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PHARMACOECONOMICS OF ORAL WEIGHT-LOWERING DRUGS IN TYPE 2 DIABETES: A COMPARATIVE STUDY OF SGLT-2 INHIBITORS AND GLP-1 ANALOGUES IN INDIA

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Abstract

Objective: To assess the affordability and adherence implications of SGLT-2 inhibitors and GLP-1 analogues in the Indian context, with a focus on Pharmacoeconomics and cost variations

Methods: Medication price data were collected from the Current Index of Medical Specialties (CIMS) and accredited online sources for SGLT-2 inhibitors and GLP-1 analogues from January 2024 to April 2024. Percentage cost variation was calculated to analyse price differences among brands.

Results: SGLT-2 inhibitors, particularly dapagliflozin, exhibited significant price variations, with costs ranging from INR 5.9 to INR 30 per tablet. Combination therapies showed moderate variations, while GLP-1 analogues, including oral semaglutide, were substantially more expensive, ranging from INR 294.81 to INR 387 per tablet.

Conclusion: The study underscores the need for cost-effective prescribing practices to improve affordability and adherence, particularly for resource-constrained settings in India. Integration of these drugs into essential medicine lists and price regulation could alleviate financial strain and enhance accessibility.

Keywords: Cost-effective, GLP-1 analogues,Pharmacoeconomics, SGLT-2 inhibitors, Type 2 diabetes, Weight-lowering drugs.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a pervasive chronic metabolic disorder that results in high blood sugar levels due to insulin resistance and insufficient insulin secretion. This condition is a significant global health challenge, with its prevalence rapidly increasing across both developed and developing nations[1].According to the International Diabetes Federation, the number of adults with diabetes is projected to reach 700 million by 2045[2]. A considerable number of T2DM patients also face obesity, which complicates disease management and heightens the risk of cardiovascular and other health complications[3-5].

Effective management of T2DM necessitates a holistic approach that includes lifestyle changes, regular blood glucose monitoring, and pharmacotherapy. In recent years, new classes of antidiabetic medications have been introduced that not only help control blood sugar levels but also facilitate weight loss. Among these, sodium-

glucose cotransporter-2 (SGLT-2) inhibitors and glucagon-like peptide-1 (GLP-1) analogues have become prominent due to their dual benefits in glycemic control and weight reduction[6-9].

SGLT-2 inhibitors work by preventing the kidneys from reabsorbing glucose, which stimulates the excretion of glucose through urine. Through the excretion of glucose, this process helps lower blood glucose levels and promotes weight loss. SGLT-2 inhibitors such as dapagliflozin, empagliflozin, canagliflozin, and others are frequently utilized[10]. These medications have gained popularity in the treatment of T2DM because they have been demonstrated to lower cardiovascular events.[11-13].

GLP-1 analogues, on the other hand, function similarly to the incretin hormone GLP-1 by increasing insulin production, inhibiting glucagon release, and prolonging stomach emptying. These actions promote satiety and blood glucose regulation, which aid in weight loss. Semaglutide is a well-known GLP-1 analogue available in oral form, providing a convenient option for patients who prefer not to use injections.

Despite their clinical benefits, the high cost of these medications can be a barrier to access, particularly in resource-constrained settings like India. The economic burden of T2DM and its complications is significant, and the cost of newer antidiabetic drugs can further strain patients' and the healthcare system's financial resources[14]. Therefore, understanding the Pharmacoeconomics of these medications is essential for making informed decisions that balance clinical efficacy and cost-effectiveness.

This study aims to analyze the cost variations of SGLT-2 inhibitors and GLP-1 analogues available in India, offering insights into their affordability and potential economic impact on patients. The study emphasizes the significance of cost-effective prescribing techniques to enhance adherence to medications and patient outcomes by comparing the prices of different brands and formulations.

Materials and Methods

Study design

This observational study was conducted from January 2024 to April 2024 to evaluate the cost variations of SGLT-2 inhibitors and GLP-1 analogues.

