



(RESEARCH ARTICLE)



The impact of the antidiabetic oral drugs cost on health expenditure in diabetic care in México

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Abstract

Introduction: There is an urgent need to evaluate the factors contributing to the increased health expenditures in patients with diabetes mellitus, especially the cost of drugs used to treat Type 2 diabetes mellitus (T2DM) in economically developing countries.

Methods: We compared the cost of oral antidiabetic drugs using the prices of two large Mexican pharmaceutical retail corporations. The prescribed daily dose was utilized for each drug, and the total expenditure per year was calculated. In addition, the percentage expenditure on medications concerning the total annual expenditure on DM care was considered.

Results: Mean annual cost per person/year for the use of oral antidiabetic drugs ranged between US\$8.9 and US\$1355. We found significant differences between the cost of generic and brand versions of the same drug.

Conclusion: There is an increased expenditure on the treatment of T2DM. Further, the prescription patterns as newer ones are more expensive than the older drugs, hence the newer are still under patent.

Keywords: Type 2 diabetes mellitus; Cost; Drugs; Economics; Health care costs; Health expenditure; Medicines; Diabetes mellitus prevalence

1. Introduction

Diabetes mellitus (DM) is a term that designates a disease with different pathophysiological forms and diverse etiologies. The central characteristic of DM is hyperglycemia caused by a deficiency of insulin action. Deficiency in the use of glucose causes alterations in the metabolism of carbohydrates, proteins, and fats [1,2]. The most frequent form of DM is type 2 diabetes mellitus (T2DM), which affects more than 90% of patients with DM [1,2].

DM worldwide epidemiology. The prevalence of diabetes in all age groups worldwide had been estimated to reach 2.8% in 2000, 4.4% by 2030, and is predicted to increase to over 700 million by 2045. Then, the total number of people with diabetes is projected to double [3].

The prevalence of cases in developed and developing countries is constantly increasing. For example, nearly two-thirds of individuals with diabetes live in developing countries such as Brazil, India, and China, where this number is expected to increase during the next two decades [4].

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DM is a growing problem throughout the world, and in some developed countries, DM is a significant concern. For example, the Centers for Disease Control and Prevention in the USA in 2008 estimated that 26.6% of the US population had impaired glucose metabolism, in the form of DM 7.8% (23.6 million) and prediabetes 18.8% (57 million) [5]. By 2010, the number of people in the USA with diabetes had increased the population with DM 8.3% (2.2 million) [6].

DM in México. In Mexico, the prevalence of diabetes in 2016 was 10.4% [8] compared with 7% of the population in 2006 [7]. The comparative prevalence of México with representative countries in 2021 is shown in Figure 1.

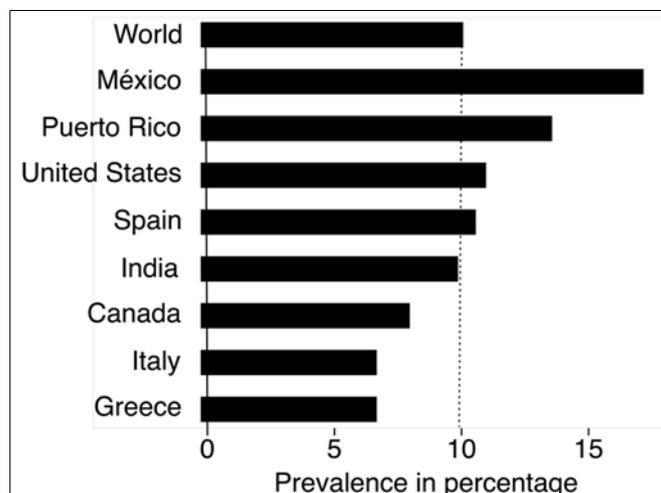


Figure 1 Comparative prevalence of diabetes mellitus in México versus representative countries in 2021. Source: Ref. [7]

1.1. World population growing and DM burden

For thousands of years, the world population only grew to a billion; Another two centuries were enough for the population to multiply by seven. The world population reached 7,000 million in 2011, and a decade later, it reached 7,900 million, and it is expected that by the year 2100, the world population will reach 10,900 million people [8].

However, the population will likely reach 9 billion in the year 2037 despite world population growth slowing. However, fertility levels remain high in countries with lower per capita income; in such a way, that the poorest countries in the future will be the most populous, such as those in sub-Saharan Africa [9, 10].

