Original Article

Annual Cost of Ischemic Heart Disease in Brazil. Public and Private Perspective

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Objective

To estimate the annual cost of coronary artery disease (CAD) management in Public Health Care System (SUS) and HMOs values in Brazil.

Methods

Cohort study, including ambulatory patients with proven CAD. Clinic visits, exams, procedures, hospitalizations and medications were considered to estimate direct costs. Values of appointments and exams were obtained from the SUS and the Medical Procedure List (LPM 1999) reimbursement tables. Costs of cardiovascular events were obtained from admissions in public and private hospitals with similar diagnoses-related group classifications in 2002. The price of medications used was the lowest found in the market.

Results

The 147 patients (65±12 years old, 63% men, 69% hypertensive, 35% diabetic and 59% with previous AMI) had an average follow-up of 24±8 months. The average estimated annual cost per patient was R$ 2.733.00, for the public sector, and R$ 6,788.00, for private and fee-for-service plans. Expenses with medications (R$ 1,154.00) represented 80% and 55% of outpatient costs, and 41% and 17% of total expenses, in public and non-public sectors, respectively. The occurrence of cardiovascular event had a great impact (R$ 4,626.00 vs. R$ 1,312.00, in SUS, and R$ 13,453.00 vs. R$ 1,789.00, for HMOs, p<0.01) on the results.

Conclusion

The average annual cost of CAD management was high, being the pharmacological treatment the main determinant of public costs. Such estimates may subsidize economical analyses in this area, and foster related healthcare policies.

Key words

cost of illness, economical analysis, coronary artery disease, cohort

Cardiovascular disease are the main causes of death in Brazil. According to data from Sistema de Informações sobre Mortalidade (Mortality Information System) of DATASUS of Ministry of Health, the mortality coefficient due to cardiovascular diseases is approximately 442/100,000 habitants[1].

Besides, coronary artery disease (CAD) is associated to an important morbidity. The need for hospital admissions, diagnostic and therapeutic procedures, medical follow-up and continuous pharmacological treatment have determined an expressive economical impact, according to government sources. Estimates of costs of such events are essential for economic assessment and cost-effectiveness studies of technologies directed towards management of ischemic heart disease.

In many countries, the direct cost, related to treating coronary artery disease patients, has been described as high. In the United Kingdom, the management cost of angina pectoris, in 2000, was calculated by the National Healthcare System (NHS) based on expenses with hospital admissions, revascularization procedures, ambulatory appointments, emergency room visits and prescribed pharmacological treatment. In 634,000 individuals assessed (1.1% of the population), the direct cost of angina reached 669 million pounds (1.3% of total NHS expenses), 32% from hospital admission expenses and 35%, with revascularization procedures[2]. In the United States, for instance, the estimated annual cost for the treatment of ischemic heart disease-related events was US$ 15,540.00 for non-fatal myocardial infarction, US$ 2,569.00, for stable angina, and US$12,058.00, for unstable angina, in 1998[3].

In Brazil, most information on the economical impact of ischemic heart disease comes from administrative database of DATASUS. Although they have an expressive number of national records and coverage, data show the direct expenses of Public Health Care System (Sistema Único de Saúde – SUS) with the disease and do not necessarily take into consideration all resources employed. Besides, they show the main limitation of administrative records: low reliability of information. In this context, the aim of this study is to estimate the annual cost of management patients with chronic ischemic heart disease in two scenarios of healthcare service in Brazil: public and non-public system of insurance and fee-for-service plans. For such, we used data from a cohort of patients with ischemic heart disease, periodically followed in a specialized clinic.

Methods

The ischemic heart disease clinic of our hospital is specialized in caring for patients with chronic coronary artery disease. Curren-

tly, the cohort consists of, approximately, 400 patients with diagnosis of coronary artery disease (CAD), defined by the presence of, at least, one of the following factors: documented history of myocardial infarction, surgical or percutaneous myocardial revascularization, lesion >50% in at least one coronary artery assessed by angiography, or the presence of individuals with angina and positive non-invasive test for ischemia. Most individuals consists of previously hospitalized patients for an acute cardiac event. For being a reference center in the region, 10 to 15% are referred from primary care units or other hospitals, and the remaining cases from other medical services of the hospital. This cohort study was approved by the Ethics and Research Committee of the Institution.

