IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Study On Drug Utilisation Pattern And Impact Of Pharmaceutical Care In Poorly Controlled Type 2 Dm Patients

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Abstract: Type 2 Diabetes Mellitus (T2DM) remains a major public health concern, particularly when poorly controlled, as it leads to serious complications such as cardiovascular disease, neuropathy, and retinopathy. Poor medication adherence, ineffective treatment regimens, and lack of patient education further worsen clinical outcomes.

This study aimed to evaluate oral anti-diabetic drug utilization patterns, therapeutic trends, medication adherence levels, drug interactions, and the educate patients on diabetes management. A prospective observational study was conducted in the General Medicine and Diabetology departments of Sri Ramakrishna Multispecialty Hospital, Coimbatore. A total of 105 T2DM patients meeting specific inclusion criteria were enrolled. The study population had a male predominance (61%), with most participants aged between 61–70 years. Macrovascular complications were more prevalent (62%) than microvascular ones, with diabetic neuropathy being the most common microvascular issue (23%). Prescription analysis revealed a high prevalence of polypharmacy, with 61% of patients prescribed 9 to 13 medications. Biguanides, notably Metformin, were the most commonly used oral hypoglycemic agents, either alone or in combination with Sitagliptin. Insulin therapy, primarily human insulin, was prescribed to 51% of patients. Drug interactions were noted in 76% of prescriptions, with 67% of these being moderate in severity. Medication adherence was found to be suboptimal, with 50% of patients exhibiting medium adherence levels. However, patient counselling yielded a significant improvement in diabetes-related knowledge, with the proportion of patients demonstrating fair knowledge increasing from 51% to 82%.

This study underscores the challenges posed by polypharmacy, drug interactions, and poor adherence in T2DM management. It also highlights the crucial role of pharmaceutical care and patient education in improving therapeutic outcomes. Strengthening counselling services and optimizing drug regimens are essential for better diabetes control and reduced complication risks.

I. INTRODUCTION

Diabetes Mellitus (DM) represents one of the most significant public health challenges globally, characterized by its rapidly increasing prevalence and the substantial morbidity and mortality associated with its complications. Among the types of diabetes, Type 2 Diabetes Mellitus (T2DM) is the most common, accounting for 90% to 95% of all diabetes cases. T2DM is a chronic and progressive condition marked by impaired glucose and lipid metabolism, where effective glycemic control is paramount in preventing severe complications such as neuropathy, nephropathy, and retinopathy. According to the International Diabetes Federation (IDF), approximately 537 million people globally are living with diabetes, and this figure is projected to rise to 643 million by 2030 and 783 million by 2045. The World Health Organization (WHO) has

also forecasted a more than doubling of global T2DM cases, with numbers soaring from 5 million in 1995 to a projected 300 million by 2025.

India, home to the world's largest diabetic population, is at the epicenter of this crisis, grappling with over 70 million affected individuals. This constitutes about 8.3% of the country's population, making diabetes the seventh leading cause of death [1]. Worryingly, about 57% of adults with diabetes in India remain undiagnosed, underscoring the challenge of managing this disease effectively. The rapid surge in diabetes prevalence in India is largely attributed to lifestyle changes, including dietary shifts, reduced physical activity, and increased rates of obesity, particularly abdominal fat accumulation. Uncontrolled diabetes poses a severe risk, leading to complications such as cardiovascular diseases, kidney problems, vision loss, and mental health issues. Early recognition of symptoms such as excessive thirst, frequent urination, and unexplained weight loss is critical for timely diagnosis and intervention, which are essential for effective management and the prevention of long-term complications .

THE IMPLICATIONS OF UNCONTROLLED DIABETES MELLITUS:

Uncontrolled diabetes mellitus, characterized by persistently elevated blood glucose levels (hyperglycemia), is associated with a myriad of acute and chronic complications that can severely impact a patient's quality of life and increase the risk of mortality [2]. The inability to achieve and maintain glycemic control leads to both microvascular and macrovascular complications that are often irreversible once they develop.

One of the most immediate and dangerous consequences of uncontrolled diabetes is Diabetic Ketoacidosis (DKA), a potentially life-threatening condition that predominantly affects individuals with Type 1 Diabetes but can also occur in those with T2DM under extreme illness. DKA arises from the body's inability to use glucose for energy due to insufficient insulin, leading to the breakdown of fat and the accumulation of ketones in the blood, which causes acidosis.

Chronic hyperglycemia in uncontrolled diabetes results in end-organ damage over time. Diabetic Retinopathy is one of the leading causes of blindness worldwide, arising from prolonged high blood sugar levels that damage the small blood vessels in the retina. Similarly, Diabetic Nephropathy, characterized by kidney damage, can lead to chronic kidney disease and eventual ESRD, necessitating dialysis or kidney transplantation.

