

Cost of glaucoma treatment in a developing country over a 5-year period

Gabriel Lazcano-Gomez, MD^a, María de los Angeles Ramos-Cadena, MD^{a,*}, Margarita Torres-Tamayo, MD^b, Alejandra Hernandez de Oteyza, MD^a, Mauricio Turati-Acosta, MD^a, Jesús Jimenez-Román, MD^a

Abstract

The aim of the study was to disclose a realistic estimate of primary open-angle glaucoma treatment, follow-up costs, and patients' monthly glaucoma-economic burden in an ophthalmology hospital in Mexico City.

Prospective survey of 462 primary open-angle glaucoma patients from 2007 to 2012 was carried out. Costs from visits, glaucoma follow-up studies, laser, and glaucoma surgical procedures were obtained from hospital pricings. Education, employment, and monthly income were interrogated. Total cost was divided into hypotensive treatment cost, nonpharmacologic treatment cost (laser and surgeries), and follow-up studies and consults. Average wholesale price for drugs analyzed was obtained from IMS Health data; monthly cost was calculated using: Monthly cost = [(average wholesale price/number of drops per eye dropper] × number of daily applications) × 30 days.

Patients were classified according to their glaucoma severity, and data were analyzed based on monthly income (average annual exchange rate: 12.85 Mexican pesos = 1 USD).

The mean age was 70 ± 10 years, women = 81%, elementary school = 39%, and unemployed = 53%. Low-income group = 266 patients (57%), 146 with mild glaucoma; moderate-income group = 176 patients (38%), 81 with mild glaucoma; high-income group = 20 patients (4.3%), 10 with mild glaucoma. Patients' monthly average economic burden in glaucoma treatment: low-income patients = 61.5%, moderate-income patients = 19.5%, and high-income patients = 7.9%.

Glaucoma-economic burden is substantial not only for health systems, but for the family and the patient. Therefore, screening plans for earlier diagnosis, and health policies that lessen the cost of disease management and increase adherence to treatment, and reduce the prevalence of blindness attributed to glaucoma are essential. These would improve quality of life, reduce personal and national expenditure, and help increase national economy.

Abbreviations: AWP = average wholesale price, GEB = glaucoma economic burden, HRT = Heidelberg retinal tomography, IOP = intraocular pressure, MC = monthly cost, NCR = National Capital Region, OCT = ocular coherence tomography, POAG = primary open angle glaucoma, SD = standard deviation, USD = United States Dollar, VF = visual fields.

Keywords: cost of glaucoma treatment, economic impact of glaucoma treatment, glaucoma economic burden in Mexico

1. Introduction

Glaucoma is expected to occur in 79.6 million people worldwide by 2020.^[1] Recommended management of glaucoma typically includes the use of medication(s) to reduce intraocular pressure (IOP) and the regular attendance of follow-up clinic visits, including visual field analysis, to monitor medication efficacy and disease progression.^[2] When choosing an appropriate medical or

surgical therapy, many factors such as efficacy, safety, cost, and patient compliance must be considered.^[3] The cumulative cost of medications used for chronic diseases is expensive, and the price of glaucoma medications has been cited as a medication adherence barrier in most,^[4-6] but not all,^[7] available studies. In the United States, the therapeutic management cost is estimated at \$2.5 billion per year, with direct costs at \$1.9 billion and indirect costs at \$0.6 billion.^[8] Several studies analyzed the annual cost of ocular hypotensive drugs using various methodologies.^[9-13] Unfortunately, researchers used a variety of approaches to quantify the glaucoma economic burden (GEB), making difficult the comparison among studies and populations.^[14,15] Despite significant clinical and GEB, only a few studies have evaluated the long-term costs of glaucoma treatment.^[16-18] In developed countries, the burden of glaucoma therapy is largely borne by the government or medical insurances; this information is unknown for the developing countries since there are still very few studies on the cost of glaucoma in these countries.^[19] However, it has been observed that developing nations are disproportionately burdened with blindness, with a resulting decrease in productivity and care costs, further limiting the economic resources of these societies.^[15] It has been described that the raise in severity of the disease increases the financial burden.^[14,20] Quality of life, a wide-ranging well-being concept of the individual's perception of his/her position of various features of his/her life, has an inverse association with glaucoma,

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^a Glaucoma Department, Asociación para Evitar la Ceguera en México,

^b Endocrinology Department, Instituto Nacional de Cardiología Ignacio Chávez, Mexico.