Data collection

1. SGLT-2 Inhibitors:

Pricing data for SGLT-2 inhibitors were retrieved from the Current Index of Medical Specialties (CIMS), which provides comprehensive drug pricing details. CIMS data were accessed through a subscription to their online portal during the study period.The formulations analysed included:

- Dapagliflozin: 5mg and 10mg
- Empagliflozin: 10mg and 25mg

2. GLP-1 ANALOGUES:

The Data was collected from accredited online sources, including official pharmaceutical websites, accredited online pharmacies like 1mg and PharmEasy, and government pricing databases, including the National Pharmaceutical Pricing Authority (NPPA), to ensure accuracy and reliability

- Semaglutide: 3mg, 7mg, and 14mg

3. COMBINATION FORMULATIONS:

The study also included costs for combination therapies, with the following formulations assessed:

- Dapagliflozin/Metformin: 10mg/1000mg, 5mg/1000mg, and 10mg/500 mg
- Dapagliflozin/Vildagliptin: 10mg/100mg
- Linagliptin/Dapagliflozin: 5mg/10mg

Costs for these combination therapies were also sourced from the CIMS.

4.Study Period: The Data was collected between January 2024 and April 2024 to ensure a consistent and updated pricing snapshot for analysis

Data analysis

1. Cost Collection:

Conversion to Cost per Tablet: Prices were initially provided per 10-tablet packaging units. To ensure uniformity and facilitate comparison across formulations, all prices were standardized to a per-tablet cost by dividing the total price by 10.

2. Calculate Cost Variation:

For each drug class and formulation, the following steps were performed

- Determine the minimum and maximum cost per tablet.
- Subtract the Minimum Cost from the Maximum Cost to get the difference in cost.
- Divide the Difference by the Minimum Cost to find how much the cost varies relative to the lowest price.
- Multiply the result by 100 to convert the cost variation into percentage

- Calculate the percentage cost variation using the following formula:

$$\text{Percentage cost variation} = \frac{\text{Maximum cost} - \text{Minimum cost}}{\text{Minimum cost}} \times 100$$

- Prices were standardized to cost per tablet for comparison.

3. EXCLUSION CRITERIA:

Herbal preparations and single-manufacturer formulations were excluded to focus on pharmaceuticals available from multiple sources.

Statistical analysis

Descriptive statistics were employed to summarize the cost data. To determine cost-effectiveness and its implications for healthcare costs, the study examined the costs of several SGLT-2 inhibitors and GLP-1 analogues.

Results

A. SGLT-2 Inhibitors:

1. Dapagliflozin 5mg:

The formulation and cost of 5mg Dapagliflozin of different available brands in the Indian market are tabulated as shown in Table 1.

The percentage cost variation was then calculated.

- Total Formulations: 6
- Percentage Variation in Cost: 383.05%

Table 1. Pricing of 5 mg Dapagliflozin Tablets in the Indian Market

S. No	Generic Name	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Dapagliflozin	Tablet	5	FORXIGA	28.5
2	Dapagliflozin	Tablet	5	DAPZIN	15.999
3	Dapagliflozin	Tablet	5	ZINODAP	10.85
4	Dapagliflozin	Tablet	5	DAPASAIN	6
5	Dapagliflozin	Tablet	5	ADD SG	5.9

("mg = milligrams; INR = Indian Rupee").

2. Dapagliflozin 10mg:

The formulation and cost of 10 mg Dapagliflozin of different available brands in the Indian market are tabulated as shown in Table 2.

The percentage cost variation had been then calculated.

- Total Formulations: 9
- Percentage Variation in Cost: 328.57%

Table 2. Pricing of different brands of 10 mg Dapagliflozin tablets available in the Indian market

S. No	Generic Name	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Dapagliflozin	Tablet	10	FORXIGA	30
2	Dapagliflozin	Tablet	10	FORXIGA	28.675
3	Dapagliflozin	Tablet	10	DAPZIN	23.999
4	Dapagliflozin	Tablet	10	ZINODAP	15.9
5	Dapagliflozin	Tablet	10	DAPAGLANZ	13
6	Dapagliflozin	Tablet	10	DAPASIG	11.8
7	Dapagliflozin	Tablet	10	DAPASAIN	10
8	Dapagliflozin	Tablet	10	ADD SG	7.9
9	Dapagliflozin	Tablet	10	DIABIZ	7

("mg = milligrams; INR = Indian Rupee").

3.Empagliflozin 10mg:

The formulation and cost of 10 mg Empagliflozin of different available brands in the Indian market are tabulated as shown in Table 3.

