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(RESEARCH ARTICLE)

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Prescription patterns and utilization of SGLT2 inhibitors in patients with Chronic Kidney Disease (CKD) and comorbidities in secondary care hospitals

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Abstract

Patients with chronic kidney disease (CKD), particularly those with co-morbid type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD), now have an important therapeutic option in the form of sodium-glucose co-transporter-2 (SGLT2) inhibitors. Realworld prescription patterns, adherence to clinical guidelines, and the impact of these inhibitors on patient outcomes remain understudied, particularly in secondary care setting, despite their demonstrated efficacy in improving renal and cardiovascular outcomes.

The study was conducted to examine how SGLT2 inhibitors were prescribed and what actual results were observed in patients with chronic kidney disease, type 2 diabetes, and cardiovascular disease. Data was acquired from the electronic health records (EHRs) of patients who were treated in secondary care hospitals, with a focus on demographic, clinical, and laboratory information. The examination of prescription trends has shown a gradual rise in the utilization of SGLT2 inhibitors among CKD patients with both T2DM and CVD in the last six months.

This increase has been particularly notable after the updated clinical guidelines highlighted their advantages for renal and cardiovascular health. From the data, the majority of patients were found to be prescribed SGLT2 inhibitors in line with the eGFR thresholds advised by present clinical guidelines. Nonetheless, discrepancies were observed in prescription practices, specifically within older populations and individuals with severely impaired renal function. This group tended to opt for alternatives like ACE inhibitors and ARBs more frequently.

Keywords: Chronic Kidney Disease; Diabetes Mellitus; Cardio Vascular disease; Prescription

1. Introduction

Chronic kidney Disease (CKD) is a developing worldwide wellbeing concern, influencing roughly 10% of the grown-up populace around the world. CKD is portrayed by a progressive loss of kidney capability, prompting the collection of side-effects, electrolyte uneven characters, and possible end-stage renal sickness (ESRD). The administration of CKD is perplexing, requiring a multi-layered approach that tends to the hidden kidney illness as well as the related co-morbidities, like diabetes, hypertension, and cardiovascular sickness.

Chronic kidney Disease (CKD) is a complicated and complex condition that influences a great many individuals around the world. It is portrayed by a progressive loss of kidney capability, prompting the collection of side-effects, electrolyte uneven characters, and possible end-stage renal sickness (ESRD). CKD is frequently joined by co-morbidities like diabetes, hypertension, and cardiovascular illness, which can additionally confuse sickness the executives [1, 2].

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The administration of CKD requires an extensive methodology that tends to the basic kidney infection as well as the related co-morbidities. Flow treatment methodologies center around easing back infection movement, overseeing side effects, and diminishing the gamble of cardiovascular occasions. In any case, regardless of these endeavours, CKD stays a main source of grimness and mortality worldwide. Sodium-glucose co-transporter 2 (SGLT2) inhibitors are a generally new class of meds that have arisen as a promising treatment choice for CKD patients. At first created for the treatment of type 2 diabetes, SGLT2 inhibitors have been displayed to have helpful impacts past glycemic control, including:

- Blood pressure reduction
- Weight loss
- Cardiovascular risk reduction
- Slowing of CKD progression

CKD is described by a slow loss of kidney capability, prompting the collection of sideeffects, electrolyte uneven characters, and inevitable end-stage renal sickness (ESRD). The movement of CKD is frequently joined by co-morbidities [3, 4, 5]

Such as:

- Diabetes
- Hypertension
- Cardiovascular disease
- Anaemia
- Mineral and bone disorders

The administration of CKD requires an extensive methodology that tends to the fundamental kidney sickness as well as the related co-morbidities.

Current treatment methodologies centeraround:

- Slowing disease progression
- Managing symptoms
- Reducing cardiovascular risk
- Improving quality of life

The National Kidney Foundation's (NKF) definition of CKD is essential for managing the condition. An educated translation regarding the assessed glomerular filtration rate (eGFR) is expected, since the GFR is as yet thought to be the best generally list of kidney capability in stable, non-hospitalized patients. Kidney harm is characterized by any of the accompanying discoveries

- Pathologic kidney anomalies
- Chronic proteinuria
- renal hematuria
- Imaging irregularities

An eGFR of less than 60 mL/min/1.73 m2 on two separate occasions over a period of less than 90 days that is unrelated to a temporary, reversible condition like volume depletion[6]

People with CKD have altogether higher paces of grimness, mortality, hospitalizations, and medical care usage. The commonness of CKD Stages 2-5 has kept on expanding beginning around 1988 as have the prevalence's of diabetes and hypertension, which are separately etiologic in roughly 40% and 25% of CKD cases.

The ongoing appraisal is that 26 million US people >20 years old have CKD. However, the most recent estimate of the prevalence of CKD is 15.2%, which is lower than the 15.9% reported in the NHANES data collected from 1999 to 2002. This estimate is based on data from 2003 to 2006 for adults in the United States under the age of 20. This diminishing was reflected in CKD Stage 1 as Stage 3 expanded to 6.5% from 2003-2006. The commonness of CKD Stages 4 and 5 has multiplied starting around 1988-1999, yet has stayed stable starting around 2002 at 0.6%.

