Estimated annual cost of arterial hypertension treatment in Brazil

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ABSTRACT

Objectives.   *To estimate the direct annual cost of systemic arterial hypertension (SAH) treatment in Brazil's public and private health care systems, assess its economic impact on the total health care budget, and determine its proportion of the 2005 gross domestic product (GDP).*

Methods.   *A decision tree model was used to determine direct costs based on estimated use of various resources in SAH diagnosis and care, including treatment (medication and nonmedication), complementary exams, doctor visits, nutritional assessments, and emergency room visits.*

Results.   *Estimated direct annual cost of SAH treatment was approximately US$ 398.9 million for the public health care system and US$ 272.7 million for the private system, representing 0.08% of the 2005 GDP (ranging from 0.05% to 0.16%). With total health care expenses comprising about 7.6% of Brazil's GDP, this cost represented 1.11% of overall health care costs (0.62% to 2.06%)—1.43% of total expenses for the Unified Healthcare System (Sistema Único de Saúde, SUS) (0.79% to 2.75%) and 0.83% of expenses for the private health care system (0.47% to 1.48%).*

Conclusion.   *To guarantee public or private health care based on the principles of universality and equality, with limited available resources, efforts must be focused on educating the population on prevention and treatment compliance in diseases such as SAH that require significant health resources.*

Key words   Hypertension; costs and cost analysis; health economics; Brazil.

Systemic arterial hypertension (SAH), which is considered both a disease and a risk factor, represents one of the greatest challenges in public health care. This challenge is exacerbated in developing countries due to the complexity of resources required to control the disease (medical services, trained personnel, medications) and the negative implications of its population-wide health im-

pact as a risk factor for other health problems, such as cardiovascular diseases.

The World Health Organization (WHO) estimates 16.6 million deaths are attributable to cardiovascular diseases annually, with 7.2 million caused by ischemic heart disease, 5.5 million by cerebrovascular diseases, and 3.9 million by SAH and other cardiac diseases (1).

Elevated blood pressure represents an independent, linear, and continuous risk factor for cardiovascular disease (2). While the definition of SAH is ambiguous and arbitrary (dependent on the morbidity and mortality risk due to disease complications), individuals are considered hypertensive when their sys-

tolic pressure readings are persistently greater than or equal to 140 mmHg and/or their diastolic pressure readings are greater than or equal to 90 mmHg, according to at least two different readings over one or more weeks under standard conditions (3–5).

Brazilian and European guidelines on SAH differ from the U.S. classification published in 2003 with regard to disease stages 2 and 3 (6–8). The U.S. version considers stages 2 and 3 as a single group ("stage 2") because the treatment indicated for both groups is the same (combined therapy or the use of two or more drugs as an initial treatment for blood pressure ≥160 × 100 mmHg). The

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definition of and indicated treatment for stage 1 (a single therapy) is the same for all three sets of guidelines (6–8).

Data from the U.S. Centers for Disease Control and Prevention (CDC) National Health and Nutrition Examination Survey (NHANES) for 1999–2002 show an SAH prevalence of 27.8% in men and 29% in women for the U.S. adult population (9). Studies estimate about one-third of the population in Latin America is affected by SAH and suggest a similar prevalence worldwide (about 30%) (10). Wolf-Maier found an average SAH prevalence of 44.2% in European countries and 27.6% in North America (11).

Studies on SAH prevalence in Brazil are greatly heterogeneous. They utilize different levels of blood pressure as diagnostic criteria, do not always include measurements from controlled hypertensive individuals and/or volunteer samples, and may not report technique standardization, complicating analysis of overall prevalence. In addition, the majority of prevalence studies focus on the southeastern region of the country (12). Based on this limited data, national SAH prevalence in Brazil is estimated at 18% to 29% in adults over 25 years of age (13).

WHO estimates that 50% of hypertensive individuals are unaware of their condition, only 50% of those who are aware of their disease are undergoing regular treatment, and only half of those undergoing treatment maintain normal blood pressure levels (14).

Data from the CDC NHANES indicate that while 63.4% of hypertensive individuals in the United States are aware of their condition, only 45.3% are undergoing treatment, and only 29.3% maintain their pressure under control (9). A European study (Health Survey for England, 1998) shows an awareness level of 52.2% in that region, with only 38% undergoing treatment, and just 10.7% maintaining their pressure under control (15).

