**ORIGINAL RESEARCH** 

# Pharmacoeconomic comparison of cost variation of oral antidiabetic drugs available in Indian market

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## ABSTRACT

Introduction: Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys andnerves. A majority of affected patients living in low-and middle-income strata of the society. Today, a substantial number of oral anti-diabetic drugs are available for the treatment of Type 2 diabetes mellitus. But, there are numerous brands available for each of the individual oral antidiabetic drug. Aims and objectives: Our study aims to find out the variation in prices of different brands of the single oral hypoglycemicdrug by calculating percent cost variation, cost ratio and the same in terms of Defined Daily Dose (DDD) as well. Methodology : The information about the prices of various brands of 19 single oral Anti-diabetic drugs were obtained. The cost of drugs were taken from the latest issue of (CIMS) Current Index of Medical Specialities April-July 2023, Drug Today April July 2023, 1mg online site. Cost ratio and Cost percent variation, was calculated using Microsoft Excel Software .Drugs belonging to same as well as different groups of anti-diabetic drugs were compared and analysed. Analysis and results: Among all oral anti- diabetic drugs, glibenclamide5 mg (900%) was found to have highest cost ratio and cost variation and canagliflozin 100 mg(10.57 %) was found to have lowest. Amidst DP44 inhibitors class of Oral Hypoglycemic Drugs, Sitagliptin 25 mg (506.67 %) has highest cost variation and saxagliptin 2.5 mg (43.16 %) showed lowest. In the group of sulfonylurea group of drugs, Glibenclamide 5 mg (900 %)& Glimepiride 0.5mg(27%) showed highest and lowest cost variation respectively. Similarly, among Thiazolidinediones, the highest cost variation was with Pioglitazone 15 mg (350 %) whereas rosiglitazone 4 mg(78%) showed the lowest.alpha glucosidase inhibitors of oral antidiabetic drugs. Voglibose 0.2mg (242.77%) showed highest and acarbose 50 mg (26.77 %) showed lowest cost variation. Conclusion: Our study reveals that The cost variation among the different brands of the same drug is very high. This imposes a great economic burden on the patients and adversely affects compliance. Thus, our study will provide an insight to the prescriber and Drug Price control authorities to minimize the financial burden on the patients, and lead to betterment of patient care in the country.

Keywords: Cost analysis, hypoglycemic drugs, cost ratio, cost percentage variation

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## INTRODUCTION

Diabetes is a chronic, multifactorial disease characterized by elevated levels of blood glucose.

It is a disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin<sup>.[1]</sup>

In the past 3 decades the prevalence of type 2 diabetes has risen dramatically in countries of all income levels. More than 8.5% of adults aged 18 years and older had diabetes in 2014 <sup>.[1].</sup> In 2019, diabetes was the direct cause of 1.5 million deaths and 48% of all deaths due to diabetes occurred before the age of 70

years.<sup>[1]</sup>Another 460 000 kidney disease deaths were caused by diabetes, and raised blood glucose causes around 20% of cardiovascular deaths<sup>.[1]</sup>. About 422 million people worldwide have diabetes, the majority living in low-and middle-income countries, and 1.5 million deaths are directly attributed to diabetes each year<sup>[1]</sup> Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades.

The majority of affected patients live in low-and middle-income strata of the society. Access to affordable treatment is crucial for survival of people

living with diabetes . As the demand for the treatment is high, supply of drugs is also high. Today, a large number of oral anti-diabetic drugs are available for the treatment of Type 2 diabetes mellitus. But, there are numerous brands available for each of the individual anti-diabetic drug. The cost variation among the different brands of drugs is very huge. This leads to reluctance of patients buying medicines and ultimately affects quality of patient care.

This study aims tocalculate the cost variation among a large number of variety of drugs; in each category of oral hypoglycemic drugs .This will analyze the variation in prices of different brands of oral antidiabetic drugs available in Indian Pharmaceutical Market.

Our research article analyzes maximum and minimum prices per "Daily Defined Dose" which provides a fixed unit of measurement independent of price, currencies, pack size and strength, enabling a standardization in cost variation among various oral hypoglycemic drugs.

It also shows the actual scenario of cost variation among the most commonly used doses of various drugs. Also DDDs can also be used as a direct measure to correlate between the price variation among various hypoglycemic drugs.

Morever, Diabetes is a chronic complication and imposes an economic burden on the patients continuously for a long term. Therefore, it is crucial to perform cost analysis every 5-6 years to keep a check on the cost variation in the latest prices of drugs. Our article does the cost analysis of the latest prices of the antidiabetic drugs with reference to CIMS 2023 and Drug today 2023.

