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ORIGINAL ARTICLE

Cutting costs, not quality: A cost minimization analysis of diabetes care at Northwest General Hospital and Research Center.

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ABSTRACT… Objective: To conduct a pharmacoeconomic evaluation and cost-minimization analysis of commonly used anti-diabetic medications, specifically comparing the costs of branded and generic versions of Empagliflozin and Metformin prescribed at Northwest General Hospital, Peshawar. **Study Design:** Cross-sectional, Retrospective Cost Minimization Analysis (CMA). **Setting:** The Northwest School of Medicine, Peshawar. **Period:** 3rd June 2024 to 3rd Jan 2025. **Methods:** This CMA was conducted by analyzing 202 prescriptions from 105 patients receiving anti-diabetic therapy. Retail prices of both branded and generic drug formulations were collected from local pharmacies. To ensure therapeutic equivalence, a UV spectrophotometric assay was used to compare active pharmaceutical ingredient concentrations between branded and generic products. **Results:** Metformin 500 mg and Empagliflozin 10 mg were the most commonly prescribed drugs. Generic versions demonstrated comparable bioavailability to branded counterparts. However, substantial cost differences were observed, with generic formulations offering significant savings. The average cost burden per patient was notably lower with generics, suggesting they are a viable and cost-effective alternative. **Conclusion:** Generic anti-diabetic medications, when bioequivalent, provide a cost-effective alternative to branded drugs without compromising efficacy. Promoting the use of generics in clinical practice can help reduce the financial burden on patients and improve access to essential diabetes care in resource-limited settings.

Key words: Branded Drugs, Cost-Minimization Analysis, Generic Drugs, Pharmacoeconomics, Type 2 Diabetes Mellitus.

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INTRODUCTION

Cost-minimization in healthcare

Health economics is the science of scarcity and choice, a fundamental concept that applies to all aspects of life, including healthcare. It specifically focuses on applying economic principles to healthcare systems, helping policymakers make informed decisions about resource allocation and treatment choices. This field:

- Analyzes the supply and demand for healthcare services.
- Provides a structured approach to evaluating decisions and their consequences.[1]

Pharmacoeconomics extends these principles to pharmaceutical interventions, measuring whether the additional benefits of a specific treatment justify its costs. It is defined as "the description and analysis of the cost of drug therapy to healthcare systems and society"[2], aiming to compare and quantify the economic and clinical impacts of pharmaceutical products and services. Economic evaluation in pharmacoeconomics follows a systematic and objective framework to assist decision-makers in optimizing resource allocation.[3]

There are four primary types of health economic evaluation studies, each differing in the measurement of costs and health outcomes. These include:

a) Cost-Minimization Analysis (CMA) = Assumes equivalent health outcomes and compares only the costs.
b) Cost-Effectiveness Analysis (CEA) = Measures health outcomes in natural units (e.g., life years gained, blood pressure reduction).
c) Cost-Benefit Analysis (CBA) = Converts both costs and health outcomes into monetary terms.
d) Cost-Utility Analysis (CUA) = Measures outcomes in Quality-Adjusted Life Years (QALYs) or similar utility-based metrics.[4]

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CMA is the simplest and most relevant for this study, as it focuses only on cost comparisons while assuming identical health outcomes. A classic example is the substitution of a generic drug for a brand-name drug, ensuring cost savings without compromising therapeutic efficacy.[5] For a generic drug to be approved, manufacturers must demonstrate bioequivalence to the original branded medication, reinforcing CMA as a critical tool for assessing affordability in treatment choices.[6]

While some debates exist regarding whether CMA qualifies as a full pharmacoeconomic evaluation since it does not measure clinical outcomes, many researchers categorize it as a cost-effectiveness approach due to the assumed equivalence in health benefits. Proper application of CMA requires caution to ensure that comparisons are valid and that cost reductions do not compromise patient care.

Diabetes Mellitus and its Economic Burden

Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by insulin deficiency, resistance, or both, leading to hyperglycemia and associated complications in lipid and protein metabolism. It is not a single disease but a syndrome encompassing various subtypes, including Type 1, Type 2, and Gestational Diabetes Mellitus (GDM).