Patients were followed by a multidisciplinary team, and all treatment is carried out in the ambulatory, including nutritional support, guidance on risk factors control and pharmacological and non-pharmacological treatment of the disease, request and performance of diagnostic tests [4-6]. Patients are managed according to valid recommendations from specialist guidelines and consensus, with a periodic review of clinical protocols. Stable patients are periodically assessed every 3 to 6 months.

For the present study, all patients seen after January 2000, with a follow-up of at least 12 months, with a minimum number of three appointments in this period, were selected within the ambulatory cohort. From 245 enrolled patients, after January 2000, 147 fulfilled inclusion criteria.

Clinical information from this sample come from routine data collection from ischemic heart disease clinic. In each visit, a standardized register is filled in at the first appointment, in which information on the history of the current disease; risk factors for CAD; past medical and cardiac history, previous events, exams and cardiac procedures; previous and current treatments are recorded. In subsequent appointments, which take place every three months on average, current signs and symptoms, new events, including admission data, procedures carried out in the period, image, laboratorial and cardiac exams, and current pharmacological treatment are checked.

All data on exams, procedures and admissions performed were double checked in the hospital IT system (AGH – Aplicativo de Gestão Hospitalar – Hospital Management System), to optimize data reliability and minimize information loss. Since only exams performed after January 2000 are available in this system, patients who started a follow-up in the ambulatory prior to that date, therefore with possibility of having been submitted to non-recorded exams in this system, were excluded from the study.

For this study, the perspective of two payers, public and private/HMOs in Brazil was adopted. They reflect the values charged for services provided and not necessarily reflect true costs, but may serve as close estimate of opportunity cost of each system. Treatment values were assessed through two reimbursement sources: values from Sistema Único de Saúde (SUS) and those from Lista de Procedimentos Médicos (LPM)[7], and they are referred as third-party costs. Estimated unit costs served as basis for the calculation of total cost, estimated through the product of the unit cost and the quantity of each item used.

The costs of pharmacological treatment, laboratory exams, myocardial perfusion scintigraphy, echocardiography, rest and exercise electrocardiogram, left cardiac catheterization with coronary angiography, ambulatory and emergency visits, and admissions because of disease-related complications or revascularization procedures were assessed.

Pharmacological treatment costs were based on the lowest price of generic dug in the market. In cases with non-existence of generic product on the market, the cost was based on the brand lowest price. Costs of laboratorial exams, image exams, graphic methods and appointments were obtained from the SUS table and LPM table from 1996 (corrected 1999), shown in table I.

Costs for hospital admissions and revascularization procedures were not based on primary data collection from ambulatory patients, but on average values charged per diagnosis of similar cases. Such estimates were obtained from analytical-financial bill of similar cases, seen in a public hospital and in a private hospital in Brazil, which means, payment values by the service provider (tab. II). From the public payer perspective, average costs were obtained for interventions by considering service provided by a SUS hospital in Brazil. For those estimates, 436 cases of coronary percutaneous procedures, 159 coronary artery bypass surgery (CABG), 58 acute myocardial infarctions, 262 admissions due to acute coronary syndrome and 476 cases of heart failure, in 2002 (tab. II) were analyzed. In a private hospital, in 2002, 17 cases of stable angina, 10 acute myocardial infarctions, 20 cases of heart failure, 58 percutaneous revascularizations and 27 CABGs were analyzed, for obtaining mean expenses with each procedure (tab. II), in addition to the inclusion of self-employed professional fees described in LPM 96 table[7].

Cost were calculated as the product between the resources used and the unit value of each product. The total cost in the period was then divided by the number of years the patient was followed-up, and the mean annual value was obtained. Data are expressed as mean values (median) in Brazilian real (R$) per year

Table I - Unit prices from the Tables of Sistema Único de Saúde - Public Healthcare System - (SUS) and Medical Procedure List - (LPM 1996)		
	SUS (R$)	LPM (R$)
Medical visits	7.55	39.00
Imaging exams		
Left cardiac catheterization with coronary angiography	470.38	1,276.00
Medical fees*		487.50
Myocardial perfusion scintigraphy		
Stress or thallium	336.00	450.00
Rest	272.21	450.00
Doppler color, two-dimensional echocardiogram	15.00	150.00
Chest X-ray	7.30	22.86
Graphic methods		
Rest electrocardiogram	1.49	18.00
Exercise electrocardiogram	19.80	77.50
Laboratory		
Complete blood count	4.11	9.00
Complete lipidic profile	8.87	18.60
Transaminases	4.02	8.40
Fasting glucose	1.85	4.20
Glycated Hemoglobin	6.55	13.50
Urea	1.85	4.20
Creatinine	1.85	4.20
Sodium	1.85	4.20
Potassium	1.85	4.20
Total CK	3.68	12.00
CK-MB	3.68	22.50
* considering main operator and an assistant.		

