factors, and demographics of 151 individuals were evaluated.

In terms of gender, men (72.7%) were found to be much more impacted than women (27-8%) in the study population. These findings align with the study done by Atray P et al., which revealed that 77.5% of the participants were male and 22.5% were female. Other studies that supported similar findings included Kamath L et al.,[11], Sujana CN et al.,[30], Tauro MC et al.,[38] and Rakshana S et al. [39] The significance of sex hormone in the illness's progression might account for the greater frequency of renal failure seen in male individuals. Studies conducted on animals in vitro revealed that estrogen has a protective effect on the kidney damage process, whereas testosterone has a detrimental effect. Research conducted on humans in vitro has demonstrated that testosterone can trigger the death of kidney proximal tubular cells. However, as compared to females, guys often consume more calories and protein. Increased consumption of protein is linked to the development and advancement of renal disorders. The participants in this study had ages ranging from 21 to 80 years, with an average age of 50.5 years, excluding those beyond the upper age limit The majority of those afflicted were in the 51–60 age range (27.2%), which is in contrast to the findings of the studies by Tauro MC et al.,[38]and Rakshana S et al.,[39] and Mohammed M et al. [15] Increases in the primary risk factors, such as diabetes mellitus, hypertension, and cardiovascular illnesses, cause CKD to grow with age.

According to the current study, the most common risk factors for CKD are HTN (79.5%) and DM (47%) which is similar to the findings of the study by Sujana CN et al., Other studies that supported these findings included Tauro MC et al,[38] Rakshana s et al.,[39], Atray et al.,[9], Kamath L et al.,[11], Mamadirk et al.,[32], Singh AK, Andrews AM[1], and Oommen JM et al.,[34].

Based on the study's eGFR levels, CKD was staged. Rakshana S et al [39],Sunil Dattu et al., Tauro MC et al.,[38], Andrews AM et al.,[1],and Rinku Joshi et al.,[26] also corroborated the same conclusions. This was in opposition to the study of Kamath L. et al.,[11], which found that most patients fall into stage 4.

Our analysis revealed the most interactions from significant, followed by moderate, and finally mild, based on a severity rating. This finding was consistent with a study by Andrews AM et al.,[1], which confirms our study's finding that the most medicines were involved. Major DDI interactions were 16.67%. In contrast to the findings of the research by Atray P et al.,[9], and Rama M et al., which indicated that mild and severe DDI were followed by the greatest number of moderate DDI. This was most effectively explained using polypharmacy. Prescriptions of five or more drugs to a single patient at a time is known as polypharmacy. Nonetheless, it is a well-known fact that using over-the-counter medications increases the risk of DI.

ATC's classification showed that the most highly recommended class of medications was composed of those from the alimentary tract and metabolic tract (35.21%), followed by cardiovascular (22.65%) and blood-forming agents (14.78%). This study is supported by the results of studies by Bajait et al.,[22], which reported on the relationship between the gastrointestinal tract and metabolism class (45%), cardiovascular (23%), and blood forming agents (21%) and by Kanani et al.,[21], which reported on the same subjects. This contrasts with research by Kamath L et al.,[11], that found that the most prevalent class of medications was the cardiovascular class, with 43.8% of the total. prescribed family of medications, as well as findings from Atray et al.,'s research Highly suggested were blood-forming agents (20.15%), cardiovascular agents (19.08%), and the alimentary tract and metabolism class (17.94%). correspondingly.

Out of total no of drugs 1880 ,most commonly prescribed class of drugs in our study was found to be antihypertensives (19.68%),followed by antibacterial agents (11.80%),vitamins and minerals (10.85%),which was in consistent with the studies such as Atray et al[9], Shastry C S et al[41], Tauro et al.,[38], Oommen JM et al., [34], that antihypertensive class of drugs were most commonly prescribed drugs .This is because a larger percentage of individuals with CKD stage 5 were included in our research. Diuretics accounted for most prescriptions among the antihypertensive class of drugs, followed by calcium channel blockers (6.06%), beta blockers (2.65%), alpha blockers (1.7%), ARBs (0.58%), and ACEs (0.37%). These results are consistent with studies conducted in tertiary care hospitals by Ahlawat et al [24], Kanani et al [21], Bajait et al.,[22], Ommen et al.,[34], Tauro et al.,[38], and Shamkuwar AC et al.

Most patients took diuretics often, particularly loop diuretics like the furosemide family of medications (7.71%), which is consistent with the findings of Ahlawat et al.,[24], Ommen et al.,[34], and Andrews AM et al.,[1], which validates our study. It helps patients with remaining renal function because it lowers the patient's mortality rate. The least prescribed antihypertensive medication class in our analysis was ACEIs (0.37%) followed by ARBs (0.58%), which is in line with a study by Prasad N et al.,[31]. The progression of the CKD phases is to blame for this.