CKD stage pervasiveness from 2003-2006 by the CKD condition are

- Stage 1- 4.1%
- Stage 2 - 3.2%
- Stage 3 - 6.5%
- Stages 4 and 5 consolidated - 0.6%

Delineated by age, all CKD stages were more pervasive in people matured ≥60 Yrs. (39.4%) than in those matured 40-59 Yrs. (12.6%) or 20–39 Yrs. (8.5%). By instructive level, CKD at any stage was more pervasive among people with under a secondary school training (22.1%) than in people with essentially a secondary school schooling (15.7%). CKD commonness was more noteworthy among non-Hispanic blacks (15.6%), non-Hispanic whites (14.5%), and among different identities (13.1%).

The prevalence's of diabetes and HTN in African Americans with CKD were 60.6% and 96%, separately, contrasted with Caucasian prevalences of 45.7% and 90.7%, separately (US Renal Information Review, 2010). In addition, the prevalence of CKD was higher in diabetics than in non-diabetics (40.2% vs. 15.4%), in people who had cardiovascular disease (CVD) than in people who didn't (28.2% vs. 15.4%), and in people who had than in people who didn't (24.6% vs. 12.5%).

ESRD is expected to cost $28 billion in 2010 and $54 billion by 2020, according to estimates. The prevalence of ESRD was higher in the fourth quarter of 2009 (N=572,569, including patients who had kidney transplants) than it was in 2005 (N=485,012). With regards to occurrence or recently started ESRD patients, diabetes was etiologic in 37.5%, HTN 24.4%, glomerulonephritis 14.8%, cystic illness 4.7%, and others 18.6%. African American patients are 3.7 times more defenceless for advancement of ESRD, and Local Americans and Asians are 1.9-and 1.3 times bound to foster ESRD [7, 8, 9].

1.1. Plan of study

The proposed study was planned to be carried out under 9 phases.

- Literature Review and Background Research
- Design and approval for the study
- Data Gathering
- Information Analysis
- Evaluation of Prescription-Influencing Factors
- Compare to Other Treatments
- Description of the Findings
- Suggestions and Reporting
- Dissemination of the Results

2. Methodology

Study site: Secondary care hospitals will host this retrospective observational study. Patients with chronic kidney disease (CKD) who were prescribed Sodium-Glucose Co-Transporter-2 (SGLT2) inhibitors will be examined in the study. Prescription patterns, adherence to clinical guidelines, and therapeutic outcomes in patients with chronic kidney disease (CKD) and comorbidities like type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) will be the primary focus of the study.

"Electronic Health Records" (EHRs) - EHR systems will be used to extract data from patient records and databases at hospitals. Demographic information, clinical history, and prescription details will all be recorded.

Clinical Laboratory Data- Laboratory records will be used to collect data on renal function, such as eGFR and the urinary albumin-to-creatinine ratio (UACR), glycemic control, such as HbA1c, and cardiovascular markers, such as lipid profile and blood pressure.

Study design: Prospective observational study

Study period: 6 Months.

3. Results

3.1. Total no: of patients with age wise distribution

Table 2 Number of Patients with Age wise Distribution

Sr. No	number of patients	age
1.	20	41
2.	35	42
3.	45	44
4.	55	45
5.	60	46
6.	78	47
7.	85	48
8.	122	49

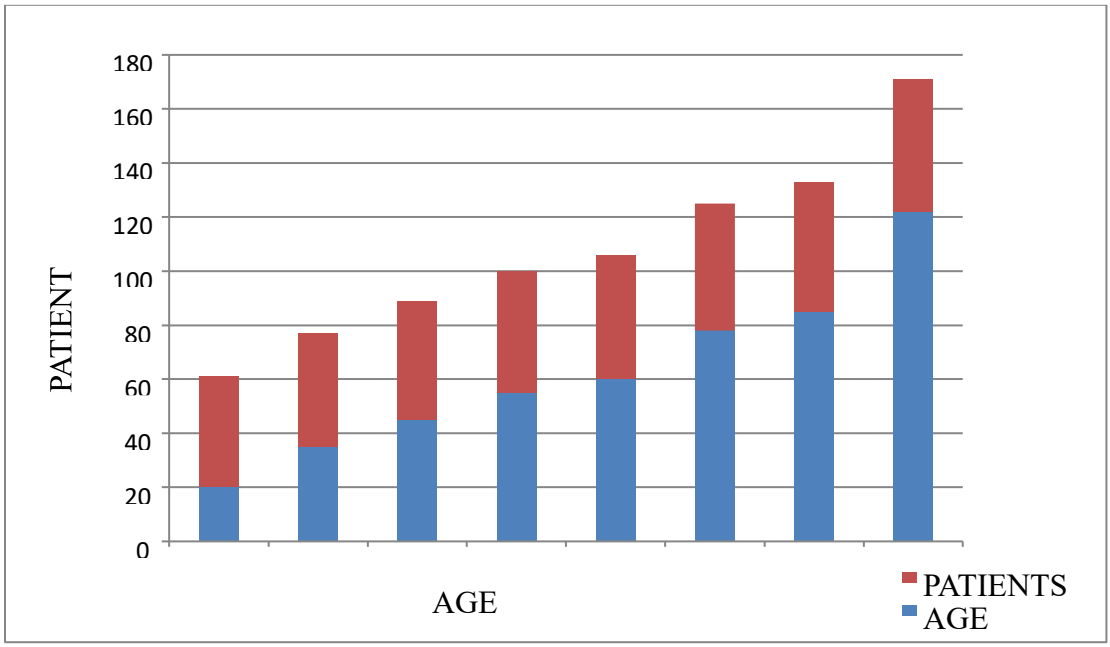


Figure 1 Illustrate Total Number of Patients with Age wise Distribution

The study results shows that 500 No's of Patients with different Age taken in the Secondary Care Hospital.