Table II - Mean costs of hospitalization and procedures of revascularization due to ischemic heart disease in a public hospital (SUS) and a private hospital, in 2002

Variable	SUS (R$)	HMOs/private
Cardiac procedures		
Cardiac catheterization	437.00	1,276.50
Professional fees[1]		487.50
Percutaneous coronary intervention	4,220.00	9,244.00
Professional fees[1]		585.00
Coronary artery bypass surgery	5,970.00	21,826.00
Professional fees[2]		2,474.40
Cardiac events with hospitalizations		
Acute myocardial infarction	910.00	4,777.00
Professional fees (7 days)		273.00
Unstable angina	710.00	5,651.00
Professional fees (5 days)		195.00
Heart failure	750.00	5,784.00
Professional fees (5 days)		195.00

[1] main operator and an assistant; [2] main operator, three assistants, one anesthetist and perfusionist.

Table III - Clinical characteristics of the population (n=147)

	N (%)*
Mean age, years	65.5±12
Male sex	93 (63.3)
Diabetes mellitus	52 (35.4)
Previous myocardial infarction	86 (58.5)
Hypertension	101 (69.3)
Positive family history	69 (46.9)
Active smoking	20 (13.6)
Previous smoking	74 (50.1)
Dyslipidemia	119 (81.0)
Obesity	47 (32.0)
Mean follow-up, months	26±8

* except when different unit.

Table IV - Total and partial annual cost of ischemic heart disease management for public and HMOs/private sector

	SUS Mean [Median] (R$)	HMOs/private Mean [Median] (R$)
Total costs	2,733.00 [1,771.50]	6,788.00 [2,670.00]
Outpatient treatment	1,488.00 [1,379.00]	2,094.00 [1,825.00]
Pharmacological treatment	1,154.00 [1,126.00]	1,154.00 [1,126.00]
Clinic visits	28.00 [24.5]	143.00 [126.00]
Laboratory	58.00 [53.50]	130.00 [114.00]
Tracing and imaging exams*	153.00 [22.00]	310.00 [137.00]
Cardiac catheterization	95.00 [0.00]	357.00 [0.00]
Hospital total	1,245.00 [0.00]	4,693.00 [0.00]

Tracing and imaging exams = echocardiography, myocardial scintigraphy, resting and exercise electrocardiogram and chest x-ray.
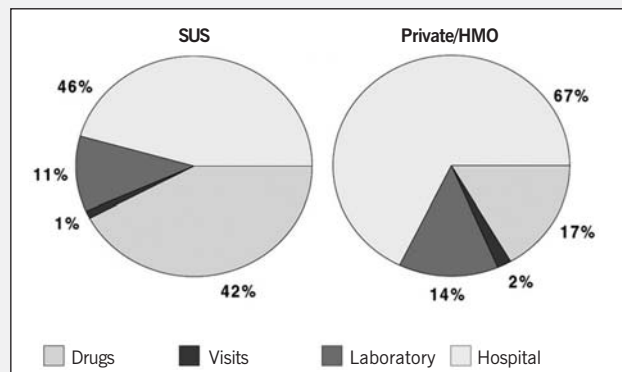

Fig. 1 - Proportion of ischemic heart disease costs in the public and private healthcare systems in Brazil.

of follow-up. Costs associated with management or control of other concomitant diseases or indirect costs, such as time spent with the treatment or productive time, were not included in the analyses.

Costs were assessed in their totals and subdivided into expenses with outpatient care (all exams carried out in ambulatory, appointments, pharmacological treatment) and inpatient (admissions and revascularization) management. For both perspectives, partial and total, potential clinical predictors of higher cost were assessed: presence of diabetes mellitus, hypertension, smoking, dyslipidemia, sex, age and previous myocardial infarction.