Furthermore, Diabetic Neuropathy affects up to 50% of diabetic patients and can lead to debilitating conditions such as peripheral neuropathy, where nerve damage causes pain, tingling, and loss of sensation in the extremities. This loss of sensation significantly increases the risk of foot ulcers, infections, and ultimately, amputations [2]. In addition to microvascular complications, uncontrolled diabetes is a major contributor to cardiovascular diseases (CVDs), including coronary artery disease, stroke, and peripheral artery disease. Hyperglycemia accelerates the development of atherosclerosis, leading to increased morbidity and mortality from CVDs, which are the leading cause of death among individuals with T2DM. Glycemic Variability, or fluctuations in blood glucose levels, is another significant concern in uncontrolled diabetes [3]. These fluctuations, particularly when they include episodes of hypoglycemia, can be more harmful than sustained hyperglycemia alone. Effective management strategies should focus on stabilizing blood glucose levels to minimize these fluctuations. A personalized treatment plan, incorporating continuous glucose monitoring and tailored medication adjustments, can help achieve more consistent glycemic control.

CHALLENGES IN MANAGING UNCONTROLLED DM

Uncontrolled diabetes despite treatment can result from various factors, including issues related to patient adherence, medication efficacy, lifestyle choices, and systemic challenges within the healthcare system. For instance, patients may struggle with adhering to prescribed treatments due to side effects, lack of understanding, or personal beliefs [4].

Medication efficacy can be compromised if drugs are not taken as directed or if there are issues with the medication itself [5]. Lifestyle factors such as diet, exercise, and stress management play a crucial role in diabetes control, and deviations from recommended practices can lead to suboptimal outcomes.

Additionally, systemic challenges, such as limited access to healthcare, can further complicate diabetes management [6]. Given these complexities, adherence to treatment regimens becomes a critical focus.

MEDICATION ADHERENCE

Effective management of type 2 diabetes involves a combination of adopting a healthy lifestyle, following a balanced diet, and using medication. Adherence to this comprehensive care plan is crucial for managing diabetes effectively [7].

The World Health Organization defines adherence as "the extent to which a person's behavior—taking medication, following diet, and/or making lifestyle changes—aligns with the recommendations from a healthcare provider." Reports indicate that adherence to oral hypoglycemic agents (OHA) ranges from 36% to 93% across different populations [8]. Non-adherence to prescribed treatments is a serious global health issue, often leading to poor glycemic control and complications such as neuropathy, nephropathy, and retinopathy. To develop effective strategies for improving adherence, pharmacists need to assess how well patients follow their medication regimens and identify factors that may contribute to non-adherence. It's important to pinpoint specific barriers to medication adherence in type 2 diabetes, particularly those that can be modified. Strategies should aim to lessen the medication burden and address any negative beliefs patients may have about their treatment [9].

MORISKY MEDICATION ADHERENCE SCALE (MMAS)

The Morisky Medication Adherence Scale (MMAS) is a widely recognized, standardized self-report tool designed to measure medication adherence in patients with chronic conditions. Due to its low cost and minimal time expenditure, self-reported questionnaires like the MMAS are frequently used in clinical practice. While early studies suggested that self-reports might underestimate non-adherence compared to methods like pill counts or biological assays, subsequent research has shown that they can provide reasonably accurate estimates.

The MMAS, developed by Morisky et al., consists of an eight-item questionnaire that efficiently assesses adherence. Items 1 through 7 have yes/no response options, with scoring adjusted for item 5, while item 8 uses a 5-point Likert scale to gauge the difficulty of remembering to take medications. The total score ranges from 0 to 8, categorizing patients into high, medium, or low adherence levels. The significance of the MMAS lies in its simplicity and effectiveness as a tool to address non-adherence in patients. Validated by clinicians and healthcare professionals across different chronic conditions and countries, the MMAS has proven to be a valuable resource for identifying adherence concerns, such as forgetting to take medications or discontinuing them without physician guidance. A higher score on the scale indicates better adherence, while a lower score suggests potential struggles with non- adherence. By helping clinicians and health organizations pinpoint underlying issues that prevent patients from taking their medications as prescribed, the MMAS plays a crucial role in improving patient outcomes and enhancing the quality of care.