The levels of awareness and control of SAH are greater in the United States than in other developed countries that offer greater access to health care, suggesting that access to the health care system is less important than standardization of behavior for control of the disease (16, 17).

SAH has high medical and social costs, primarily due to its many associated complications, which include cerebrovascular disease, coronary artery dis-

ease, cardiac insufficiency, chronic renal insufficiency, and peripheral vascular disease, the most frequent causes of mortality, morbidity, incapacity, and use of medical services worldwide. In Brazilian public health care, known as the Unified Healthcare System (*Sistema Único de Saúde*, SUS), cardiovascular diseases were responsible for 1 181 612 hospital admissions per year, at a cost of US$ 546.6 million in 2005 (18). The available evidence on the economic impact of hypertension is mainly limited to studies in developed countries, with few studies available in Brazil.

Treatment of SAH and its associated complications among the 50 to 60 million Americans with the condition cost an estimated US$ 37.2 billion in 2003 (19). Direct costs include hospital costs (US$ 5.1 billion), nursing home costs (US$ 3.6 billion), expenses for doctors and other health care professionals (US$ 9.2 billion), home health care costs (US$ 1.5 billion), and anti-hypertension medication costs (US$ 17.8 billion). It should be noted that the amount of resources devoted to hypertension treatment is generally underestimated due to the frequent association of costs with comorbidities. The isolated cost of anti-hypertension drugs represents 47.8% of the estimated direct total expenses for health care in the United States in 2003, an increase of 14.8% over the previous year (19).

SAH also has high indirect costs, such as the loss of individual productivity; reductions in hypertensive individuals' perceived quality of life; and pharmacological treatment (20–22). In 2003, the estimated indirect costs due to loss of productivity caused by SAH morbidity and mortality in the United States was US$ 7.0 billion and US$ 6.1 billion respectively (19).

Estimates of the economic impact of SAH can be used to guide health policy decision-making, particularly when limited resources require extremely precise allocation. To date, this type of evidence has been limited in Brazil. This study aimed to fill this gap by carrying out the following three steps:

1. Estimating the annual direct cost of treating SAH in Brazil in the public and private health care systems;
2. Assessing the impact of this cost on the total health care budget (public and private);

3. Determining the value of this cost as a proportion of the country's gross domestic product (GDP) for 2005.

MATERIALS AND METHODS

From January to December 2005, a quantitative, predictive model (decision tree) was used to calculate Brazil's annual direct costs for treating arterial hypertension, based on the assumptions described below. Resource use/cost estimates were derived from national statistics and professional consensus.

Decision tree design

The decision tree components included explicitly specified therapy options and consequences. The model was used to quantify probabilities and values for all potential outcomes.

Using the literature, the authors estimated SAH prevalence in Brazil, the percentage of recognized ("diagnosed") hypertensive individuals, the percentage of diagnosed hypertensive individuals undergoing treatment ("diagnosed, undergoing treatment"), and the number of those individuals who maintained their blood pressure within recommended levels ("diagnosed hypertensive individuals, undergoing treatment, controlled"). The following eight hypertension subgroups were then determined, based on epidemiological prevalence data and pursuant to a combination of U.S. and Brazilian classifications for arterial hypertension: controlled stage 1; controlled stage 2 and 3; non-controlled stage 1; non-controlled stage 2 and 3; untreated stage 1; untreated stage 2 and 3; undiagnosed stage 1; and undiagnosed stage 2 and 3.

The first part of the study entailed the use of a scenario-based decision tree (a model projecting various outputs under different sets of conditions) based on the most relevant and consistent epidemiological data. As per statistics from the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*, IBGE), prevalence of hypertension among adults for the year 2005 was estimated at 28.5% (22)—or 33.6 million of the 118 million people over age 18 in Brazil, according to national indicators. Based on the WHO research indicating that only about 50% of hypertensive individuals worldwide are diagnosed with the condition (14), the

study estimated the number of diagnosed hypertensives in Brazil at about 16.8 million. Based on national data indicating that only about 52% of diagnosed hypertensive individuals undergo treatment, and only about 6.5% of those receiving treatment keep their blood pressure under control (Pa < 140 × 90 mmHg) (i.e., despite undergoing treatment, about 93.5% have not reached the recommended levels) (23), the population of Brazilian hypertensives receiving treatment and maintaining controlled blood pressure was estimated at about 8.7 million and about 0.6 million respectively. Each of these three disease groups ("diagnosed," "treated," and "controlled") was then divided into two subgroups: stage 1, and stages 2 and 3 (reflecting both U.S. and Brazilian hypertension guidelines) (6, 7). Based on one Brazilian study, the distribution of hypertension prevalence across stages 1, 2, and 3 was estimated at 53.3%, 35.7%, and 11%, respectively (24).