3.2. Gender wise distribution

Table 3 Gender wise Distribution

S.No	Sex	no of patients
1.	Male	245
2.	Female	255
	Total	500

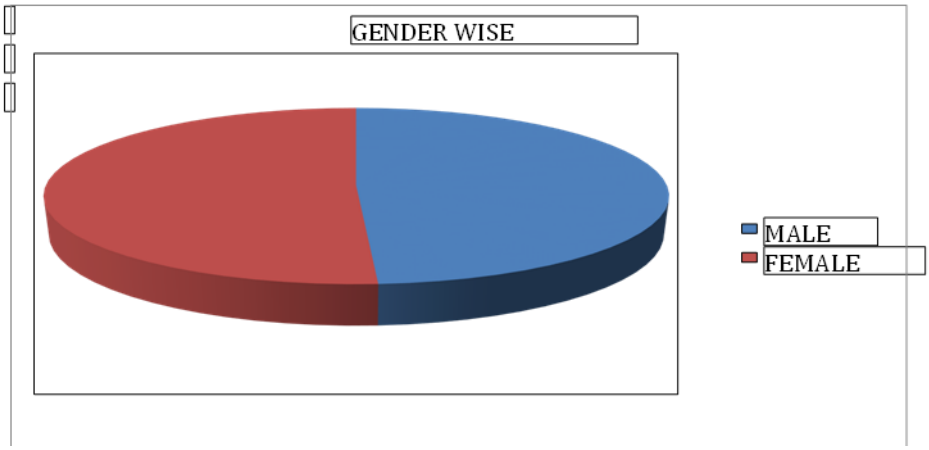


Figure 2 Illustrate Total Number of Patients with Gender wise Distribution

Results: 500 No's of Patients with Gender wise taken in the Secondary Care Hospital.

3.3. Prescription of CKD patient

3.3.1. Initial treatment stage of prescription

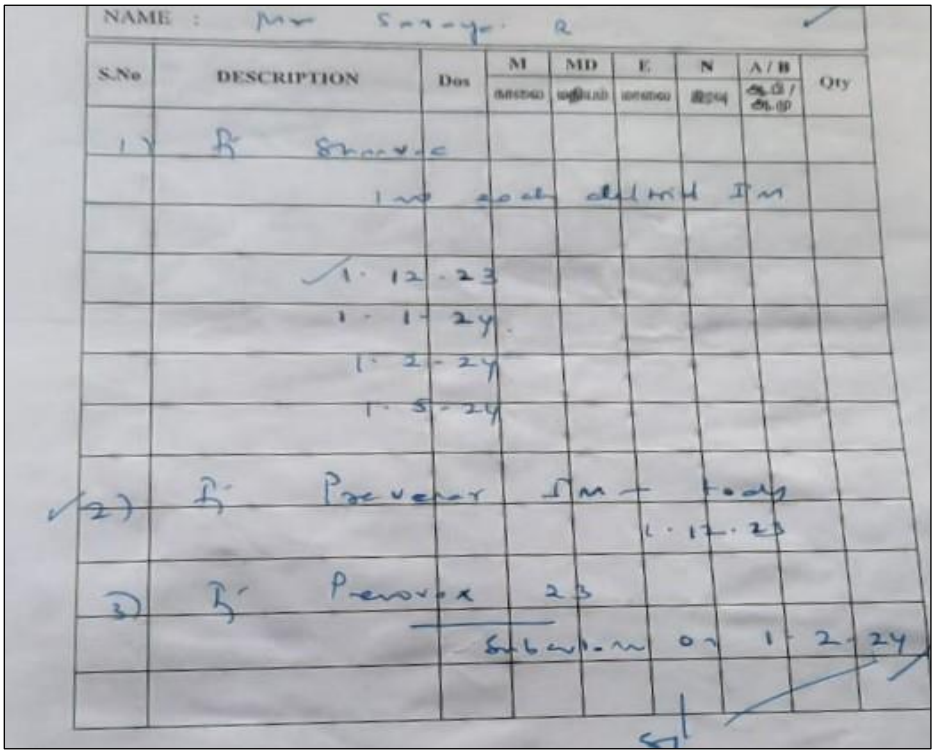
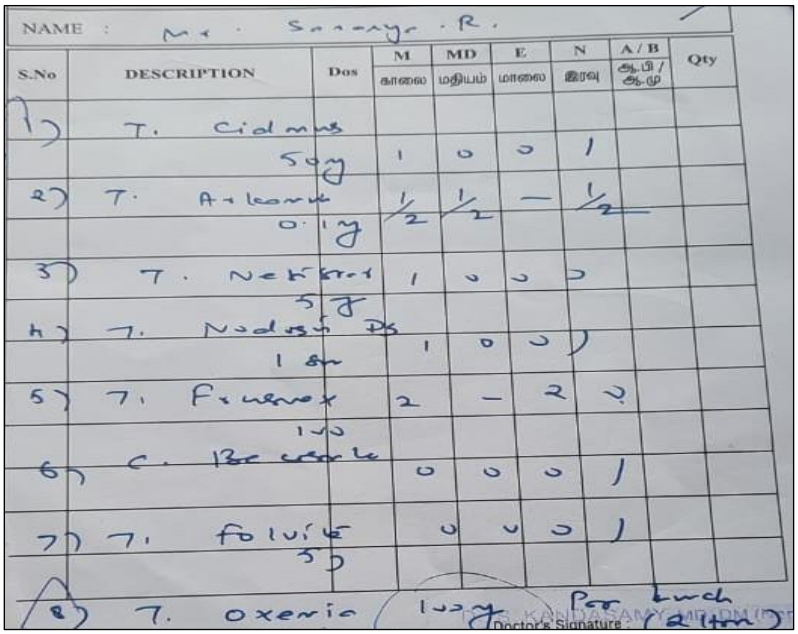