DRUG INTERACTIONS

In the context of diabetes management, drug interactions represent a significant clinical concern, especially when multiple medications are prescribed to manage coexisting conditions. These interactions can alter the pharmacokinetics or pharmacodynamics of oral hypoglycemic agents, potentially leading to suboptimal glycemic control or exacerbation of adverse effects. For instance, the concomitant use of sulfonylureas with certain cardiovascular drugs, like beta- blockers, may mask symptoms of hypoglycemia, complicating diabetes management. Therefore, understanding the potential for drug-drug interactions is crucial for clinicians to tailor treatment plans that minimize risks while maximizing therapeutic efficacy [10].

THE ROLE OF PHARMACISTS IN MANAGING UNCONTROLLED TYPE 2 DM

Pharmacists play a pivotal role in the management of uncontrolled type 2 diabetes mellitus by providing essential support in medication management, patient education, and monitoring therapy outcomes. Given their accessibility and frequent interactions with patients, pharmacists are well-positioned to identify medication-related issues, such as non-adherence, incorrect dosing, or potential drug interactions, which can lead to poor glycemic control. They can conduct medication reviews to optimize treatment regimens, ensuring that patients are receiving the most effective therapy with minimal risk of adverse effects. Furthermore, pharmacists can assist in the initiation and titration of therapies, such as insulin, under collaborative practice agreements, helping to achieve better glycemic control and prevent complications [11]..

In addition to their role in medication management, pharmacists are integral to patient education and self-management support. They provide counseling on the proper use of medications, the importance of adherence, and the lifestyle modifications necessary for effective diabetes management. By educating patients on recognizing symptoms of hypo- and hyperglycemia and understanding the significance of regular blood glucose monitoring, pharmacists empower patients to take an active role in managing their condition. Moreover, pharmacists can offer guidance on the use of devices such as glucometers and continuous glucose monitors, ensuring patients use these tools effectively. Through these efforts, pharmacists help bridge the gap between patients and the broader healthcare system, contributing to improved outcomes and quality of life for individuals with uncontrolled type 2 diabetes [12].

II. RESEARCH METHODOLOGY

A prospective observational study was conducted in the General Medicine Department of Sri Ramakrishna Hospital, Coimbatore, a 1000-bedded multi-speciality tertiary care teaching hospital, over a duration of six months with a sample size of 105 in-patients. The study focused on patients aged 18 years and above diagnosed with Type 2 Diabetes Mellitus (T2DM) having HbA1c levels >7% and willing to participate, while excluding patients below 18 years, pregnant women, critically ill individuals, those with incomplete data, and those unwilling to give consent. A well-designed data collection form was developed and used to gather comprehensive patient information including demographic details (name, age, gender, reason for admission, duration of illness, social and educational history), current medications (drug name, dosage, route, frequency, indication, start/stop dates), past medical and medication history (allergies, co-morbidities, previous therapies), and laboratory investigations. Data were collected through direct patient interviews, patient progress records, treatment charts, and lab reports, with the assistance of nursing staff. Patients were routinely monitored for medication-related problems (MRPs) such as inappropriate medication use, polypharmacy, noncompliance, and drug-drug interactions using primary (standard literature), secondary (Micromedex), and tertiary sources (e.g., BNF, AHFS, Martindale) available in the clinical pharmacy department. Whenever necessary, clinical pharmacist services such as patient counselling, interaction checks, and drug information were provided to improve therapeutic outcomes. Identified MRPs were discussed with physicians during ward rounds and outpatient visits. All assessed information was documented and statistically analyzed using descriptive statistics, with results represented as graphs and percentages.

III. RESULT

TABLE 1: GENDER CATEGORIZATION (n=105)

GENDER	NO OF PATIENTS	PERCENTAGE
Male	64	61%
Female	41	39%

Gender distribution analysis showed that males comprised the majority of the study population, accounting for 61% of the total sample.

TABLE 2: AGE DISTRIBUTION (n=105)

AGE GROUP	NO OF PATIENTS	PERCENTAGE
31-40	8	8%
41-50	9	9%
51-60	33	31%
61-70	35	33%
>70	20	19%

From the study data, maximum number of patients 35 (33%) were between the age group of 61-70 years.

TABLE 3: LENGTH OF STAY
(n=105)

NO OF DAYS	NO OF PATIENTS	PERCENTAGE
1 to 5	58	55%
6 to 10	40	38%
11 to 15	7	7%

Most patients were hospitalized for 1-5 days for 55% of patients, following 6-10 days for 38% and 11-15 days for 7% as length of stay.

TABLE 4: CO-MORBID CONDITIONS
(n=105)

DIAGNOSIS	NO OF PATIENTS	PERCENTAGE
SHT	39	36%
CKD	3	3%
CAD	9	8%
HYPOTHYROIDISM	6	6%
COPD	6	6%
ACUTE GASTROENTERITIS	2	2%
PARKINSONISM	2	2%
DYSLIPIDEMIA	7	7%
CELLULITIS	3	3%
HYPERLIPIDEMIA	6	6%
NIL	22	21%

Co-morbid conditions observed in the study population were Systemic Hypertension, CAD, Dyslipidemia and Hypothyroidism.

