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Ten-year trends in glaucoma drop prescribing and expenditure under Irish community drug schemes, 2015–2025

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Abstract

Background

Glaucoma prescribing represents one of the largest components of ophthalmic drug expenditure, yet national prescribing trends in the Republic of Ireland have not been examined since 2003. This study evaluated changes in glaucoma prescribing, expenditure and opportunities for cost containment in the Republic of Ireland between 2015 and 2025.

Methods

National prescribing data for all glaucoma eye drops reimbursed under the General Medical Services, Drug Payment Scheme and Long-Term Illness schemes were obtained from the Primary Care Reimbursement Service. Costs were adjusted for inflation and population growth. Temporal trends were assessed using Kendall's tau, and a cheapest-alternative substitution model was used to estimate theoretical cost savings.

Results

Between 2015 and 2025, the PCRS reimbursed €139.9 million for 6.78 million glaucoma prescriptions. Prescriptions increased by 50.1% overall and 36.8% per capita ($\tau = 0.891$, 95% CI 0.683–1.099, $p = 0.0002$), while inflation-adjusted expenditure remained stable despite a 22.5% increase in nominal expenditure ($\tau = -0.200$, 95% CI −0.667–0.267, $p = 0.436$). Generic prescribing declined from 9.9% to 1.8% of prescriptions ($\tau = -0.927$, 95% CI −1.083– −0.771, $p < 0.001$), whereas preservative-free prescribing increased from 9.6% to 43.1% ($\tau = 1.000$, $p < 0.001$). A cheapest-alternative substitution model identified €30.68 million (21.9%) in theoretical cost savings.

Conclusions

Glaucoma prescribing in Ireland increased substantially over the past decade while inflation-adjusted expenditure remained stable despite rising prescribing volumes. Although opportunities for cost savings narrowed over time, substantial theoretical savings remained. Greater use of cost-effective prescribing, supported by national formulary guidance, could further improve prescribing efficiency without compromising patient care.

Introduction

Glaucoma is one of the leading causes of irreversible blindness worldwide and affects approximately 3% of adults aged over 40 years in Europe.[1,2] As populations continue to age, the number of individuals requiring long-term glaucoma treatment is projected to increase substantially over the coming decades, placing increasing pressure on healthcare systems.[3] Although surgical and laser interventions have an important role in glaucoma management, topical intraocular pressure-lowering medication remains the mainstay of treatment for most patients and is typically required for life.[4] Consequently, glaucoma

medications account for a substantial proportion of ophthalmic prescribing expenditure in many healthcare systems.[5-8]

National prescribing studies have demonstrated marked changes in glaucoma treatment over the past two decades. In England, prescribing volumes increased substantially between 2009 and 2018 despite a reduction in inflation-adjusted expenditure, largely driven by increasing generic prescribing and changes in therapeutic choice.[9] Similar analyses from the Nordic countries have shown that rising prescribing volumes are primarily attributable to demographic ageing, while the introduction of generic medications has reduced overall treatment costs despite increasing demand.[10] In Japan, national prescribing studies have documented changes in the use of fixed-dose combinations, generic medicines, and newer therapeutic classes, reflecting the influence of reimbursement systems and prescribing policies on glaucoma drug utilisation.[11] Together, these studies demonstrate that glaucoma prescribing is determined not only by disease burden, but also by medicine pricing, reimbursement policy and prescribing behaviour.

In Ireland, community prescribing is reimbursed through three publicly funded schemes administered by the Health Service Executive Primary Care Reimbursement Service (PCRS): the General Medical Services (GMS) scheme, the Drug Payment Scheme (DPS) and the Long-Term Illness (LTI) scheme. Together these schemes capture the majority of publicly funded community glaucoma prescribing and provide a comprehensive national record of reimbursed prescriptions.[12,13]

Despite the importance of glaucoma prescribing to healthcare expenditure, no national analysis has been undertaken in the Republic of Ireland since Knox et al. examined prescribing trends between 1996 and 2003.[14] Since that study, glaucoma management has changed substantially. Generic formulations have become widely available, preservative-free preparations and fixed-dose combination therapies have expanded considerably, and demographic ageing has increased the number of patients requiring treatment.[2,9,15,16] At the same time, inflation and changes in pharmaceutical pricing have altered the relationship between prescribing volume and healthcare expenditure. Consequently, it is no longer clear whether the drivers of glaucoma prescribing and expenditure identified two decades ago remain applicable in contemporary Irish practice.

The present study aimed to provide the first contemporary national analysis of glaucoma prescribing in the Republic of Ireland. Specifically, we examined trends in glaucoma prescribing and expenditure under the PCRS between 2015 and 2025, adjusting expenditure for inflation and prescribing volumes for population growth. We further evaluated changes in therapeutic class utilisation, generic and preservative-free prescribing, and estimated the theoretical savings achievable through selection of the lowest-cost available preparation within each therapeutic class.

Methods

This was a retrospective observational study of national glaucoma prescribing between 2015 and 2025. Annual prescribing data for all topical glaucoma medications reimbursed under the General Medical Services (GMS), Drug Payment Scheme (DPS) and Long-Term Illness (LTI) schemes were obtained from the Primary Care Reimbursement Service (PCRS) following a formal data request. Data were provided at product-code level for each calendar year from 2015 to 2025 inclusive, with separate datasets for each reimbursement scheme. For each product, the dataset included the number of prescriptions dispensed, quantity supplied, ingredient cost and total reimbursed cost.

