e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.11.126

International Journal of Pharmaceutical Quality Assurance 2025; 16(11); 822-829

Original Research Article

Drug Prescribing Pattern of Anti-Diabetic Drugs in Type 2 Diabetes Mellitus Patients: A Retrospective Study

Md. Shahzada[1], Nilofar Yasmin Khan[2]

[1]Assistant Professor, Department of Pharmacology, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India

[2]Associate professor, Department of pharmacology, Datta Meghe Medical College, Wanadobgri, Nagpur, India

Received: 11-09-2025 / Revised: 19-10-2025 / Accepted: 28-11-2025

Corresponding Author: Dr. Nilofar Yasmin Khan

Conflict of interest: Nil

Abstract:

Background: Drug utilization studies are essential for evaluating prescribing practices and promoting rational drug use, particularly in chronic diseases like Type 2 Diabetes Mellitus (T2DM), which has a high and rising burden in India.

Aim: To assess the prescribing pattern of anti-diabetic drugs in T2DM patients in a tertiary care hospital in Bihar.

Methodology: A retrospective observational study was conducted over one year using 107 patient records identified by ICD-10 code E11. Data on demographics, clinical features, and drug therapy were analyzed using descriptive statistics and WHO ATC/DDD methodology.

Results: The study population had a mean age of 54.2 ± 11.8 years with male predominance (63.55%). Comorbidities were present in 71.03%, mainly hypertension. Oral drugs were most commonly prescribed (42.99%), followed by combination therapy (29.91%). Metformin was the most frequently used drug (67.29%), followed by insulin (45.79%) and sulfonylureas (35.51%). Monotherapy was observed in 41.12% patients, while combination therapies were also common. Insulin showed the highest utilization (DDD/100 bed-days: 0.12).

Conclusion: Prescribing patterns largely adhered to standard guidelines, with metformin as the cornerstone and increasing use of combination therapy for glycemic control.

Keywords: Type 2 Diabetes Mellitus, Drug Utilization, Prescribing Pattern, Anti-diabetic Drugs, Metformin, DDD.

Introduction

Drug Utilization (DU) studies became an important tool to monitor prescription patterns and optimize therapeutic outcomes. DU study was first described in Northern Europe and UK mid-1960s [1]. It has since become an important tool for assessing rational drug use, trend analysis in prescribing and for ensuring the safety and effectiveness of pharmacotherapy. Drug utilization research as defined by World Health Organization (WHO) is "the marketing, distribution, prescription and use of drugs in a society, with special emphasis on the resulting medical, social and economic consequences [2]." This definition illustrates the diversity of DU studies across flexible domains, covering clinical and public health contexts.

To ensure standardization of drug utilization research across the world, World Health Organization 1st proposed Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) classification system in 1996 [2]. This system offers a consistent structure for organizing drugs according to their therapeutic use and enables quantitative comparison of drug consumption across various populations and healthcare environments. The ATC/DDD system has improved the analysis of the patterns for drug prescribing and has become an irrefutable statistical method for presenting information on utilization of drugs. DU studies contribute to the understanding of irrational prescribing, polypharmacy and inappropriate use of drugs which are important issues in contemporary health care [3].

DU studies function as an important feedback mechanism for physicians and other healthcare providers in hospital settings. These studies will help develop targeted educational intervention to optimize rational drug therapy through scrutiny of prescription patterns. They are also crucial for evaluating patients' compliance to prescribed therapies, especially in chronic diseases such as diabetes mellitus [4]. In addition, better compliance leads to better therapeutic results, which will decrease the risk of progression of disease and complications. These DU studies

further help in enhancing the overall standard of patient management by reducing adverse drug reactions and ensuring rational or needed medication he/she receives.

Diabetes mellitus (DM), especially type 2 diabetes mellitus (T2DM), has become a serious public health problem worldwide. Diabetes is becoming more common worldwide and in the next years, this trend will continue [5] According to both global and national estimates, India is one of the countries with a high burden of diabetes, so much so that it is also called the "diabetes capital of the world." This increasing trend is heavily linked to rapid urbanization, sedentary lifestyles and dietary patterns, as well as genetic factors (if any). Diabetes is a silent killer affecting millions and regions like Bihar have less awareness about chronic diseases, with healthcare resources scant requiring additional focus from the healthcare system [6].