TABLE 5: COMPLICATIONS OF DIABETES

DIAGNOSIS	NO OF PATIENTS	PERCENTAGE
MICROVASCULAR COMPLICATION	**24**	**23%**
DIABETIC NEUROPATHY	16	15%
DIABETIC NEPHROPATHY	7	7%
DIABETIC RETINOPATHY	1	1%

MACROVASCULAR COMPLICATIONS	**65**	**62%**
CAD	39	37%
CCF	16	15%
CVA	10	10%
ACUTE METABOLIC COMPLICATIONS	**4**	**4%**
DIABETIC KETOACIDOSIS	4	4%

Analysis of complications of poorly controlled T2DM found that microvascular complications affected 23% of patients, with diabetic neuropathy being most common, while macrovascular complications affected 62%, highlighting a higher prevalence of macrovascular issues.

TABLE 6: WHO CORE INDICATORS

Average number of drugs prescribed per prescription	10
Percentage of drugs prescribed by generic name	23%
Percentage of encounters with antibiotic prescribed	14%
Percentage of drugs prescribed from NLEM	14%
Percentage of encounters with injectable drug prescribed	10%
Percentage of encounters with fixed dose combination	4%
Total number of drugs prescribed in 105 prescription n = 1089	

The study analysed WHO core indicators, revealing that the average number of drugs per prescription was 10, with only 23% prescribed by generic name, and 14% prescribed from NLEM list.

TABLE 7: DRUGS PER PRESCRIPTION (n=105)

NO OF DRUGS	NO OF PRESCRIPTION	PERCENTAGE
4 to 8	29	28%
9 to 13	64	61%
14 to 19	12	11%

A total of 105 prescriptions were analysed for number of drugs per prescription and found that 64 prescriptions (61%) contained 9 to 13 drugs, indicating a high rate of polypharmacy.

TABLE 8: ANTI-DIABETIC DRUG PER PRESCRIPTION

NO OF DRUGS	NO OF PRESCRIPTIONS	PERCENTAGE
1 to 2	63	60%
3 to 4	32	30%
5 to 6	10	10%

The number of diabetes drugs prescribed per prescription showed that 63 (60%) prescriptions included 1 to 2 drugs.

TABLE 9: OHA CLASS PRESCRIBED

CLASS PRESCRIBED	NUMBER OF TIMES PRESCRIBED	PERCENTAGE
SULPHONYLUREAS	49	29%
BIGUANIDES	58	35%
DPP-4 INHIBITORS	48	29%
THIAZOLIDINEDIONES	2	1%
SGLT 2 INHIBITORS	8	5%
ALPHA GLUCOSIDASE INHIBITORS	2	1%

Among Oral Hypoglycemic Agents (OHA), Biguanides were the most frequently prescribed class (35%).

TABLE 10: INSULIN TYPE DISTRIBUTION

INSULIN TYPE	FREQUENCY	PERCENTAGE
HUMAN INSULIN	55	51%
HUMAN INSULIN ANALOGUE	42	49%

The distribution of insulin types showed that 51% of prescriptions were for Human Insulin, with a slight preference for Human Insulin over analogues.

TABLE 11: VARIOUS INSULIN PREPARATION

INSULIN PREPARATION	FREQUENCY	PERCENTAGE
INSULIN ASPART	6	6%
INSULIN DEGLUDEC	3	3%
INSULIN GLARGINE	26	24%
INSULIN GLULISINE	5	5%
INSULIN LISPRO	5	5%
INSULIN MIXTARD	3	3%
INSULIN REGULAR	52	48%
PREMIXED INSULIN	7	6%

Various insulin preparations were analysed, and Insulin Regular (48%) was most frequently prescribed, followed by Insulin Glargine, aligning with previous studies on insulin preferences.

TABLE 12: UTILIZATION OF ANTIDIABETIC DRUGS AS MONOTHERAPY

NAME OF THE DRUG	NO OF PRESCRIPTIONS	PERCENTAGE
PARENTERAL	**13**	68%
REGULAR INSULIN	9	47.3%
INSULIN GLARGINE	3	16%
INSULIN ASPART	1	5%
ORAL FORMULATION	**6**	**32%**
METFORMIN	5	26%
VILDAGLIPTIN	1	5%

In monotherapy, among parenterals, Insulin regular was prescribed with 47.3% whereas among oral drugs, Metformin was prescribed with 26%.