Under the GMS and LTI schemes, all reimbursed prescriptions are captured irrespective of cost. Under the DPS, however, the PCRS reimburses only the proportion of a household's monthly medication expenditure exceeding the statutory reimbursement threshold. This threshold was €144 throughout 2015–2017, and was subsequently reduced in five steps to €80 by March 2022. Consequently, prescriptions dispensed to DPS patients whose cumulative monthly medication costs remained below this threshold were not captured within the DPS dataset. As the threshold fell over time, a greater proportion of prescriptions became reimbursable, which may have modestly overestimated the apparent increase in DPS prescription volume during the later study years

Each preparation was classified according to active ingredient, therapeutic class (prostaglandin analogue, beta-blocker, carbonic anhydrase inhibitor, alpha-agonist, Rho-kinase inhibitor and fixed-dose combinations), preservative-free status, and branded or generic status. Generic status was determined directly from the drug description field provided by the PCRS. Preparations recorded under an international non-proprietary (molecule) name were classified as generic, and those recorded under a proprietary trade name were classified as branded. Drug classification was applied consistently throughout the study period.

Annual population estimates and Consumer Price Index (CPI) data were obtained from the Central Statistics Office (CSO). To facilitate comparison with previous English prescribing studies, prescribing expenditure was adjusted for inflation using a chained CPI with 2015 as the reference year (index = 100). Prescription volumes and expenditure were additionally standardised to the Irish population and expressed per 10,000 population using annual CSO population estimates.

Temporal trends were assessed using Kendall's rank correlation coefficient (τ), consistent with previous national prescribing studies, as annual observations were non-parametric and limited to eleven time points. Statistical significance was defined as $p < 0.05$. Bootstrapped 95% confidence intervals for τ (1,000 replications) are reported where estimable; variables exhibiting perfect concordance ($\tau = \pm 1.000$) precluded CI estimation. Statistical analyses were performed using Stata version 19.5 (StataCorp, College Station, TX, USA).

A cheapest-alternative substitution model was constructed to estimate the theoretical maximum cost savings achievable by selecting the lowest-cost available preparation within each therapeutic class for each calendar year. Therapeutic classes were defined as: prostaglandin analogue monotherapy, beta-blocker monotherapy, carbonic anhydrase inhibitor monotherapy, alpha-agonist monotherapy, fixed-dose

beta-blocker/prostaglandin analogue combinations, and fixed-dose beta-blocker/carbonic anhydrase inhibitor combinations. For each class and year, the preparation with the lowest observed cost per prescription was identified, irrespective of active ingredient, preservative status or formulation type. Total class expenditure was recalculated assuming all prescriptions were dispensed at this unit cost. The difference between observed and modelled expenditure was summed across all years to estimate cumulative theoretical savings over the study period. As this model does not distinguish between individual active agents, preservative-free and preserved formulations, or differences in patient tolerability, the estimated savings represent a theoretical upper limit rather than an achievable clinical target.

Only aggregated, anonymised prescribing data were analysed. No individual patient data were accessed and ethical approval was therefore not required.

Results

Prescriptions: Between 2015 and 2025, the PCRS reimbursed a total of €139.92 million for 6,779,896 prescriptions for topical glaucoma medications under the GMS, DPS and LTI schemes. Annual prescription volume increased from 513,809 (1,101.2 per 10,000 population) in 2015 to 771,113 (1,505.8 per 10,000 population) in 2025 (see Figure 1), representing increases of 50.1% in absolute terms and 36.8% after adjustment for population growth (Kendall's $\tau = 0.855$, $p < 0.001$). As these data reflect prescription counts rather than individual patients, the increase may partly reflect changes in prescribing frequency, the number of products per patient, or scheme coverage, in addition to any true increase in the number of patients treated. Prescribing increased progressively throughout the study period, with the largest annual increases occurring between 2021 and 2023. By 2025, the PCRS reimbursed approximately 257,000 more glaucoma prescriptions annually than in 2015, equivalent to an increase of 404.6 prescriptions per 10,000 population.

Expenditure: Nominal expenditure increased from €11.85 million in 2015 to €14.51 million in 2025, representing a statistically significant increase of 22.5% (Kendall's $\tau = 0.818$, $p < 0.001$). However, after adjustment for inflation using the Consumer Price Index, real expenditure remained stable throughout the study period, ranging from €11.55 million to €12.26 million (see Figure 2) with no significant temporal trend (Kendall's $\tau = -0.200$, $p = 0.436$). Inflation-adjusted expenditure peaked at €12.26 million in 2020 before declining to €11.58 million in both 2023 and 2024, with a modest increase to €11.68 million in 2025. Overall, inflation-adjusted expenditure in 2025 remained only €168,480 below the level observed in 2015, despite substantially higher prescription volumes.