To determine the population of the various disease subgroups, using the epidemiological data from the decision tree model, initial sensitivity analyses were conducted for three different scenarios for diagnosis and treatment: baseline (i.e., national statistics), best-case ("scenario favoring diagnosis and treatment"), and worst-case ('scenario not favoring diagnosis and treatment") (Table 1). The best-case scenario used the same SAH prevalence values as the baseline scenario but an increased proportion of diagnosed individuals (63%), hypertensive individuals undergoing treatment (74%), and controlled hypertensive individuals (29%). These data were derived from the results of the above-mentioned U.S. epidemiology survey (NHANES) (9), based on the assumption that the United States has the best indices for recognizing the disease and determining the proportion of controlled individuals. The worst-case scenario also used the same SAH prevalence as the base scenario but assumed a lower percentage of diagnosed hypertensive individuals (40%), of which only 35% were assumed to undergo treatment and just 4% kept their blood pressure under control.

Use of resources

Estimated resource use was based on the indications of the *IV Brazilian Guidelines on Hypertension* (7) regarding treat-

ment (medication and non-medication) and complementary exams. The estimated number of doctor visits, nutritional assessments, and emergency room visits resulting from hypertension crises (hypertensive urgencies and emergencies, which were assigned a prevalence of 76% and 24%, respectively) was based on the opinions of experts (cardiologists and nephrologists from the Federal University of São Paulo specializing in SAH), which were collected through a questionnaire.

The following level of resource use was assumed with respect to doctor visits: two visits/year for controlled hypertensive groups, three visits/year for stage 1 non-controlled hypertensive groups, and four visits/year for stage 2 and 3 non-controlled hypertensive groups. It was also assumed that all subgroups of hypertensive individuals undergoing treatment had only one nutritional assessment per year.

The costs of doctor visits, nutritional assessments, and complementary exams were based on the SUS List of Procedures (25) for the public health care system and on the Brazilian Hierarchical Classification of Medical Procedures (*Classificação Brasileira Hierarquizada de Procedimentos Médicos*, CBHPM) published by the Brazilian Medical Association (*Associação Medica Brasileira*, AMB) for the private health care system (26). The cost of medications was based on consumer prices from the 2005 edition of the *Brasíndice Pharmaceutical Guide* (27); a 30% (empirical) discount was applied to drugs purchased by the public health

system to account for its capacity for volume purchases.

In calculating resource use/costs for SAH-related laboratory tests, this study only included the basic tests recommended by the *IV Brazilian Guidelines on Hypertension*: resting electrocardiogram (ECG); serum potassium and creatinine levels; fasting glycemia; total cholesterol; HDL-cholesterol; triglycerides; and type I urine tests. It was assumed that all hypertensives undergoing treatment would be subject to these tests once each year. In the case of hypertension crises, the following complementary tests were assumed to have taken place: resting ECG; two chest X-rays (posteroanterior and profile); type I urine; blood biochemistry (glycemia, sodium, potassium, hemoglobin, and hematocrit); eye fundoscopy or retina maps; and brain computed tomography (CT) scans.

For stage 1 hypertensive patients, the use of monotherapy was assumed, in the following proportions: diuretics, 50%; beta blockers, 20%; angiotensin-converting enzyme inhibitors (ACEIs), 10%; calcium antagonist, 10%; and angiotensin II receptor antagonists, 10%. For stage 2 and 3 hypertensive patients, combined therapy (the use of two drugs) was assumed in the following proportions: beta blocker + diuretic, 50%; ACEI + diuretic, 10%; angiotensin II receptor antagonists + diuretic, 10%; calcium antagonist + ACEI, 10%; calcium antagonist + beta blocker, 10%; and beta blocker + ACEI, 10%.