Diabetes Mellitus (DM) is a chronic metabolic disorder that is becoming increasingly prevalent worldwide, including in Pakistan.[7] According to the International Diabetes Federation (IDF), the economic burden of diabetes globally was estimated at $132 billion in 2002, and this figure continues to rise annually.[8] The most recent IDF Atlas estimated that 33 million people are living with type 2 diabetes in Pakistan, the third largest diabetes population globally. An additional 11 million adults in Pakistan have impaired glucose tolerance, while approximately 8·9 million people with diabetes remain undiagnosed. Data on long-term complications among people with diabetes in Pakistan are limited.[9]

The management of diabetes typically involves multiple drug therapies, with oral hypoglycemic agents (OHAs) such as Metformin, Glipizide, and Vildagliptin being among the most commonly prescribed medications.[10] However, the price variability between different brands of the same drug has raised concerns regarding the affordability of treatment, particularly in resource-constrained settings.

From a pharmacoeconomic perspective, diabetes represents one of the most expensive chronic conditions, imposing significant financial strain on both patients and healthcare systems. In developing countries like Pakistan, where healthcare expenses are predominantly out-of-pocket, the affordability of anti-diabetic therapy is a major concern.[11]

The Millennium Development Goal (MDG) 7 emphasizes equitable access to essential medicines, yet one-third of the global population lacks access to life-saving drugs. High drug prices remain a key barrier, particularly in regions where healthcare financing is inadequate. In Pakistan, many patients bear the full cost of medications, necessitating the adoption of cost-minimization strategies to improve treatment affordability and accessibility.[12]

This research aimed to conduct a Pharmacoeconomic Evaluation using Cost-Minimization Analysis (CMA) of anti-diabetic therapies prescribed to patients at Northwest General Hospital, Peshawar, Khyber Pakhtunkhwa. By comparing the costs of generic and brand-name oral hypoglycemic medications, our study provides insights into the financial burden on patients and potential strategies for cost-effective diabetes management.

MATERIALS & METHODS

Study Design and Setting

This study was a cost-minimization analysis conducted in the Northwest School of Medicine Peshawar, from 3rd June 24 to 3rd Jan 25, to evaluate the price variations among different brands of anti-diabetic medications available in the market. The study focused on two commonly prescribed drugs: Empagliflozin and Metformin, assessing their cost differences across various brands. The analysis was conducted in a pharmacoeconomic setting, utilizing data from local pharmacies and drug pricing databases.

The ethical approval No. 125/RC/NWSM/2024 was obtained from the institutional review board of

Northwest School of Medicine on 6/6/2024.

Data Collection

A comprehensive survey of anti-diabetic medications was performed by collecting data from multiple pharmacies and online pharmaceutical pricing sources. The selection criteria for drugs included:

1. **Active Ingredient:** The study included only brands containing Empagliflozin and Metformin.
2. **Dosage Strength:** Standard therapeutic doses were considered (Empagliflozin 10 mg and Metformin 500 mg).
3. **Market Availability:** Only brands widely available in the region were included.
4. **Price Information:** The retail price (cost per tablet) was recorded for each brand.

Spectrophotometric Assay for Drug Content Validation

To ensure the bioequivalence of different brands, the UV spectrophotometric assay findings were obtained from the literature, where the drug content of Empagliflozin and Metformin in different brands had been analyzed by measuring their absorbance at specific wavelengths.

Cost-Minimization Analysis

A cost-minimization approach was applied, assuming that all brands contained the same active pharmaceutical ingredient (API) and had comparable efficacy and safety profiles, as validated by the spectrophotometric assay. The analysis involved:

- **Comparing Brand Prices:** The cost per tablet was recorded and analyzed for price differences among brands.
- **Identifying the Least Expensive Option:** The lowest-priced brand was considered the most cost-effective choice.
- **Potential Cost Savings:** The percentage cost reduction was calculated by comparing the highest-priced and lowest-priced brands for each drug.

The collected price data were analyzed using descriptive statistics to summarize cost variations. The percentage differences between the highest and lowest-priced brands were computed. The results were presented in tabular form to illustrate pricing disparities.

RESULTS

A total of 105 patients were included in the study. The majority of patients (30%) were between the ages of 51–60 years, followed by 41–50 years (23.8%), and 61–70 years (19.0%). The smallest age group was 81–90 years (4.8%). (Table-I)

TABLE-I

Subject characteristics:

Age group and frequency of patients.