Generic vs branding: Over the study period, branded preparations accounted for 6,456,383 prescriptions (95.2%) and €135.16 million (96.6%) of total expenditure, while generic preparations accounted for 323,513 prescriptions (4.8%) and €4.76 million (3.4%) of total expenditure. The proportion of prescriptions dispensed as generics declined significantly throughout the study period (Kendall's $\tau = -0.927$, $p < 0.001$), falling from 9.9% of prescriptions and 7.3% of expenditure in 2015 to 1.8% and 1.1%,

respectively, in 2025 (see Figure 3). In absolute terms, generic prescribing decreased by 71.9%, from 50,823 to 14,260 prescriptions, while branded prescribing increased by 63.5%, from 462,986 to 756,853 prescriptions.

Preservative-free prescribing: Preservative-free formulations accounted for 1,979,766 prescriptions (29.2%) and €44.05 million (31.5%) of total expenditure during the study period. Their share of both prescribing and expenditure increased in every year of the study period (Kendall's $\tau = 1.000$, $p < 0.001$ for both). The proportion of prescriptions dispensed as preservative-free formulations increased from 9.6% in 2015 to 43.1% in 2025 (see Figure 3), while their share of expenditure increased from 12.6% to 46.2%. In absolute terms, preservative-free prescribing increased from 49,374 to 332,721 prescriptions (+573.9%), whereas prescribing of preserved formulations decreased slightly from 464,435 to 438,392 prescriptions (−5.6%).

Therapeutic class trends: Prostaglandin analogues remained the dominant therapeutic class throughout the study period, accounting for 47.3% of prescriptions and 45.5% of expenditure in 2015, compared with 43.1% and 41.4%, respectively, in 2025 (see Figure 4). The proportion of expenditure attributable to fixed-dose prostaglandin analogue/beta-blocker combinations increased consistently from 17.6% to 27.3% (Kendall's $\tau = 1.000$, $p < 0.001$), representing the largest shift observed among all therapeutic classes. During the same period, expenditure attributable to carbonic anhydrase inhibitor monotherapy declined from 12.9% to 9.1%, beta-blocker/carbonic anhydrase inhibitor combinations declined from 15.0% to 12.4%, and alpha-agonist monotherapy declined from 4.1% to 2.2%. A prostaglandin analogue/Rho-kinase inhibitor combination entered the dataset in 2024 and accounted for 0.9% of expenditure by 2025. Overall, prostaglandin-containing preparations (including monotherapy and combination products) increased from 63.1% to 69.6% of total expenditure over the study period.

Theoretical cost savings: Application of the cheapest-alternative substitution model identified cumulative theoretical savings of €30.68 million, representing 21.9% of total reimbursed glaucoma drug expenditure over the study period. This figure represents a theoretical upper limit, as the model does not account for differences in active agents, preservative status or individual patient tolerability between preparations within the same class. Annual potential savings declined from €3.52 million (29.7% of annual expenditure) in 2015 to €2.06 million (14.2%) in 2025 (Kendall's $\tau = -0.636$, $p = 0.008$). Potential savings varied substantially between therapeutic classes (see Figure 5). Prostaglandin analogue monotherapy accounted for the greatest absolute saving (€10.91 million; 18.0% of class expenditure), followed by fixed-dose beta-blocker/carbonic anhydrase inhibitor combinations (€8.18 million; 41.1%), beta-blocker/prostaglandin analogue combinations (€6.65 million; 20.8%), and carbonic anhydrase inhibitor monotherapy (€3.51 million; 25.7%). Minimal or no theoretical savings were identified for alpha-agonist/carbonic anhydrase inhibitor combinations, alpha-agonist/beta-blocker combinations, or prostaglandin analogue/Rho-kinase inhibitor combinations. Overall, the model estimated that approximately one-fifth of reimbursed glaucoma drug expenditure represented theoretically avoidable expenditure under the assumptions of the substitution model.

Price variation within classes: Within each therapeutic class, the cost of a month's supply of the most expensive available option consistently exceeded that of the cheapest option, and this gap was wide and persistent across the study period (Supplementary Figure 1). In 2015, for example, the most expensive alpha-agonist, Iopodine 0.5%, cost €12.57 for a month's supply compared with €7.96 for Alphagan, a difference of 58%. In 2016, the most expensive prostaglandin analogue, Saflutan SDU, cost €21.19 for a month's supply compared with €7.66 for generic latanoprost, almost three times the price. In 2019, the most expensive beta-blocker, Betoptic SDU, cost €12.54 compared with €2.63 for a month's supply of Timoptol, a nearly five-fold difference. These persistent within-class price differentials, evident even between products with equivalent therapeutic effect, underpin much of the theoretical savings identified by the substitution model above.

Discussion

This study provides the first national analysis of glaucoma prescribing in the Republic of Ireland since Knox et al. examined prescribing trends between 1996 and 2003, and the first to use inflation-adjusted expenditure, population-adjusted prescribing rates and a therapeutic substitution model.[14] Four principal findings emerge: a substantial increase in prescribing volume without a corresponding rise in real expenditure; a shift towards fixed-dose combination and preservative-free formulations; a marked decline in generic prescribing, contrasting with trends in England; and considerable theoretical scope for cost savings through product selection.