Compliance levels of 80% and 40% respectively were assumed for patients

TABLE 1. Estimated population[a] of arterial hypertension subgroups in Brazil under three different scenarios for diagnosis and treatment, São Paulo, January to December 2005

Disease subgroup[b] (n = 33.6 million)	Baseline scenario[c] (No. of hypertensives)	Best-case scenario[d] (No. of hypertensives)	Worst-case scenario[e] (No. of hypertensives)
Controlled, stage 1	306 778	2 493 146	101 654
Controlled, stage 2 and 3	261 330	2 123 791	86 594
Non-controlled, stage 1	4 412 888	6 103 908	2 439 705
Non-controlled, stage 2 and 3	3 759 127	5 199 626	2 078 267
Untreated, stage 1	4 356 615	3 020 587	4 719 667
Untreated, stage 2 and 3	3 711 191	2 573 092	4 020 457
Undiagnosed, stage 1	9 076 282	6 534 923	10 891 538
Undiagnosed, stage 2 and 3	7 731 648	5 566 786	9 277 977

[a] Author calculations based on 2005 national population and prevalence data (22) and estimated prevalence of 53.3%, 35.7%, and 11% for stages 1, 2, and 3 respectively (24).
[b] As per Brazilian and U.S. disease classifications (7).
[c] Assumes 50% diagnosis rate, based on global data (14) and 52% and 6.5% treatment and control rate, respectively, based on national data (23).
[d] "Scenario favoring diagnosis and treatment"; based on hypothetical diagnosis, treatment, and control rates of 63%, 74%, and 29%, respectively, as recorded in U.S. survey data (9).
[e] "Scenario not favoring diagnosis and treatment"; based on hypothetical diagnosis, treatment, and control rates of 40%, 35%, and 4%, respectively.

whose blood pressure was kept under control and patients whose blood pressure was not kept under control.

It was also assumed that only 1–2% of all hypertensives would have a hypertension crisis requiring a visit to the emergency room and possible hospitalization ("hypertension emergency"), as per prior research (28), and that this type of complication would not occur among patients with controlled blood pressure or undiagnosed individuals in stage 1. For all other groups, the following incidence was assumed: stage 1 (non-controlled), 1%; stage 2 and 3 (non-controlled), 2%; untreated stage 1, 0.5%; untreated stage 2 and 3, 1%; undiagnosed stage 2 and 3, 0.25%.

Based on a study by the Brazilian Ministry of Health National Agency for Supplemental Health Insurance (*Agência Nacional de Saúde Suplementar*, ANS) indicating 19.4% of the Brazilian population has access to some form of a private health care plan (29), it was assumed that 80% of the population would use the public health care system (SUS) and 20% would use the private system. It should be noted that the ANS estimate did not consider indirect costs or the cost of comorbidities.

Follow-up sensitivity analysis

Toward the end of the study, another sensitivity analysis was carried out. Based on the results of this second analysis, some of the estimates in which there was a certain degree of uncertainty were adjusted to reflect more accurately the potential impact of the three different scenarios for diagnosis, and treatment (baseline, best-case, and worst-case) on the total cost of treatment.

Macroeconomic analysis

In this step, the cost of treating SAH was estimated as a proportion of total 2005 GDP (about US$ 797.4 billion) (22) and as a proportion of the 7.6% of the GDP the World Bank estimates was spent by Brazil's public and private health care systems (3.5% and 4.1% respectively) during that year (30).

Exchange rate

To allow for comparison of the current study results to those from international studies, the estimated costs were converted into U.S. dollars, using a nominal exchange rate of 2.43 Brazilian reais (R$) per dollar (the year-long average in 2005) (30).

RESULTS

According to the decision tree model used in the current study, the baseline diagnosis and treatment scenario cost about US$ 398.9 million for the public (SUS) health care system and about US$ 272.7 million for the private health care system (Table 2). This translates to 1.43% of total SUS expenses (varying from 0.79% to 2.75%) and 0.83% of all private health care system expenses (0.47% to 1.48%). In the public system, the largest cost component was drugs, which accounted for 52.3% of the total, followed by doctor visits (20.6%). In the private system, doctor visits were the largest cost component (42.0%), followed by drugs (27.3%). In the public system, the highest annual per capita cost was associated with treating controlled stage 2 and 3 patients (US$ 99.05), followed by non-controlled stage 2 and 3 patients (US$ 71.44). The reverse was true in the private system, where non-controlled stage 2 and 3 hypertensive patients cost US$ 191.06 annually per capita, and controlled stage 2 and 3 patients cost US$ 185.59.

The best-case scenario (with higher levels of diagnosis and treatment) would cost about US$ 766.6 million for the public system and about US$ 483.6 million for the private system, with drugs and doctor visits representing the major cost components (60% in the public system and 38% in the private system respectively).