1.2. Diabetes mellitus world burden and Health expenditure in DM care

Diabetes leads to thousands of deaths and billion-dollar spending despite being a predictable lifestyle disease. The health expenditure for people living with diabetes mellitus is assumed to be twice that of people without the disease and was reported to be USD 760.3 billion globally in 2019 [11].

DM burden in México. Latvia, Hungary, Mexico, Lithuania, and the Slovak Republic had the highest preventable mortality rates, at more than 300 premature deaths per 100,000 population [12].

1.3. Cost of treatment of non-insulin-dependent diabetes mellitus

Health expenditures for people with diabetes are assumed to be two-fold higher than for people without diabetes. The prevalence of DM and the costs related to its treatment are constantly increasing. Therefore, the costs of managing DM will represent an unsustainable burden for the financing of the health system in Mexico. From this, radical changes are required managing patients with DM and in the prevention of new cases [13].

One of 5.92 Mexicans between 20-79 years ($83,741.6 \times 10^{-3}$) has DM. The age-adjusted comparative diabetes prevalence for persons between 20-79 years was 16.9%. The number of adults (20-79 years) with DM are $14,123.2 \times 10^{-3}$, and the total number of persons with type DM (9-19 years) is $13,952 \times 10^{-3}$ [14].

Table 1 México: Diabetes report and perspectives 2000-2045

	2000	2011	2021	2030	2045
Prevalence 1 (%)	14.2	15.6	16.9	18.3	18.9
People with diabetes (In 1,000s)	4387.3	10293.7	14123.2	17062.7	21181.9
DM health expenditure 2 (USD million)	n.a.	n.a.	19,946.8	22,549.9	25,490.3
DM person expenditure 3 (USD)	n.a.	815.0	1,412.3	1,596.7	1,804.9

1. Age-adjusted comparative prevalence of diabetes, (%); 2. Total diabetes-related health expenditure, (USD million); 3. Diabetes-related health expenditure per person, (USD); Source: Ref. [14]

1.4. DM burden in México

The country also has one of the highest rates of diabetes related-deaths 184,384 (20-79 years), and disability-adjusted life-years, which is particularly concerning. Obesity is tightly linked to diabetes. In Mexico, 65% of the population is overweight, and 30% of the population is obese—the second highest rate in the world after the USA. This high prevalence of obesity can be, at least partly, attributed to economic progress and free-trade agreement [15].

The economic burden of diabetes was estimated to be around USD \$3.872 billion, says ENSANUT. The cost per person with DM (20-79 years) is 1,412.3 USD. In total, Mexico spends around 2.5 to 5.6 percent of its GDP on treating diabetes directly or indirectly through attention to overweight and obesity [14].

1.5. DM oral drugs market in México

We use the recommended or prescribed daily dose (PDD) to evaluate and compare the costs of drugs to treat DM. It is essential to underline that the PDD does not necessarily correspond to the daily dose defined (DDD) a fixed unit of measurement [16].

The average dose prescribed according to a representative sample of prescriptions is considered the prescribed daily dose (PPD). The PDD can be determined from studies of prescriptions, medical or pharmacy records, and it is important to relate the PDD to the diagnosis on which the drug is used. The PDD will give the average daily amount of a drug that is prescribed. When there is a substantial discrepancy between the PDD and the DDD, it is essential to take this into consideration when evaluating and interpreting drug utilization figures [16].

DM drugs market in México. The diabetes drugs market in México is segmented into oral antidiabetic drugs, insulins, non-insulin injectable drugs, and combination drugs. The characteristic oral antidiabetic drugs groups are shown in Table 2.

Table 2 Characteristics oral antidiabetic drugs groups

Groups	Drugs
Biguanides	Metformin
Sulfonylureas	Glipizide, glyburide, glimepiride, glibenclamide, gliclazide
Thiazolidinediones (TZDs)	Pioglitazone
Dipeptidyl peptidase IV (DPP-4) inhibitors	Sitagliptin, saxagliptin, linagliptin
Sodium-glucose transport protein 2 (SGLT2) inhibitors	Canagliflozin, dapagliflozin, empagliflozin, ertugliflozin
Alpha-glucosidase inhibitors	Acarbose, miglitol, voglibose
Meglitinides	Repaglinide, nateglinide
Dopamine D2 receptor agonist	Bromocriptine-QR

Source: Ref. [17]

2. Material and methods

2.1. DM oral drugs costs in México

Drug prices were obtained from two large retail pharmaceutical chains: *Farmacias Similares*, which only sell generic drugs and *Farmacia San Pablo*, which sells generic and brand drugs. For each drug, the prescribed daily dose was calculated, that is, an average daily dose; and then the total expenditure per year was calculated. In addition, the percentage expenditure on medications concerning the total annual expenditure on DM care was calculated.

