

Real-world savings in medication-related costs up to 5 years with the use of the second-generation trabecular implant (iStent inject®) in mild open-angle glaucoma

Economia real em custos relacionados a medicamentos por até 5 anos com o uso do implante trabecular de segunda geração (iStent inject®) no glaucoma de ângulo aberto inicial

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How to cite:

Guedes RA, Moraes DA, Guedes VM, Gravina DM, Chaoubah A. Real-world savings in medication-related costs up to 5 years with the use of the second-generation trabecular implant (iStent inject®) in mild open-angle glaucoma. Rev Bras Oftalmol. 2025;84:e0072.

doi:

<https://doi.org/10.37039/1982.8551.20250072>

Keywords:

Open-angle glaucoma; Medical treatment; Glaucoma; iStent inject®; Costs and cost analysis

Descritores:

Glaucoma de ângulo aberto; Tratamento médico; Glaucoma; iStent inject®; Custos e análise de custos

Received on:
May 5, 2025

Accepted on:
Sep 3, 2025

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Conflict of interest:

RAPG (consultant and speaker: Abbvie,
Alcon, Bausch Lomb, Glaukos); DAGM
(none); VMGP (none); DMG (none); AC
(none).

Financial support:

no financial support for this work.



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ABSTRACT

Objective: To assess medication-related costs in patients with open-angle glaucoma subjected to iStent inject®.

Methods: Retrospective study of patients with early-stage open-angle glaucoma who underwent iStent inject® implantation within the Brazilian private healthcare system and were followed for a period of 1 to 5 years. The study population comprised 234 patients with a mean age of 68.4 years old. The capacity to reduce intraocular pressure, amount of antiglaucoma medications required, and monthly cost of the necessary antiglaucoma medications during follow-up were evaluated. The accumulated cost of medications over 5 years was also calculated. The results obtained (Group 1 – iStent inject®) were compared with the theoretical cost of maintaining the same medication regimen from baseline (Group 2 – Medications). A theoretical extrapolation of the costs to the Brazilian public healthcare system was also performed.

Results: The study population consisted of 234 patients with a mean age of 68.4 years old. Mean intraocular pressure and medication reductions from baseline to final follow-up were 15.4 and 76.2%, respectively. At baseline, 70.1% of eyes used two or more medications, while 73.1% were medication-free by the end of follow-up. An 80% sustained reduction in monthly medication costs was observed. The mean accumulated 5-year medication-related costs (US dollars) per patient in Groups 1 and 2 were \$555.94 and \$3,160.79, respectively, in the private sector and \$100.42 and \$512.82, respectively, in the public sector.

Conclusion: In this real-world analysis, iStent inject® implantation significantly reduced both medication use and related costs over a 5-year period. These findings suggest a potential long-term economic benefit for healthcare systems, especially when managing early-stage open-angle glaucoma.

RESUMO

Objetivo: Avaliar os custos relacionados à medicação em pacientes com glaucoma de ângulo aberto submetidos ao iStent inject®.

Métodos: Estudo retrospectivo de pacientes com glaucoma de ângulo aberto em estágio inicial submetidos ao implante do iStent inject® no sistema de saúde privado brasileiro e acompanhados por um período de 1 a 5 anos. Foram avaliados a capacidade de redução da pressão intraocular, a quantidade de medicamentos antiglaucomatosos necessários e o custo mensal dos medicamentos antiglaucomatosos necessários durante o acompanhamento. O custo acumulado dos medicamentos ao longo de 5 anos também foi calculado. Os resultados obtidos (Grupo 1 – iStent inject®) foram comparados com o custo teórico de manutenção do mesmo regime medicamentoso desde o início do tratamento (Grupo 2 – Medicamentos). Também foi realizada uma extrapolação teórica dos custos para o Sistema Único de Saúde.

Resultados: A população do estudo foi composta de 234 pacientes com média de idade de 68,4 anos. As reduções médias da pressão intraocular e da medicação, do início ao fim do acompanhamento, foram de 15,4 e 76,2%, respectivamente. No início do acompanhamento, 70,1% dos olhos utilizavam dois ou mais medicamentos, enquanto 73,1% estavam livres de medicação ao fim do acompanhamento. Observou-se uma redução sustentada de 80% nos custos mensais com medicamentos. Os custos médios acumulados de 5 anos relacionados à medicação (dólares americanos) por paciente nos Grupos 1 e 2 foram de US\$ 555,94 e US\$ 3.160,79, respectivamente, no setor privado e de US\$ 100,42 e US\$ 512,82, respectivamente, no setor público.

Conclusão: Nesta análise de mundo real, o implante do iStent inject® reduziu significativamente o uso de medicamentos e os custos relacionados ao longo de um período de 5 anos. Esses achados sugerem potencial benefício econômico a longo prazo para os sistemas de saúde, especialmente no tratamento do glaucoma de ângulo aberto em estágio inicial.

