Published in final edited form as:

Med Care. 2017 June ; 55(6): 552–560. doi:10.1097/MLR.0000000000000719.

Cost-Effectiveness of Antihypertensive Medication: Exploring Race and Sex Differences Using Data from the REasons for Geographic and Racial Differences in Stroke Study

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Abstract

Background—Antihypertensive medication decreases risk of cardiovascular disease (CVD) events in adults with hypertension. Although black adults have higher prevalence of hypertension and worse CVD outcomes compared with whites, limited attention has been given to the cost-effectiveness of antihypertensive medication for blacks.

Objective—To compare the cost-effectiveness of antihypertensive medication treatment versus no-treatment in white and black adults.

Research Design—We constructed a State Transition Model to assess the costs and quality-adjusted life-years (QALYs) associated with either antihypertensive medication treatment or no-treatment using data from the REasons for Geographic and Racial Differences in Stroke (REGARDS) study and published literature. CVD events and health states considered in the model included stroke, coronary heart disease, heart failure, chronic kidney disease, and end-stage renal disease.

Subjects—White and black adults with hypertension in the United States of America, 45 years of age.

Measures—Yearly risk of CVD was determined using REGARDS data and published literature. Antihypertensive medication costs were determined using Medicare claims. Event and health state costs were estimated from published literature. All costs were adjusted to 2012 US dollars. Effectiveness was assessed using QALYs.

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Conflict-of-interest/financial disclosure statement:

Gabriel S. Tajeu, Stephen Mennemeyer, Nir Menachemi, Robert Weech-Maldonado, and Meredith Kilgore have no conflict of interest to report.

Results—Antihypertensive medication treatment was cost-saving and increased QALYs compared with no-treatment for white men (\$7,387; 1.14 QALYs), white women (\$7,796; 0.89 QALYs), black men (\$8,400; 1.66 QALYs), and black women (\$10,249; 1.79 QALYs).

Conclusions—Antihypertensive medication treatment is cost-saving and increases QALYs for all groups considered in the model, particularly among black adults.

Introduction

Hypertension, diagnosed as a systolic blood pressure (SBP) ≥ 140 mm Hg or diastolic blood pressure (DBP) ≥ 90 mm Hg among individuals not taking antihypertensive medication, is common in the US, affecting almost one-third of adults.^{1–3} Hypertension is associated with increased risk of stroke and coronary heart disease (CHD), chronic kidney disease (CKD) and end-stage renal disease (ESRD), and an annual cost to the US healthcare system of approximately \$22 billion.^{4,5} Antihypertensive medication can lower blood pressure (BP) and therefore mitigate negative consequences of hypertension.¹ For instance, studies suggest that even modest BP reductions can lower the 5-year risk of stroke and myocardial infarction (MI) by 41% and 22%, respectively.^{2,6} Despite the benefits of antihypertensive medication, data show that among US adults diagnosed with hypertension, approximately 25% were not treated using antihypertensive medication.⁷

In addition to being effective for treatment of hypertension, antihypertensive medication has also been found to be cost-effective,^{5,8–10} and cost-saving.¹¹ Cost-effectiveness analysis is a useful tool for decision-making and resource allocation, allowing decision-makers to identify the lowest cost and most clinically beneficial treatments.^{9,12} However, studies on the cost-effectiveness of antihypertensive medication primarily focus on treatment for whites and the general population rather than blacks.⁸ This is of concern for several reasons. Black adults have the highest prevalence of hypertension in the US, are less likely to have controlled hypertension, and experience higher death rates from hypertension-related events such as stroke, CHD, and heart failure (HF) compared with whites.^{1,13,14}

Given the under-treatment of hypertension among the US population, disparities in hypertension control and outcomes between black and white US adults, and the potential opportunity for improvements in outcomes associated with antihypertensive medication treatment, the purpose of this paper is to assess the cost-effectiveness of antihypertensive medication treatment in white and black men and women using a State Transition Model (STM).¹⁵ We use data from the REasons for Geographic and Racial Differences in Stroke (REGARDS) study in order to derive race and sex specific model inputs for the STM. REGARDS oversampled black adults to investigate racial differences in stroke,¹⁶ therefore the data were particularly well suited for use in this analysis. This study will be of interest to insurance providers, health care organizations, policymakers, and researchers seeking to address disparities in quality of care and more efficiently use healthcare resources.