The finding that inflation-adjusted expenditure remained stable despite a 50% increase in prescribing suggests that glaucoma drug expenditure has been effectively contained over the past decade. This represents a marked improvement compared with Knox et al., who documented a 227% nominal rise in glaucoma drug costs between 1996 and 2003, equivalent to approximately 155% in real terms when the same CSO CPI series is applied. This is substantially higher than the stable real expenditure observed in the present study.[14] However, the mechanisms underlying these trends appear to differ between the two healthcare systems. Whereas expenditure control in England has been largely attributed to widespread generic prescribing, the Irish data demonstrate that stable real expenditure was achieved despite a progressive decline in generic utilisation. This suggests that pricing policy and medicine reimbursement have played a more important role in determining expenditure trends in Ireland than generic substitution alone. With the number of people living with glaucoma in Europe projected to continue increasing because of demographic ageing, maintaining cost-effective prescribing will become increasingly important for healthcare sustainability.

One plausible contributor to this improved price containment is the introduction of statutory reference pricing in Ireland under the Health (Pricing and Supply of Medical Goods) Act 2013, shortly before the start of the present study period.[17] Under this framework, the Health Service Executive may set a reference price for a group of interchangeable medicines, above which reimbursement is capped unless a clinical exemption applies. By limiting the amount reimbursed for a medicine irrespective of which

specific product is dispensed, this mechanism may have helped contain aggregate expenditure even in the absence of substantial generic substitution.

Prescribing patterns changed substantially over the study period. Fixed-dose prostaglandin analogue/beta-blocker combinations accounted for an increasing proportion of expenditure, consistent with international trends favouring fixed-dose therapy to improve adherence and reduce treatment burden.[9,10,18,19] Preservative-free prescribing increased more than fourfold, rising from 9.6% to 43.1% of all prescriptions by 2025, substantially exceeding rates reported in England.[16] This trend is consistent with increasing recognition of ocular surface toxicity associated with chronic preservative exposure and the expanding availability of preservative-free formulations. However, the revised NICE guidelines recommend preservative-free preparations only in patients with symptomatic ocular surface disease, rather than as a default first-line choice.[20] The observation that preservative-free formulations now account for over four in ten glaucoma prescriptions raises the possibility that their use in Ireland extends beyond this guideline-defined indication, although prescribing data alone cannot determine whether this reflects a genuinely high prevalence of symptomatic ocular surface disease in this population, more liberal application of the guideline criteria, or broader changes in prescribing behaviour and product availability.

Perhaps the most important finding is that Ireland has followed a prescribing trajectory fundamentally different from that observed in England. Hogg and Connor reported that generic prescribing increased from 11.7% to 55.2% of glaucoma prescriptions between 2009 and 2018 following national guidance recommending generic-first prescribing.[9] By contrast, generic prescribing in Ireland declined from 9.9% to just 1.8% over the present study period. This divergence is unlikely to reflect differences in the underlying clinical evidence, which is common to both healthcare systems. Instead, it suggests that differences in pharmaceutical pricing and reimbursement policy have had a greater influence on prescribing behaviour.

The therapeutic substitution model identified substantial opportunities for improving prescribing efficiency. Overall, €30.68 million in theoretical savings were identified, equivalent to 21.9% of total glaucoma drug expenditure during the study period. Although these estimates represent an upper bound because the model assumes complete clinical interchangeability within therapeutic classes, they demonstrate considerable variation in prescribing costs between therapeutically comparable products. The greatest opportunities for savings were identified within prostaglandin analogue monotherapy and fixed-dose beta-blocker/carbonic anhydrase inhibitor combinations, where lower-cost alternatives were available but used infrequently. Interestingly, annual theoretical savings declined significantly over the study period, from 29.7% of annual expenditure in 2015 to 14.2% in 2025. This suggests that price differentials between higher- and lower-cost preparations narrowed over time, reducing, but not eliminating, the scope for further savings through product selection alone.

This study has several limitations. First, the analysis used aggregated prescribing data and therefore could not account for individual patient characteristics, clinical indications or prescribing

appropriateness. Second, the dataset was restricted to PCRS-reimbursed community prescriptions and did not include private prescriptions. Third, because the DPS dataset captures only prescriptions exceeding the monthly reimbursement threshold, total community prescribing is likely to be underestimated. Also, the reduction in this threshold between 2015 and 2022 means that the apparent increase in DPS prescription volume over the study period may partly reflect greater scheme capture rather than true growth in prescribing. Another limitation is that the therapeutic substitution model assumes complete clinical interchangeability within drug classes and therefore estimates the theoretical upper limit of achievable savings rather than clinically attainable cost reductions. Finally, population adjustment was performed using total crude population estimates rather than age-standardised rates. Given that glaucoma prevalence increases markedly with age, and that Ireland's population aged substantially over the study period, the per-capita prescribing figures presented may underestimate the true increase in age-adjusted treatment rates. Nevertheless, the study analyses the largest national glaucoma prescribing dataset available in Ireland and provides the first comprehensive assessment of prescribing trends, expenditure and potential cost-saving opportunities over the past decade.

