Abolishing Coinsurance for Oral Antihyperglycemic Agents: Effects on Social Insurance Budgets

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Objective: To assess the effects of abolishing coinsurance for oral antihyperglycemic agents (OAAs) on the social insurance fund budget in Greece.

Study Design: A mathematical model estimating the effect of a decrease in patient coinsurance rate on demand for and adherence to OAAs and the subsequent clinical and economic outcomes.

Methods: Price elasticity of demand for antidiabetic agents was used to estimate quantity demand change as a result of a coinsurance rate decrease and consequent increased adherence to OAAs. Given the inverse relationship between OAA adherence and glycated hemoglobin (A1C) level, the model calculated the mean decrease in A1C level and associated cost savings based on the cost difference between patients with controlled versus uncontrolled A1C levels.

Results: A decrease in patient coinsurance rate from 25% to 0% led to an incremental increase in OAA adherence of 30.5% and a mean decrease in A1C level of 0.6%. The A1C level decrease contributed to an 18.5% "shift" of uncontrolled patients to controlled A1C levels (≤7%), which in economic terms translated into savings of €324 per patient over a 3-year period and an investment return rate of 122.8%. A series of 1-way and 2-way sensitivity analyses were conducted to verify the robustness and validity of the outcomes.

Conclusion: The introduction of policies aimed at abolishing coinsurance for OAAs can result in improved patient outcomes and cost savings for the healthcare system.

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Diabetes mellitus is one of the most common and costly chronic diseases, imposing a considerable burden on patients and healthcare budgets worldwide. According to the World Health Organization,[1] approximately 171 million individuals in 2000 had diabetes, mostly type 2 diabetes mellitus (T2DM). Life expectancy increases and lifestyle changes are expected to dramatically increase the prevalence of diabetes in the coming decades. Studies predict that the number of adult patients with diabetes will exceed 300 million[2] by 2025 and 366 million[3] by 2030.

Diabetes is a widespread disease in Greece, affecting 7.6% of men and 5.9% of women among the general population (based on 2005 data).[4] The total direct cost of T2DM in 2009 was €2.3 billion, or 12% of the country's annual health expenditure,[5] which is comparable to respective US findings[6] but is well above the European mean (3%-6%).[7]

The significant expenditures attributed to diabetes result from the need for intensive patient monitoring, particularly for the management of diabetic complications, which accounts for 55% of total patient costs.[7] The occurrence of complications is largely attributed to poor control of glycated hemoglobin (A1C) level,[8] which, according to guidelines, should not exceed 7%.[9] Adequate control of A1C level has been shown to prevent or delay the occurrence of complications and to contain diabetes-related costs.[10-14]

Adherence to treatment is a commonly accepted prerequisite for achieving glycemic goal (A1C level ≤7%).[1] As a result of several factors,[15] much evidence reveals poor or partial adherence,[16-19] with one of the most important variables being the cost of treatment.[20,21] Specifically in the case of chronic diseases, patient cost sharing can lead to reduced consumption of essential drugs and consequently to poor adherence, adverse clinical outcomes, and increased costs.[22] This relationship has been documented for diabetes (eg, Karter et al,[22] Piette et al,[23] Mahoney,[24] Colombi et al[25]) and for other chronic conditions (eg, Joyce et al,[26] Gibson et al,[27] Gibson et al[28]).

To improve treatment access, the Greek Social Health Insurance (SHI) system has abolished coinsurance for several chronic illnesses, including diabetes. However, the 0% coinsurance rate applies only to patients with insulin-dependent diabetes, while those receiving oral

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antihyperglycemic agents (OAAs) are subject to a 25% coinsurance rate.

In light of this, the present study aimed to assess the costs and benefits of a potential coinsurance rate decrease from the existing 25% to 0% for OAAs in a universal coverage setting. Particularly tested was the hypothesis that economic benefits for the Greek SHI system from full coverage of OAAs would outweigh the relative costs. Therefore, extension of coverage would be accompanied by economic and clinical benefits for patients and by cost savings for the third-party payer, the perspective from which this analysis was conducted.