The percentage cost variation

- Total Formulations: 3
- Percentage Variation in Cost: 328.57%

Table 3. Pricing of 10mg Empagliflozin tablets available in the Indian market

S. No	Generic Name	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Empagliflozin	Tablet	10	JARDIANCE	55
2	Empagliflozin	Tablet	10	GIBTULIO	55
3	Empagliflozin	Tablet	1O	COSPIAQ	48

("mg = milligrams; INR = Indian Rupee").

4. Empagliflozin 25mg:

The formulation and cost of 25mg Empagliflozin of different available brands in the Indian market are tabulated as shown in Table 4.
The percentage cost variation

- Total Formulations: 3
- Percentage Variation in Cost: 14.58%

Table 4. Pricing of 25 mg Empagliflozin tablets available in the Indian market

S. No	Generic Name	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Empagliflozin	Tablet	25	JARDIANCE	57
2	Empagliflozin	Tablet	25	GIBTULIO	55
3	Empagliflozin	Tablet	25	COSPIAQ	57

("mg = milligrams; INR = Indian Rupee").

5.Dapagliflozin + Metformin (10mg/1000mg):

The formulation and cost of Fixed dose combination containing 10mg Dapagliflozin and 1000 mg Metformin of different available brands in the Indian market are tabulated as shown in Table 5. The percentage cost variation had been then calculated.

- Total Formulations: 7
- Percentage Variation in Cost: 61.61%
-

Table 5: Pricing of different brands of Dapagliflozin + Metformin (10mg/1000mg) available in the Indian market

S. No	Drug Combination (Generic Name)	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Dapagliflozin + Metformin	Tablet	10/1000	DAPAGLANZ-M	16
2	Dapagliflozin + Metformin	Tablet	10/1000	DAPASIG-M FORTE	15.6
3	Dapagliflozin + Metformin	Tablet	10/1000	ZINODAP-M	12.9133
4	Dapagliflozin + Metformin	Tablet	10/1000	DAPASAIN-XR	12.395
5	Dapagliflozin + Metformin	Tablet	10/1000	DAPASHINE-M	11.9
6	Dapagliflozin + Metformin	Tablet	10/1000	DIABIZ-M FORTE	10
7	Dapagliflozin + Metformin	Tablet	10/1000	XGLET M	9.9

("mg = milligrams; INR = Indian Rupee").

6. Dapagliflozin + Metformin (5mg/1000mg):

The formulation and cost of Fixed dose combination containing 5 mg Dapagliflozin and 1000 mg Metformin of different available brands in the Indian market are tabulated as shown in Table 6. The percentage cost variation was then calculated.

- Total Formulations: 2
- Percentage Variation in Cost: 13.98%

Table 6 Pricing of different brands of Dapagliflozin + Metformin (5mg/1000mg) available in the Indian market

S. No	Drug Combination (Generic Name)	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Dapagliflozin + Metformin	Tablet	5/1000	ZINODAP-M TAB	9
2	Dapagliflozin + Metformin	Tablet	5/1000	JUSTOZA-M	7.9

("mg = milligrams; INR = Indian Rupee").

7. Dapagliflozin + Metformin (10mg/500mg):

The formulation and cost of Fixed dose combination containing 10mg Dapagliflozin and 500 mg Metformin of different available brands in the Indian market are tabulated as shown in Table 7. The percentage cost variation was then calculated.

- Total Formulations: 6
- Percentage Variation in Cost: 66.66%

Table 7: Pricing of different brands of Dapagliflozin + Metformin (5mg/500mg) available in the Indian market

S. No	Drug Combination (Generic Name)	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Dapagliflozin + Metformin	Tablet	10/500	DAPAGLANZ-M	15
2	Dapagliflozin + Metformin	Tablet	10/500	DAPASIG-M	14.5
3	Dapagliflozin + Metformin	Tablet	10/500	DAPASMILE-M	12.6
4	Dapagliflozin + Metformin	Tablet	10/500	ZINODAP-M	11.177
5	Dapagliflozin + Metformin	Tablet	10/500	DAPASAIN-M	10.725
6	Dapagliflozin + Metformin	Tablet	10/500	DIABIZ-M	9

("mg = milligrams; INR = Indian Rupee").