Descriptive data are reported as a percentage for categorical variables and mean, with a confidence interval or median, and inter-quartile range (IQR), for continuous variables. Costs are represented as mean (to represent the best estimate per patient) and as median (to represent the best cost estimate of a typical patient). Non-parametric variables suffered logarithmic transformation to reach a more normal distribution. Outpatient and total values were compared through Student T-test for independent samples. Hospital values, even after logarithmic transformation, were skewed and were analyzed with Mann-Whitney test. Bivariate and multivariate analysis were carried out with general linear models (GLM) tests, which does not assume residual normality. A value of $p < 0.05$ was considered statistically significant.

Results

One hundred and forty-seven (147) patients who fulfilled inclusion criteria, with mean follow-up of 24±8 months were selected; their characteristics at inclusion in the study are described in table III. During follow-up, 63 (43%) patients had cardiac catheterization (total of catheterizations: 70), 33 (22%) were submitted to percutaneous coronary intervention (PCI) (total of PCIs: 39), 15 (10%) had coronary artery bypass surgery (CABG) and 47 (32%) were admitted due to cardiovascular causes (total of admissions: 69).

Mean annual health care cost in this sample, based on values paid by SUS, was R$ 2,733.00±2,307.00 [median R$ 1,771.00], being outpatient care costs responsible for 54.4% of the total (tab. IV). Expenses with cardiovascular pharmacological treatment were

the greatest contributors for the annual cost of ischemic heart disease treatment (R$ 1,154.00), representing 77.5% of ambulatory care costs and 42% of the total (fig. 1). Pharmacological treatment consisted of combinations of platelet anti-aggregant, anti-ischemic, anti-diabetics, anti-hypertensive and hypolipemic drugs for most patients (tab. V). On average, patients were taking 4.4±1.3 (median 4 and IQR 3-5) different classes of drugs, for a mean annual cost of R$ 1,154.00 [median R$ 1,126.00 and IQR R$ 812.00 – R$ 1,446.00]. Individuals with cardiovascular events had illness costs 3 times higher than those without events in the period (R$ 4,626.00 vs. R$ 1,312.00, p=0.001).

In values of non-public system, the average cost per patient was R$ 6,788.00±7,842.00 [median R$ 2,670.00], and the

Table V - Most prescribed pharmacological therapies and ambulatory exams in units per patients, partial costs and impact of each item on outpatient costs, assuming the perspective from SUS payer			
	Unit/patient/year	Partial costs (R$) Mean [Median]	% from ambulatory costs 100
Pharmacological treatment	4.4±1.3 medicines	1,154.00 [1,126.00]	77.50
Platelet antiaggregants		30.50 [32.00]	
Beta-blockers		186.00 [183.00]	
Calcium antagonists			53.00 [0.00]
Nitrates		121.00 [0.00]	
ACE inhibitors		373.00 [483.50]	
Other anti-hypertensive		16.50 [25.00]	
Statins		284.00 [360.00]	
Furosemide		7.50 [0.00]	
Amiodarone		8.00 [0.00]	
Antidiabetics		74.00 [0.00]	
Medical appointments	3.6±1.6 appointments	28.00 [24.50]	1.90
Laboratory	11.9±9.6	58.50 [53.50]	3.90
Lipidic profile		25.00 [27.00]	
Tracing and image exams	1.9±1.4	153.00 [22.00]	10.20
Electrocardiogram		2.00 [1.50]	
Chest X-ray		4.00 [0.00]	
Echocardiography		5.00 [0.00]	
Myocardial scintigraphy		136.00 [0.00]	
Exercise ECG		6.00 [0.00]	
Cardiac catheterization	0.2±0.4	95.00 [0.00]	6.40

hospital expenses corresponded to 69% of the total (tab. IV). Admissions represented 34% of hospital total and 23% of total costs, a similar percentage was observed for CABG - 28% of hospital cost and 20% of total costs, and for percutaneous revascularization – 31% and 21%, respectively. The impact of the presence of events on total costs was enormous (R$ 13,453.00 versus R$ 1,788.00; p<0.001). In the analysis of components of outpatient cost, pharmacological treatment was still its greatest determinant, even having the lowest market values (fig. 1). However, it corresponded to 55% of ambulatory care expenses, a percentage of less magnitude than that observed for the public system.