Take-Away Points

To our knowledge, this is the first study to examine the effects of abolishing coinsurance for oral antihyperglycemic agents (OAAs) on both utilization and healthcare expenditures in a universal coverage setting.

- The findings indicate that full coverage of OAAs can result in clinical and economic benefits for patients and in cost savings for the healthcare system.
- Cost-sharing policies targeting drugs for chronic conditions should be carefully examined and specifically designed for each therapeutic class and pharmacologic subgroup before implementation to avoid adverse clinical and economic effects.

METHODS

The study method focuses on transformation of the research hypothesis into a mathematical model populated with literature data. A PubMed literature review was performed using the following 4 combinations of key terms: *A1C* and *complications*, *A1C* and *adherence*, *adherence* and *complications*, and *adherence* and *cost-sharing*. Results were limited to articles published in English or in Greek between January 1, 2000, and December 31, 2009. Studies about type 1 diabetes, long-term complications, and treatments other than OAAs were excluded. From the remaining articles, we selected those that provided quantitative data for the relationship between coinsurance rate and adherence, adherence and A1C level, A1C level and short-term complications, price elasticity and demand for OAAs, and costs and clinical outcomes of T2DM. Where available, studies reporting Greek data were used.

Model Description

The model initially attempted to estimate the effect of a potential decrease in cost sharing on the demand for OAAs and to convert increased demand into improved adherence. Given the documented inverse relationship between OAA adherence and A1C level,[29] this change in adherence was used to estimate the mean change and the new A1C levels compared with baseline. Taking into account changes in A1C level and A1C level distribution in the population with T2DM in Greece, the number of uncontrolled patients who "shift" to controlled A1C levels was estimated. The mean and total cost differences between controlled and uncontrolled patients are key points of the model on which the economic benefits of potential full coverage are estimated.

Specifically, the change in demand for OAAs resulting from a coinsurance rate decrease was estimated by price elasticity of demand, derived from the literature (as detailed in the next paragraph). Because of particularities among the pharmaceutical market in which reimbursement for drugs takes place within the perspective of social insurance, a nonlinear relationship exists between price and quantity demand.[30] Therefore, the use of arc elasticity rather than elasticity of a linear demand curve was considered more appropriate on scientific grounds.

Adherence to treatment was derived from the medication possession ratio (MPR), defined as the ratio of the total number of days for which the patient was supplied with the prescribed drug to the duration of follow-up.[25,31] When the total quantity is increased, the number of days for which the patient was supplied with OAAs is increased accordingly (assuming that the patient consumed the supplied drugs), and the adherence rate to treatment also rises by extension. Marginal increase in adherence is calculated based on baseline adherence to OAAs, which was drawn from the literature (**Table 1**) because of the absence of relative Greek data. For a conservative approach, the value was chosen from the midrange reported in a review of adherence rates to diabetes medications.[20]

According to the literature, an incremental increase in OAA adherence leads to a decrease in A1C level.[29] Specifically, a 10% increase in adherence results in a mean A1C level reduction of 0.19% (Table 1). Marginal increase in adherence from the elimination of cost sharing will result in improved clinical outcomes (decreased A1C levels) for the variables on which the possible economic benefits are examined. For consistency, all studies that provided data for the model measured adherence by the same method used for the model calculations analyzed earlier.

Cost Calculations

The total direct cost of diabetes can be analyzed as (1) the direct cost for patient monitoring and follow-up and (2) the cost for management of complications. To date, the only study reporting T2DM cost data for Greece is by Athanasakis et al,[5] who estimated the mean annual direct cost of follow-up per patient in patient groups (controlled vs uncontrolled) and the mean cost of follow-up and complications regardless of A1C level control.