Conclusion

Glaucoma prescribing in Ireland increased substantially between 2015 and 2025 while inflation-adjusted expenditure remained remarkably stable despite a 50% increase in prescribing volume. Unlike in England, this occurred alongside a marked decline in generic prescribing, suggesting that pricing policy, rather than generic substitution, may have played a more important role than generic substitution in containing expenditure within the Irish healthcare system. Although opportunities for theoretical savings have narrowed over time, approximately one-fifth of glaucoma drug expenditure remained potentially avoidable under the assumptions of the substitution model. Future prescribing policy should therefore focus not only on encouraging cost-effective prescribing but also on ensuring that pharmaceutical pricing and reimbursement policies support economically efficient treatment choices without compromising the quality of glaucoma care.

Declarations

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Authorship: AD was responsible for designing the study, requesting the data from PCRS, analysing the data, and writing the manuscript. RF was responsible for statistical analysis and revising the manuscript. EC and FOL were both responsible for literature review and recommending revisions to the manuscript.

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Figures

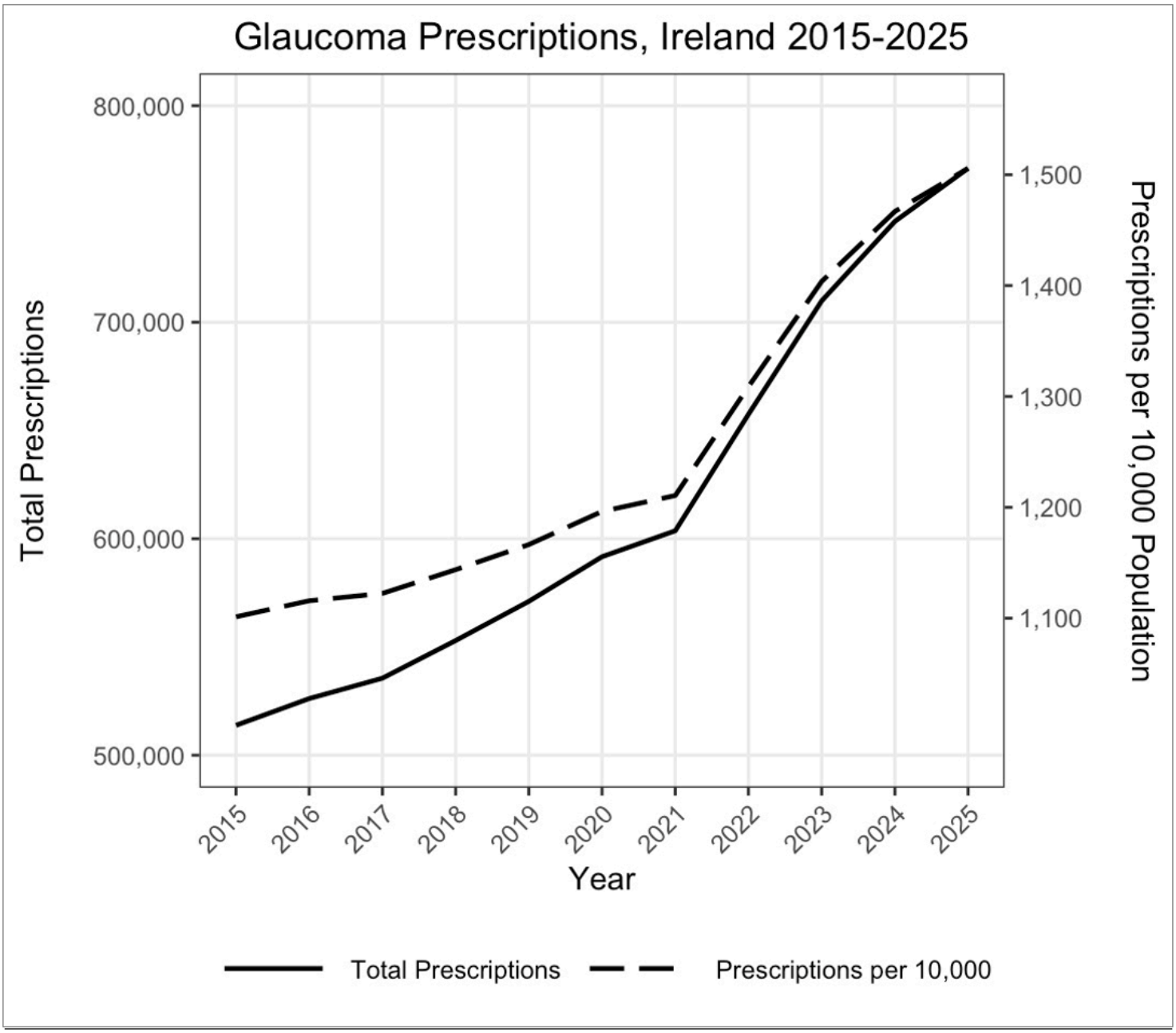


Figure 1

Total glaucoma prescriptions and prescriptions per 10,000 population reimbursed under the GMS, DPS and LTI schemes, Ireland 2015–2025.