Our study will help to guidethe notify the National Pharmaceutical Pricing Authority to intervene and regulate the prices of these frequently used hypoglycemic drugs.

Also, providing a drug manual to the physicians with information on the various available brands and their prices would be beneficial.

## METHODOLOGY

The study was conducted at the Department of Pharmacology, M.G.M medical college and M.Y Hospital Indore. An analytical and comparative type of

economic analysisof various oral anti diabetic drugs available in the Indian Marketwas the mainstay of our research. The information about the prices of various brands of 19 single oral Anti-diabetic drugs were obtained. The cost of drugs was taken from the latest issue of (CIMS) Current Index of Medical Specialities April-July 2023<sup>[2]</sup> Drug Today April July 2023<sup>[3],</sup>1 mg online site and market survey.Maximum minimum cost per tablet among various brands of five classes of antidiabetic drugs was calculated.Cost ratio and cost percent variation was calculated using Microsoft excel software.

#### **CASE DEFINITIONS:**

# 1. Daily Defined dose<sup>[4]</sup>

The assumed average maintenance dose per day for a drug used for its main indication in adults

## **2. Cost ratio**<sup>[5]</sup>

It is the ratio of the cost of the costliest to the cheapest branded formulation of a particular drug which gives an idea of how much is the expensive brand costlier than the cheapest brand of the same drug.

# 3. Cost variation percent<sup>[6]</sup>

It was calculated as follows Cost variation %= Maximum cost-Minimum cost: Minimum cost x100.

The minimum and maximum price per unit (tablet/capsule) among various brands of drugs was calculated .

DDD of a particular drug in the same and different doses were calculated.

Number of manufacturing companies were also noted. **Daily defined dose** of each drug was mentioned. Then, Minimum and maximum price per DDD was also calculated by multiplying DDD with respective price(in rupees)per unit.

Now, the difference in prices of different brands of same drug were compared by calculating cost ratio and cost variation percentage. The data obtained was expressed in percentages and the results have been shown in tables and bar graphs.

## RESULTS

The following table summarizes the minimum price and maximum price per DDD,cost ratio and cost variation percentage of each drug and their respective doses.

	Drug		Minimu					
	_	Daily	m cost	Minimu	Maximu	Maximu		
		Define	(Per	m Price	m (Per	m Price		%
		d Dose	Tablet)	per DDD	Tablet)	per DDD	Cost Ratio	Variation
		Daily		Minimu		Maximu		Cost
S.N		define	Minimu	m price	Maximu	m price		Percent
0	Drug	d dose	m price	per DDD	m price	per DDD	Cost ratio	Variation
1.	Sitagliptin 25						6.06666666	506.666666
	mg	100 mg	6	24	36.4	145.6	7	7
2.	Sitagliptin 50						1.71428571	71.4285714
	mg		7.7	15.4	13.2	26.4	4	3
3.	Sitagliptin						3.80645161	280.645161
	100 mg		9.3	9.3	35.4	35.4	3	3