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and relative deficiency of the hormone. It is linked to long-term sequelae involving cardiovascular, renal, neurological and ophthalmic systems. Characterized by insulin resistance, T2DM is a complex disease that demands an elaborative approach for dealing with such etiology through lifestyle modifications and pharmacological treatments. T2DM management has a plethora of anti-diabetic medications that have been available in recent decades. These consist of conventional agents such as metformin, sulfonylureas, and insulin along with newer categories like DPP-4 inhibitors, SGLT2 inhibitors, and GLP-1 receptor agonists

The growing variety of anti-diabetics has made prescribing more complicated. While choosing an appropriate therapy, physicians should take into account various attributes, including patient variables, comorbidities, drug activity, safety profile, cost and availability. In the resource poorly resource–constrained setting like Bihar economic considerations along with drug availability affects prescribing behaviour significantly. Hence, it is imperative to study the patterns of drug prescribing so that rationality and cost effectiveness can be ensured in evidence-based drug therapy.

Research on such patients is especially relevant as the subsequent timely initiation of adequate therapy could modify disease course and prevent complications [7]. An assessment of the prescribing habits at diagnosis sheds light on the treatment paths chosen by physicians initially, and any divergence from standard therapy protocols. These also help to know how much national and international guidelines can be followed in real world clinical practice.

Moreover, retrospective approaches analyze previously collected patient data and can provide useful information on drug use patterns effectively and efficiently. These can show trends over time, areas of concern, and act as a platform for changing prescribing. Any such study becomes significant for states like Bihar, where data on drug utilization in treating diabetes is almost non-existent. Its role in the development of region-specific strategies for optimal diabetes care and improved patient outcomes [8].

In addition to this, rational prescription of anti-diabetic drugs is important to decrease adverse drug reaction and prevent polypharmacy. Unnecessary drug usage raises not only the likelihood of side effects but also imposes an economic strain on patients in low- and middle-income areas [9]. These kinds of DU studies can identify such issues, and help in suggesting the use of safer, more cost-effective therapeutic options.

So, the analysis of the drug prescribing pattern of anti-diabetic drugs in Type 2 Diabetes Mellitus patients would be essential for evaluating current clinical practices and finding out areas to improve. Such studies may help identify rationality of prescriptions, guideline adherence and overall quality of diabetes care.

The current study was conducted to evaluate the drug utilization pattern of anti-diabetic drugs among newly diagnosed Type 2 Diabetes Mellitus patients in Bihar, India. Therefore, to address the usage of different anti-diabetic drugs and encourage rationality use of medicines for better patient care and improved outcome to treatment, a retrospective study was conducted.

Methodology

Study Design: This study was a retrospective observational study conducted to evaluate the prescribing pattern of anti-diabetic drugs in patients with Type 2 Diabetes Mellitus (T2DM). The study involved reviewing previously recorded patient data without any direct intervention or interaction with patients. The objective was to analyze drug utilization patterns and prescribing trends in a real-world clinical setting.

Study Area: The study was conducted in the Department of Pharmacology, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India.

Study Duration: The study was carried out over a period of one year from January 2024 to December 2024.

Sample Size: A total of 107 patient records were included in the study. These records were selected based on the predefined inclusion and exclusion criteria to ensure the relevance and reliability of the data collected for analysis.

Study Population: The study population comprised patients diagnosed with Type 2 Diabetes Mellitus who were receiving anti-diabetic treatment and

whose medical records were available in the hospital database. Patients of both genders and various age groups were included to provide a comprehensive overview of prescribing patterns.

Data Collection: Data were collected retrospectively from the Medical Record Department (MRD) using the International Classification of Diseases (ICD-10) coding system, specifically code E11 for Type 2 Diabetes Mellitus. A structured and predesigned case record form was used to extract relevant information. The collected data included demographic details such as age and gender, clinical features, duration of illness, comorbid conditions, details of prescribed anti-diabetic drugs including dosage, frequency, route of administration, and type of therapy (monotherapy or combination therapy), along with laboratory findings and discharge summaries where available.