* Correspondence: María de los Angeles Ramos-Cadena, Glaucoma Department, Asociación para Evitar la Ceguera en México, Mexico and NYU Langone Medical Center, Department of Ophthalmology, 462 First Avenue NBV 5N18 New York NY, 10016 (e-mail: angelesramos17@gmail.com).

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its resultant visual impairment, and economic burden of its treatment.^[21–23] It is important to know how much each patient spends on the treatment of their disease and accurately measure the impact on their monthly income in our country. Therefore, the purpose of this study was to disclose a realistic estimate of the primary open-angle glaucoma (POAG) treatment and follow-up costs in an ophthalmology hospital in Mexico City, and the extent to which it challenges our patients economically.

2. Materials and methods

A prospective survey was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board and Ethics Committee before initiation. Four hundred sixty-two patients with POAG were included, with a minimum of 5 years of follow-up, diagnosed at least 1 year previous to 2007, with regular attendance to their scheduled clinical appointments, and with no interruptions on their glaucoma treatment for more than a week, according to their clinical chart. Patients who met the inclusion criteria and signed the informed consent completed a questionnaire about their age, educational level, employment, monthly income, and economic sufficiency or dependence. The number of visits and glaucoma follow-up studies, and also every topical treatment plan, laser, or glaucoma surgical procedures, were recorded in detail and verified for each patient in their clinical charts for the 5-year period evaluated.

The average wholesale price (AWP) for each drug analyzed in the study over the period 2007 to 2012 was obtained from IMS Health data.^[24] The total cost was divided into 3 subgroups: hypotensive treatment cost, nonpharmacologic treatment cost that included laser and glaucoma surgical procedures; and glaucoma follow-up studies and consults that included pachymetry, 24-hour IOP study, visual fields (VF), ocular coherence tomography (OCT), Heidelberg retinal tomography (HRT), ultrasonography, and consults expenses. To obtain the monthly cost (MC) of each hypotensive drug, we calculated its theoretical duration in days by bottle assuming each milliliter of glaucoma medication contains 20 drops, and considering the bottle's volume and dosage of each medication, using the following formula:

$$MC = ([AWP/\text{number of drops per eye dropper}] \times \text{number of daily applications}) \times 30 \text{ days}$$

The MC was individualized according to the number of months that the patient used that hypotensive medication. The sum of all topical therapy expenses per patient used from 2007 to 2012 represents the total hypotensive treatment cost. The nonpharmacologic treatment and glaucoma follow-up studies and consults costs were obtained according to each year's hospital pricing of the Asociación Para Evitar la Ceguera en México.

The study population was divided into 5 stages according to POAG severity (mild, moderate, severe, progression to moderate, and progression to severe) along the 5 years analyzed, based on VF defects evaluated by the Hodapp-Anderson-Parrish classification. Patients were staged on the basis of the worse eye VF score. Furthermore, we also studied our sample based on monthly income (low, moderate, high) as it was determined by the Instituto Nacional de Estadística y Geografía (INEGI, Institute of National Statistics and Geography) as follows: low=equal or minus 2 minimum wages, moderate=3 to 5 minimum wages, high=equal or more to 6 minimum wages.^[25,26] Costs in Mexican pesos were converted to US dollars using an average

annual exchange rate for the period 2007 to 2012 of 12.85 Mexican pesos for 1 USD.^[27]

2.1. Statistical analyses

The worse eye was designated as the study eye and used for disease severity. Variables are expressed as means±SD, or as frequencies. The study population was divided by monthly income. Groups were compared according to glaucoma severity inside each monthly income, with parametric and nonparametric analysis of variance (ANOVA). All statistical analyses were performed using SSPP 16 for Windows.