The worst-case scenario (with lower levels of diagnosis and treatment) would cost about US$ 220.4 million for the public system and about US$ 152.5 million for the private system. Drugs and doctor visits were also the main cost components in this scenario but at slightly different proportions (52.3% in the public system and 42% in the private system respectively).

Based on the results listed above, estimates of the direct annual cost of treating arterial hypertension in Brazil varied between about US$ 372.9 million (worst-case scenario) and about US$ 1.3 billion (best-case scenario). The base scenario cost was about US$ 671.6 million, or about 0.08% of the 2005 GDP (varying from 0.05% to 0.16%) and about 1.11% (0.62% to 2.06%) of all health care spending.

Broken down by arterial hypertension subgroup, the estimated direct annual cost to the public health care system was US$ 50.82 for stage 1 controlled hypertensive individuals; US$ 99.05 for stage 2 and 3 controlled hypertensive individuals; US$ 39.05 for non-controlled stage 1 hypertensive individuals; US$ 71.44 for non-controlled stage 2 and 3 hypertensive in-

TABLE 2. Estimated baseline-scenario[a] resource costs (in U.S. dollars and as proportion of total cost) for arterial hypertension treatment in Brazil's public and private health care systems, São Paulo, January to December 2005

Resource[b]	Cost to public health care system (US$[c])	% of total cost[d]	Cost to private health care system (US$[c])	% of total cost[d]	Total cost (US$[c])
Doctor visits	82 448 525.29	20.6	114 663 512.00	42.0	197 112 037.29
Nutritional assessments	8 689 768,68	2.1	12 085 108.76	4.4	20 774 877.45
Laboratory tests	65 978 939.06	16.5	46 729 087.23	17.1	112 708 026.30
Drugs	208 952 400.02	52.3	74 625 857.14	27.3	283 578 257.16
Management of hypertension crises	32 791 040.52	8.2	24 590 653.09	9.0	57 381 693.61
Total	398 860 673.59		272 694 218.25		671 554 891.84

[a] Assumes 50% diagnosis rate based on global data (14), and 52% and 6.5% treatment and control rates, respectively, based on national data (23).
[b] Resource use based on *IV Brazilian Guidelines on Hypertension* (7) and questionnaire responses from cardiologists and nephrologists from the Federal University of São Paulo (all other resources).
[c] Based on a nominal exchange rate of 2.43 Brazilian reais (R$) per U.S. dollar (year-long average in 2005) (30).
[d] Sums do not equal 100% due to rounding.

dividuals; US$ 1.02 for untreated stage 1 hypertensive individuals; US$ 2.05 for untreated stage 2 and 3 hypertensive individuals; and US$ 0.53 for undiagnosed stage 2 and 3 hypertensive individuals. Based on its estimated 20% share of health care provision in Brazil, the private health care system would incur the following costs: US$ 116.46 for stage 1 controlled hypertensive individuals; US$ 185.59 for stage 2 and 3 controlled hypertensive individuals; US$ 115.96 for non-controlled stage 1 hypertensive individuals; US$ 191.19 for non-controlled stage 2 and 3 hypertensive individuals; US$ 3.12 for untreated stage 1 hypertensive individuals; US$ 6.21 for untreated stage 2 and 3 hypertensive individuals; and US$ 1.56 for undiagnosed stage 2 and 3 hypertensive individuals.

DISCUSSION

Estimating the cost of SAH is complicated by the fact that the condition is only one of many risk factors involved in the etiology of several other diseases.

Nonetheless, hypertension should be considered a major concern given its effect on a broad range of health and economic issues that are important to individuals as well as society. For example, it is one of the most expensive diseases to treat; the cost of treating a hypertensive individual is 80% higher than the cost of treating normotensive patients (31). In addition, in a large number of cases it is not properly treated, especially in Brazil. This contributes to various complications (e.g., lesions in target organs) that are the main cause of the higher costs associated with the disease over the long term. Therefore, as shown in an Italian study, improving the treatment of arterial hypertension would reduce the incidence of other health conditions and contribute to lowering the overall cost of health care services (32).

In the same study, known as the Pandora Project, the most significant direct cost component in treating SAH was anti-hypertension drugs (42.7% of the total cost), followed by hospitalization (28.4%, including hospitalization for SAH, acute myocardial infarction, coronary artery disease, heart failure and vascular diseases of the brain); visits to general practitioners (15.1%); and laboratory tests (10.6%) (32).