Figure 3 Prescription of CKD Patient - Initial

3.4. Intermediate treatment stage of prescription



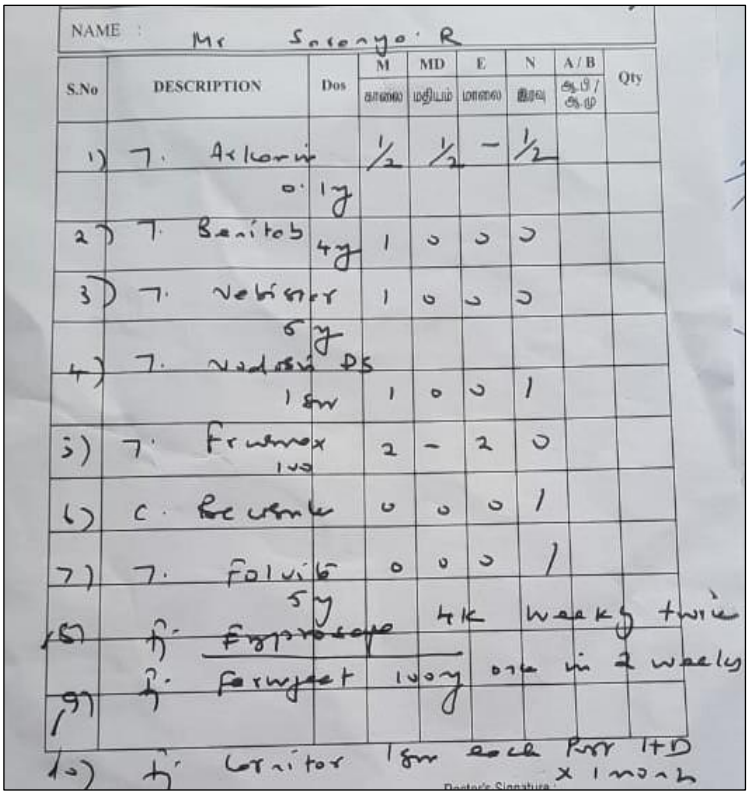
NAME : Mr. Saranya. R.

S.No	DESCRIPTION	Dos	M காலை	MD மதியம்	E மாலை	N இரவு	A / B ஆ.பி / ஆ.மு	Qty
1)	T. Cidmus 50mg		1	0	0	1		
2)	T. Arkamin 0.1mg		½	½	—	½		
3)	T. Nebistar 5mg		1	0	0	0		
4)	T. Nadosh DS 1 Sw		1	0	0	1		
5)	T. Frumenox 1vd		2	—	2	0		
6)	C. Becosule		0	0	0	1		
7)	T. folvite 5mg		0	0	0	1		
8)	T. Oxenia	1vd					Pre lunch	

Doctor's Signature

Figure 4 Prescription of CKD Patient – Intermediate

3.5. Final stage treatment of prescription



NAME : Mr Saranya. R

S.No	DESCRIPTION	Dos	M காலை	MD மதியம்	E மாலை	N இரவு	A / B ஆ.பி / ஆ.மு	Qty
1)	T. Arkamin 0.1mg		½	½	—	½		
2)	T. Benitab 4mg		1	0	0	0		
3)	T. Nebistar 5mg		1	0	0	0		
4)	T. Nadosh DS 1 Sw		1	0	0	1		
5)	T. Frumenox 1vd		2	—	2	0		
6)	C. Becosule		0	0	0	1		
7)	T. folvite 5mg		0	0	0	1		
8)	T. Erythrocap		4K	weekly twice				
9)	T. Forwgeat	1vd	one in 2 weekly					
10)	T. Lornitor	1Sw	each Pkt 1+D x 1 month					

Doctor's Signature

Figure 5 Prescription of CKD Patient - Final

4. Data analysis report

Prescription Patterns and Outcomes of SGLT2 Inhibitors in CKD Patients with Comorbidities

4.1. Descriptive Statistics

A total of 500 patients with CKD and comorbid T2DM and/or CVD were included in the study.