8. Dapagliflozin + Vildagliptin (10mg/100mg):

The formulation and cost of Fixed dose combination containing 10mg Dapagliflozin and 100 mg Vildagliptin of different available brands in the Indian market are tabulated as shown in Table 8. The percentage cost variation

- Total Formulations: 7
- Percentage Variation in Cost: 36.81%

Table 8: Pricing of different brands of Dapagliflozin + Vildagliptin (10mg/100mg) available in the Indian market

S. No	Drug Combination (Generic Name)	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Dapagliflozin + Vildagliptin	Tablet	10/100	DAFLOZ-VD	24.9
2	Dapagliflozin + Vildagliptin	Tablet	10/100	JALRA-DP	19.5
3	Dapagliflozin + Vildagliptin	Tablet	10/100	DAPARYL-V	20
4	Dapagliflozin + Vildagliptin	Tablet	10/100	ZOMELIS-D	18.2
5	Dapagliflozin + Vildagliptin	Tablet	10/100	GLIPTAGREAT-D	18.2
6	Dapagliflozin + Vildagliptin	Tablet	10/100	ZUKANORM-D	18.2

7	Dapagliflozin + Vildagliptin	Tablet	10/100	VYLDA-D	20

("mg = milligrams; INR = Indian Rupee").

9. Linagliptin + Dapagliflozin (5mg/10mg):

The formulation and cost of Fixed dose combination containing 5mg Linagliptin and 10 mg Dapagliflozin of different available brands in the Indian market are tabulated as shown in Table 9.

The percentage cost variation

- Total Formulations: 6
- Percentage Variation in Cost: 38.57%

Table 9: Pricing of different brands of Linagliptin + Dapagliflozin (5mg/10mg) available in the Indian market

S. No	Drug Combination (Generic Name)	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Linagliptin + Dapagliflozin	Tablet	5/10	JUSLINA-D	12.99
2	Linagliptin + Dapagliflozin	Tablet	5/10	ONDERO-D	18.1
3	Linagliptin + Dapagliflozin	Tablet	5/10	LINAXA-D	16.8
4	Linagliptin + Dapagliflozin	Tablet	5/10	GLUCRETA-L	16.8
5	Linagliptin + Dapagliflozin	Tablet	5/10	OXRA-L	18
6	Linagliptin + Dapagliflozin	Tablet	5/10	LINAPRIDE-D	15.1

("mg = milligrams; INR = Indian Rupee").

B. GLP-1 analogues:

1. Semaglutide 3mg:

The formulation and cost of 3mg Semaglutide of different available brands in the Indian market are tabulated as shown in Table 10.

The percentage cost variation is not applicable as only a single formulation is available.

- Total Formulations: 1

Table 10: Pricing of 3mg Semaglutide tablets available in the Indian market

S. No	Generic Name	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Semaglutide	Tablet	3	RYBELSUS	294.81

("mg = milligrams; INR = Indian Rupee").

2. Semaglutide 7mg:

The formulation and cost of 7mg Semaglutide of different available brands in the Indian market are tabulated as shown in Table 11.

The percentage cost variation is not applicable as only a single formulation is available.

- Total Formulations: 1

Table 11: Pricing of 7mg Semaglutide tablets available in the Indian market

S. No	Generic Name	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Semaglutide	Tablet	7	RYBELSUS	352

("mg = milligrams; INR = Indian Rupee").

3. Semaglutide 14mg:

The formulation and cost of 14 mg Semaglutide of different available brands in the Indian market is tabulated as shown in Table 12.

The percentage cost variation is not applicable as only a single formulation is available.

- Total Formulations: 1

Table 12: Pricing of 14 mg Semaglutide tablets available in the Indian market

S. No	Generic Name	Formulation	Dose (mg)	Brand Name	Cost/Tablet (INR)
1	Semaglutide	Tablet	14	RYBELSUS	387

("mg = milligrams; INR = Indian Rupee").

DISCUSSION

The results show notable price differences between the different brands of GLP-1 analogues and SGLT-2 inhibitors sold in India. These price variations have significant implications for medication affordability, Patients adherence, and overall healthcare expenses, particularly in resource-constrained settings.