Inclusion Criteria

- Patients diagnosed with Type 2 Diabetes Mellitus (ICD-10: E11)
- Patients of both genders and all age groups
- Patients receiving at least one anti-diabetic medication
- Complete and accessible medical records

Exclusion Criteria

- Patients with Type 1 Diabetes Mellitus
- Gestational diabetes cases
- Patients with incomplete or missing medical records
- Patients not receiving anti-diabetic therapy

Study Procedure: Patient records were identified using the ICD-10 code E11 for Type 2 Diabetes Mellitus. Relevant data were systematically extracted and recorded in a structured format. The prescribing patterns were analyzed based on the type of anti-diabetic drugs prescribed, whether the therapy was monotherapy or combination therapy, and the use of oral hypoglycemic agents versus insulin. Drug utilization was further assessed using the Defined Daily Dose (DDD) methodology to standardize comparisons.

$$\text{DDD/100 bed} - \text{days} = \frac{\text{Drug consumption during study period (mg)} \times 100}{\text{WHO DDD (mg)} \times \text{study duration} \times \text{bed strength} \times \text{average occupancy index}}$$

Where:

- Study duration = 365 days
- Bed strength = (as per hospital data)
- Average occupancy index = (as applicable during study period)

Statistical Analysis: The collected data were entered into Microsoft Excel and subsequently analyzed using SPSS software version 20.0. Descriptive statistics were used to summarize the data, with continuous variables expressed as mean and standard deviation, and categorical variables presented as frequencies and percentages. The results were displayed in the form of tables and graphical representations such as bar charts and pie charts. Drug utilization was evaluated using the DDD per 100 bed-days method to quantify and compare the consumption of anti-diabetic drugs."

Result

Table 1 presents the demographic and clinical profile of the patients, showing a male predominance with 68 males (63.55%) compared to 39 females (36.45%), and a mean age of 54.2 ± 11.8 years. The mean BMI was 25.3 ± 4.2 kg/m², with most patients being of normal weight (46; 42.99%), followed by overweight (34; 31.78%) and obese (19; 17.76%), while 8 (7.48%) were underweight. Lifestyle factors included smoking in 12 patients (11.21%), alcohol use in 9 (8.41%), and tobacco chewing in 5 (4.67%). A family history of diabetes was present in 14 patients (13.08%), and the mean hospitalization duration was 6.2 ± 3.5 days. Comorbidities were common, affecting 76 patients (71.03%), with hypertension being the most frequent (32; 29.91%), followed by respiratory diseases (21; 19.63%), infectious diseases (13; 12.15%), ischemic heart disease (6; 5.61%), and dyslipidaemia (4; 3.74%). Overall, the table indicates that the study population mainly comprised middle-aged males with a high burden of comorbidities, particularly hypertension.

Table 1: Demographics of the Patients

Parameter	n (%)
Male	68 (63.55%)
Female	39 (36.45%)
Mean age ± SD (years)	54.2 ± 11.8
Smoker	12 (11.21%)
Alcoholic	9 (8.41%)
Tobacco chewers	5 (4.67%)
Mean BMI ± SD (kg/m²)	25.3 ± 4.2
Underweight	8 (7.48%)
Normal	46 (42.99%)
Overweight	34 (31.78%)

Obese	19 (17.76%)
Family history of diabetes	14 (13.08%)
Mean hospitalization days ± SD	6.2 ± 3.5
Comorbidities (n = 107)	
Condition	**n (%)**
Comorbidities present	76 (71.03%)
Hypertension	32 (29.91%)
Respiratory diseases	21 (19.63%)
Infectious diseases	13 (12.15%)
Ischemic heart disease	6 (5.61%)
Dyslipidaemia	4 (3.74%)

Table 2 presents the clinical characteristics of the patients, showing a mix of diabetic-specific and general symptoms. Among diabetic symptoms, generalized weakness was the most common (18; 16.82%), followed by fatigue (15; 14.02%) and polyuria (10; 9.35%), while burning micturition (8; 7.48%), polydipsia (6; 5.61%), and polyphagia (5; 4.67%) were less frequent. Among other symptoms, fever was the most common overall (28; 26.17%), followed by cough (17; 15.89%). Overall, the findings indicate that general symptoms like fever and cough were more prevalent than classic diabetic symptoms, with weakness and fatigue being the most common diabetes-related complaints.