3. Results

The files of 462 patients with registered continuous follow-ups from 2007 to 2012 were reviewed. The mean age of the subjects was 70±10 years, women constituted 81% of the study population, elementary school was the most frequent (39%) level of education, 245 subjects (53%) were unemployed, and 51 subjects (20.8%) reported glaucoma-related visual disability as the main cause of their employment status (eg, unemployed, part-time). The diagnostic study most frequently performed was VF, with a total of 4375 studies in 462 subjects, followed by pachymetry, with a total of 364 studies in 353 subjects, and 321 structural diagnostic studies (HRT and OCT) in only 218 subjects. Two hundred sixty-five patients (57%) underwent IOP-control surgery, 117 experienced monocular surgery, and 148 had a bilateral intervention, resulting in a total of 413 procedures. A total of 10,135 consults were registered for the total of the sample.

Glaucoma treatment costs were organized into 3 categories as follows: hypotensive treatment costs, nonpharmacologic treatment costs, and consults and studies costs. According to POAG severity status, groups were compared and labeled as mild, moderate, severe, those who had progression from mild to moderate, and from moderate to severe glaucoma. Two hundred sixty-six patients (57%) were classified into the low-income group, the majority (146 patients) being subjects with mild glaucoma. There were 176 patients (38%) in the moderate-income group, 81 of them classified as mild glaucoma. Twenty subjects (4.3%) were classified in the high-income group. In addition, the percentage that the patients spend from their monthly income in the total cost of their glaucoma treatment was calculated, and detailed results are disclosed in Table 1. Low-income patients spent an average of 61.5% of their monthly income in their glaucoma treatment, the highest GEB was observed in the group of patients with moderate glaucoma (92.8%); on the other hand, moderate-income subjects spent 19.5% in average and again the highest GEB was found in the moderate-glaucoma group (24%). Finally, there were only 20 patients in the high-income group and they spent an average of 7.9% of their monthly income in their glaucoma treatment; 10 in the mild-glaucoma stage and 10 in the severe group, with a 6.4% and 9.4% total glaucoma treatment expense from their monthly income, respectively.

4. Discussion

This is the first study in Mexican population that shows how much the patients with glaucoma spend in their glaucoma treatment. As previously mentioned by Varma et al, glaucoma is not only the first cause of irreversible blindness, but is also a

Table 1**Direct cost of glaucoma treatment, patients' income, and glaucoma severity in 2007 to 2012 period.**

Income	Glaucoma severity					P
	Mild (n=146)	Moderate (n=21)	Severe (n=59)	Mild to moderate (n=20)	Mod to severe (n=20)	
Low (n=266)						
HT treatment	2374 ± 2210	3706 ± 465	3000 ± 1225	3079 ± 1052	3331 ± 1638	0.004
Non-pharmacologic	563 ± 695	598 ± 149	820 ± 651	982 ± 386	874 ± 897	0.010
Studies and consults	678 ± 201	590 ± 171	612 ± 231	696 ± 146	891 ± 176	0.000
Total Treatment	3864 ± 2770	7974 ± 2542	4857 ± 1740	4916 ± 1200	5437 ± 691	0.000
GB (%) Av=61.5%	34.2	92.8	56.4	61	62.9	0.000
	Mild (n=81)	Moderate (n=22)	Severe (n=52)	Mild to moderate (n=10)	Mod to severe (n=11)	
Moderate (n=176)						
HT treatment	2741 ± 1655	3432 ± 1168	3020 ± 1781	2760 ± 0	2030 ± 82	0.129
Nonpharmacologic	177 ± 476	1339 ± 32	641 ± 575	0	51 ± 170	0.000
Studies and consults	771 ± 161	737 ± 224	732 ± 391	954 ± 0	1083 ± 93	0.000
Total treatment	4242 ± 1574	5680 ± 1112	4945 ± 1978	3839 ± 0	4331 ± 51	0.001
GB (%) Av=19.5%	19.3	24	18.8	20.5	15	0.031
	Mild (n=10)	Moderate (n=0)	Severe (n=10)	Mild to moderate (n=0)	Mod to severe (n=0)	
High (n=20)						
Hypotensive treatment	3059 ± 0		3189 ± 0			0.000
Nonpharmacologic	0		566 ± 0			
Studies and consults	784 ± 0		1137 ± 0			
Total treatment	4194 ± 0		5487 ± 0			0.000
GB (%) Av=7.9%	6.4		9.4			0.000