A Brazilian study supported the Italian data, identifying drugs as the costliest

component in SAH treatment (33% of the direct and indirect cost), followed by health plans (23%), and doctor visits (22%). Per-capita annual anti-hypertension drug expenditures were US$ 161.62 (33).

Another Brazilian publication revealed monthly medication costs of US$ 87.10 for treatment alone, US$ 159.00 for treatment with two drugs (combined treatment), and US$ 294.00 for combined treatment of three or more drugs, with cost-effectiveness in favor of diuretics for blockers and ACEIs (34). An estimated average monthly cost of treatment was US$ 32.00 in the group of controlled hypertensive patients and US$ 39.50 in the non-controlled group. This same study demonstrated that 46.6% of hypertensive individuals underwent monotherapy whereas 53.4% received combination therapy.

In 2003, the American Heart Association estimated that the cost of treating SAH and its complications in the United States was around US$ 37.2 billion (21). Direct costs included hospitalization (US$ 5.1 billion), nursing home care (US$ 3.6 billion), physicians and other health care professionals (US$ 9.2 billion), home health care (US$ 1.5 billion), and anti-hypertension drugs (US$ 17.8 billion). The isolated cost of anti-hypertension drugs represented 47.8% of the direct spending on SAH reported in the 2003 U.S. estimate.

According to the study model, the annual estimated cost to society of treating SAH was about US$ 671.6 million in the baseline scenario and varied between a low of about US$ 372.9 million in the scenario with lower levels of diagnosis and treatment and a high of about US$ 1.3 billion in the scenario favoring diagnosis and treatment. In the public health care system (baseline scenario), drugs represented the largest share or 52% (about US$ 209 million) of the total, followed by doctor visits (21%), complementary laboratory tests (17%), emergency room visits (8%), and nutritional assessments (2%). In the private system, doctor visits were the largest cost component, representing 42% of the total (about US$ 114.7 million), followed by drugs (27%), complementary laboratory tests (17%), emergency room visits (9%), and nutritional assessment (4%).

As expected, sensitivity analysis showed that changing drug spending would have the highest impact on the overall cost of treatment. The analysis also showed the scenario with the higher

level of diagnosis and treatment—the objective of any health care program—would have the highest cost. However, this cost would be mitigated over time as more hypertensive patients reached standard levels of disease control and thus realized a drop in their hospital costs as the number of complications declined.

Applying Hodgson's estimate of the breakdown of the total cost attributable to arterial hypertension (35), in which 21% of the cost is due to SAH per se, 27% to cardiovascular complications, and the remaining 52% is associated with other diseases, about US$ 671.6 million would be required to treat SAH per se (base scenario), about US$ 863.4 million would be allocated to cardiovascular complications, and about US$ 1.7 billion would be spent on comorbidities, for a total of about US$ 3.2 billion, or about 0.4% of Brazil's GDP and about 5.3% of its total health care spending.

While international guidelines for treating SAH do not necessarily call for the use of thiazide diuretics, they do suggest them as the drug of choice for initial therapy or in association with other drugs for hypertensive patients who do not present complications. This recommendation is reinforced by a recent meta-analysis of 42 random studies (36). According to the literature reviewed for the current study, thiazide diuretics are selected most frequently to represent the diuretic drug category in cost estimations because they have the best cost-benefit ratio.

Limitations

This study made several assumptions about resource use in the construction of the decision tree model that may be considered limitations. For example, based on the prevalence of overweight and obesity in the Brazilian population, nutritional assessments were assumed to occur once per year for all patient groups, and doctor visits were assumed to occur twice per year for controlled hypertensive groups, three times per year for stage 1 non-controlled hypertensive groups, and four times per year for stage 2 and 3 non-controlled hypertensive groups.

Another questionable assumption was that the use of monotherapy would be advocated for patient groups with stage 1 hypertension and the use of combination therapy (with only two drugs) would be advocated for the other groups, even though these decisions are usually

not linear (i.e., they are often based on a variety of criteria). The study's assumption that adherence to treatment was 80% for controlled hypertensives and 40% for non-controlled hypertensives may also be considered a limitation.