Table 1. Baseline Variables of the Model

Variable	Value	Source
Price elasticity of demand, €	−0.25	Goldman et al,[33] 2004; Rosen et al,[34] 2005
Baseline adherence, %	61	Dezii et al,[35] 2002
Change in glycated hemoglobin level divided by change in adherence, %	0.19	Schectman et al,[29] 2002
Direct annual cost per controlled patient, €	1053.01	Athanasakis et al,[5] 2010
Direct annual cost per uncontrolled patient, €	1681.71	Athanasakis et al,[5] 2010
Annual cost of complications per patient, mean, €	1702.28	Athanasakis et al,[5] 2010
Share in total cost of complications among controlled and uncontrolled patients, %	37.4 for controlled; 62.6 for uncontrolled	Menzin et al,[13] 2001
Annual cost of OAAs per patient, €	352.01	Liatis et al,[32] 2009
Annual cost sharing for OAAs per patient, €	88.00	Liatis et al,[32] 2009

OAAs indicates oral antihyperglycemic agents.

Given that the 2 patient groups (controlled vs uncontrolled) contribute differently to the total cost of complications, it was necessary to allocate the expenses based on the method by Menzin et al.[13] Their study was performed among a sample of patients with baseline demographic characteristics comparable to those of the general population with diabetes in Greece (mean age, 63.4 years[13] vs 63.8 years[5]; and ratio of men to women, 55.1-44.9[13] vs 56.1-43.9[4]), and the authors concluded that controlled and uncontrolled patients contributed 37.4% and 62.6%, respectively, to the total cost of diabetic complications over 3 years (Table 1). The results of the cost allocation for complications were added to the follow-up cost reported by Athanasakis et al[5] to estimate the total cost of T2DM among patients in Greece over a 3-year period based on level of A1C control.

The cost difference and subsequent aggregate cost savings resulting from better adherence and improved control formed the basis of the predicted economic benefit of the intervention. The cost of the intervention was calculated based on prescription data for patients with T2DM by Liatis et al.[32] All costs were adjusted to 2009 prices using a 3.5% discount rate. Model variables are summarized in Table 1.

Sensitivity Analyses

To evaluate the robustness of the outcomes, results were subjected to a series of 1-way deterministic sensitivity analyses by testing different values of the key variables in the model. A 2-way sensitivity analysis was performed for the variables that had the greatest effect on results.

RESULTS

Base-Case Analysis

According to the base-case analysis, a decrease in patient coinsurance rate from 25% to 0% would lead to an OAA price reduction, which would result in a 50% quantity demand increase based on the arc price elasticity of −0.25 used.[33,34] With an assumed baseline adherence of 61%[35] (**eAppendix** available at **www.ajmc.com**) and a follow-up duration of 365 days, a 50% rise in quantity demand would increase the days that a patient complied with treatment from 222.65 to 333.98. According to the MPR, this change would result in an incremental OAA adherence increase of 30.5% (assumed to remain stable during the study period). Based on the inverse relationship between OAA adherence and A1C level, the model predicts a mean decrease of 0.579% in A1C levels.

According to Liatis et al,[32] the A1C level distribution among Greek patients with diabetes follows a normal distribution, with a mean (SD) of 7% (1.2%). The distribution mean coincides with the threshold A1C level between controlled and uncontrolled patients according to guidelines.[9] Based on the normal distribution (mean [SD], 7% [1.2%]), the calculated mean A1C level decrease would cause the distribution to shift to the left, resulting in an 18.5% incremental increase in the number of patients with A1C levels of 7% or less.

According to Athanasakis et al,[5] the follow-up costs of controlled and uncontrolled patients with T2DM over a 3-year period are €3159 and €5045, respectively (Table 1), whereas the mean annual follow-up cost is €4177.50 per patient irrespective of A1C control. The overall 3-year mean patient cost is €9284.30,[5] of which €5107 are expenses due to complications. As already mentioned, complication expenses were allocated to the 2 groups according to the ratio by Menzin et al,[13] resulting in complication costs for controlled and uncontrolled patients of €1910 and €3197, respectively, and 3-year total costs (follow-up and complications) of €5069 and €8242, respectively. Consequently, the estimated 3-year cost difference between a controlled and uncontrolled patient is €3173.

To quantify the results of this analysis, the investment return rate was evaluated in financial terms (cost – benefit) in a hypothetical cohort of 100 patients. The total economic benefit from the introduction of the intervention for a cohort of 100 patients was estimated at €58,830.60 based on the cost difference between controlled and uncontrolled patients (€3173), multiplied by the percentage of patients (18.54%) who achieved A1C level control.