Table 2: Clinical Characteristics of the Patients	
Clinical Characteristics	**n (%)**
Diabetic Specific	
Generalized weakness	18 (16.82%)
Fatigue	15 (14.02%)
Polyuria	10 (9.35%)
Burning micturition	8 (7.48%)
Polydipsia	6 (5.61%)
Polyphagia	5 (4.67%)
Others	
Fever	28 (26.17%)
Cough	17 (15.89%)

Table 3 presents the distribution of therapy types among patients, showing that oral anti-diabetic drugs were the most commonly used, prescribed in 46 patients (42.99%). Combination therapy with oral drugs and insulin was used in 32 patients (29.91%), indicating a substantial proportion requiring intensified treatment. Insulin alone was administered to 21 patients (19.63%), while a smaller group of 8 patients (7.48%) were managed with diet control only. Overall, the findings suggest that most patients required pharmacological treatment, with a notable number needing combination therapy for better glycemic control.

Table 3: Oral / Insulin Therapy of the Patients	
Therapy Type	**n (%)**
Oral anti-diabetic drugs	46 (42.99%)
Insulin therapy	21 (19.63%)
Oral + Insulin combination	32 (29.91%)
Diet control only	8 (7.48%)

Table 4 presents the distribution of anti-diabetic drug classes used in the study population, showing that biguanides (metformin) were the most commonly prescribed, used in 72 patients (67.29%). Insulin was the second most frequent, administered to 49 patients (45.79%), followed by sulfonylureas in 38 patients (35.51%). Other classes were used less commonly, including alpha-glucosidase inhibitors in 9 cases (8.41%), DPP-4 inhibitors in 6 cases (5.61%), thiazolidinediones in 5 cases (4.67%), and meglitinides in 3 cases (2.80%). Overall, the findings indicate a predominant use of metformin, with substantial reliance on insulin and sulfonylureas, while newer or less commonly used drug classes had relatively limited utilization.

Table 4: Treatment with Anti-Diabetic Drugs	
Drug Class	**n (%)**
Biguanides (Metformin)	72 (67.29%)
Insulin	49 (45.79%)
Sulfonylureas	38 (35.51%)
Alpha-glucosidase inhibitors	9 (8.41%)
Thiazolidinediones	5 (4.67%)
DPP-4 inhibitors	6 (5.61%)
Meglitinides	3 (2.80%)

Table 5 presents the patterns of combination anti-diabetic therapy, showing that the most common regimen was biguanides combined with insulin, used in 14 patients (31.11%). This was followed by sulfonylureas with biguanides in 12 patients (26.67%) and triple therapy with sulfonylureas, biguanides, and insulin in 9 patients (20.00%). Other combinations included sulfonylureas with insulin in 5 cases (11.11%), and regimens involving alpha-glucosidase inhibitors, such as biguanides with alpha-glucosidase inhibitors and insulin (3; 6.67%) and a four-drug combination (2; 4.44%). Overall, the findings indicate that combinations involving biguanides and insulin were most frequently used, with increasing complexity of therapy in a smaller proportion of patients.

Table 5: Combination of Anti-Diabetic Drugs	
Combination Therapy	**n (%)**
Biguanides + Insulin	14 (31.11%)
Sulfonylureas + Biguanides	12 (26.67%)
Sulfonylureas + Biguanides + Insulin	9 (20.00%)
Sulfonylureas + Insulin	5 (11.11%)
Biguanides + Alpha-glucosidase inhibitors + Insulin	3 (6.67%)
Sulfonylureas + Biguanides + Alpha-glucosidase inhibitors + Insulin	2 (4.44%)

Table 6 presents the Defined Daily Dose (DDD) per 100 bed-days for various anti-diabetic drugs, reflecting their utilization patterns in the study setting. Insulin had the highest utilization with a DDD/100 bed-days of 0.12, based on a total usage of 12,800 IU (WHO DDD: 40 IU). Among oral agents, metformin showed the next highest usage (DDD/100 bed-days = 0.065) with a total of 420,000 mg (WHO DDD: 2 g), indicating it as the most commonly used oral drug. Sulfonylureas such as glimepiride (0.028), glipizide (0.015), and glibenclamide (0.01) had moderate utilization levels, while pioglitazone had the lowest usage with a DDD/100 bed-days of 0.002. Overall, insulin and metformin were the most frequently utilized anti-diabetic agents, with relatively lower use of other oral hypoglycemic drugs.