Methods

Population

The simulation study population was modeled using demographic and clinical data from REGARDS study participants. REGARDS is an on-going observational study of risk factors associated with stroke and has enrolled 30,239 participants. Blacks were oversampled to better understand the stroke risk differences between blacks and whites. The study design, recruitment, and data collection procedures used in REGARDS has been described in detail previously.¹⁶ In brief, participants aged 45 years and older were recruited between 2003 and 2007. Data on cardiovascular disease (CVD) history, sociodemographic, lifestyle, and psychosocial characteristics were collected using a computer assisted telephone interview. Physical and physiological measures and biological samples were collected during a subsequent in-home visit along with written informed consent. SBP and DBP were measured twice, 30 seconds apart, after the participant had been seated for 5 minutes. The average of these measurements was recorded.¹⁶ Hypertension was defined as an average SBP ≥ 140 mm Hg, average DBP ≥ 90 mm Hg, and/or self-reported use of antihypertensive medication. Number of antihypertensive medications was determined from a pill bottle review. The current study sample was limited to REGARDS participants who were identified as taking antihypertensive medication (n=18,036). The University of Alabama at Birmingham institutional review board approved this study.

Treatment strategies

We compare antihypertensive medication treatment with a simulated no-treatment strategy. We utilized demographic and clinical characteristics of REGARDS participants who were taking antihypertensive medication at baseline to derive the simulation population for the treatment group. Participants were classified based on the race and gender likelihood that they would be treated with 1, 2, 3, or 4 antihypertensive medications. Antihypertensive medication is primarily utilized to lower BP and we assumed BP would be the only difference between the treatment and no-treatment strategies. Therefore, to create a no-treatment comparison group, we extrapolated SBP from the treated group. We projected that for every medication a participant was prescribed, their SBP would be lowered 9 mm Hg.¹⁷ To estimate the SBP of a participant in the simulated no-treatment group who was not treated but should have been treated using one medication, their SBP would be 9 mm Hg higher than an individual who was taking one antihypertensive medication; 18 mm Hg higher if they should have been treated with two antihypertensive medications, and so forth.

Model

The STM assessed the cost-effectiveness of antihypertensive medication treatment versus no-treatment for white men, white women, black men, and black women (Figure 1). We included costs of antihypertensive medications and adverse events, and utilities of health states measured in quality-adjusted life-years (QALYs) in the model (Table 1). We considered seven classes of antihypertensive medication in the model; diuretic, beta blocker, angiotensin converting enzyme inhibitor, calcium channel blocker, aldosterone receptor antagonist, alpha blocker, and angiotensin receptor blocker. Participants entered the STM at age 45 and remained in the model until they died or reached 100 years of age.¹⁵ Participants

could suffer multiple events per year. For instance, a participant could transition from a no-event state, to suffering an MI, to then suffering a fatal stroke in one year. Participants could not suffer the same event twice in one year. Adverse events and health states included non-fatal or fatal stroke, CHD (non-fatal MI or fatal CHD), HF, CKD, ESRD, and death. A complete list of events and health states considered in the model is listed in Supplemental Table 1. CVD risk increases when an individual suffers an event such as a stroke or MI.¹⁸ The STM accounts for this increased risk of future events (Supplemental Methods). The STM was created with TreeAge Pro (version 15.1).

Data and model input sources

We utilized REGARDS data for several model inputs including the distribution of the number of antihypertensive medications participants were prescribed by race and sex in the treatment strategy (Table 2). This distribution was used to determine the corresponding number which participants should have been treated with for the no-treatment strategy. REGARDS data were also used to determine 10-year Framingham Stroke and CHD risk scores (Supplemental Methods), converted to yearly event probabilities.¹⁹ Transition probabilities for stroke and CHD were then assigned to model participants based on age (45–64, 65–74, 75 years of age), race, sex, and number of antihypertensive medications prescribed (1, 2, 3, 4 medications) (Supplemental Methods).