In the analysis of cardiac risk predictors of costs, from public healthcare system point of view, hypertension and female sex had an association with higher costs in ambulatory management (tab. VI). Individuals with diabetes mellitus had a trend towards higher costs. Considering the total annual cost, only the presence of hypertension was significantly association with higher costs. In the analysis of the same predictors through the values of non-public system, none of these associations had statistical significance (data not shown).

Taking into consideration that this cohort of patients consists of a high risk group and, during studied period, 44% of the cases had some major event (admission and/or revascularization procedure), these data might not be representative of other populations. In order to assess the impact of this factor on final results, an estimate of the total cost of ischemic heart disease was carried out, by varying the probability of events in the group from 0% to 50%, and the results are illustrated in figure 2.

Table VI - Clinical predictors of costs in the public sector (R$), mean [median]			
	Male	Female	p
Outpatient	1,404.00 [1,302.00]	1,632.00 [1,577.00]	0.04
Hospital	1,270.00 [0]	1,201.00 [0.00]	0.97
Total	2,674.00 [1,693.00]	2,834.00 [1,909.00]	0.44
	Age ≥70	Age <70	p
Outpatient	1,429.00 [1,369.00]	1,521.00 [1,384.00]	0.42
Hospital	1,318.00 [0]	1,176.00 [0]	0.51
Total	2,748.00 [1,905.00]	2,697.00 [1686]	0.63
	Diabetes	Without diabetes	p
Outpatient	1,622.00 [1,587.00]	1,415.00 [1,245.00]	0.06
Hospital	1,360.00 [0.00]	1,182.00 [0.00]	0.62
Total	2,982.00 [2,074.00]	2,597.00 [1,611.00]	0.18
	Previous AMI	Without AMI	p
Outpatient	1,459.00 [1,360.00]	1,530.00 [1,470.00]	0.52
Hospital	1,243.00 [0.00]	1,247.00 [0.00]	0.66
Total	2,702.00 [1,732.00]	2,777.00 [1,782.00]	0.98
	SH	Without SH	p
Outpatient	1,593.00 [1,494.00]	1,250.00 [1,198.00]	<0.01
Hospital	1,389.00 [0.00]	917.00 [0.00]	0.27
Total	2,982.00 [1,885.00]	2,167.00 [1,570.00]	0.02

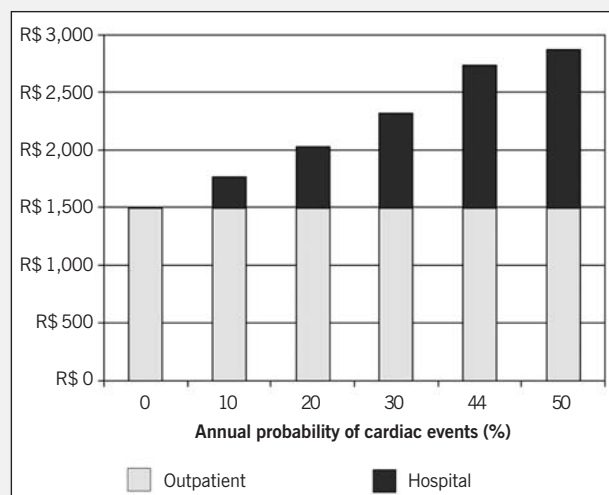SUS - Sistema Único de Saúde (Single Healthcare System); AMI - acute myocardial infarction;

Fig. 2 - Annual cost for the public system of ischemic heart disease management, assuming different probabilities of cardiac events.

Discussion

The fact that coronary artery disease generates direct and indirect expenses to governments, HMOs and to a very significant number of patients who, for years, have lived with growing and endless expenses in healthcare sector is of public knowledge. In an outpatient cohort of patients with chronic coronary artery disease, treated according to current evidence from the literature, the annual costs shown were very high. We showed that the main determinants of costs are chronic pharmacological treatment and invasive interventions (cardiac catheterization and revascularization procedures), both for patients attended by Sistema Único de Saúde, and those attended by different HMOs and private medicine. However, it draws our attention that the annual total and partial management cost is very different between payments attributed to coronary artery disease for public patients and that related to private care. Such fact is even more expressive when patients had an acute coronary event and needs admission or intervention. Whereas in SUS the cost, in average, triplicates, for HMOs and private, it is multiplied by seven. On the other hand, regardless of the service provider, the cost with pharmacological treatment represents a high percentage of total annual cost.