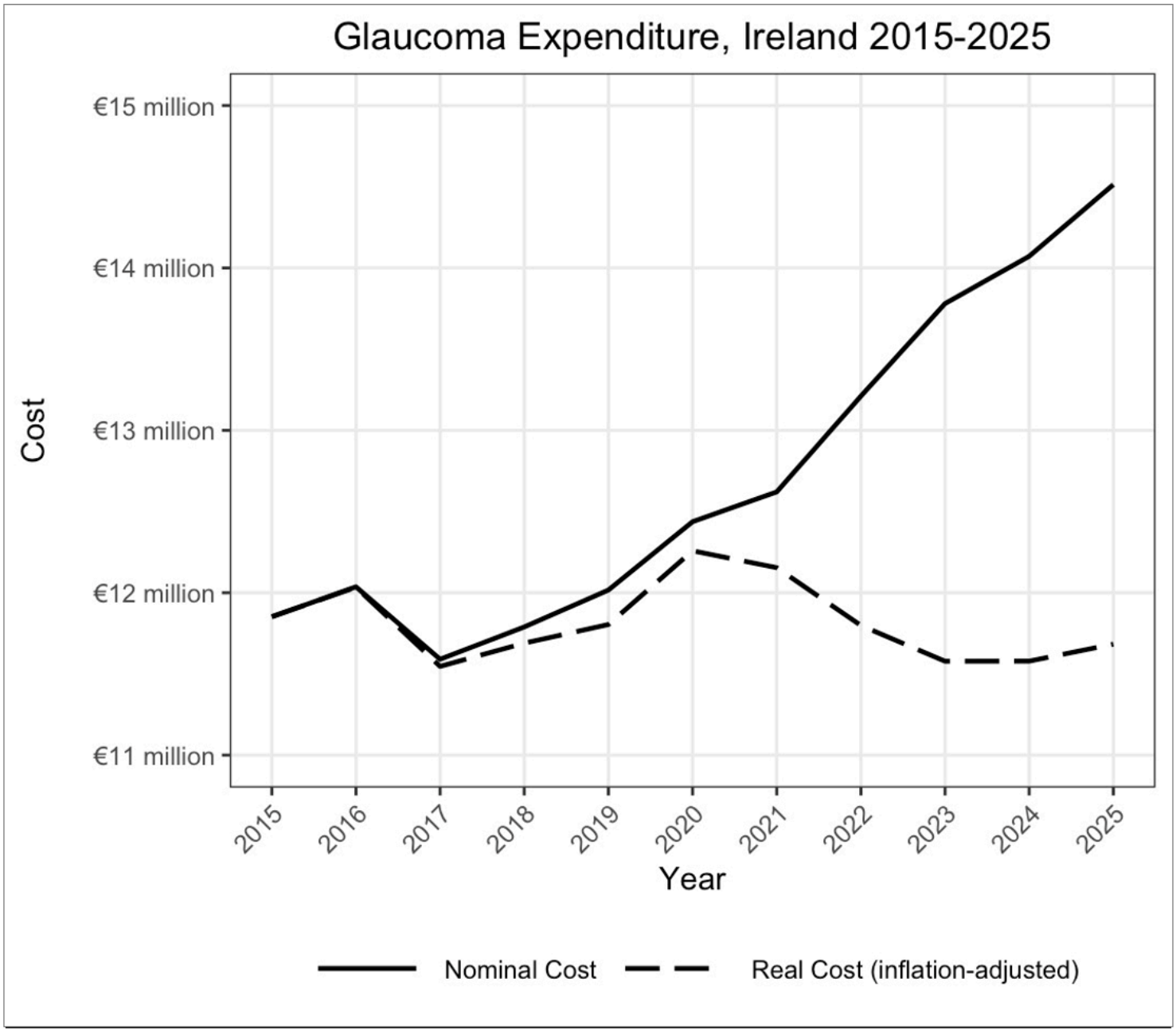


Figure 2

Nominal and real (inflation-adjusted) annual glaucoma drug expenditure, Ireland 2015–2025.