TABLE 13: UTILIZATION OF ANTIDIABETIC DRUGS AS DUAL THERAPY

NAME OF THE DRUG	NO OF PRESCRIPTIONS	%
ORAL + PARENTERAL	**22**	**21%**
METFORMIN + INSULIN REGULAR	4	4%
GLICLAZIDE + INSULIN REGULAR	6	6%
VILDAGLIPTIN + INSULIN GLARGINE	4	4%
VILDAGLIPTIN + INSULIN MIXTARD	2	2%
SITAGLIPTIN +INSULIN REGULAR	2	2%
GLIMEPRIDE + REGULAR INSULIN	2	2%
DAPAGLIFLOZIN + INSULIN MIXTARD	2	2%
ORAL + ORAL	**4**	**4%**
METFORMIN + GLIMEPRIDE	2	2%
METFORMIN + GLICLAZIDE	2	2%

Most frequently prescribed dual therapy in our study is Gliclazide +Insulin regular with 6%.

TABLE 14: ANTI-DIABETIC DRUGS UTILIZATION IN COMBINATION THERAPY

DRUGS PRESCRIBED	NO. OF PATIENTS	PERCENTAGE
GLICLAZIDE + VILDAGLIPTIN + METFORMIN + INSULIN REGULAR	5	13%
GLIMEPRIDE + VILDAGLIPTIN + METFORMIN + INSULIN GLARGINE	6	16%
GLICLAZIDE + INSULIN GLUSINE + INSULIN DEGLUDEC	3	8%
METFORMIN+ VILDAGLIPTIN + INSULIN REGULAR	4	10%
VILDAGLIPTIN + METFORMIN + GLICLAZIDE	2	5%

+ INSULIN DECLUDEC + INSULIN ASPART		
SITAGLIPTIN + GLICLAZIDE + GLIMEPIRIDE + REPAGLINIDE + INSULIN REGULAR	1	3%
REMOGLIFLOZIN + GLIMEPIRIDE + INSULIN REGULAR	2	5%
VILDAGLIPTIN + METFORMIN + INSULIN GLARGINE	1	3%
METFORMIN + SITAGLIPTIN + INSULIN LISPRO + INSULIN GLARGINE	1	3%
METFORMIN + PIOGLITAZONE + SITAGLIPTIN + GLICLAZIDE	1	3%
SITAGLIPTIN + GLICLAZIDE + METFORMIN + INSULIN LISPRO + INSULIN GLARGINE	1	3%
METFORMIN + GLICLAZIDE + LINAGLIPTIN + INSULIN LISPRO + INSULIN GLARGINE	1	3%
VILDAGLIPTIN + METFORMIN + GLICLAZIDE	2	5%
METFORMIN + GLICLAZIDE + INSULIN ASPART +INSULIN DEGLUDEC	2	5%
METFORMIN + VILDAGLIPTIN + INSULIN REGULAR	1	3%
DAPAGLIFLACIN + SITAGLIPTIN + INSULIN REGULAR	1	3%
PIOGLITAZONE + EMPAGLIFLOZIN + METFORMIN + GLICLAZIDE	1	3%
SITAGLIPTIN + GLICLAZIDE + INSULIN REGULAR	3	8%

Most frequently prescribed anti diabetic drug in combination therapy is Glimepride + Vildagliptin + Metformin + Insulin Glargine dual with 6%.

TABLE 15: ANTI-DIABETIC DRUGS UTILIZATION IN FIXED DOSE COMBINATION

DRUGS PRESCRIBED	NO. OF PATIENTS	PERCENTAGE
VILDAGLIPTIN+METFORMIN	17	24%
SITAGLIPTIN+METFORMIN	19	27%
GLIMEPRIDE+METFORMIN	13	18%
GLIPIZIDE+METFORMIN	3	4%
REMOGLIFLOZIN+VILDAGLIPTIN	5	7%
SITAGLIPTIN+DAPAGLIFLOZIN	3	4%
LINAGLIPTIN+METFORMIN	3	4%
GLICLAZIDE+METFORMIN	2	3%
VILDAGLIPTIN+DAPAGLIFLOZIN	2	3%
TENEGLIPTIN+METFORMIN	1	1%
METFORMIN+GLIMEPRIDE+ VOGLIBOSE	1	1%
DAPAGLIFLOZIN+GLIMEPRIDE + METFORMIN	2	3%

The study found that Sitagliptin + Metformin was the most commonly prescribed fixed-dose combination.

TABLE 16: POTENTIAL DRUG INTERACTIONS (n=105)

INCIDENT OF INTERACTION	NO.OF PRESCRIPTIONS	PERCENTAGE
PRESENT	80	76%
ABSENT	25	24%

Potential drug interactions were present in 76% of the prescriptions, highlighting a high incidence of drug interactions in the study population.