INTRODUCTION

Glaucoma is a major cause of irreversible vision loss and blindness worldwide.⁽¹⁾ A significant increase in both the incidence and prevalence of glaucoma is expected in the future, mainly owing to population growth and aging.⁽¹⁾

Mainstream glaucoma therapy involves the chronic use of topical medications, which can effectively reduce the intraocular pressure (IOP) and control the disease.⁽²⁾ Despite their apparent simplicity, eye drops present several challenges that can compromise treatment outcomes.^(3,4) The persistence and adherence to eye drop applications are not ideal, leading to poor long-term IOP control and disease progression.^(5,6) Conservative topical medications may lead to tissue toxicity in both the ocular surface and trabecular meshwork, affecting patients' comfort and quality of life and potentially negatively interfering with trabecular degeneration.^(3,7,8)

The economic burden of chronic topical therapy is significant for patients, healthcare systems, and society.^(9,10) Medication costs represent the primary component of direct glaucoma-related expenses, especially because most patients require multiple drugs over extended periods.⁽⁹⁻¹²⁾

Glaucoma therapy has evolved over the past two decades, with novel nonpharmacological treatments being presented as alternatives to medications.^(2,13) Selective laser trabeculoplasty (SLT) and trabecular angle surgeries have been used as replacement therapies for medications in patients with mild-to-moderate open-angle glaucoma (OAG), demonstrating similar efficacy and higher safety, while offering some advantages regarding persistence, adherence, quality of life, disease progression, and the need for more invasive glaucoma procedures.⁽¹⁴⁻²⁴⁾

Second-generation trabecular micro bypass (iStent inject[®]) is a microinvasive glaucoma angle surgery that is used to treat mild-to-moderate OAG. In some countries, its use is restricted to combined cataract extractions. In Brazil, the indications comprise both combined and stand-alone use. Many studies worldwide have proven its ability to achieve a sustained long-term reduction in IOP, as well as a significant reduction in medication use, reducing the burden of topical treatments.^(21,23,25-28) There is robust evidence of its economic viability in many cost-effectiveness and cost-utility studies.^(22,29-34) However, most of these economic analyses are model-based and use different clinical and mathematical assumptions. Moreover, long-term real-world data on the economic impact of trabecular implants as a substitute for medications for OAG are scarce.

This study aimed to assess medication-related costs in patients with OAG subjected to iStent inject[®].

METHODS

This study comprised a retrospective longitudinal analysis of eyes treated with micro invasive glaucoma surgery using the second-generation trabecular micro bypass device, iStent inject[®] (Glaukos Inc., Aliso Viejo, CA, USA) at a private glaucoma referral center.

The inclusion criteria were patients with primary and secondary (pigmentary or pseudo-exfoliation) OAG (> 18 years old) subjected to iStent inject[®] surgery, alone or combined with cataract surgery, with at least 12 months of follow-up and up to 5 years of follow-up. We only included patients with early-stage glaucoma (mean deviation [MD] > -6.00 dB). In cases in which both eyes were eligible, we chose the eye with the lowest MD.

Exclusion criteria included patients with other types of glaucoma, any intraoperative complication preventing implantation of both stents, prior incisional glaucoma surgery, other ocular diseases influencing visual assessment (retinal diseases, corneal opacities, and uveitis), or insufficient clinical data.

Implantation of the iStent inject[®] was conducted using a standard surgical technique. The surgeon implanted the devices under a direct gonioscopic view in the inferonasal quadrant (1 to 2 clock hours apart). Accurate positioning of the iStent inject[®] was verified via gonioscopic examination, which was performed both during surgery and at all clinical examinations throughout follow-up. Standard phacoemulsification with a foldable intraocular lens was initially performed if the surgery was combined with cataract extraction surgery.

A typical medication regimen was followed after the procedure, with patients receiving both antibiotics and steroid drops for a period of 3 to 4 weeks. We stopped all glaucoma medications from the day of surgery, and the decision to restart any glaucoma medication was made individually based on the target IOP predefined by the physician. Predetermined criteria were not identified.

We reviewed the medical records of eligible patients who underwent iStent inject[®] implantation between October 2017 and January 2024. All medical records of the patients during the study period were analyzed to preserve patient confidentiality and identification. The following sociodemographic and clinical data were collected: age, race, laterality, type of glaucoma; stage of glaucoma according to visual field deficit (early [MD ≥ -6.00 dB], moderate [MD between -6.00 and -12.00], advanced [MD < -12.00 dB]); visual acuity; history of ocular health and general health; quantity, duration of use and

type of each medication used for glaucoma before the surgical procedure and throughout the follow-up period up to 5 years; IOP before the procedure and throughout the follow-up period up to 5 years; and complications during the procedure and throughout the follow-up period. Time points were as follows: baseline; day 1; day 15 (\pm 5 d); day 30 (\pm 7 d); day 90 (\pm 15 d); day 180 (\pm 30 d); year 1 (\pm 30 d); year 2 (\pm 60 d); year 3 (\pm 60 d); year 4 (\pm 60 d); and year 5 (\pm 60 d).

All patients in the study were covered by the Brazilian supplementary health system (SS), under which glaucoma medications are paid out-of-pocket. Data on the costs related to the use of each medication for glaucoma treatment were collected from the perspective of the SS. The mean and standard deviation (SD) of medication prices (in Brazilian Reals, R\$), grouped by active ingredient, were obtained from pharmacy price lists, using the maximum retail price to the consumer. Prices were then converted to US dollars using the exchange rate as of January 1st, 2025 (US\$ 1.00 = R\$ 6.20).