GB=glaucoma burden, HT=hypertension, Mod=moderate.

major worldwide epidemiological challenge.^[14,28] Currently, an estimated 3% of the population over 40 years old has glaucoma, with an average between 65% and 75% of glaucoma cases still undiagnosed; put in different words, the previous diagnosis rate was 34% in developed countries and 8% in developing countries.^[1] The elevated number of undiagnosed glaucoma patients may be attributed to its asymptomatic nature, which in consequence may bring reactive increased medical vigilance or late diagnosis.^[8] Glaucoma is a stressful disease on family finances, the greater part of treatment expenditure is on medication at present, with more potent but more costly topical hypotensive replacing the old treatments.^[20] Studies have shown that in developing countries, direct costs referring to hospital visits, glaucoma-related procedures, and hypotensive medications are significant; and indirect costs indicating transportation, hours away from work, and nursing homes are also considerable.^[14,20] It has been published that both—the growing global and individual costs of glaucoma—increase as the disease worsens.^[8,14,20] Early identification and treatment of POAG may reduce personal and societal economic burdens.^[14]

In this study, we analyzed the direct costs of glaucoma treatment and the economic challenge it represents for the monthly income of 462 POAG patients from the Glaucoma Service of the Asociación Para Evitar la Ceguera en México.

The sample in this study was disproportionately represented by women (81%). In people with glaucoma, this disparity was foreseen by Quigley and Broman^[1] when they suggested it is probably secondary to women's greater longevity; in 2006 they estimated that this disproportion could increase because of a larger women global population.

Recent studies have analyzed the financial burden of glaucoma in developing countries. Adio and Onua^[20] performed an analysis of the direct and indirect costs to determine the economic challenge of POAG in Rivers State, Nigeria; they reported that the average glaucoma patient has an expense of 49.8% of their

monthly income. In our study, we found that more than half of the patients belong to the low-income group and they showed an average direct-cost expense of 61.5% of their monthly income. These results are interesting, because our study analyzed only direct costs and the research by Adio and Onua included the indirect costs as well, finding between results an 11.7% difference in monthly expenses, which would imply that glaucoma in our hospital is a more expensive disease to treat compared with that in Rivers State, Nigeria. Although, this assumption is difficult to ascertain since our data are stratified by monthly income and disease severity, and the Nigerian study used an average income of a typical glaucoma patient.

Another research study conducted in an Indian population this year described the total cost of glaucoma treatment, including direct and indirect expenses, to be 18.4% of the monthly income among the lower-income group, coming from the areas of Delhi and the National Capital Region (NCR), and 41.9% in subjects coming from distant rural areas.^[19] Patients in the lower-middle-income group from Delhi and NCR had a 9.1% expense from their monthly income, whereas subjects from distant areas had a 21.1% expense.^[19] People in the upper-middle-income group had 4.6% expenditure from their monthly income, and from distant areas, it was 10.2%.^[19] Patients from the higher-income group spent 5.2% in glaucoma treatment from their monthly wages if coming from Delhi and NCR, and 6.8% if coming from distant rural areas.^[19] If compared with our analysis, we obtained a difference of 19.5% of monthly expenses in the low-income group from distant areas, but some similar results to those of patients from distant rural areas in the lower-middle-income group and the higher-income group. These similarities to patients from distant rural areas might be because our hospital is a specialized ophthalmology center caring for patients who attend from all around the country, although it is only a hypothesis since our research was only focused on direct costs. It is of interest that the results we obtained from the low-income group were different