In addition, medication treatment costs were based on estimated percentages of use calculated for each class of drugs according to cost-benefit ratios (as in the studies mentioned above that assumed the frequent use of thiazide diuretics due to their favorable cost-benefit ratio). While the drug use implied by these assumptions follows literature recommendations, it differs from clinical practice, where the most widely prescribed drugs are ACEIs and calcium antagonists (37), which are more expensive than thiazide diuretics. Therefore, the study's assumptions about medication treatment may have resulted in an underestimation of drug costs.

The study also had limitations with regard to estimated resource costs. For example, the cost of resources used for treatment in the private sector differs from those in most public health care plans, despite the careful work of the AMB in formulating the prices used in the CBHPM estimates. Therefore, the study's assumption that public and private treatment resource costs were the same could have skewed the results. In addition, the authors were unable to verify that the amounts the SUS pays for SAH-related procedures—the values used in the current study—reflected their true cost. It

should be noted, however, that the effect of any faulty assumptions about resource costs on the overall direct cost estimate would not have been significant with regard to estimated hospitalization costs (which were primarily related to hypertensive emergencies, estimated to occur among only 1–2% of all hypertensives) and overall expenditures for complications (which would have been minimal over the 12-month study period).

On the other hand, the study duration could have had a limiting effect on the cost estimates for complications, as short study periods can result in underestimations of resource use for this variable. There is a lack of data for SAH-related complications at the country level, but it is generally assumed that the frequency of hypertension crises is associated with the stage and control of disease: the more controlled the patient, the less likely he or she is to develop a hypertensive urgency or emergency. It should be noted that in estimating these costs the authors assumed SAH caused complications that resulted in significant hospital costs but they did not attribute all cardiovascular events to the condition, which is merely one of many risk factors for cardiovascular disease.

Recommendations

To guarantee the provision of public and private health care based on the principles of universality and equality, within a context of limited available re-

sources, efforts must be aimed at educating the population to increase prevention and treatment compliance for diseases such as SAH.

Hypertension is a highly prevalent disease that often goes undetected and is associated with other comorbidities and risk factors that create high costs and overhead. These costs must be taken into account in designing and developing health policies to ensure more effective treatment and thus reduce the number and severity of potential complications.

Efforts to increase awareness, treatment compliance, and control of arterial hypertension could reduce disease prevalence, the need for medical care, and the costs associated with the disease and its complications (36).

Conclusion

The estimated direct annual cost to the public and private health care systems in Brazil for SAH treatment is about US$ 671.6 million, based on data for 2005, representing 0.08% of the GDP for that year. Based on World Bank data indicating total expenses for Brazilian health care account for approximately 7.6% of the GDP, these treatment costs represents 1.11% of overall health care. Based on national statistics indicating an 80–20 distribution of health care costs between the public and private systems, respectively, this translates to 1.43% of total SUS expenses and 0.83% of all private health care system expenses.

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RESUMEN

Costo estimado anual del tratamiento de la hipertensión arterial en Brasil

Objetivos. Estimar el costo directo anual del tratamiento de la hipertensión arterial sistémica (HAS) en los sistemas sanitarios público y privado de Brasil, evaluar su impacto económico en el presupuesto total de salud y determinar la proporción del producto interno bruto (PIB) que ocupó en 2005.

Métodos. Se empleó un modelo de árbol de decisión para determinar los costos directos según el uso estimado de varios recursos en el diagnóstico y la atención de la HAS, incluidos el tratamiento (con medicamentos y sin ellos), los exámenes complementarios, las visitas del médico, las evaluaciones nutricionales y las visitas a servicios de emergencia.

Resultados. El costo anual directo estimado del tratamiento de la HAS fue de aproximadamente US$ 398,9 millones en el sistema público y US$ 272,7 millones en el privado, lo que representó 0,08% del PIB en 2005 (mínimo: 0,05%; máximo: 0,16%). Con un gasto total en salud de cerca de 7,6% del PIB de Brasil, este costo representó 1,11% del costo total en salud (de 0,62% a 2,06%): 1,43% de los gastos totales del Sistema Único de Salud (de 0,79% a 2,75%) y 0,83% de los gastos del sistema privado (de 0,47% a 1,48%).

Conclusiones. Para garantizar servicios públicos o privados de salud basados en los principios de universalidad y equidad, con recursos limitados, los esfuerzos se deben enfocar en educar a la población en el cumplimiento de las medidas de prevención y el tratamiento de enfermedades, que como la HAS, requieren considerables recursos sanitarios.

Palabras clave Hipertensión; costos y análisis de costo; economía de la salud; Brasil.