Next, theoretical extrapolation was performed to determine the economic impact of the Brazilian Unified Health System (SUS), a universal coverage health system. We applied the same cost proportions and differences, using the prices from the SUS SIGTAP table (<http://sigtap.datasus.gov.br/tabela-unificada/app/sec/inicio.jsp>). We performed this analysis to obtain potential long-term medication-related cost savings from a public health perspective that covers the majority of the Brazilian population.

Because the data were collected from one eye of each patient, we assumed that both eyes achieved the same clinical outcomes regarding IOP and medication quantity reduction. Based on this rationale, we assumed the monthly duration and costs for each medication bottle. We then calculated the real potential economic impact on patients and health systems as if both eyes had achieved the same clinical outcome.

After data collection, we hypothesized medication-related costs as if the patients continued the same medication regimen from baseline until the end of follow-up. Group 1 – iStent inject[®] comprised the real cohort analysis (cost of reintroducing the antiglaucoma eye drops) and Group 2 – Medications comprised the hypothetical cohort, considering the maintenance of the same therapy used at the baseline. Finally, a comparative analysis of the two groups was conducted.

Because the literature shows a synergistic positive effect of combining the iStent inject[®] procedure with

cataract surgery, with a greater reduction in medication usage in combined surgeries, we performed the same cost analysis comparing the standalone and combined procedures.⁽³⁵⁾

Data were recorded and analyzed using Statistical Package for the Social Sciences (SPSS) software (version 21.0; IBM SPSS, USA). A critical value of 95% was defined for confidence intervals and p-values.

The study protocol followed the tenets of the Declaration of Helsinki and was approved by the Ethics in Research Committee (CAAE: 75128423.3.0000.5147).

RESULTS

Two hundred thirty-four eyes met the inclusion and exclusion criteria and comprised the study population. Mean \pm SD age of patients was 68.4 \pm 9.5 years. Most patients were Caucasian (83.8%), whereas 16.2% were non-Caucasian (black and mixed races). Primary OAG comprised most glaucoma types (93.2%), and 6.8% of the eyes exhibited secondary OAG. We observed laterality in 51.7% of the right eyes and 48.3% of the left eyes. There was a slight prevalence among female patients (56.4%).

Of all eyes included in the analysis, 196 (83.8%) underwent a combined procedure and the rest (38/234) underwent a standalone implantation of iStent inject[®]. The baseline visual acuity of the study population was 20/30 or higher in 67.1% of eyes (63.3% in combined surgery eyes and 86.8% in standalone eyes), 20/40 to 20/100 in 25.6% of eyes (28.6% and 10.5% in combined and standalone eyes, respectively), and 20/200 or lower in 7.3% of eyes (8.2% and 2.6% in combined and standalone eyes, respectively). There were no significant differences between the combined and standalone eyes with regard to mean age, sex, race, laterality, or OAG subtypes.

Clinical outcomes

The evolution of the mean IOP and mean number of medications per eye from baseline to the end of follow-up, as well as the respective number of eyes at each time point, are shown in table 1. At baseline, significant differences were observed between the combined and standalone groups: the combined group had a mean IOP of 15.9 mmHg and used an average of 2.0 medications, while the standalone group had a mean IOP of 17.5 mmHg and used 2.7 medications ($p = 0.020$ for IOP; $p < 0.001$ for medication count). Intraocular pressure trends in both groups are illustrated in figure 1.

Table 1. Evolution of intraocular pressure and mean number of medications per eye from baseline to the end of follow-up

Time point	IOP (mmHg)	Medications per eye	Eyes
Baseline	16.2 ± 3.4	2.1 ± 1.0*	234
Day 1	12.5 ± 3.8*	0.0 ± 0.0*	234
Month 1	13.6 ± 3.3*	0.3 ± 0.7*	234
Month 6	13.4 ± 2.5*	0.4 ± 0.8*	234
Year 1	13.3 ± 2.3*	0.5 ± 0.8*	234
Year 2	13.4 ± 2.3*	0.5 ± 0.9*	192
Year 3	13.9 ± 2.6*	0.6 ± 0.9*	167
Year 4	13.7 ± 2.3*	0.5 ± 0.9*	99
Year 5	14.0 ± 1.9*	0.5 ± 0.9*	85

Results expressed as mean ± standard deviation or n.

* p < 0.001 for paired comparisons versus baseline (t-test for paired samples).

IOP: intraocular pressure.

Final mean (± SD) IOP and number of medications were 13.7 (±2.1) mmHg and 0.5 (±0.9), respectively, for mean (± SD) follow-up time of 37.8 (±20.1) months (n = 234). The mean percentage of IOP and number of medications reduced from baseline to the last follow-up were 15.4 and 76.2%, respectively.

At baseline, 70.1% of the eyes were taking two or more glaucoma medications (65.3 and 94.8% in the combined and standalone groups, respectively; p < 0.001). At the last follow-up, 73.1% of the patients were medication-free (79.6 and 39.5% in the combined and standalone groups, respectively; p < 0.001).

All eyes remained in early-stage glaucoma (MD > -6.00 dB) during the follow-up time. No differences were observed in the proportion of eyes in each visual acuity category (20/30 or higher; 20-40 to 20-100; 20/200 or lower) from baseline to the end of follow-up in the standalone eyes (p = 0.418). However, combined eyes benefited from an improvement in visual acuity as follows: the visual acuity of 20/30 or higher was 63.3% at baseline, whereas this proportion increased to 92.9% at the end of follow-up (p < 0.001).