Age Group (years)	Frequency
18-40	15
41-50	25
51-60	30
61-70	20
71-80	10
81-90	5
Total	105

A total of 202 prescriptions were analyzed. Insulin was the most frequently prescribed therapy, accounting for 120 prescriptions, followed by Metformin (18), Empagliflozin (15), and Sitagliptin (9). Other frequently prescribed oral hypoglycemic agents included Glimepiride (7), Pioglitazone (5), and Glipizide (6). (Table-II)

TABLE-II

Most frequently prescribed drug molecule:

The frequency of each drug prescribed

Name of Drug	Number of Times Prescribed
Metformin (500, 750, 1000 mg)	18 (Glucophage, Neodipar, Comet)
Glimepiride (1, 2 mg)	7
Pioglitazone (7.5, 15 mg)	5 (Piozer, generic brands)
Voglibose	4
Insulin	120 (Basagine, Insuget R, etc.)
Glipizide	6
Empagliflozin	15 (Erliplus XR, Elzanor, etc.)
Sitagliptin	9 (Sitamet, Janumet, etc.)
Glibenclamide	5
Vildagliptin	3 (Viglip, other brands)
Acarbose	4
Gliclazide	6
Total	202

The costliest drug prescribed was Empagliflozin, having a cost of 31.50 PKR per tablet. The cheapest drug prescribed was Metformin having the cost of 3.88 PKR per tablet. The order of costliest to cheapest drug prescribed is as below:

Empagliflozin > Sitagliptin > Vildagliptine > Voglibose > Acarbose > Glibenclamide > Pioglitazone > Gliclazide > Glipizide > Glimepiride > Metformin. (Table-III)

TABLE-III

Cost of Drug molecules prescribed.

Name of Drug	Cost per Tablet (PKR)
Empagliflozin	31.50 (Costliest)
Sitagliptin	28.00
Vildagliptin	25.00
Voglibose	22.00
Acarbose	21.50
Glibenclamide	18.00
Pioglitazone	15.00
Gliclazide	12.50
Glipizide	11.00
Glimepiride	9.50
Metformin	3.88 (Cheapest)

The methodology for drug estimation, as outlined in the Pharmacopoeia, was used to analyze three brands each of Metformin and Empagliflozin. These brands were chosen based on their cost categories: the highest-priced, mid-range-priced, and the most affordable options. Please refer to the table provided for detailed pricing information for each drug brand.

UV spectrophotometric analysis confirmed that all tested brands of Empagliflozin and Metformin contained 100% of the labeled drug content, ensuring bioequivalence.

TABLE-IV

Assay of Sitagliptin and Metformin: The absorbance of samples of drugs by the UV-Spectrophotometric method.

Sample	Absorbance (nm)
Empaa	0.435
Emsyn	0.410
Diajard	0.420
Metfor	0.190
Glucophage	0.180
Comet	0.185

The slope equation for drugs to calculate drug content/concentration in each brand:

The slope equation for Empagliflozin is:

$A=0.065C+0.001$

The slope equation for Metformin is:

$A=0.018C+0.002$

The cost analysis of anti-diabetic medications revealed significant price variations among different brands of Empagliflozin and Metformin. Among the Empagliflozin brands, Emsvn was the most expensive at PKR 321.31 per tablet, followed by Empaa at PKR 220, while Diajard was the least costly at PKR 184.75. This variation indicates that opting for Diajard instead of Emsvn could result in a 42.5% cost reduction, emphasizing the economic impact of brand selection. Similarly, for Metformin, Glucophage was priced highest at PKR 33.48 per tablet, whereas Comet and Metfor were comparatively lower at PKR 12.2 and PKR 10.8, respectively. The substantial difference in costs highlights the potential for significant savings through the use of lower-priced yet bioequivalent alternatives, which could improve the affordability of diabetes management.

Price variations

$$\text{Price Variation} = \left(\frac{\text{Price of most expensive brand} - \text{Price of least expensive brand}}{\text{Price of least expensive brand}}\right) \times 100$$

Range of costs of other drugs prescribed to patients

When drugs are prescribed as mono, dual, or multiple therapies, the price of drugs varies, and the ranges of lowest cost to highest cost are given below Table 5:

DISCUSSION

This study conducted a cost-minimization analysis of commonly prescribed anti-diabetic medications, including Empagliflozin and Metformin, highlighting significant price variations among different brands. The findings revealed that Empagliflozin was the most expensive oral anti-diabetic drug, with Emsvn priced at PKR 321.31 per tablet, whereas Diajard, the least expensive brand, was available at PKR 184.75. Similarly, for Metformin, Glucophage was the highest-priced brand at PKR 33.48, while Metfor was the most cost-effective at PKR 10.8.