TABLE 17: DRUG INTERACTION BASED ON SEVERITY (n=80)

INCIDENT OF INTERACTION	NO. OF PRESCRIPTIONS	PERCENTAGE
MAJOR	28	29%
MODERATE	64	67%
MINOR	4	4%

Based on the severity of drug interactions, 67% were moderate, 29% major, and 4% minor, reflecting a pattern of moderate to major drug interactions.

TABLE 18: DRUG INTERACTIONS WITH ANTIDIABETICS (n=80)

DRUGS	SEVERITY	EFFECT
FUROSEMIDE + METFORMIN	MINOR	Increases levels of metformin
METFORMIN + FUROSEMIDE	MINOR	Decreases levels of furosemide
AMITRIPTYLINE + METFORMIN	MINOR	Increases the effects of metformin
SITAGLIPTIN + GLIMEPIRIDE	MINOR	Either drug increases the effects of the other
ONDANSETRON + METFORMIN	MODERATE	Increases levels of metformin
DICLOFENAC + GLIMEPIRIDE	MODERATE	Diclofenac increases the effects of glimepiride
BUDESONIDE + METFORMIN	MODERATE	Increases risk of hyperglycemia
FORMOTEROL + METFORMIN	MODERATE	Increased risk of hyperglycemia and potential loss of glycemic control
ASPIRIN + GLIMEPIRIDE	MODERATE	Increases the effects of glimepiride
INSULIN ISOPHANE + LINEZOLID	MODERATE	Increased risk of hypoglycaemia
LINEZOLID + METFORMIN	MODERATE	Increased risk of hypoglycaemia
INSULIN ASPART + LINEZOLID	MODERATE	Increased risk of hypoglycaemia
GLIMEPIRIDE + LINEZOLID	MODERATE	Increased risk of hyperglycaemia
CIPROFLOXACIN + DAPAGLIFLOZIN	MAJOR	Increased risk of hypoglycaemia
NPH INSULIN + CIPROFLOXACIN	MAJOR	Increased risk of hypoglycaemia
CIPROFLOXACIN + GLIMEPIRIDE	MAJOR	Increases the risk of hypoglycaemia

ASPIRIN + INSULIN GLARGINE	MAJOR	Increases effects of insulin glargine
TELMISARTAN + GLIPIZIDE	MAJOR	Increases the risk of hypoglycaemia

Most interactions between these drugs involve changes in blood glucose control, with minor to moderate severity effects such as increased or decreased drug levels, potential loss of glycemic control, or increased risk of hypoglycaemia or hyperglycaemia, while major interactions primarily heighten the risk of hypoglycaemia or significantly increase insulin or sulfonylurea effects.

TABLE 19: CATEGORISATION OF ADHERENCE BASED ON MMAS-8 SCORE (n=105)

CATEGORY	NO OF PATIENTS	PERCENTAGE
Low medication adherence (score between 0-5)	40	38%
Medium medication adherence (score between 6-7)	53	50%
High medication adherence (score >7)	12	11%

Medication adherence assessment revealed that 50% of patients had medium adherence, with a notable percentage showing low adherence, emphasizing the need for improved adherence strategies

TABLE 20: CATEGORISATION OF ADHERENCE BASED ON MMAS-8 SCORE (n=105)

S.no	MMAS – 8	YES	NO
1	Do you sometimes forget to take your pills?	48 (46%)	57 (54%)
2	People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your medication?	46 (44%)	59 (56%)
3	Have you ever cut back or stopped taking your medicine without telling your doctor because you felt worse when you took it?	50 (48%)	55 (52%)
4	When you travel or leave home, do you sometimes forget to bring along your medicine?	50 (48%)	55 (52%)
5	Did you take all your medicine yesterday?	51 (49%)	54 (51%)
6	When you feel like your symptoms are under control, do you sometimes stop taking your medicines?	55 (52%)	50 (48%)
7	Taking medicine every day can be a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?	48 (46%)	57 (54%)

8	How often do you have difficulty remembering to take all your medicines?	a. Never/Rarely	37	(35.2%)
		b. Once in a while	29	(27.6%)
		c. Sometimes	20	(19%)
		d. Usually	10	(9.5%)
		e. All the time	9	(8.5%)

The MMAS-8 adherence data from the sample (n=105) shows that a significant proportion of participants reported occasional forgetfulness, intentional non-adherence, or inconvenience in taking medications, indicating varying levels of adherence behaviors that contribute to low to medium overall adherence.