Most patients (94.9%) did not require any other glaucoma re-intervention during follow-up. Five patients (2.1%) underwent filtering surgery (three in the combined surgery group and two in the standalone group). Seven patients (3.0%) underwent SLT during follow-up (six in the combined surgery group and one in the standalone group).

Success rates were as follows: (1) complete success (with no adjunctive medication) with IOP < 18 mmHg for 70.9% (77.0% for combined eyes and 39.5% for standalone eyes; p < 0.0001) and with IOP < 15 mmHg for 52.1% (57.7% for combined eyes and 23.7% for standalone eyes; p < 0.0001); (2) qualified success (with or without medication) with IOP < 18 mmHg for 95.7% (98.0% for combined eyes and 84.2% for standalone eyes; p = 0.002) and with IOP < 15 mmHg for 69.7% (72.4% for combined eyes and 55.3% for standalone eyes; p = 0.03).

Medication and medication-related cost analysis

Table 2 presents the proportion of each medication class and its respective unity cost from the SS perspective at baseline and at 1-, 3-, and 5-years post-surgery. Medication prices from SUS differ, as these are directly provided to patients through public services. SUS prices were obtained from the Brazilian Ministry of Health's Procedure, Medication, and OPM Table Management System [accessed on April 3, 2024]. Available at: <http://sigtap.datasus.gov.br/tabela-unificada/app/sec/procedimentoCompativelConsulta.jsp>. Prices are listed as follows: first-line therapy (betablocker), US\$ 1.00; second-line therapy (carbonic anhydrase inhibitor or Alpha 2 agonist), US\$ 4.73; third-line therapy (prostaglandin analog), US\$ 6.89; combination of two medications (first-and second-line

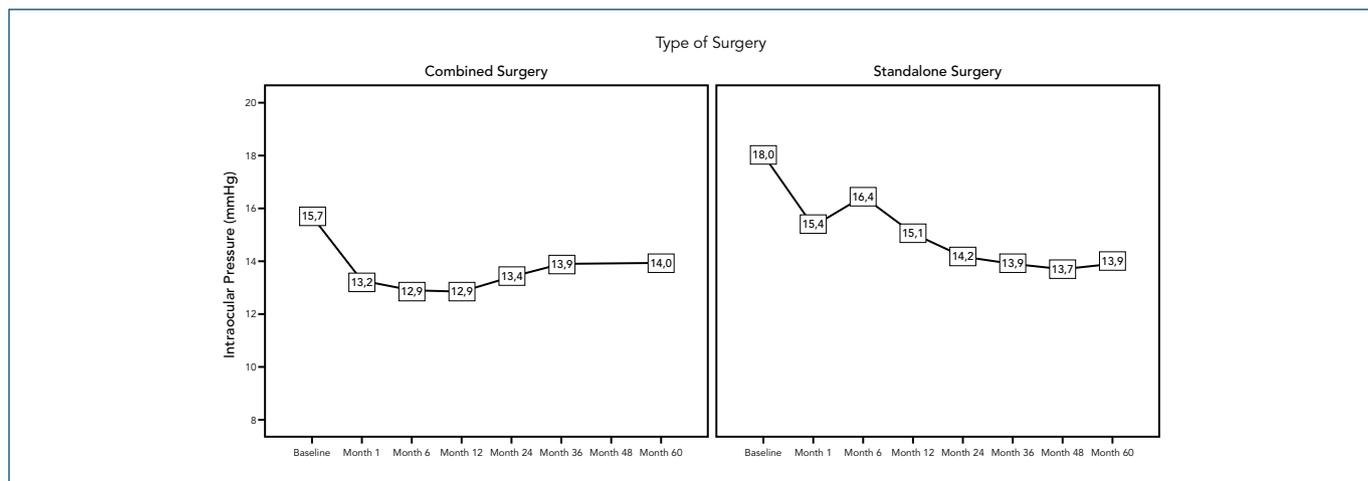


Figure 1. Evolution of intraocular pressure during follow-up, according to surgery type.

therapies), US\$ 5.27; combination of two medications (first-line and third-line therapies), US\$ 7.89; combination of three medications (first-line + second-line + third-line therapies), US\$ 12.15; combination of four medications (first-, second-, second-, and third-line therapies), US\$ 16.42.

Table 2. Medication type and its respective unit cost (from supplementary health system perspective) and usage proportions alongside selected follow-up time points

Medication class	Unit cost (US\$)	Baseline	Year 1	Year 3	Year 5
Beta-blocker	2.7 ± 0.3	70.9	21.8	17.9	8.5
Carbonic anhydrase inhibitor	15.9 ± 5.1	40.2	6.8	7.3	4.7
Alpha 2-agonist	14.2 ± 6.7	16.2	2.6	1.7	1.2
Prostaglandin analogs	53.0 ± 203.3	85.5	11.5	12.0	4.7

Source: National Health Surveillance Agency (ANVISA). Drug prices: MG; [accessed April 2, 2024]. Available at: <https://www.gov.br/anvisa/pt-br/assuntos/medicamentos/cmcd/precos>. We collected prices of medications available at pharmacies and calculated the mean and standard deviation (SD) for each medication class. Prices were collected in Brazilian Reais (R\$) and converted to US dollars (US\$), using values as of January 1st, 2025 (R\$ 6.2 = US\$ 1.0). Results expressed as mean ± standard deviation or %.