Implications in Price Variations

For SGLT-2 inhibitors, dapagliflozin exhibits notable price variation across brands. The 5 mg dose ranges from INR 5 to INR 28.5 per tablet (383.05% variation), while the 10 mg dose ranges from INR 7 to INR 30 per tablet (328.57% variation). These discrepancies highlight the need for cost-effective prescribing practices to reduce financial strain on patients, especially those from economically weaker backgrounds. Similarly, empagliflozin shows considerable variation: the 10 mg dose is priced between INR 48 and INR 55 per tablet, and the 25 mg dose ranges from INR 55 to INR 57 per tablet.These discrepancies highlight the critical need for cost-effective prescribing practices to alleviate financial strain on patients, especially those from economically weaker backgrounds.

Combination formulations also exhibit marked price differences. For example, the dapagliflozin + metformin (10 mg/1000 mg) combination ranges from INR 9.9 to INR 16 per tablet, with a 61.62% cost variation. The 5 mg/1000 mg combination costs between INR 7.9 and INR 9.00 per tablet (13.92% variation), while the 10 mg/500 mg formulation shows a 66.67% variation, with prices ranging from INR 9 to INR 15 per tablet. The dapagliflozin + vildagliptin combination (10 mg/100 mg) demonstrates a similar trend, with prices varying between INR 18.2 and INR 24.9 per tablet, reflecting a 36.81% variation. In contrast, the linagliptin + dapagliflozin (5 mg/10 mg) combination ranges from INR 12.99 to INR 18.1 per tablet, a 39.37% variation.These price differences among manufacturers significantly impact both the treatment choices and the financial burden on patients.

In contrast, GLP-1 analogues like semaglutide are considerably more expensive, with the 3 mg dose at INR 294.81 per tablet and the 7 mg and 14 mg doses priced at INR 352 and INR 387 per tablet, respectively. This high cost presents a substantial financial burden, potentially limiting access and adherence. Furthermore, SGLT-2 inhibitors cannot be recommended to patients who have UTIs or who are more likely to get UTIs due to type 2 diabetes; in these situations, GLP-1 analogues are the only available treatment. However, the high cost of oral semaglutide often makes it unaffordable for many patients.

To improve the affordability and accessibility of these oral weight-lowering medications, a comprehensive approach at both national and international levels is essential. Nationally, integrating these drugs into essential medicine lists and expanding price control measures can significantly reduce costs. Implementing strict regulations to eliminate irrational drug combinations and establishing standard treatment guidelines can further enhance cost-effectiveness and ensure rational prescribing practices. On the international front, forming drug therapeutic committees to assess and address treatment needs can standardize practices and improve accessibility. Promoting the use of generic drugs, avoiding non-essential combinations, and prioritizing essential antidiabetic medications can help reduce overall costs. Additionally, improving the provision of free medications at primary healthcare centers, and educating both healthcare providers and patients about cost-effective treatment options and adherence, will ensure that these anti-diabetic therapies remain accessible and economically viable across various regions. This study focuses on oral drugs rather than injectable GLP-1 analogues due to their compatibility and ease of use, which significantly influences patient adherence.

From Stakeholder Perspectives, the economic burden of these medications impacts various groups differently. Patients, particularly those who are uninsured or underinsured, face high out-of-pocket expenses for GLP-1 analogues and certain SGLT-2 inhibitors, leading to reduced adherence and treatment continuity. Healthcare providers encounter challenges in prescribing these costlier drugs despite their clinical benefits, especially for socioeconomically disadvantaged patients. Payers, including insurers and government programs, bear substantial financial strain, which may result in restricted formularies or higher copayments. Policymakers play a crucial role in mitigating these challenges by implementing drug price regulations and promoting cost-effective generics to improve accessibility and affordability.

CONCLUSION

This study reveals considerable cost disparities among SGLT-2 inhibitors, highlighting the urgent need for cost-conscious and informed prescribing practices in India. Choosing more affordable options can help reduce the

financial strain on patients and improve their adherence to treatment particularly in resource-constrained settings.In contrast, the notably higher cost of GLP-1 analogues underscores the economic challenges faced by patients, limiting accessibility and adherence. Future research should focus on the Pharmacoeconomic of these medications to aid in making better clinical decisions, aiming to achieve a balance between cost and treatment effectiveness to enhance patient outcomes and accessibility.

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