Table 4 Descriptive analysis

Sr. No	Demographic Variable	Value
1.	Age	40 to 50
2.	Gender	
2.1.	Male	245
2.2.	Female	255
3.	Comorbidities	
3.1.	T2DM	267
4.	CVD Stage	
4.1.	CKD Stage 1	16%
4.2.	CKD Stage 2	32%
4.3.	CKD Stage 3	36%
4.4.	CKD Stage 4	16%

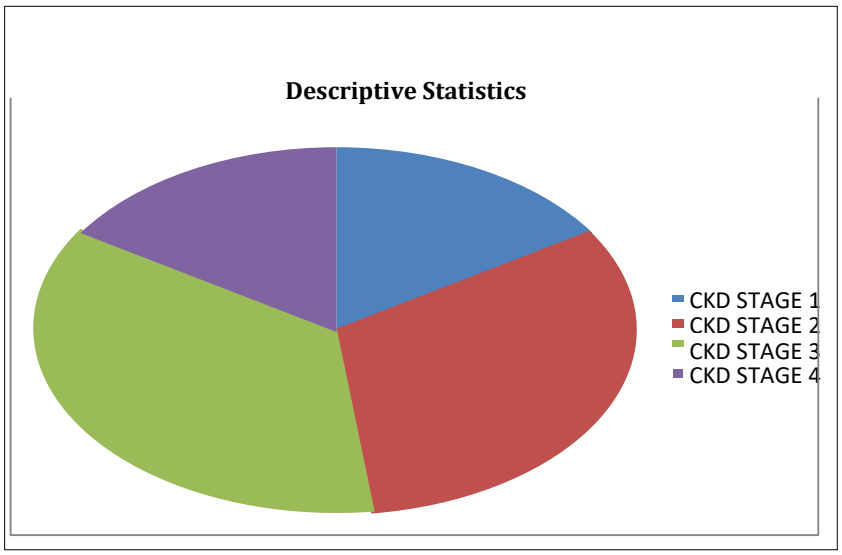


Figure 6 Illustrate Descriptive Statistics

4.2. SGLT2 inhibitors

Table 5 SGLT2 inhibitors Drugs

Sr. No	SGLT2 inhibitors	No. of Patients	Percentage	Dosage
1.	Empagliflozin	200	57.1	25mg
2.	Canagliflozin	120	34.3	10mg
3..	Dapagliflozin	30	8.6	100mg

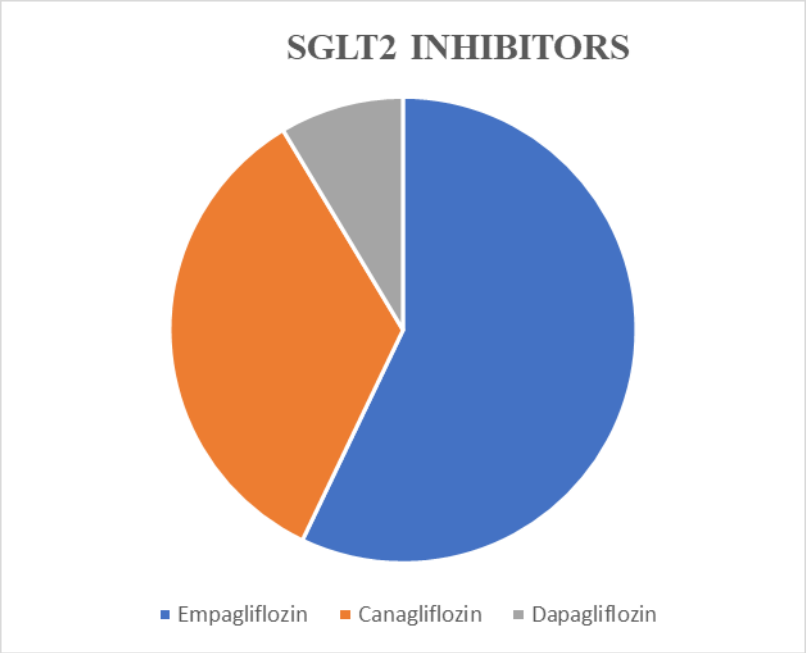


Figure 7 SGLT2 inhibitors Drugs

The percentage of SGLT2 inhibitors Drugs has Empagliflozin as 57.1%, Canagliflozin as 34.3%, and Dapagliflozin as 8.9%

4.3. Trends in SGLT2 Inhibitor Use Over Time

Table 6 SGLT2 Inhibitors Prescribed (%)

Sr. No	Month	SGLT2 Inhibitors Prescribed (%)
1.	March	50
2.	April	60
3.	May	65
4.	June	70
5.	July	72
6.	August	74