Considering that these values must not decrease in the next years, with technological advances and constant discoveries in the area, the future becomes very worrisome. In a country with an per capita income of R$ 9,380.00 (US$ 3,330.00) and a minimum salary of R$ 260.00, only healthcare assistance provided by solid systems may afford such expenses, by assuring that therapies, which have a proven impact on morbidity and mortality, are offered to the population. Even so, it seems clear that expenses with chronic pharmacological treatment have taken over an expressive amount resource for these patients. In this study, we do not differentiate whoever purchased the medication – part of it may have been subsidized by public pharmacies. However, in our experience, most of it has been under the responsibility of the patient himself/herself and his/her family[5]. Some strategies of subsidizing or reducing medication prices must be pursued to assure adequate long-term treatment to these patients. As opposed to other diseases, it is speculated that an expressive percentage of our population cannot afford regular pharmacological treatment on the levels described in this study. In a previous study, we have demonstrated in this same cohort of patients that, for those seen in the public system, the medication cost is one of the most frequent reason of non-adhesion to the treatment prescribed[5].

Similar studies in Brazil are scarce and comparisons with other countries must be conducted carefully, to the extent that the simple monetary conversion of the findings does no reflect the purchasing power of the population[8,9]. In the comparison of economic indexes among countries, the conversion into International dollars has been recommended, which means that an international dollar (IU) is equivalent to the same purchasing power of one American dollar in the United States. By using this recommendation of the World Health Organization for conversion into international units [purchasing power parity (PPP): 1 Int$=R$ 0,776, in 2000], the costs with ischemic heart disease management would have been estimated in Int$ 3,522.00 and Int$ 8,747.00, for the public and private sectors, respectively.

A similar study, carried out in the USA[2], estimated that the average cost per patient with coronary artery disease, in 5 years, is approximately US$ 15,000.00, annual value of US$ 3,000.00, which means, similar to those converted values described in this study for the public sector, and surprisingly, lower than those paid by the private sector in Brazil. Such analysis, based on American governmental estimates, describes that the annual cost of CAD care was even lower for outpatient cases, U$2,569.00 for stable angina and, in cases without events, U$1,051.00 per year[2]. Data from the United Kingdom point out to lower annual values for pharmacological treatments of cases with angina or post-acute event, of ≤311 (~US$560.00)[10]. It seems that, by adjusting to monetary differences, the cost of CAD for the Brazilian population is higher than that described in other countries, especially outpatient follow-up, without considering events and interventions.

In the United Kingdom, in 2000, it was estimated an expense of 669 million pounds for direct cost of angina pectoris, and 32% of the expenses were with hospital admission and 35%, with revascularization procedures[3]. In Brazil, we estimate that more than half of expenses with CAD are assigned to ambulatory care (53%). Those differences are not surprising at all, as although our population was a high risk group, with a high percentage of cardiac events, intervention costs is lower in our country. Reports from other diseases point out to a proportionally lower remuneration for healthcare professionals in Brazil.

Similarly to other sectors, clinical variables were not strong cost predictors. In this study, only systemic hypertension, diabetes mellitus and female sex related to higher expenses. The association of higher costs with hypertension can be explained by a greater number of drugs used. The great impact of the occurrence of events on estimated costs is also understandable, due to the need for admission, performance of more complex imaging tests and revascularization procedures.

Some limitations of our study must be acknowledge. Patients evaluated are seen in a specialized in ischemic heart disease clinic, with rigorous and frequent follow-up, and with multidisciplinary support, that is, most patients are treated according to current guidelines. Besides, a great proportion of patients has partial public support for their pharmacological therapy free- of-charge, which facilitates their access to medical care protocols standardized for ischemic heart disease. This may not happen in other regions in the country, which may lead to sub estimation of the true economical impact of CAD, to the extent that the access to medical care and treatments are under the contingency of other factors other than the demand.

In conclusion, we demonstrated through a prospective and observational study that the cost of coronary artery disease is high for both the public and private sector. The two main determinants of high cost are admission with instability of the disease and the chronic pharmacological therapy. Comparisons with other countries, by adjusting to monetary differences and purchasing power, point out, unexpectedly, to higher costs than those reported by developed countries. The acknowledgement of such fact should reinforce the need for more effective strategies of subsiding and/or reducing medication prices, with the responsibility of not being able to provide our population with the best scientific evidence.

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