Figures 2 and 3 show the evolution of mean monthly medication costs from both private (SS) and public (SUS) perspectives for the entire study population. The relative reductions (%) in monthly medication-related costs from the ss perspective were 84.6% in year 1, 78.1% in year 3, and 81.1% in year 5. Additionally, considering the SUS costs, the reductions achieved in years 1, 3, and 5 were 83.4, 77.3, and 79.0%, respectively.

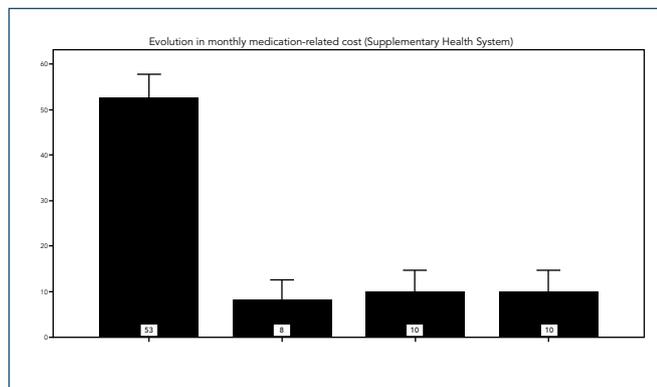


Figure 2. Evolution of monthly medication-related costs in the supplementary health system.

The 5-year medication-related cost (mean ± SD, US\$) in Group 1 was 555.94 ± 1,180.24 per patient, whereas the projected 5-year medication-related cost in Group 2 was 3,160.79 ± 1,361.54. The iStent inject® procedure resulted in 82.4% reduction in out-of-pocket expenses in the private sector over a 5-year period. From SUS perspective, the iStent inject® reduced the 5-year medication-related cost by US\$412.40 per patient, an 80.4% decrease (Group 1: US\$100.42; Group 2: US\$512.82). Figure 4 presents the 5-year medication-related cost breakdown by combined

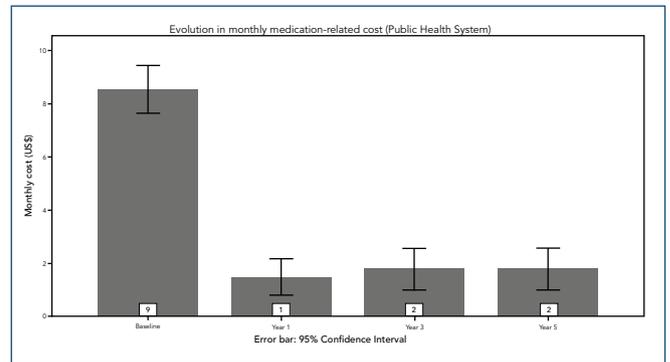


Figure 3. Evolution of monthly medication-related costs in the public health system.

and standalone procedures. Although we observed a statistically significant reduction ($p < 0.0001$) in both surgery types, we noticed a greater reduction in medication costs for the combined procedures.

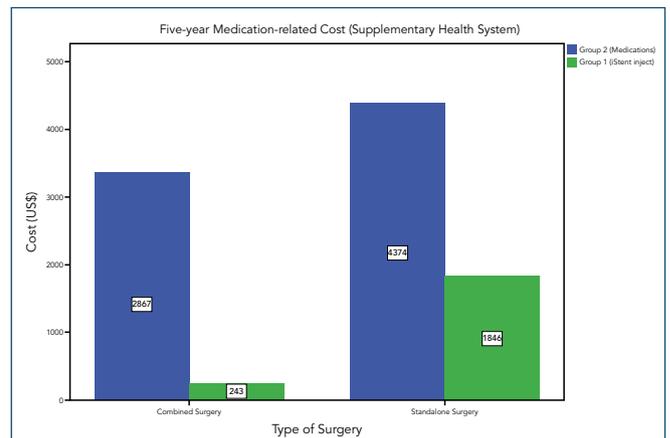


Figure 4. 5-year medication-related cost in the supplementary health system, according to surgery type.

DISCUSSION

Our results suggest major savings in medication-related costs over a 5-year period when using iStent inject® in patients with early-stage OAG from both private and public perspectives in Brazil.

While there are several treatment options for early-stage OAG, medications remain the most commonly used.⁽²⁾ However, these medications have some potentially significant side effects (poor adherence and tolerability, interference with the quality of vision and quality of life, and elevated treatment-related costs) that can jeopardize glaucoma control.^(5,6,9,28)

Recently, nonpharmacological therapies, such as SLT and trabecular angle surgeries, have emerged as replacement therapies for medications.^(14,26) These approaches offer multiple benefits from quality of life, clinical, and economic standpoints. Globally, SLT in particular has been

promoted as both a first-line and replacement therapy by various health systems and glaucoma societies.^(2,20)

Trabecular stenting has been used globally for over a decade. The second-generation iStent, the iStent inject[®], is now widely used across many countries, including Brazil, where it is reimbursed by both supplementary and public health systems. It is indicated for early to moderate stages of OAG, especially in patients who are intolerant to medications or those requiring additional IOP reduction despite ongoing therapy.^(13,36)

In our study, the iStent inject[®] achieved a 15.4% reduction in IOP and an approximate 75% reduction in medication use. Most patients were medication-free by the end of the follow-up period (73.1%). Although this study was not designed to evaluate efficacy outcomes, these results are consistent with findings from previous iStent inject[®] analyses.^(21,27,37,38) Therefore, these results reflect the expected clinical outcomes and can be used to perform real-world assessments of medication-related costs.