Insulin (3.13%) was the most often given antidiabetic medication, followed by oral hypoglycemic medications (0.05%). This is consistent with research by Ommenet al [34], Zaman Huri M et al, Rakshana S et al [39], and Bajait et al [22], which found that insulin was administered more frequently than oral hypoglycemic agents. Our findings disagreed with research conducted by N Prasad et al.,[31], Tauro et al.,[38], and Alramahi p et al.,[23].

H2 blockers (5% of the antisecretory medication class) were used more frequently than PPI (2.55%), which is similar with the research by Oommen et al.,[34], that confirms our findings.

In related research, the most often prescribed hemopoietin agent was erythropoietin (3.82%), which was followed by folic acid (3.4%) and iron sucrose (3.35%). This runs concurrently with Sujana et al.,[30], investigation. This was best explained by the fact that most CKD patients have lost kidney structural integrity, which results in a deficiency of EPO, which causes the patient to become anemic. Erythropoietin is therefore advised. In research conducted concurrently with Sujana et al [30], the most given hemopoietin agent was erythropoietin (3.82%), followed by folic acid (3.4%) and iron sucrose (3.35%). This was best explained by the fact that most CKD patients have lost kidney structural integrity, which results in a deficiency of EPO, which causes the patient to become anemic. Erythropoietin is therefore advised.

Phosphate binders make up 6.22% of all prescription medications. Among PBs, sevelamer (5.9%) was given more frequently than calcium carbonate (0.31%), which is at odds with research by Bajait et al.,[22] and N Prasad et al.,[31].

The average number of prescription medications prescribed prior to prescription in our study was 12.45%, in accordance with WHO prescribing standards. This figure is much more than that reported by Devi et al (7.4%) [36], Bajait (9.4%)[22],Kanani et al (9.35%)[21], Rakshana et al (7.2%)[39],Ahlawat (6.5%)[24],and Kamath et al (5.13%)[11].The size of the research population and the prescribing habits of physicians might be the cause of this variation in the average number of medicines.

The proportion of medications administered by generic name in the current study was 1191 (63.35%), which was comparable to the study done by Kanani et al.,[21] (64%).However, it is more than the findings of the research done by Chawla 24 (34%), Atray 32 (1.9%), Shastry CS et al[41](8.7%), Bajait et al. (16), and Ahlawat et al.[9]. Many national and international organizations constantly advise doctors to prescribe medications under their generic names to encourage the responsible use of medications. The reason for the larger number of prescriptions including antibiotics (86.75%) compared to the studies by C.S. Shastry et al.,[41] (3.9%) and Rakshana et al.,[39]. (64%), is that medicines help the study population avoid illnesses connected to access.

The proportion of injections administered out of the total 1880 medicines prescribed was 100%. This is higher than the percentages reported in the research by C.S. Shastry et al.,[41] (56.26%), Devi et al.,[36] (32%), Kamath et al.,[11] (16.6%), and Atray et al.,[9] (9.7%).

The medication that the EML recommended was found to be 73.9% in our study, which is higher than the results of studies by Kamath L et al.,[11] (65.8%), Devi et al[36] (53%), Bajait et al. (52%), Atray et al.,[9] (44%), but lower than the findings of studies by Kanani et al.,[21] (76.6%), Ahlawat et al..[24] (80%). This shows that the key medication list in our setup is being followed to a decent degree.

CONCLUSION:

The kidneys maintain fluid, electrolyte balance, and metabolize medications, but chronic kidney disease (CKD) impairs drug elimination and alters pharmacokinetics. CKD is marked by irreversible changes in kidney function or structure, progressing gradually over time.

This study outlines the way medical professionals regularly prescribe to individuals with renal failure admitted to hospital. Most of the patients who were hospitalized had stage 5 CKD and associated risk factors such cardiovascular disease, diabetes mellitus, and hypertension. Early management of these causative variables can reduce CKD-related morbidity and death.

The average number of medications used per patient makes sense because there are several contributing factors and risk factors, and polypharmacy is unavoidable.

The study lists the different types of medications that are administered to people with renal failure, highlighting the high proportion of sickness in this population. To improve the general health of CKD individuals, there is a need for the establishment of sustainable methods for implementation and general dissemination of evidence-based guidelines. Essential medication list improves rational of drugs.

Recommendations of our study:

It suggests a paradigm for ongoing assessment of prescriptions in medical facilities.

The study makes recommendations for possible improvements to prescription regimens designed especially for those with CKD.

- Promoting the usage of medications on the list of necessary medications.
- Essential medications are thought to be more economical.
- Encouraging the usage of generic medications.
- Generic medications are less expensive and have similar efficacy.
- Makes necessary drugs easier to get.
-Lessens the cost of healthcare for both patients and providers.
- Establishes uniform prescription procedures.
- May lessen misunderstandings and mistakes made when administering medications.

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