Table 2. Results of the Base-Case Analysis[a]

Incremental increase in adherence, %	30.5
Decrease in glycated hemoglobin level, mean, %	0.579
Incremental increase in controlled patients, %	18.54
Cost difference between controlled and uncontrolled patients, €	3173.00
Total economic benefit per 100 patients, €	58,830.60
Total investment cost per 100 patients, €	26,401.30
Net economic benefit per 100 patients, €	32,429.30
Investment return rate, %	122.8

[a]Values were calculated for a 3-year period using 2009 prices in euros.

Estimation of the total investment cost was based on data by Liatis et al[32] indicating that the mean annual cost of pharmaceuticals for patients managed with OAAs only is €352 per patient. Consequently, the increase in OAA reimbursement rate from 75% to 100% would result in a total investment cost of €26,401.30 over a 3-year period for the hypothetical cohort of 100 patients.

Therefore, the net economic benefit of the investment would be €32,429.30 per 100 patients or €324.30 per patient, reflecting an investment return rate of 122.8%. These data are summarized in Table 2.

Sensitivity Analyses

A 1-way sensitivity analysis was conducted by calculating the investment return rate when the model variables were varied ±20% from baseline (Table 3). The analysis demonstrated that in all cases full coverage of OAAs remained profitable, with investment return rates ranging from 69% to 176.6%. Performing a threshold sensitivity analysis for predicted adherence showed that the outcomes remained favorable even for an incremental increase of 13.26% in baseline adherence. A 2-way sensitivity analysis of the variables with the greatest effect on results (ie, baseline adherence relative to sharing in the cost of complications among controlled and uncontrolled patients) revealed favorable results for all combinations of the 2 variables within the specified ±20% range (Table 4).

DISCUSSION

Patient cost sharing, especially in the case of chronic diseases, is a matter of intense debate. The present study was conducted to evaluate economic outcomes for a third-party payer that could result from abolishing coinsurance for OAAs.

The study method was based on construction of a research hypothesis in the context of limited data availability from the Greek healthcare sector. A potential decrease in patient coinsurance rate translated to improved prescribed treatment adherence and to subsequent clinical and financial benefits of decreased A1C levels. This well-established relationship between A1C levels and clinical outcomes and costs[10-12,14] was quantified by calculating the incremental increase in the percentage of controlled patients with diabetes in Greece and reflected the economic benefit of the intervention.

The final cost–benefit results of potentially abolishing copayments for OAA revealed that this could be beneficial for the SHI system. Specifically, the intervention translated to a 122.8% investment return rate over 3 years, a rate many times greater than the usual credit return on capital in developed

Table 3. Results of 1-Way Sensitivity Analysis

Variable	Baseline Variables of the Model	Sensitivity Range Tested, ±20%	Net Economic Benefit per Patient, €[a]	Investment Return Rate, %[a]
Price elasticity of demand, €	–0.25	–0.20 to –0.30	212.90 to 430.30	80.60 to 162.97
Baseline adherence, %	61.00	48.80 to 73.20	212.90 to 430.30	80.60 to 162.97
Change in glycated hemoglobin level divided by change in adherence, %	0.019	0.016 to 0.023	236.700 to 434.080	89.660 to 164.400
Share in total cost of complications among controlled and uncontrolled patients, %	37.40 for controlled; 62.60 for uncontrolled	44.90 to 55.10 for controlled; 29.90 to 70.10 for uncontrolled	181.69 for controlled; 440.80 for uncontrolled	69.00 for controlled; 176.60 for uncontrolled

[a]The net economic benefit and investment return rate were calculated for a 3-year period using 2009 prices in euros.