The iStent inject[®] procedure is mostly used in combined procedures with cataract surgery, although it can be used as a standalone procedure. Our study population comprised a higher proportion of patients who underwent combined procedures; however, since stenting is also approved for standalone procedures in Brazil, we were able to include a minority of standalone eyes, enhancing the generalization of the outcomes.

When comparing the clinical outcomes, we observed a difference in the preoperative IOP and number of medications between the combined and standalone eyes. The latter presented a statistically higher IOP (17.5 mmHg versus 15.9 mmHg) and higher number of medications (2.7 versus 2.0). The main reason for this was selection bias. Many combined eyes already had well-controlled IOP prior to surgery; if IOP was not adequately controlled, cataract surgery alone would not have been sufficient, and these eyes would not have been selected for stenting. Conversely, most eyes in the standalone group needed escalation of glaucoma treatment, as the mean IOP was close to 18 mmHg, with a high number of glaucoma medications (mean: 2.7).

Although both groups (standalone and combined) benefited from the procedure, differences in indication criteria led to variations in baseline characteristics. These, in turn, influenced clinical outcomes—complete success rates were higher in the combined group—and economic outcomes, where cost savings were also greater for combined procedures. In summary, based on our results, we cannot confirm that the combined procedures

are better than the standalone procedures, either clinically or economically. The cost analyses presented here should be interpreted for the entire study population and each subgroup independently without making comparisons between them.

When analyzing unit costs, we noticed a considerable difference between prices in the private (SS) and public (SUS) sectors. The SUS secures lower prices by purchasing medications in bulk directly from pharmaceutical companies, leveraging its role as both provider and payer.

At baseline, most patients used a prostaglandin analog (85.5%), followed by a betablocker (70.9%) and carbonic anhydrate inhibitors (40.2%). This has a major impact on monthly costs, as prostaglandin has the highest cost among all glaucoma medications. Along with the follow-up, we observed a significant reduction in the number of patients using a prostaglandin analog, varying from approximately 10% in year 1 and 3 to 5% in year 5. We also notice a significant reduction in the proportions of all types of medication, reflecting the capacity of the iStent inject[®] implantation to reduce medication burdens.

After the procedure, we observed an approximately 80% reduction in monthly medication-related costs for both SS and SUS. This cost reduction was sustained over the 5-year follow-up, which is relevant from the payer's perspective. In the SS, medications are not reimbursed and must be purchased out-of-pocket by patients, as private insurance companies or health maintenance organizations do not cover these expenses. Using real-world cost data, the monthly savings over the follow-up period were found to be over \$40 per patient. Considering Brazil's minimal wage as of January 1st, 2025 (US\$ 245.00), savings could represent 16% of a family's monthly income. The accumulated 5-year cost of medications after the iStent inject[®] procedure is \$555.94 per patient, whereas the theoretical accumulated 5-year cost for the same medication regimen from baseline is projected to be \$3,160.79. This has a significant and non-negligible impact on family budgeting.

In the SUS, however, glaucoma medications are distributed through public referral centers—clinics and hospitals—with the SUS assuming full responsibility for treatment provision and funding. Health systems usually consider the long-term economic impact of new technologies to help decision-makers choose the most cost-effective alternative and/or the one generating the greatest savings. The 5-year accumulated cost per patient from the SUS perspective for the same medication regimen from baseline was calculated at ~\$512.82. The same calculation for the iStent inject[®] cohort was calculated at ~\$100.42.

According to government data, public glaucoma referral centers in Brazil treat approximately 250,000 patients annually. When applying the values obtained in this study to the Brazilian reality and numbers, we can infer that using iStent inject® could offer the SUS savings of \$1,690.00 per patient over 5 years. This equates to savings of approximately \$100 million for the total number of registered patients ($412.40 \times 250,000$), which would have a huge impact on the public system budget.

We observed a difference in cost savings between the combined and standalone procedures, with the combined procedures offering a greater reduction in medication-related costs. Nevertheless, one should be cautious in affirming that combined procedures are better at generating future savings. Although there may be a synergistic effect between the iStent inject® procedure and phacoemulsification, differences in populations and clear selection bias do not allow for such a comparison.

Our results have some limitations, including the retrospective design of the study and the collection of data from only one center. Certain assumptions were necessary, such as projecting costs for Group 2 based on the premise that patients remained on their baseline treatment regimens throughout the follow-up. In addition, we extrapolated the same clinical results to a different population when analyzing SUS costs.

Nevertheless, our study has notable strengths. It provides the first real-world evidence of long-term medication cost savings following the iStent inject® procedure. It includes data on both combined and standalone procedures, drawn from systematically maintained electronic medical records, which reduces the risk of errors and data loss. Furthermore, all surgeries were performed by the same surgeon, minimizing variability in surgical technique and outcomes.

CONCLUSION

This real-world analysis demonstrated a substantial and sustained reduction in medication-related costs over a 5-year period following the iStent inject® procedure—whether combined or standalone. These findings highlight a significant economic impact for patients, families, healthcare systems, and society as a whole.