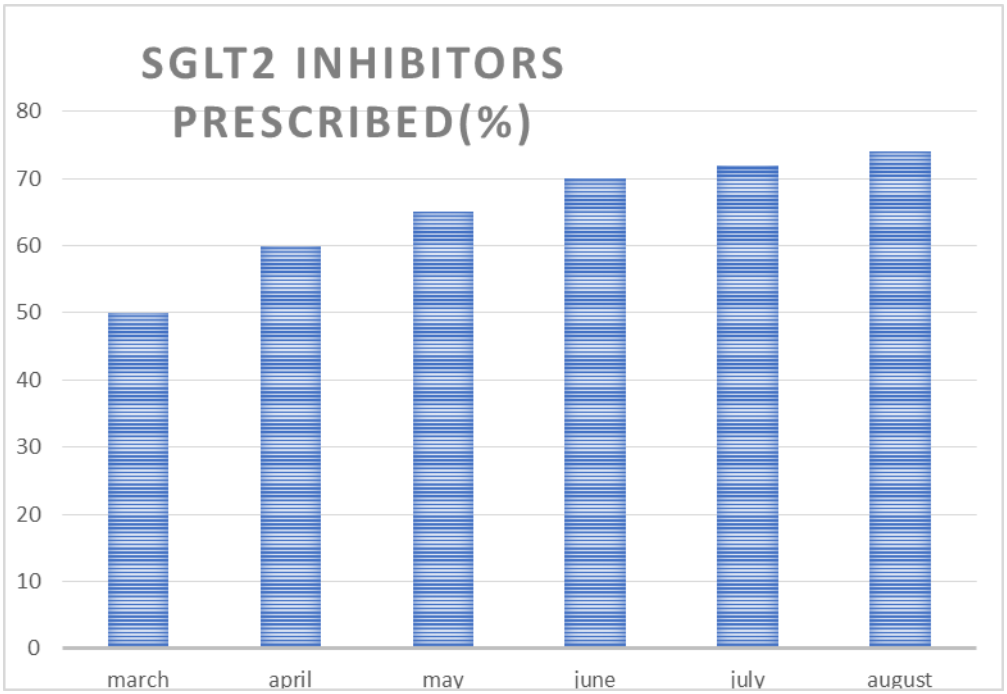


Figure 8 SGLT2 Inhibitors Prescribed (%)

SGLT2 Inhibitors Prescribed (%) has March 50, April 60, May 65, June 70, July 72, august 74.

4.4. Based on change in egfr rate

Table 7 Change in eGFR Rate

Sr. No	Month	eGFR Rate
1.	March	3mL/Min/1.73m^2
2.	April	2.5mL/Min/1.73m^2
3.	May	2mL/Min/1.73m^2
4.	June	1.5mL/Min/1.73m^2
5.	July	1mL/Min/1.73m^2
6.	August	0.5mL/Min/1.73m^2

4.5. Based on hospitalization for heart failures

Table 8 Hospitalization for Heart Failures

Sr. No	Month	Number of Patients	Percentage
1.	March	75	15%
2.	April	75	13%
3.	May	75	10%
4.	June	75	09%
5.	July	75	08%
6.	August	75	05%

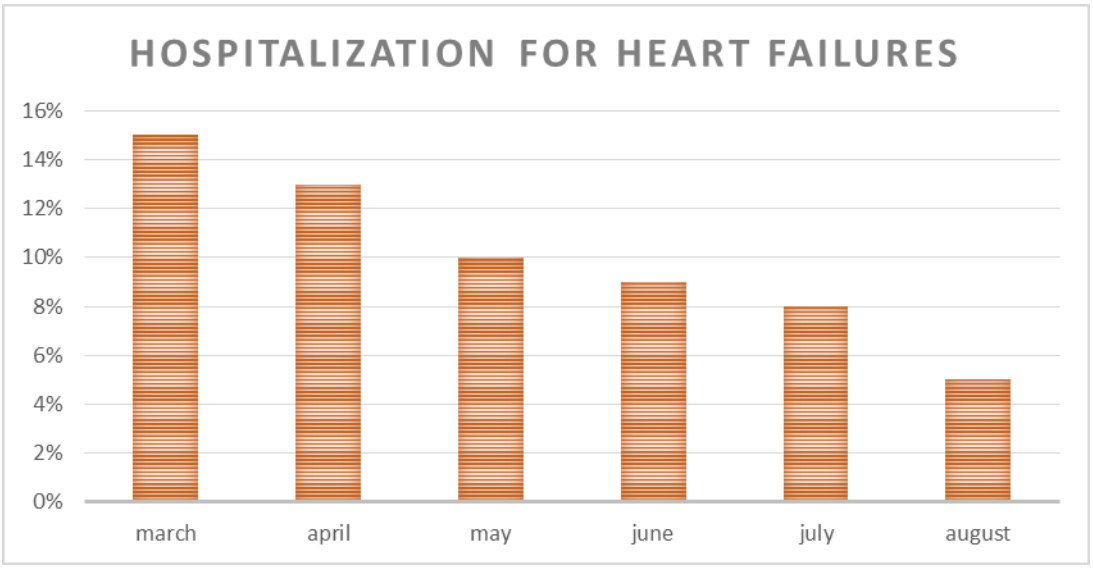


Figure 9 Hospitalization for Heart Failures

The result of Hospitalization for Heart Failures is gradually decreased.

4.6. Based on blood pressure reduction

Table 9 Blood Pressure Reduction

Sr. No	Month	Number of Patients	Systolic BP
1.	March	267	150mmHg
2.	April	231	146mmHg
3.	May	220	143mmHg
4.	June	200	140mmHg
5.	July	230	134mmHg
6.	August	245	130mmHg

4.7. Based on weight loss of patients

Table 10 Weight Loss of Patients

Sr. No	Month	Weight in Kg
1.	March	85
2.	April	84
3.	May	83.5
4.	June	83
5.	July	82
6.	August	80