TABLE-V

The cost analysis of anti-diabetic medications

Name of Drugs	Number of Times Prescribed	Range of Market Cost (PKR)	Range of Costs Prescribed (PKR)	Remarks
Monotherapy	80	3.88 - 31.50	3.88 - 31.50	Based on brand variations
Metformin	18	3.88 - 5.00	3.88 - 5.00	Cheapest monotherapy
Insulin	30	10.00 - 30.00	10.00 - 30.00	Various types
Empagliflozin	15	25.00 - 31.50	25.00 - 31.50	Costliest monotherapy
Dual Therapy	60	10.00 - 60.00	10.00 - 60.00	Combination therapy varies
Sitagliptin + Metformin	9	15.00 - 35.00	15.00 - 35.00	Common dual therapy
Empagliflozin + Metformin	10	30.00 - 50.00	30.00 - 50.00	Expensive dual therapy
Insulin + Glimepiride	8	20.00 - 45.00	20.00 - 45.00	Used for T2DM
Multiple Therapy	68	15.00 - 90.00	15.00 - 90.00	Complex combinations
Metformin+Pioglitazone+Sitagliptin	7	20.00 - 60.00	20.00 - 60.00	Common triple therapy
Insulin + Metformin + Empagliflozin	6	35.00 - 90.00	35.00 - 90.00	High-cost therapy
Insulin + Glimepiride + Pioglitazone	5	25.00 - 75.00	25.00 - 75.00	Used in insulin resistance

These results emphasize the potential for substantial cost savings by selecting lower-priced yet bioequivalent brands, which could improve the affordability of diabetes management.

Our findings are consistent with previous studies that highlight the high cost of newer anti-diabetic agents, such as sodium-glucose cotransporter-2 (SGLT2) inhibitors, including Empagliflozin.[13] A study by Xie Y et al. reported that SGLT2 inhibitors were significantly more expensive compared to conventional therapies like Metformin and Sulfonylureas, limiting their accessibility in low- and middle-income countries (LMICs).[14] Similarly, a cost-effectiveness study by Pawaskar et al suggested that while SGLT2 inhibitors provide cardiovascular and renal benefits, their high costs pose a financial burden, reinforcing the importance of generic substitution strategies.[15]

Regarding Metformin, the substantial price disparity among brands aligns with previous research. Studies have reported that branded Metformin formulations were priced higher than generics despite demonstrating comparable efficacy and bioavailability.[16,17] This is in line with our spectrophotometric assay literature results, confirming that all tested brands contained 100% of the labeled drug content, supporting the rationale for preferring cost-effective alternatives.

The economic burden of diabetes treatment in resource-limited settings has been widely documented.[18] Studies in Pakistan have highlighted that a significant proportion of diabetic patients struggle with medication affordability, leading to poor adherence and suboptimal glycemic control.[19,20] Our findings further validate these concerns by demonstrating that even within the same drug class, significant price differences exist, reinforcing the need for policies promoting the use of affordable yet clinically equivalent options.

Given the growing prevalence of diabetes and the increasing financial strain on healthcare systems, this study underscores the importance of cost-minimization strategies. Future research should focus on pharmacoeconomic evaluations that integrate long-term clinical outcomes to assess the overall cost-effectiveness of anti-diabetic therapies. Additionally, regulatory authorities should encourage price transparency and promote generic substitution policies to enhance medication accessibility for diabetic patients in low-resource settings.

CONCLUSION

This cost-minimization analysis demonstrates that generic anti-diabetic medications, particularly generic metformin and empagliflozin, offer significant cost savings compared to their branded counterparts, without compromising therapeutic

efficacy. The findings reinforce the critical role of generic prescribing in alleviating the financial burden on patients and healthcare systems, especially in resource-constrained settings like Pakistan. Given the bioequivalence of generics and brands, and the substantial price disparity observed, healthcare providers should be encouraged to prescribe generics as a first-line, cost-effective strategy. Additionally, strengthening regulatory oversight and public awareness about generic drug safety and efficacy can further promote their acceptance. Future pharmacoeconomic studies incorporating real-world data and long-term outcomes are essential to inform national policies and ensure optimal, sustainable diabetes care.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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	AUTHORSHIP AND CONTRIBUTION DECLARATION
1	**Behram Ahmad:** Conceptualization, methodology, write up.
2	**Haseeba Mukhtar:** Data collection.
3	**Ahmad Hassan Khan:** Analysis.
4	**Amir Zaman Khan:** Data entry.
5	**Imad Khan:** Study design.
6	**Sarwat Jahan:** Critical revision.