Table 4. Results of the 2-Way Sensitivity Analysis Showing Investment Return Rates for Various Combinations of Baseline Adherence and Sharing in the Total Cost of Complications[a]

Share in Total Cost of Complications Among Controlled Patients, %	Baseline Adherence, %							Share in Total Cost of Complications Among Uncontrolled Patients, %
	48.8	52.9	57	61	65	69.1	73.2	
29.9	**110.4**	141.7	159.6	176.6	193.9	210.3	213.3	70.1
32.4	96.7	**126.0**	142.8	158.7	174.9	190.2	193.0	67.6
34.9	83.1	**110.4**	125.9	140.8	155.8	170.1	172.7	65.1
37.4	69.5	94.7	**109.1**	122.8	136.8	150.0	152.4	62.6
39.9	55.8	79.0	92.3	**104.9**	**117.7**	129.9	132.1	60.1
42.4	42.2	63.4	75.5	87.0	98.7	**109.7**	**111.8**	57.6
44.9	28.5	47.7	58.6	69.0	79.6	89.6	91.4	55.1

[a]Values in boldface represent combinations of the 2 variables above which the investment return rate exceeds 100%.

economies. In monetary terms, if the system invested €264 for every patient with T2DM managed with OAAs, it could obtain a net benefit of €324.30 per patient over a 3-year period by preventing more intensive follow-up patterns and management of complications. Full-scale implementation of this policy for all 448,500 patients with diabetes managed solely with OAAs in Greece[5] would require a total investment of €118,404,000 and could lead to a potential 3-year net benefit of €145,448,550.

The present study outcomes are in line with literature that documents the inverse relationship between cost sharing and treatment adherence, as well as subsequent effects on patients' clinical status and health expenditures.[23-26,33] Most of these studies investigate the consequences of increased cost sharing, whereas few approach the issue from the perspective of decreasing coinsurance rates or copayments. To our knowledge, the present study is the first to examine the effects of abolishing copayments for OAAs in a European universal coverage setting and demonstrates that the introduction of such policies in the management of chronic conditions could result in improved outcomes and economic benefits for patients and in cost savings for third-party payers.

Our study has some limitations. Because of the limited time frame of the analysis (3 years), calculations focused on the estimation of costs attributed only to short-term complications. This limitation can arguably lead to underestimation of results given that long-term diabetic complications are associated with higher morbidity and costs. In addition, the allocation of complication costs to controlled and uncontrolled patients was based on the study by Menzin et al,[13] who adopted an A1C level control threshold of 8%, in contrast to the 7% threshold in existing guidelines.[9] This contributes to further underestimation of the results. Moreover, Menzin et al do not report patient characteristics such as the presence of other (nondiabetic) complications or concomitant medications; therefore no assumptions could be made on these variables for our study population.

Another important issue is the cross-country transferability of elasticity estimates. In general, research on price elasticity of demand for pharmaceuticals remains scarce outside of the United States (particularly in Europe). To our knowledge, the only study on cross-country comparisons of elasticity is by Alexander et al,[36] who concluded that price elasticities for a representative sample ("basket") of prescription medications were identical in the United States, Italy, and Spain. Given that the latter 2 countries have health systems, socioeconomic indices (eg, gross domestic product per capita), and demographic characteristics comparable to those of Greece, transferability of elasticity estimates seems plausible. Nevertheless, this was further corroborated by testing the estimates with extensive sensitivity analyses.

Furthermore, our base-case analysis assumes that the resultant adherence remains stable over the study period, as in similar investigations.[35] To address the possibility that this effect may not prove to be uniform over time, rigorous sensitivity analyses on baseline and predicted adherence were performed. The threshold sensitivity analysis demonstrated that a change in adherence of only 13.26% above baseline would still produce favorable results. This increase corresponds to an extremely low elasticity of 0.10, suggesting that the true response to abolishing copayments would be substantially higher and the results economically beneficial.

Finally, patient cost sharing, although important, is not the only factor influencing adherence. That other factors contribute to adherence levels has been expressed in the model by divergence of predicted adherence after full coverage (91.5%) from absolute adherence. These variables constitute an area for further investigation.

In conclusion, our study demonstrates that abolishing copayments for OAAs could generate significant economic benefits for the SHI system and for society as a whole. The results

add to existing evidence supporting that cost-sharing policies do not always serve policy makers' initial intentions because shifting cost to patients with chronic illness can produce adverse clinical and economic effects. Our sensitivity analysis corroborated the robustness of the results, suggesting that implementation of policies aimed at decreasing or abolishing copayments for OAAs could result in improved patient outcomes and in cost savings for the healthcare system.

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