TABLE 20: HbA1c MEASUREMENTS PRE- AND POST- PHARMACEUTICAL COUNSELLING

GROUP	MEAN	STANDARD DEVIATION	STANDARD ERROR OF THE MEAN	N
PRE-COUNSELLING	9.5	2.02	0.198	105
POST-COUNSELLING	64	1.97	0.193	105

HbA1c dropped from 9.534 to 7.490, a reduction of 2.044 units, indicating improved blood sugar control with therapeutic management and pharmaceutical care.

TABLE 21: STATISTICAL ANALYSIS

MEASURE	VALUE
MEAN DIFFERENCE (PRE - POST)	2.044
STANDARD ERROR OF DIFFERENCE	0.119
T-STATISTIC	17.1837
DEGREES OF FREEDOM (DF)	104
TWO-TAILED P-VALUE	<0.0001
95% CONFIDENCE INTERVAL	1.808-2.280

Overall, the study highlights a high prevalence of polypharmacy and significant potential for drug interactions among patients. Despite varied medication adherence, patient knowledge significantly improved following counselling. These findings emphasize the need for careful medication management and enhanced patient education to improve outcomes.

IV. DISCUSSION

A total of 105 patients were included in the study, among them 64 (61%) were male and 41 (39%) were female. The percentage of men were more when compared to female (TABLE-1). The result on gender categorisation has revealed that the study population comprises of more number of male patients.

Age distribution of the patients was analysed, and it was found that 35 (33%) patients were in the age group of 61-70 years, 33 (31%) patients were in the age group of in the age group of 51-60 years, 20 (19%) patients were in the age group of >70 years, 9 (9%) patients were in the age group 41-50 years, and 8 (8%) patients

were in the age group of 31-40 years. The study shows that the maximum number of patients in the study group were in the age group of 61-70 years (TABLE -2).

The length of stay of the patients in the study site was also analysed and found that 58 (55%) of the patients were hospitalized for a period between 1-5 days, 40 (38%) had 6-10 days, and 7 (7%) had 11-15 days as their length of stay. The majority of the study population was hospitalized for a period of 1-5 days (TABLE-3).

The assessment of past medical history revealed that 83 (79%) patients had pre-existing comorbid conditions, where SHT was present in 39 patients (36%), followed by CAD in 9 patients (8%). Other common co-morbid conditions found in the population were Dyslipidemia in 7 patients (7%), Hypothyroidism in 6 patients (6%), COPD in 6 patients (6%), Acute Gastroenteritis in 2 patients (2%) (TABLE-4). A significant proportion of the patients has pre-existing co-morbid conditions with SHT being the most common (36%).

Based on the medical history, microvascular complications were present in 24 patients (23%), with diabetic neuropathy being the most common (15%), followed by diabetic nephropathy (7%) and retinopathy (1%). Macrovascular complications were more prevalent, affecting 65 patients (62%), with Coronary artery disease (37%) being the most common, followed by congestive heart failure (15%) and cerebrovascular accident (10%). Acute metabolic complications, specifically diabetic ketoacidosis, were observed in 4 patients (4%) (TABLE-5). The study found a higher prevalence of macrovascular compared to microvascular complications in poorly controlled type 2 diabetes patients.

A total of 105 prescriptions were screened, and the WHO core indicators were analyzed (TABLE-6). The study found that the average number of drugs prescribed per prescription was 10. Only 23% of the drugs were prescribed by their generic name. Antibiotics were prescribed in 14% of the patients, while 14% of the drugs were from the NLEM. Injectable drugs were prescribed in 10% of the patients, and fixed-dose combinations were used in 4% of the cases. The total number of drugs prescribed across all 105 prescriptions was 1,089.

A total of 105 prescriptions were analysed to determine the number of drugs per prescription. Among these, 29 (28%) prescriptions had 4 to 8 drugs, 64 (61%) had 9 to 13 drugs, and 12 (11%) had 14 to 19 drugs (TABLE-7). The majority of prescriptions comprised 9 to 13 drugs. The number of anti-diabetic drugs prescribed per prescription (TABLE- 8), it was found that 63 (60%) prescriptions included 1 to 2 drugs, 31 (30%) prescriptions contained 3 to 4 drugs, and 11 (10%) prescriptions included 5 to 6 drugs.

The prescriptions were further evaluated for the OHA class prescribed. The results showed that Biguanides were prescribed in 58 patients (35%), Sulphonylureas were prescribed in 49 patients (29%), DPP-4 Inhibitors were prescribed in 48 patients (29%) (TABLE-9). The data indicates that Biguanides were the most frequently prescribed class of OHA.