4.	Vildagliptin						3.38461538	238.461538
	50 mg	100 mg	6.5	13	22	44	5	5
5.	Vildagliptin	- U					2.09195402	109.195402
	100 mg		8.7	8.7	18.2	18.2	3	3
6	Saxaglintin						1 43165467	43 1654676
0.	2.5 mg	5 mg	27.8	55.6	39.8	79.6	6	3
7	Savaglintin	Jing	27.0	55.0	57.0	17.0	1 75161200	75 1612003
7.	Saxagiiptiii		21	21	512	54.2	1.75101290	73.1012903
0			51	51	34.5	34.5	5	2
8.	Alogliptin	2.5	o <b>-</b>	10.4	~ -	10.4		0
	12.5 mg	25 mg	9.7	19.4	9.7	19.4	1	0
9.	Alogliptin 25							
	mg		11.9	11.9	11.9	11.9	1	0
10.	Glibenclamid							
	e 1.25 mg	10 mg	0.38	3.04	0.38	3.04	1	0
11.	Glibenclamid						1.81081081	81.0810810
	e 2.5 mg		0.37	1.48	0.67	2.68	1	8
12	Glibenclamid						_	
12.	e 5 mg		0.5	1	5	10	10	900
12	Clinizida 2.5		0.5	1	5	10	4 50250250	250 250250
15.	Glipizide 2.5	10	0.27	1.00	1.04	1.00	4.39239239	559.259259
	mg	10 mg	0.27	1.08	1.24	4.96	3	3
14.	Glipizide 5							
	mg		0.4	0.8	1.2	2.4	3	200
15.	Glipizide 7.5							
	mg		1.3	1.73	1.3	1.73	1	0
16.	Glipizide 10						3.33333333	233.333333
	mg		0.6	0.6	2	2	3	3
17.	Gliclazide 30						2,70454545	170.454545
1.1.	mg	60 mg	44	8.8	11.9	23.8	5	5
18	Gliclazide 40	00 mg		0.0	11.9	23.0	1 7553191/	75 53191/8
10.			282	3 78	4 05	7 42	0	0
10	Cliplorido 60		2.82	5.70	4.95	7.42	2 10059004	110.059004
19.	Gliciazide 60		7.2	7.2	15 4	15 4	2.10958904	110.958904
20	mg		1.3	1.5	15.4	15.4	1	1
20.	Gliclazide 80						2.890/9229	189.079229
	mg		4.67	3.5	13.5	10.12	1	1
21.	Glimepiride						1.27533460	
	0.5 mg	2 mg	5.23	20.92	6.67	26.68	8	27.5334608
22.	Glimepiride							
	1 mg		1.6	3.2	4.14	8.28	2.5875	158.75
23.	Glimepiride							
	2  mg		2.75	2.75	6.49	6.49	2.36	136
24	Glimeniride						3 4444444	244 444444
2	3 mg		45	3	15.5	10.33	4	4
25	Glimeniride		1.5	5	15.5	10.55	2 60072451	160 072451
23.	4 mg		7 26	3 63	10.6	0.8	2.07772431	8
24	+ mg		1.20	5.05	17.0	7.0	0	0
∠0.	Rosigiliazone	6	2	10	2	10	1	0
	1 mg	6 mg	2	12	2	12	1	0
27.	Rosiglitazone						1.93333333	93.3333333
	2 mg		3	9	5.8	17.4	3	3
28.	Rosiglitazone							
	4 mg		5	7.5	8.9	13.35	1.78	78
29.	Rosiglitazone						2.70270270	170.270270
	8 mg		3.7	2.77	10	7.5	3	3
30.	Pioglitazone						2.77142857	177.142857
	7 5 mg	30 mo	35	14	97	38.8	1	1
31	Pioglitazona	50 mg	5.5	17	7.1	50.0	1	1
51.	15 mg		16	3 7	7 7	14.4	15	350
22	Dioglitagene		1.0	5.2	1.2	14.4	4.3	200 222500
52.	Piogintazone		2.1	2 1	10.1	10.1	3.90322380	290.522580 C
22	30 mg	200	5.1	5.1	12.1	12.1	0	0
33.	Canaglitlozin	200mg	50.1	100.2	55.4	110.8	1.10578842	10.5788423

	100mg						3	2
34.	Canagliflozin						1.12743506	12.7435064
	300mg		123.2	82.13	138.9	92.6	5	9
35.	Dapagliflozin							
	5mg	10mg	5	10	26.5	53	5.3	430
36.	Dapagliflozin						2.33333333	133.333333
	10mg		12	12	28	28	3	3
37.	Empagliflozi						4.95555555	395.555555
	n 10mg	17.5mg	13.5	23.625	66.9	117.075	6	6
38.	Empagliflozi							
	n 25mg		16	11.2	58.2	40.74	3.6375	263.75
39.	Remogliflozi						1.22641509	22.6415094
	n 100mg		10.6		13		4	3
40.	Acarbose						1.34328358	
	25mg	300mg	6.7	80.4	9	108	2	34.32
41.	Acarbose							
	50mg		12.8	76.8	16.2	97.2	1.265625	26.5625
42.	Voglibose							
	0.2mg	0.6 mg	3.53	10.59	12.1	36.3	3.42	242.77
43.	Voglibose							
	0.3mg		5.6	11.2	16.3	32.6	2.91	191
44.	Miglitol							
	25mg	3mg	17.6	2.11	17.6	2.11	1	0
45.	Rapaglinide							
	0.5 mg	4mg	2.2	17.6	10.2	81.6	4.6363	363.636
46.	Rapaglinide							
	1mg		4.4	17.6	19.5	78	4.4318	343.1818
47.	Rapaglinide							
	2mg		7.8	15.6	27.5	55	3.5256	252.5614
48.	Nateglinide							
	60mg	360mg	3	18	4.5	27	1.5	50

The following figures compares the percentage of cost variation among different drugs of same category.



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## DISCUSSION

Diabetes is one of the most common diseases affecting people of all age groups. An effective management of diabetes mellitus comprises of both lifestyle modifications and pharmacologic therapies as necessary to meet individualized glycemic goals of the patients.

Diabetes affects more than 77 million individuals in India in 2019, which is expected to rise to over 134 million by 2045<sup>[9].</sup> As the demand is high, the supply is also high.