AUTHORS' CONTRIBUTION

Ricardo Augusto Paletta Guedes: Conceptualization, Design, Data Collection, Supervision, Validation, Writing, Review. Daniel Augusto Guedes Moraes: Data Collection, Supervision, Validation, Review. Vanessa Maria Paletta

Guedes: Data Collection, Validation, Review. Daniela Marcelo Gravina: Data Collection, Validation, Review. Alfredo Chaoubah: Supervision, Validation, Review.

REFERENCES

- World Health Organization (WHO). World report on vision. Geneva, Switzerland: WHO; 2019 [cited 2025 Sep 2]. Available from: <https://www.who.int/publications/i/item/world-report-on-vision>
- European Glaucoma Society Terminology and Guidelines for Glaucoma, 5th Edition. 5th ed. Savona, Italy: Publicomm; 2020.
- Baudouin C, Labbé A, Liang H, Pauly A, Brignole-Baudouin F. Preservatives in eyedrops: the good, the bad and the ugly. *Prog Retin Eye Res.* 2010;29(4):312-34.
- Baudouin C. Mechanisms of failure in glaucoma filtering surgery: a consequence of antiglaucomatous drugs? *Int J Clin Pharmacol Res* 1996;16(1):29-41.
- Nordstrom BL, Friedman DS, Mozaffari E, Quigley HA, Walker AM. Persistence and adherence with topical glaucoma therapy. *Am J Ophthalmol.* 2005;140(4):598-606.
- Newman-Casey PA, Salman M, Lee PP, Gatwood JD. Cost-Utility Analysis of Glaucoma Medication Adherence. *Ophthalmology.* 2020;127(5):589-98.
- Baudouin C. Side effects of antiglaucomatous drugs on the ocular surface. *Curr Opin Ophthalmol.* 1996;7(2):80-6.
- Baudouin C, Denoyer A, Desbenoit N, Hamm G, Grise A. In vitro and in vivo experimental studies on trabecular meshwork degeneration induced by benzalkonium chloride (an American Ophthalmological Society thesis). *Trans Am Ophthalmic Soc.* 2012;110:40-63.
- Traverso CE, Walt JG, Kelly SP, Hommer AH, Bron AM, Denis P, et al. Direct costs of glaucoma and severity of the disease: a multinational long-term study of resource utilisation in Europe. *Br J Ophthalmol.* 2005;89(10):1245-9.
- Lee PP, Walt JG, Doyle JJ, Kotak SV, Evans SJ, Budenz DL, et al. A multicenter, retrospective pilot study of resource use and costs associated with severity of disease in glaucoma. *Arch Ophthalmol.* 2006;124(1):12-9.
- Lindblom B, Nordmann JP, Sellem E, Chen E, Gold R, Polland W, et al. A multicentre, retrospective study of resource utilization and costs associated with glaucoma management in France and Sweden. *Acta Ophthalmol Scand.* 2006;84(1):74-83.
- Schultz NM, Wong WB, Coleman AL, Malone DC. Predictors, Resource Utilization, and Short-term Costs of Laser Trabeculoplasty Versus Medication Management in Open-Angle Glaucoma. *Am J Ophthalmol.* 2016;168:78-85.
- Guedes RA. Non-pharmacological therapies for open angle glaucoma. Are we facing a paradigm shift? *Rev Bras Oftalmol* 2025;84:e0001.
- De Keyser M, De Belder M, De Belder J, De Groot V. Selective laser trabeculoplasty as replacement therapy in medically controlled glaucoma patients. *Acta Ophthalmol.* 2018;96(5):577-e581.
- Wong MO, Lee JW, Choy BN, Chan JC, Lai JS. Systematic review and meta-analysis on the efficacy of selective laser trabeculoplasty in open-angle glaucoma. *Surv Ophthalmol.* 2015;60(1):36-50.
- Philippin H, Matayan E, Knoll KM, Macha E, Mbishi S, Makupa A, et al. Selective laser trabeculoplasty versus 0.5% timolol eye drops for the treatment of glaucoma in Tanzania: a randomised controlled trial. *Lancet Glob Health.* 2021;9(11):e1589-e1599.
- Barbosa LEO, Barboza WL, Guedes RP, Pereira CD, Susanna R Jr, Hatanaka M. Selective Laser Trabeculoplasty as a Substitute for Medications in Patients with Mild-to-moderate Glaucoma in the Brazilian Public Health System. *J Glaucoma.* 2024;33(5):303-9.
- Gazzard G, Konstantakopoulou E, Garway-Heath D, Adeleke M, Vickerstaff V, Ambler G, et al.; LiGHT Trial Study Group. Laser in Glaucoma and Ocular Hypertension (LiGHT) Trial: six-year results of primary selective laser trabeculoplasty versus eye drops for the treatment of glaucoma and ocular hypertension. *Ophthalmology.* 2023;130(2):139-51.