Table 6: Defined Daily Dose (DDD) per 100 Bed-Days				
Drugs Prescribed	**ATC Code**	**WHO DDD**	**Total Drug Used**	**DDD/100 Bed-Days**
Insulin	A10AD01	40 IU	12,800 IU	0.12
Metformin	A10BA02	2 g	420,000 mg	0.065
Glimepiride	A10BB12	2 mg	180 mg	0.028
Glibenclamide	A10BB01	10 mg	220 mg	0.01
Glipizide	A10BB07	10 mg	310 mg	0.015
Pioglitazone	A10BG03	30 mg	150 mg	0.002

Table 7 presents the pattern of anti-diabetic therapy among the study population, showing that monotherapy was the most commonly used approach, observed in 44 patients (41.12%). This was followed by dual therapy in 31 patients (28.97%) and polytherapy with more than two drugs in 24 patients (22.43%). A smaller proportion of patients, 8 (7.48%), were managed with lifestyle modification alone. Overall, the findings indicate that most patients required pharmacological treatment, with a considerable number needing combination therapy to achieve glycemic control.

Table 7: Pattern of Anti-Diabetic Therapy	
Therapy Pattern	**n (%)**
Monotherapy	44 (41.12%)
Dual therapy	31 (28.97%)
Polytherapy (>2 drugs)	24 (22.43%)
Lifestyle modification only	8 (7.48%)

Discussion

Our study demonstrated a demographic profile that is largely consistent with previously published reports yet also diverges from them in certain respects. The mean age of patients evaluated in the current study was 54.2 ± 11.8 years, slightly higher than that described by Shukla et al. (2014) [10], with mean age of 48.4 ± 9.07 years, but comparable to other Indian studies showing the predominance of middle age in T2DM population (Patel et al., 2011) [11]. This supports the notion that T2DM predominantly affects middle-aged groups, although the marginally higher mean age in our study may represent delayed diagnosis or variations in eras of healthcare access. This 63.55% male predominance in our study also correlates with high stage Indian studies (Patel et al., 2011; Vengurlekar et al., 2008) [11,12], however there are contradicting results by Alam et al. (2014) [13], in which females had a relatively higher proportion. This variation might be explained by sociocultural determinants that impact healthcare-seeking behavior."

The average BMI (25.3 ± 4.2 kg/m²) of our cohort suggests risk for overweight, which agrees with the findings reported by Shukla et al. (2014) [10], with BMI of 24.67 ± 4.41 kg/m². Furthermore, the overall prevalence of overweight and obesity in our study (49.54%) reflects the increasing burden of metabolic risk factors and complements reports identifying obesity as one of the predominant contributors to T2DM in India (Kaveeshwar & Cornwall, 2014) [9]. Nonetheless, the incident of 7.48% underweight patients indicates less emphasized dual nutritional burden comorbidity in earlier studies.

Comorbidities were highly prevalent in our study (71.03%), and hypertension was the most common at 29.91%, which is comparable to observations by Patel et al. (2011), which also identified hypertension as a significant comorbidity [11], this reinforces the well-established link between T2DM and cardiovascular risk factors. Nonetheless, the higher proportions of respiratory and infectious diseases in our cohort (19.63% and 12.15%, respectively) may vary from several prior studies that focused more on cardiovascular comorbidities than respiratory ones, which could reflect a potential influence of hospitalization status or regional variation in disease characteristics.

Regarding clinical presentation, classical symptoms like polyuria (9.35%) and polydipsia (5.61%) were reported less often than during classic diabetes symptomatology descriptions. This is in contrast to previous reports where these symptoms were more abundant (Das et al., 2011) [14]. The nonspecific symptoms, such as fever (26.17%) and cough (15.89%), were more prevalent even though this may reflect the presence of concurrent infections among hospitalized cases. This variation suggests that diagnosis based on classical symptoms alone may be delayed, especially in an inpatient population.

In terms of treatment patterns, the most frequently used modality was OAD (42.99%), followed by combination therapy with insulin (29.91%) This aligns with previous reports highlighting the role of pharmacotherapy in addition to lifestyle modification (Boccuzzi et al., 2001) [15]. However, it is worth nothing that the rates of diabetes prevention through diet and exercise Were lower than some studies like in 2002 with Diabetes Prevention Program Research Group data (13.44%) [16] which may indicate a stricter prescription practice towards our population.