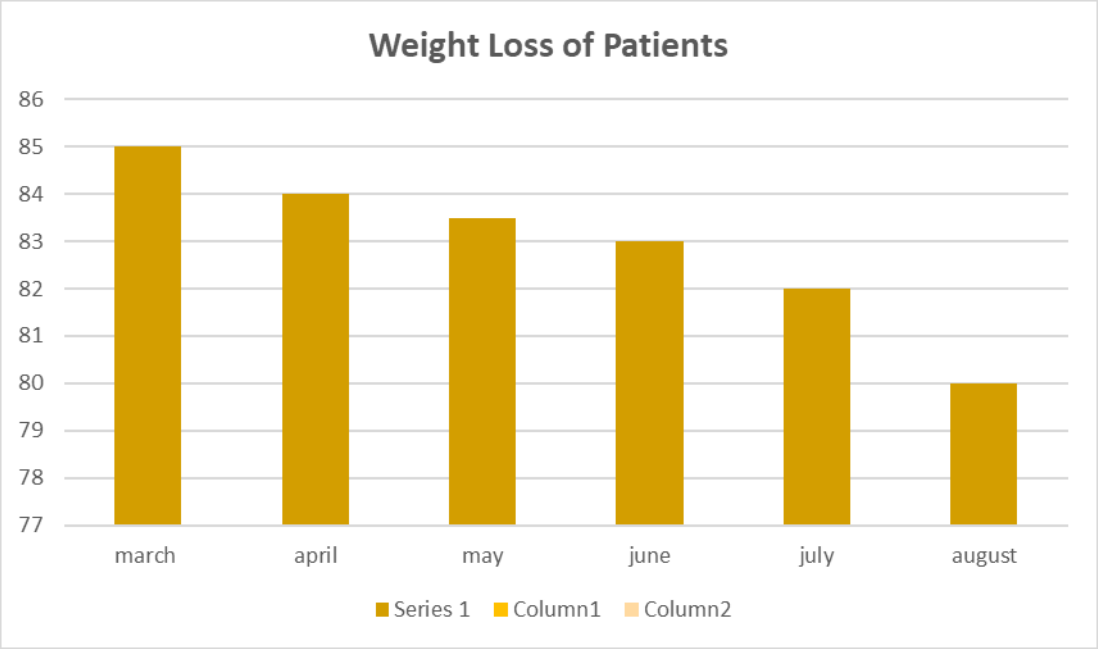


Figure 10 Weight Loss of Patients

The result shows that the Weight Loss of Patients is gradually decreased month by month

4.8. Based on frequency of dose adjustments

Table 11 Frequency of Dose adjustments

Sr. No	Month	Dose adjustments
1.	March	03 days Once
2.	April	05 days Once
3.	May	10 days Once
4.	June	14 days Once
5.	July	20 days Once
6.	August	Once in a Month

4.9. Based on mortality rates

Table 12 Mortality rates

Sr. No	Month	Mortality rates
1.	March	4%
2.	April	3.7%
3.	May	3%
4.	June	2.9%
5.	July	2%
6.	August	1%

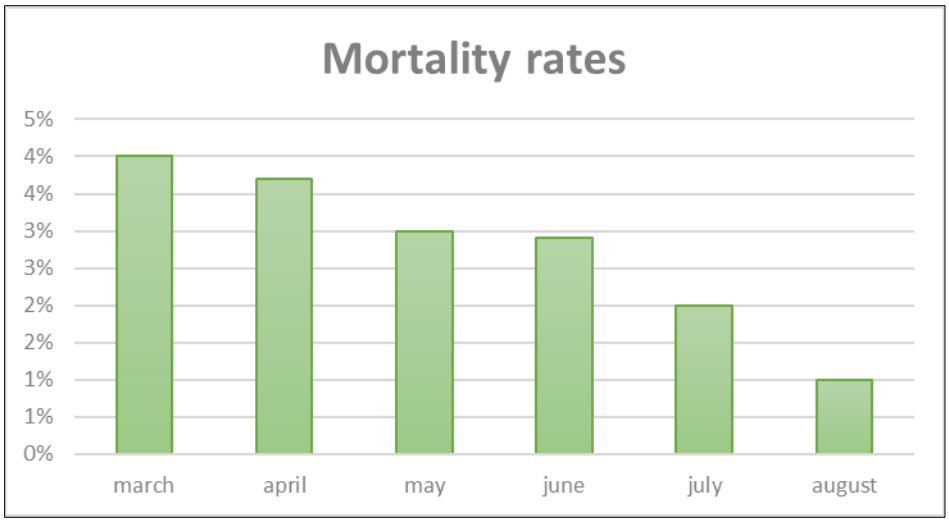


Figure 11 Mortality rates

The result shows Mortality rates is that march 4%, April 3.7%, may 3%, june2.9%, July 2%, august 1%.

5. Conclusion

The findings of this study propose that although SGLT2 inhibitors are increasingly being recommended for CKD patients with coexisting T2DM and CVD, numerous obstacles and opportunities for enhancement persist. The rise in prescriptions is in line with clinical guidelines, however, discrepancies in prescription behaviors, especially within specific demographic groups (e.g., elderly patients or individuals with significantly impaired kidney function), show the necessity for improved adherence to the guidelines.

These findings align with prior research, emphasizing the importance of improving side effect management and enhancing patient education to boost long-term adherence.

The essential elements to grasp in order to comprehend the obstacles to providing optimal care lie in the demographic, clinical, and institutional factors that impact the prescription of SGLT2 inhibitors in CKD patients. The study unveiled that younger patient with fewer comorbidities and improved access to healthcare tended to be prescribed SGLT2 inhibitors, whereas individuals from lower socio-economic backgrounds or those with intricate comorbid conditions typically opted for alternative therapies.