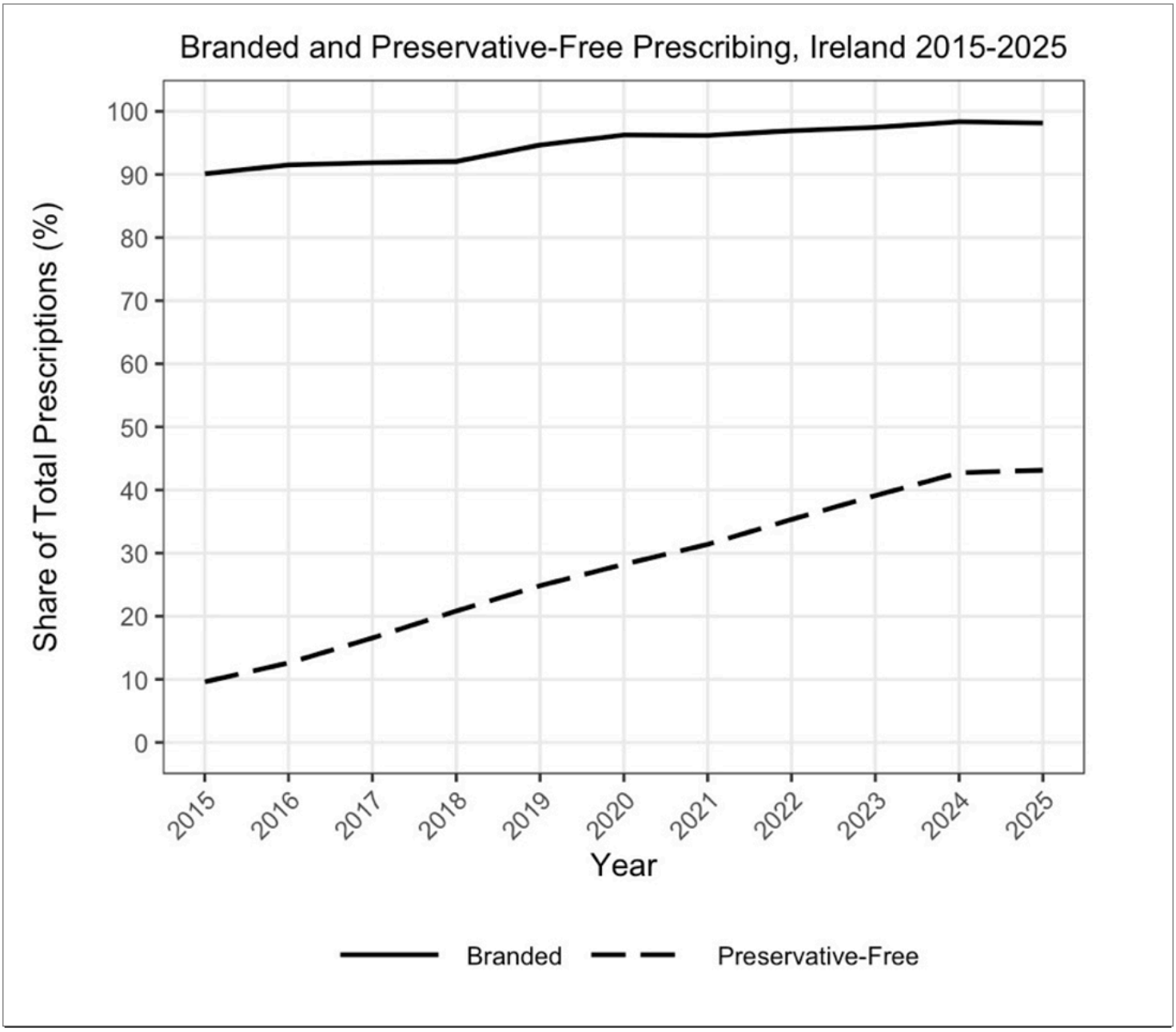


Figure 3

Branded and preservative-free prescribing as a proportion of total glaucoma prescriptions, Ireland 2015–2025. These categories are not mutually exclusive.