In our study, the most prescribed drug was metformin (67.29%) and this is in strong concordance with several other studies (Johnson et al., 2006) [17]. This is in line with current guidelines which suggest metformin as first line therapy due its efficacy, safety profile and additional metabolic benefits (DeFronzo et al., 2013) [8]. But our results are at odds with the investigations on Al Khaja et al. (2001) [18] and Chiang et al. (2006) [19], where sulfonylureas were prescribed more frequently suggesting regional differences in prescribing practices.

The use of insulin in our study (45.79%) was relatively high compared to some outpatient-based studies but is comparable to findings by Abdi et al. (2012) [20], who also reported high insulin utilization. This may be explained by the inpatient nature of our study population and the need for rapid glycemic control in patients with poor baseline control or acute illness. The DDD/100 bed-days for insulin reported in our study (0.12) was slightly higher than previous reports (0.088–0.16), which again indicates a consistent trend of increased use of insulin by inpatients.

In terms of the combination therapy patterns, metformin with insulin (31.11%) and metformin plus sulfonylureas (26.67%) were similar to previous studies which stated these combinations as commonest (Sultana et al., 2010) [21]. On the other hand, the higher prevalence of more complex regimens based on three or more combined drugs (20.00%) in our cohort reflect a higher degree of disease severity or therapeutic intensification than studies where dual therapy predominated.

The relative predominance of monotherapy in our study (41.12%) corroborates results by Patel et al. (2013) [22], who found a high proportion of patients with single-drug therapy. The proportion is lower than theirs, which was 81.58%, showing that the combination therapy in our setting can be more observed. This could be due to differences in distributions of patient characteristics, such as longer disease duration or higher baseline glucose levels.

The reported results may also be additionally supported by drug utilization analyses, which revealed metformin and glimepiride also present in similar utilization patterns as those described by Abdi et al. (2012) [20], although the relative order was slightly different. Because of safety issues, global trends have limited the widespread use of thiazolidinediones (0.002 DDD/ 100 bed-days) as in our study setting.

Our results are seen, contrary with previous studies regarding the dominance of metformin seen, as well as the rising use of insulin and the role of combination therapy in T2DM management. Nevertheless, variations in symptom profiles, comorbidity patterns and extent of polytherapy suggest the impact of the study setting, patient population and continuum of clinical practices. Hence, continuous studies of drug utilization are necessary for rational prescribing as per patient needs in varied settings.

Conclusion

The current retrospective study emphasizes the trend of prescribing anti-diabetic agents among patients with Type 2 Diabetes Mellitus showing a predilection for middle-aged individuals with a male preponderance and a high burden of comorbidities especially hypertension. The clinical presentation was indeed varied, although all patients had classical diabetic symptoms and of the associated conditions. Management of these individuals was effective, with oral anti-diabetic agents used in isolation or additively with insulin in most cases, representing a trend towards combination therapy for improved glycemic control. As the most common class prescribed was biguanides (metformin), followed by insulin and sulphonylureas, this would indicate compliance with standard treatment guidelines. Key points: the combination arms often contained biguanides in addition to insulin or a sulfonylurea challengingly indicating stepwise intensification. Analysis of defined daily dose indicated rational use of the drugs. Finally, this analysis shows a preference for evidence-based, combination-oriented therapy emphasizing metformin as the hallmark of treatment in addition to tailored therapies according to individual patient characteristics and comorbidities.