Among 350 patients given SGLT2 inhibitors, 85% received prescriptions in line with recommended clinical guidelines considering eGFR thresholds and coexisting diabetes. In 15% of cases, prescriptions did not comply with the guidelines, mainly because they were issued despite the patient's eGFR being below the recommended threshold of <30 mL/min/1. 73m^2. Prescribing to patients without diabetes, where off-label use was observed. The association between guideline adherence and demographic factors like age, gender, and stage of CKD was evaluated through a Chi-square test.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Coresh J, Selvin E, Stevens LA, Manzi J, Kusek JW, Eggers P, Van Lente F, Levey AS. Prevalence of chronic kidney disease in the United States. JAMA. 2007;298(17):2038–47. https://doi.org/10.1001/jama.298.17.2038 Epub 2007/ 11/08. PubMed PMID: 17986697.

[2] Hoerger TJ, Wittenborn JS, Segel JE, Burrows NR, Imai K, Eggers P, Pavkov ME, Jordan R, Hailpern SM, Schoolwerth AC, Williams DE. A health policy model of CKD: 1. Model construction, assumptions, and validation of health consequences. Am J Kidney Dis. 55(3):452–62. https://doi.org/10.1053/j.ajkd.2009.11.016 Epub 2010/02/02. PubMed PMID: 20116911.

[3] Anavekar NS, McMurray JJ, Velazquez EJ, Solomon SD, Kober L, Rouleau JL, White HD, Nordlander R, Maggioni A, Dickstein K, Zelenkofske S, Leimberger JD, Califf RM, Pfeffer MA. Relation between renal dysfunction and cardiovascular outcomes after myocardial infarction. N Engl J Med. 2004; 351(13):1285–95 PubMed PMID: 15385655.

[4] Go AS, Chertow GM, Fan D, McCulloch CE, Hsu CY. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. N Engl J Med. 2004;351(13):1296–305. https://doi.org/10.1056/NEJMoa041031 Epub 2004/09/24. PubMed PMID: 15385656.

[5] Keith DS, Nichols GA, Gullion CM, Brown JB, Smith DH. Longitudinal follow- up and outcomes among a population with chronic kidney disease in a large managed care organization. Arch Intern Med. 2004;164(6):659–63 PubMed PMID: 15037495. System USRD. USRDS 2013 Annual data report: atlas of end-stage renal disease in the United States. Bethesda: Division of Kidney U, and Hematological Diseases, National Institute of Diabetes And Digestive Kidney Diseases; 2013.

[6] Mendu ML, Waikar SS, Rao SK. Kidney disease population health Management in the era of accountable care: a conceptual framework for optimizing care across the CKD Spectrum. Am J Kidney Dis. 2017;70(1):122– 31. https://doi.org/10.1053/j.ajkd.2016.11.013 Epub 2017/01/31.

[7] Grant RW, Cagliero E, Sullivan CM, Dubey AK, Estey GA, Weil EM, Gesmundo J, Nathan DM, Singer DE, Chueh HC, Meigs JB. A controlled trial of population management: diabetes mellitus: putting evidence into practice (DM-PEP). Diabetes Care. 2004;27(10):2299–305 Epub 2004/09/29. PubMed PMID: 15451891.

[8] Jaffe MG, Lee GA, Young JD, Sidney S, Go AS. Improved blood pressure control associated with a large-scale hypertension program. JAMA. 2013; 310(7):699–705. https://doi.org/10.1001/jama.2013.108769 Epub 2013/08/31. PubMed PMID: 23989679; PMCID: PMC4270203.

[9] Schmittdiel J, Bodenheimer T, Solomon NA, Gillies RR, Shortell SM. Brief report: the prevalence and use of chronic disease registries in physician organizations. A national survey. J Gen Intern Med. 2005;20(9):855–8. https://doi.org/10.1111/j.15251497.2005.0171.x Epub 2005/08/25. PubMed PMID: 16117756; PMCID: PMC1490197.

[10] Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A. Improving chronic illness care: translating evidence into action. Health Aff (Project Hope). 2001;20(6):64–78 Epub 2002/01/31. PubMed PMID: 11816692.

[11] Jolly SE, Navaneethan SD, Schold JD, Arrigain S, Konig V, Burrucker YK, Hyland J, Dann P, Tucky BH, Sharp JW, Nally JV. Development of a chronic kidney disease patient navigator program. BMC Nephrol. 2015;16:69. https://doi.org/10.1186/s12882-015-0060-2 Epub 2015/05/31. PubMed PMID: 26024966; PMCID: PMC4459709.

[12] Rucci P, Mandreoli M, Gibertoni D, Zuccala A, Fantini MP, Lenzi J, Santoro A. A clinical stratification tool for chronic kidney disease progression rate based on classification tree analysis. Nephrol Dial Transplant. 2014;29(3):603- https://doi.org/10.1093/ndt/gft444 Epub 2013/11/30. PubMed PMID: 24286974.

[13] Rajapurkar MM, John GT, Kirpalani AL, Abraham G, Agarwal SK, Almeida AF, Gang S, Gupta A, Modi G, Pahari D, Pisharody R, Prakash J, Raman A, Rana DS, Sharma RK, Sahoo RN, Sakhuja V, Tatapudi RR, Jha V. What do we know about chronic kidney disease in India: first report of the Indian CKD registry. BMC Nephrol. 2012;13:10. https://doi.org/10.1186/1471-2369-13-10 Epub 2012/03/07. PubMed PMID: 22390203; PMCID: PMC3350459.