Similar to other CE models,^{8–10,18,20} we used published literature for several model inputs including transition probabilities for CKD, ESRD, HF, and mortality following events, as well as differences in these transition probabilities by race and sex (Table 1). Data on renal events and estimates of excess risk of CKD and ESRD for blacks compared with whites were obtained from the United States Renal Data System (USRDS) and MarketScan® data.^{21,22} Race-based mortality from other causes not included in the model was estimated using the National Center for Health Statistics mortality rate tables.²³ We also used published literature to determine QALY ratings associated with health states (Table 1). All future utilities were discounted using a 3% rate.²⁴

Costs

We included drug costs and costs of adverse events and health states in the model. Antihypertensive treatment costs are based on the cost and number of antihypertensive medications prescribed (Supplemental Methods). We used Medicare claims data from 2012 to estimate the cost of antihypertensive medication (Table 1). Costs of events and health states were determined using published estimates (Table 1). We used a third party payer perspective in the estimation of health care related costs. All costs were adjusted to 2012 US dollars using the Consumer Price Index and future costs were discounted using a 3% rate.^{24,25}

Post-event health states

Participants started in a “no-event” health state and subsequently transitioned to “post-event” states once an adverse event occurred. For instance, if a participant suffered a non-fatal MI, the cost of the event would be immediately assessed, and they would transition to a “post MI” health state for the following year. Excess yearly health care costs and QALY disutility

associated with health states were assessed at the beginning of each year for which the participant remained in the health state. Once a participant suffered an event and entered a health state, they remained in that health state until suffering another event or death. If participants suffered subsequent events which resulted in combined health states, yearly costs were calculated as the sum of the costs of the health states, and QALYs were assigned according to the health state with the lowest utility. Participants could suffer a stroke or MI while in any health state. We made the assumption that certain combinations of health conditions were not survivable (Supplemental Methods; Supplemental Table 1). For a description of additional model assumptions, please refer to the Supplemental Methods.

Sensitivity Analysis

We conducted one-way sensitivity analyses,^{26,27} varying parameters by $\pm 50\%$. We considered a parameter sensitive if varying it resulted in a cost-effectiveness ratio that was double the baseline value.²⁰ Additionally, we conducted probabilistic sensitivity analysis using triangle distributions randomly sampled 1,000 times for costs and QALYs varied by $\pm 50\%$. We also simulated a worst-case scenario analyses by varying all costs and QALYs by $\pm 50\%$ in favor of no-treatment.

Results

At baseline, 18,036 REGARDS participants were taking antihypertensive medication; 4,536 white women, 5,469 black women, 4,882 white men, and 3,149 black men (Table 2). Black participants had the highest prevalence of smoking and diabetes. White women were most likely to be treated with only one antihypertensive medication at baseline (43.8%) and had the lowest average SBP (126.1 mm Hg) while being treated with one medication compared with other race and sex groups (Table 2). Among participants taking four or more antihypertensive medications, black men had the highest prevalence of being treated with this number of medications at baseline (10.3%) and had the highest average SBP (136.6 mm Hg) while receiving this treatment compared to other race and genders.

Table 3 shows one-year probabilities for stroke and CHD by race, sex, age, and number of antihypertensive medications prescribed among treated and untreated REGARDS participants. Among both the treatment and no-treatment strategies, white women entered the STM with the lowest one-year stroke and CHD risks. For instance, the one-year probability for stroke events among white women in the treatment strategy ranged from 0.4% on one medication to 0.7% on 4 or more medications at baseline for ages 45–65. Black men had the highest baseline one-year stroke and CHD risk in both the treatment and no-treatment strategies. For 10-year Framingham stroke and CHD risk among these subgroups, refer to Supplemental Table 2.