References

1. Raphael M, Vijayanarayana K, Thunga G, Rao KN, Sreedharan N. Utilization pattern of antidiabetic drugs in type 2 diabetes mellitus in tertiary care hospital. Research Journal of Pharmacy and Technology. 2017 Jul 1;10(7):2063-8.
2. Bergman U, Elmes P, Halse M, Halvorsen T, Hood H, Lunde PK, Sjöqvist F, Wade OL, Westerholm B. The measurement of drug consumption: drugs for diabetes in Northern Ireland, Norway and Sweden. European journal of clinical pharmacology. 1975 Mar;8(2):83-9.
3. Capellà D. Descriptive tools and analysis. WHO regional publications. European series. 1993 Jan 1.
4. Bergman U, Grimsson A, Wahba AH, Westerholm B. Studies in drug utilization: methods and applications. World Health Organization. Regional Office for Europe; 1979.
5. Štimac D, Čulig J. Outpatient utilization of psychopharmaceuticals in the city of Zagreb 2001-2006. Psychiatria danubina. 2009 Feb 24;21(1):56-64.
6. Akkati S, Sam KG, Tungha G. Eemergence of promising therapies in diabetes mellitus. The Journal of Clinical Pharmacology. 2011 Jun;51(6):796-804.
7. Giaccari A, Giorda CB, Riccardi G, De Micheli A, Bruno G, Monge L, Frontoni S. Comment on: Inzucchi et al. Management of Hyperglycemia in Type 2 Diabetes: A Patient-Centered Approach. Position Statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care 2012; 35: 1364–1379. Diabetes Care. 2012 Oct 1;35(10):e71-.
8. DeFronzo RA, Eldor R, Abdul-Ghani M. Pathophysiologic approach to therapy in patients with newly diagnosed type 2 diabetes. Diabetes care. 2013 Jul 17;36(Suppl 2):S127.
9. Kaveeshwar SA, Cornwall J. The current state of diabetes mellitus in India. The Australasian medical journal. 2014 Jan 31;7(1):45.
10. Shukla V, Karoli R, Chandra A. A study of newly diagnosed type 2 diabetes mellitus patients from rural areas. J Assoc Physicians India. 2014 Aug; 62:682-4.
11. Patel M, Patel IM, Patel YM, Rath SK. A hospital-based observational study of type 2 diabetic subjects from Gujarat, India. Journal of Health, Population and Nutrition. 2011;29(3):265-72.
12. Vengurlekar S, Shukla P, Patidar P, Bafna R, Jain S. Prescribing pattern of antidiabetic drugs in Indore city hospital. Indian journal of pharmaceutical sciences. 2008 Sep;70(5):637.
13. Alam MS, Aqil M, Shah Qadry SA, Kapur P, Pillai KK. Utilization pattern of oral hypoglycemic agents for diabetes mellitus type 2 patients attending out-patient department at a university hospital in New Delhi. Pharmacology & Pharmacy. 2014;5(07):636-45.
14. Das P, Das BP, Rauniar GP, Roy RK, Sharma SK. Drug utilization pattern and effectiveness analysis in diabetes mellitus at a tertiary care centre in eastern Nepal. Indian J Physiol Pharmacol. 2011 Jul 1;55(3):272-80.
15. Boccuzzi SJ, Wogen J, Fox J, Sung JC, Shah AB, Kim J. Utilization of oral hypoglycemic agents in a drug-insured US population. Diabetes care. 2001 Aug 1;24(8):1411-5.

16. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. New England journal of medicine. 2002 Feb 7;346(6):393-403.
17. Johnson JA, Pohar SL, Secnik K, Yurgin N, Hirji Z. Utilization of diabetes medication and cost of testing supplies in Saskatchewan, 2001. BMC Health Services Research. 2006 Dec 12;6(1):159.
18. Al Khaja KA, Sequeira RP, Mathur VS. Prescribing patterns and therapeutic implications for diabetic hypertension in Bahrain. Annals of Pharmacotherapy. 2001 Nov;35(11):1350-9.
19. Chiang CW, Chiu HF, Chen CY, Wu HL, Yang CY. Trends in the use of oral antidiabetic drugs by outpatients in Taiwan: 1997–2003. Journal of clinical pharmacy and therapeutics. 2006 Feb;31(1):73-82.
20. Abdi SA, Churi S, Kumar YR. Study of drug utilization pattern of antihyperglycemic agents in a South Indian tertiary care teaching hospital. Indian journal of pharmacology. 2012 Mar 1;44(2):210-4.
21. Sultana G, Kapur P, Aqil M, Alam MS, Pillai KK. Drug utilization of oral hypoglycemic agents in a university teaching hospital in India. Journal of clinical pharmacy and therapeutics. 2010 Jun;35(3):267-77.
22. Patel B, Oza B, Patel KP, Malhotra SD, Patel VJ. Pattern of antidiabetic drugs use in type-2 diabetic patients in a medicine outpatient clinic of a tertiary care teaching hospital. Int J Basic Clin Pharmacol. 2013 Jul;2(4):485-91.