3. Results

The cost of oral drugs for DM in México and its relation to the total annual expenditure for diabetes care is shown in Table 3.

Table 3 Prices of oral antidiabetic drugs in México.

Groups	PDD	Annual cost (USD)	Proportion of annual drug expenditure in the total annual expenditure for the diabetes care (%)
Biguanides			
Metformin	1.700 mg	40.6	2.9
Sulfonylureas			
Glibenclamide	5 mg	8.9	0.6
Glimepiride	2 mg	30.1	2.1
TZDs			
Pioglitazone	30 mg	204.1	14.5
DPP-4 inhibitors			
Sitagliptin	100 mg	650.3	46.0
SGLT2) inhibitors			
Dapagliflozin	10 mg	549.7	38.9
Empagliflozin	30 mg	1354.5	95.9
Canagliflozin	100 mg	1102.4	78.1
Alpha-glucosidase inhibitors			
Acarbose	150 mg	133.8	9.5

PPD= Prescribed daily dose; USD= United States dollar; TZDs= Thiazolidinediones; DPP-4= dipeptidyl peptidase IV inhibitors; SGLT2= Sodium-glucose transport protein 2 inhibitors; Source: Own elaboration.

4. Discussion

It is estimated that between 2009 and 2034 the number of people diagnosed with DM will increase 1.8 times; and the annual expenditure related to DM will almost triple [18].

Besides, cultural and educational aspects may play a role in the success or failure of DM disease management programs. It has been found that, although the rates of ulceration, infection, and vascular disease in the lower extremities were like those of non-Hispanic whites, amputation were more frequent in Mexican Americans [19]. Moreover, it seems that DM is a disease that is favored by cultural characteristics and lifestyle of the Hispanic population [20].

It is essential to contain the costs related to the treatment of DM to consider the use of clinical guidelines and treatment algorithms, such as the most recent management guideline of the American Diabetes Association/European Association

for the Study of Diabetes (ADA/EASD); These guidelines allow decisions to be made on the use of treatments and limit the uses of second-line drugs for patients who respond appropriately to first-line pharmacotherapies [21].

Algorithms for managing the people with DM should be designed and implemented to decrease the disease burden of the financing drug and medical systems. Also, strategies for early detection and initiation of treatment should be implemented. For example, one study showed that positive lifestyle changes or the administration of metformin can prevent or delay the onset of the disease could prevent or delay the development of DM [22].

One study showed that positive lifestyle changes improved the efficacy of metformin administration, and this effect was independent of the age, body mass index, and ethnicity of study participants [23].

Otherwise, the Mexican Government should focus on the earliest days of life to help change mindsets. Breastfeeding, which is the best nutrition to prevent obesity, should be promoted [24]. Moreover, children in school must be taught basic nutritional knowledge and healthier meals should be provided in cafeterias to develop healthy habits [25].

5. Conclusion

The prevalence, morbidity, mortality, and cost of treating DM are expected to increase dramatically and put enormous pressure on an already overstretched healthcare system. Therefore, it is imperative to find medical and social ways to deal with this disease more effectively, reducing the suffering caused by this disease and decreasing the treatment costs.

Furthermore, every health professional needs to get involved. Each health facility should propose insulin vials and diabetics check-ups, and HbA1c tests should be free. The federal government must help states improve public facilities, especially in rural areas, to ensure people can access the care they need. Even if Mexico is a federal country, subnational administrations should not stay autonomous. Delegation of fiscal authority should be improved: fiscal reforms are now a public health issue.

Various national health policies need to be implemented to make the necessary changes to reduce the burdens associated with DM from not adequately following evidence-based and other DM management guidelines. In addition, poverty reduction and healthy lifestyles should be promoted, which have been shown to reduce DM-associated mortality and delay comorbidities. In addition, managed care organizations must be integrated into the health system, striving to reduce the costs of healthcare expenditures.

Compliance with ethical standards

Disclosure of conflict of interest

We declare to have no funding to carry out this research and no conflict of interest.

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