Based on the analysis of randomly screened prescriptions, 55 prescriptions (51%) were for Human Insulin, while 51 prescriptions (49%) were for Human Insulin Analogues (TABLE-10). The distribution indicates a slight preference for Human Insulin among the study population. Out of the total insulin prescriptions, the distribution was as follows: Insulin Regular was the most frequently prescribed, with 52 prescriptions (48%). This was followed by Insulin Glargine with 26 prescriptions (24%). Insulin Aspart was prescribed in 6 prescriptions (6%). Premixed Insulin was prescribed in 7 prescriptions (6%). Insulin Glulisine and Insulin Lispro were each prescribed in 5 prescriptions (5%). Insulin mixtard was used in 3 prescriptions (3%), along with Insulin Degludec (TABLE-11).

Prescriptions revealed that Metformin was the most frequently prescribed OHA in 5 patients (5%), followed by Vildagliptin in 1 patient (1%). Parenterally, Insulin Regular was prescribed frequently in 9 patients (9%), followed by Insulin Glargine in 3 patients (3%) (TABLE-12).

Assessing the prescriptions for drugs in dual therapy revealed that, combination of Metformin with Insulin Regular was the most frequently prescribed combination in 4 patients (4%), followed by Gliclazide with Insulin Regular in 6 patients (6%) (TABLE-13) which showed that Metformin and Gliclazide with insulin improved glycaemic control.

Assessment of prescriptions for drugs in combination therapy revealed that, combination of Glimepride, Vildagliptin, Metformin with Insulin Glargine was the most frequently prescribed combination in 6 patients (16%), followed by Gliclazide, Vildagliptin, Metformin with Insulin Regular in 5 patients (13%) (TABLE-14). Biguanides (Metformin) was highly prescribed anti-diabetic drug in both single and combination drug therapies which improved glycaemic control.

For oral hypoglycemic agents (OHAs) in fixed dose therapy, the most frequently prescribed was Sitagliptin + Metformin, used in 19 patients (27%%). This was followed by Vildagliptin + Metformin, prescribed in 17 patients (24%), and Glimepiride + Metformin, used in 13 patients (18%). (TABLE-15). The predominant use of Sitagliptin + Metformin suggests that this combination, involving biguanides (metformin) and DPP-4 inhibitors (sitagliptins), is the most established and favored therapy in this study.

The study found that drug-drug interactions were present in 80 prescriptions (76%) of the prescriptions, with 25 prescriptions (24%) showing no interactions (TABLE-16). Based on the screened prescriptions, the study found that drug interaction based on severity varied among patients, with 29% showing major incidence of drug interactions, 67% showing moderate incidence of drug interactions, and 4% demonstrating minor incidence of drug interactions (TABLE-17). The study found that medication adherence varied among study population with 38% showing low adherence, 50% showing medium adherence, and 11% demonstrating high adherence (Table-19). However, it was noted that the participants were non-adherent to blood glucose testing. Emphasizing self-care activities and medication adherence is crucial for improving outcomes in the management of T2DM. The HbA1c levels dropped from a mean of 9.534 during the baseline study to 7.490 at end of the study, marking a significant reduction of 2.044 units (TABLE -20). This indicates that the therapeutic management of diabetes along with pharmaceutical care was effective in improving blood sugar control.

V. CONCLUSION

The study concludes that pharmaceutical care programs can significantly enhance the quality of life and clinical outcomes for patients with poorly controlled type 2 diabetes mellitus. The findings emphasize that drug utilization patterns must align with rational prescribing practices, ensuring optimal use of antidiabetic medications. This goal is achieved by both adhering to prescribing guidelines and supporting patient adherence to treatment plans for effective glycemic control.

The study also highlights the value of feedback to prescribers, aiming to raise awareness about the rational use of medications and, ultimately, reduce morbidity and mortality in diabetic patients. It provides insights that can inform future research and contribute to improving management strategies for glycemic control in diabetes mellitus.

Furthermore, the results demonstrated that clinical pharmacists play a crucial role in achieving primary therapeutic goals for overall diabetes control. Improved patient knowledge assessments clearly indicated the benefits of pharmacist-provided counselling and the importance of consultations with a pharmacist in a hospital setting.

Pharmaceutical care provided by clinical pharmacists was effective in reducing blood glucose levels and improving the overall quality of life for patients. The study underscores the importance of reviewing current diabetes prescribing guidelines and providing prescribers with valuable feedback on the rational use of antidiabetic drugs.

V. ACKNOWLEDGMENT

We sincerely thank S.N.R. Sons Charitable Trust, Sri Ramakrishna Hospital, and Dr. S. Sriram, Principal of the College of Pharmacy, Sri Ramakrishna Institute of Paramedical Sciences, Coimbatore, for their support and for providing the necessary facilities to carry out this study.

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