19. Cantor L, Lindfield D, Ghinelli F, Świder AW, Torelli F, Steeds C, et al. Systematic literature review of clinical, economic, and humanistic outcomes following minimally invasive glaucoma surgery or selective laser trabeculoplasty for the treatment of open-angle glaucoma with or without cataract extraction. *Clin Ophthalmol*. 2023;17:85-101.
20. Garg A, Gazzard G. Selective laser trabeculoplasty: past, present, and future. *Eye (Lond)*. 2018;32(5):863-876. Erratum in: *Eye (Lond)*. 2020;34(8):1487.
21. Healey PR, Clement CI, Kerr NM, Tilden D, Aghajanian L. Standalone iStent Trabecular Micro-bypass Glaucoma Surgery: A Systematic Review and Meta-Analysis. *J Glaucoma*. 2021;30(7):606-20.
22. Guedes RA, Pepe C, Dias L, Murta L, Gravina DM, Chaoubah A. Preventing glaucoma progression using the trabecular micro-bypass implant iStent Inject®. A cost-effectiveness analysis. *Rev Bras Oftalmol* 2021;80:1-8.
23. Hengerer FH, Auffarth GU, Conrad-Hengerer I. iStent inject trabecular micro-bypass with or without cataract surgery yields sustained 5-year glaucoma control. *Adv Ther*. 2022;39(3):1417-31.
24. Vold SD, Voskanyan L, Tetz M, Auffarth G, Masood I, Au L, Ahmed II, Saheb H. Newly Diagnosed Primary Open-Angle Glaucoma Randomized to 2 Trabecular Bypass Stents or Prostaglandin: Outcomes Through 36 Months. *Ophthalmol Ther*. 2016;5(2):161-72.
25. Ahmed II, Katz LJ, Chang DF, Donnenfeld ED, Solomon KD, Voskanyan L, et al. Prospective evaluation of microinvasive glaucoma surgery with trabecular microbypass stents and prostaglandin in open-angle glaucoma. *J Cataract Refract Surg*. 2014;40(8):1295-300.
26. Guedes RA, Gravina DM, Guedes VM, Chaoubah A. Trabecular microbypass as replacement therapy in pharmacologically controlled open-angle glaucoma patients. *Arq Bras Oftalmol*. 2023;86(3):240-7.
27. Popovic M, Campos-Moller X, Saheb H, Ahmed IIK. Efficacy and Adverse Event Profile of the iStent and iStent Inject Trabecular Micro-bypass for Open-angle Glaucoma: A Meta-analysis. *J Curr Glaucoma Pract*. 2018;12(2):67-84.
28. Schweitzer JA, Hauser WH, Ibach M, Baartman B, Gollamudi SR, Crothers AW, Linn JE, Berdahl JP. Prospective Interventional Cohort Study of Ocular Surface Disease Changes in Eyes After Trabecular Micro-Bypass Stent(s) Implantation (iStent or iStent inject) with Phacoemulsification. *Ophthalmol Ther*. 2020;9(4):941-53.
29. Patel V, Ahmed I, Podbielski D, Falvey H, Murray J, Goeree R. Cost-effectiveness analysis of standalone trabecular micro-bypass stents in patients with mild-to-moderate open-angle glaucoma in Canada. *J Med Econ*. 2019;22(4):390-401.
30. Nieland K, Labbé A, Schweitzer C, Gicquel G, Kleintjens J, Ostawal A, et al. A cost-effectiveness analysis of iStent inject combined with phacoemulsification cataract surgery in patients with mild-to-moderate open-angle glaucoma in France. *PLoS One*. 2021;16(6):e0252130.
31. Teus MA, Belda JI, Lavín C, Garcia-Feijó J, Falvey H, Buseghin G, et al. Cost-effectiveness analysis of iStent Inject® implantation during cataract surgery compared to cataract surgery alone for mild to moderate open-angle glaucoma patients in Spain. *Expert Rev Ophthalmol*. 2021;16(4):319-28.
32. Paletta Guedes RA, Gravina DM, Paletta Guedes VM, Chaoubah A. iStent Inject (Second-generation Trabecular Microbypass) Versus Nonpenetrating Deep Sclerectomy in Association with Phacoemulsification for the Surgical Treatment of Open-angle Glaucoma and Cataracts: 1-Year Results. *J Glaucoma*. 2020;29(10):905-11.
33. Gravina DM, Guedes RAP, Chaoubah A. Cost-utility of primary non-pharmacological treatment of open-angle glaucoma. *Rev Bras Oftalmol* 2023;82:e0011.
34. Guedes RAP, Souza CP, dos Santos Dias LL, et al. A Brazilian cost-utility analysis of trabecular micro-bypass with iStent inject® for the treatment of open-angle glaucoma. *Rev Bras Oftalmol* 2022;81:e0049.
35. Paletta Guedes RA, Gravina DM, Paletta Guedes VM, Chaoubah A. Factors Associated with Unqualified Success After Trabecular Bypass Surgery: A Case-control Study. *J Glaucoma*. 2020 Nov;29(11):1082-7.
36. Guedes RAP. Micro-invasive glaucoma surgeries. Are they worth it? *Rev Bras Oftalmol* 2019;78:217-18.
37. Samuelson TW, Sarkisian SR Jr, Lubeck DM, Stiles MC, Duh YJ, Romo EA, et al.; iStent inject Study Group. Prospective, randomized, controlled pivotal trial of an ab interno implanted trabecular micro-bypass in primary open-angle glaucoma and cataract: two-year results. *Ophthalmology*. 2019 Jun;126(6):811-21.
38. Gillmann K, Mansouri K. Minimally invasive glaucoma surgery: where is the evidence? *Asia Pac J Ophthalmol (Phila)* 2020;9:203-14.