Oral hypoglycemic drugs are one of the most prescribed drugs in the society. As a result of the enormous demand, there are numerous brands of each formulation produces by a wide variety of pharmaceutical companies in the Indian Market. This leads to a huge variation in the prices of different brands of a single drug. In our country, a majority of diabetic patients fall in the middle and low income strata of the society. World Health Organization says that the Prevalence has been risingmore rapidly in low- and middle-income countries than in highincome countries. <sup>[2].</sup> Hence, it is vital for to keep a check on its prices as it can influence the drug selection, cost regulation and formulatory development so as toreduce the economic burden on the patients. <sup>[7]</sup>Therefore, our study focuses on the cost analysisof the variation in prices of different brands of

oral antidiabetic drugs available in Indian Pharmaceutical Market.

The study was conducted at the Department of Pharmacology, M.G.M medical college and M.Y Hospital Indore. An analytical and comparative type of economic analysis of various oral anti diabetic drugs available in the Indian Market was the mainstay of our research.

The information about the prices of various brands of 19 single oral Anti-diabetic drugs were obtained. The cost of drugs was taken from the latest issue of (CIMS) Current Index of Medical Specialities April-July 2023, Drug Today April July 2023, 1 mg online site and market survey. Maximum and minimum cost per tablet among various brands of five classes of antidiabetic drugs was calculated. The prices were calculated in terms of DDD as well.Cost ratio and cost percent variation per DDD was calculated using Microsoft excel software.Cost analysis among drugs in same class and different classes was done by cost variation and cost percentage variation. Results were plotted in tables and graphs.

The highest percentage of cost variationwas Glibenclamide 5mg (900%) whereas canagliflozin 100 mg (10.57%) showed the lowest cost variation.

Figure 1 shows price variations among DP44 inhibitors of OHA's. Sitagliptin 25 mg (506.67 %) has highest cost variation and saxagliptin 2.5 mg (43.16 %) showed lowest.

Figure 2shows price variations amidst sulfonylurea group of OHA's. Glibenclamide 5 mg (900 %) & Glimepiride 0.5mg(27%)shows maximum and minimum price variation of pricevariationsrespectively.

Figure 3 shows price variations among Thiazolidinediones. The highest percentage of cost variation was Pioglitazone 15 mg (350 %) whereas rosiglitazone 4 mg(169 %) showed the lowest percent cost variation .

Figure 4 shows price variations in the group of SGLT 2 inhibitorsOHA's,Dapagliflozin 5 mg(430 %) had highest and Canagliflozin 100mg (10.57 %) showed lowestcost variation.

Figure5 shows price variations among alpha glucosidase inhibitors of OHA's.Voglibose 0.2mg (242.77%)showed highest and Acarbose 50 mg (26.27%)showed lowest cost variation.

In meglitinides group of OHAs,Rapaglinide 1mg (363 %) had highest and nateglinide 60 mg had lowest (50%) cost variation.

cost variation (50%) .Earlier cost analysisstudieshave also shown highest cost variation with Glibenclamide 5 mg and least variation with miglitol 25 mg.Another study revealed highest cost variation of glimiperide 1 mg (3450 %) and among the thiazolidinediones,Pioglitazone 15 mg shows a maximum, price variation of  $300\%^8$ .One more study also revealed Pioglitazone 15 mg to be having highest cost variation 185.7 and Acarbose 25 mg (117.18%) to have lowest cost variation<sup>13</sup> .In yet another study,Glimepiride (1 mg) shows maximum price variation of 655.38% and repaglinide 2 mg 30.66 % showed the least variation  $^{(14)}$ 

To summarize, in order to fulfil the ever increasing demand, a large number of oral hypoglycemic drugs are being continuously supplied in the market by different pharmaceutical companies. In India, most physicians use brand names while prescribing drugs and are unaware of other brands and the wide variation in prices that exists. On the other hand, Pharmaceutical companies continue to promote their brands to the physicians with profitable offers. To regulate the prices, ceiling prices of drugs has been fixed by DPCO <sup>(8)</sup>.but are these measures enough? Obviously not .Inspite of strict regulations, our study revealed a wide range

large cost variation among most commonly prescribed oral anti-diabetic drugs This leads to wide range of price variation and becomes an obstacle in the treatment for both the physicians and patient<sup>(9)</sup>.Our study will help to notify the National Pharmaceutical Pricing Authorityto intervene and regulate the prices of these commonly used hypoglycemic drugs.

Also our study can help in providing a drug manual to the physicians with information on the various available brands and their prices would be helpful.

## CONCLUSION

Our study showed a wide variation in the cost of antidiabetic drugs available in Indian market .This imposes a great economic burden on the patients and adversely affects compliance. Thus, our study will provide an insight to the prescribers and National Pharmaceutical Pricing Authority to minimize the financial burden on the patients which will ultimately lead to betterment of patient care in the country.

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