from the Nigerian and Indian studies in 11.7% and 19.5%, respectively, theoretically meaning that the treatment of glaucoma for patients in our hospital is more expensive for the patients in this group, even if just direct costs were evaluated in our study. We believe this is explained by the elevated expense (92.8%) glaucoma treatment represents to the patients in the low-income group with a moderate disease (Table 1). This phenomenon is repeated in the moderate-income group as well, in which moderate-stage glaucoma patients had the highest expenditure in POAG treatment. This contradicts previous publications which stated that glaucoma costs increase as the disease worsens.^[8,14,20] This might be because of the teaching and training characteristics of our hospital, in which resource consumption increases with the first signs of disease progression, as the result of reactive increased medical vigilance by residents and glaucoma fellows in an attempt of avoiding progression to severe stages of glaucoma.

The majority of patients evaluated in this study had monthly low wages that, associated with costly glaucoma treatment, may result in a significant economic progression. It is not uncommon for glaucoma patients to concomitantly suffer a variety of chronic-degenerative ocular and systemic diseases that also represent an expense associated with the treatment of glaucoma.^[29–33] Cost-effective health care to reduce GEB is of the utmost importance, more so in the developing world, which spends about 20% to 50% of their monthly salary in its treatment.^[15,19,20] Therefore, early disease recognition and proactive management, and preventing progression beyond the early stages may reduce the overall national and personal economic burden, may limit the reduction of productivity from vision loss, and consequently may preserve patients' quality of life.^[8,14,20,34,35] POAG and its resulting visual impairment are associated with limitation of daily functions that may exacerbate and lead to loss of autonomy and depression, loneliness, and anxiety.^[23] These factors that negatively impact quality of life are very closely related with the cost of the treatment and adverse reactions to it.^[23] In fact, the very aim of glaucoma is not to keep IOP at optimum limits or to achieve perfect functional studies; it is to preserve the patient's autonomy and vision-related quality of life.^[22,23]

A number of measures can be implemented in an effort to reduce the economic challenge glaucoma represents for patients, like adding counselors or explanatory videos in glaucoma services' waiting areas to help reduce waiting and consult times, glaucoma screening programs for patients over 40 years old, cheaper health insurance schemes or microloan facilities, and supervised consults in teaching hospitals to avoid reactive resource consumption.^[8,19,34,35] The information provided by this and other analyses on the economic impact of glaucoma may catch the attention of physicians and policymakers to help ameliorate this burden and put glaucoma in a priority place.

This study has some limitations, the main limitation being its retrospective nature, in verifying information in patients' charts. We assumed that each milliliter of medication contained 20 drops; however, it is known that the variation in the volume and the number of drops dispensed can vary even between 2 bottles of the same drug. The model did not incorporate the cost of potential adverse effects and calculations were based only on direct costs; indirect expenses were not included. The researchers who analyzed the economic burden of glaucoma in developing countries used a variety of approaches to quantify the economic challenge glaucoma represents in patients' monthly wages, making difficult and uncertain the comparison among studies and populations. It is important to mention that we analyzed data

from patients in the glaucoma department of a third-level ophthalmologic hospital, and results may reflect the condition of our patients, not the rest of the country's population.

This is the first study in a Mexican population that shows the cost patients with POAG spend on their treatment in an ophthalmologic hospital. The economic burden associated with glaucoma is substantial not only for the health system but also for the family and the patient. Therefore, it is essential to implement new and efficient standard of care for earlier diagnosis, health policies that lessen the cost of disease management, improving adherence to treatment, and reducing the prevalence of blindness attributed to glaucoma. These would potentially improve quality of life by reducing personal and national expenditure of health care services and help increase national economy.

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