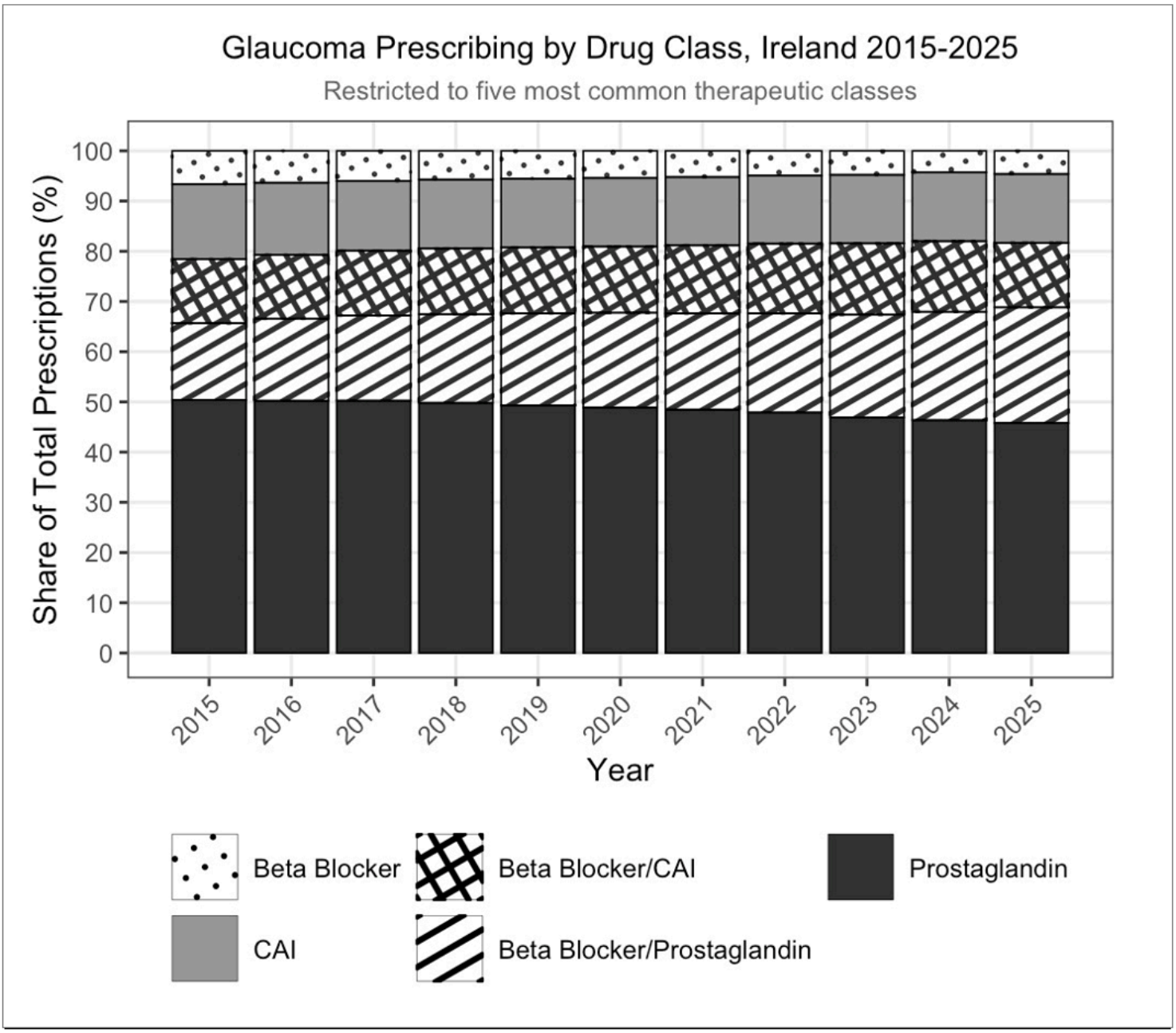


Figure 4

Share of total glaucoma prescriptions by therapeutic class, Ireland 2015–2025 (five most common classes shown).

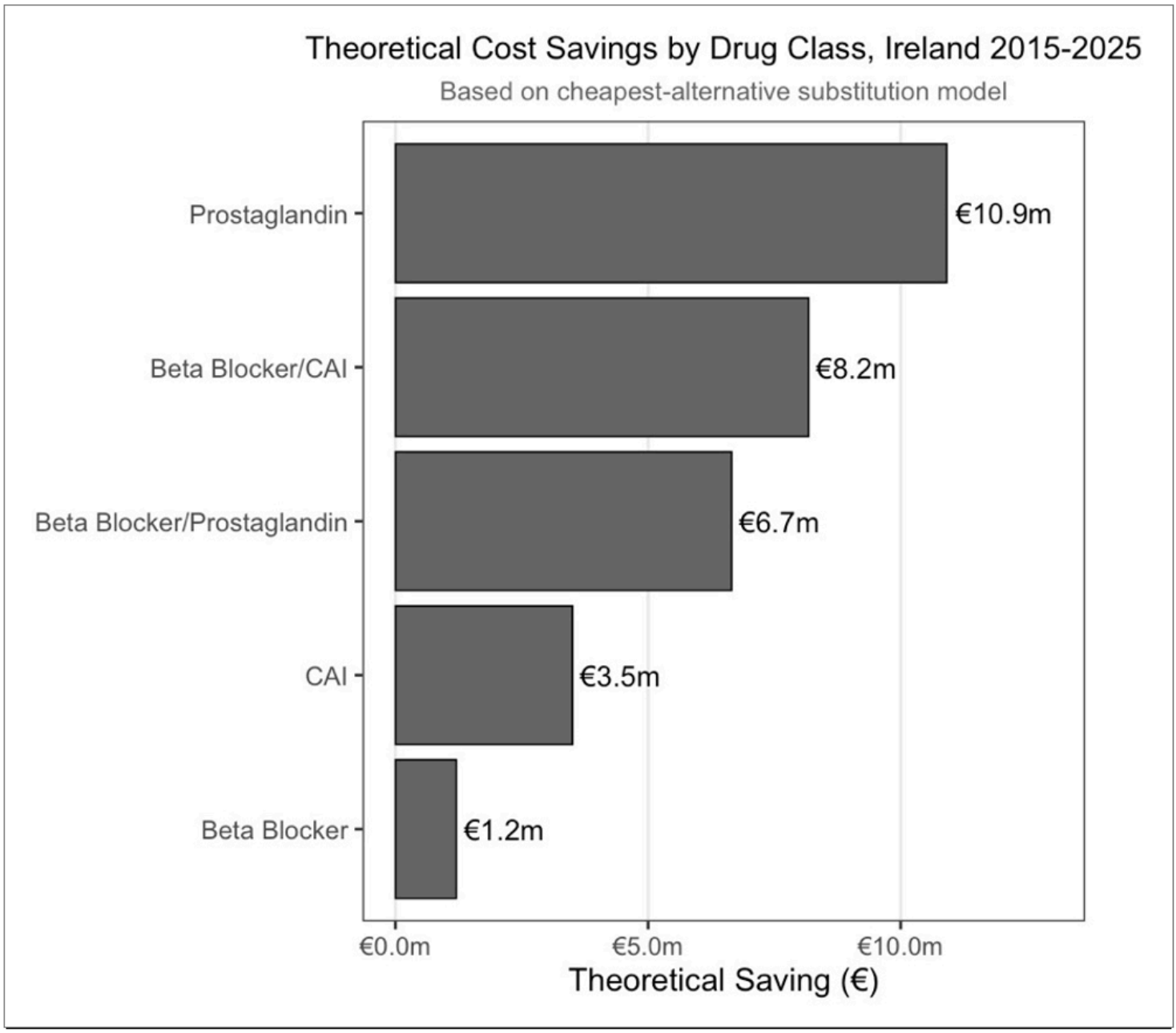


Figure 5

Theoretical cost savings by therapeutic class based on cheapest-alternative substitution model, Ireland 2015–2025.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFigure1.docx