Table 4 shows lifetime costs and QALYS for the treatment scenario compared with no-treatment. Lifetime costs in the treatment scenario were lower compared with no-treatment for all race and sex categories. White women who were treated with antihypertensive medication had the lowest lifetime healthcare costs (\$45,318). However, the incremental costs for treated black women were the most cost saving among all race and sex groups, costing \$10,249 less compared with the no-treatment scenario. In all cases, treatment

resulted in a gain of QALYs for treated participants compared with no-treatment. Black women in the treatment group had the largest increase in QALYs gained compared with those in the no-treatment group (1.79 QALYs).

The model was not sensitive to changes in cost or QALY parameters during one-way sensitivity analyses. Antihypertensive treatment remained cost-saving and always dominated no-treatment with lower costs and more QALYs for all race and sex groups (Supplemental Figure 1). Costs of CHD, CKD, and HF had the largest influence on cost-effectiveness ratios in sensitivity analyses. In probabilistic sensitivity analysis simulations, treatment remained cost saving and increased the number of QALYs, and treatment of black participants resulted in more savings and QALYs gained in comparison to whites (Supplemental Figure 2). In the worst-case scenario analyses, all race and sex combinations of the treatment strategy remained cost-saving and dominated the no-treatment strategy (Supplemental Table 3).

Discussion

The main finding of the current study is that antihypertensive treatment is cost-saving and produced more QALYs compared with no-treatment for all race and sex groups, particularly among black adults. There are several potential explanations for this finding. First, treatment has been shown to be effective in reducing BP and lowering the risk of CVD events across the spectrum of BP levels.^{2,6} Lowering the risk of CVD leads to lower yearly healthcare expenditures and more QALYs. Second, antihypertensive treatment is relatively inexpensive and generic versions of most drugs are currently available.²⁸

The results of this study are similar to Moran et al. 2015 who report that antihypertensive medication treatment, following guidelines of the 2014 recommendations of the Eighth Joint National Committee, would result in cost savings and increased QALYs among men between 45–75 years of age with either stage 1 hypertension (SBP between 140 to 159 mm Hg), stage 1 hypertension and diabetes or CKD, and stage 2 hypertension (SBP ≥ 160 mm Hg), and among women between 45–75 years of age with stage 2 hypertension.¹¹ While our results were comparable to Moran et al. for men and women, our model allowed us to not only assess the cost-effectiveness of treatment by sex, but also by race, and treatment of blacks resulted in the most cost savings. Similar to the results of this study, Tasosa et al. found that treatment of blacks was more cost-effective compared with treatment of whites. Using an age group comparable to our own, they report cost-effectiveness ratios for antihypertensive treatment of \$23,148/QALY for blacks and \$35,213/QALY for the general population. However, unlike our results, Tasosa et al. did not find treatment to be cost-saving. However, it is difficult to compare the two studies as Tasosa et al. examined a diabetic population and also assessed treatment of hyperlipidemia and hyperglycemia, in addition to hypertension. This highlights a shortcoming of the current literature on the cost-effectiveness of antihypertensive medication treatment: there is very little comparability between studies.^{8–10}

One potential explanation for the finding that treatment of blacks resulted in the most cost savings is that white individuals, on average, are healthier than blacks.²⁹ For example, at baseline, white individuals had lower BP compared with blacks. Therefore, in the current

model, blacks who were not treated with antihypertensive medication entered higher categories of CVD risk as they progressed through the model compared with whites and thus experienced worse outcomes. However, while antihypertensive treatment of blacks was more cost-saving compared with whites, whites had lower average healthcare costs overall. This is likely also due to lower SBP, the need for less medication, and better general health at baseline among whites compared with blacks.

The observation that whites had lower SBP than blacks at baseline could be attributed to better general health among whites, or this finding could be due to other factors. First, whites may respond better to antihypertensive medication treatment than blacks. For instance, Cushman et al. reported that compared with whites, blacks had worse hypertension control following treatment with antihypertensive medication and this difference could not be explained by baseline demographic or clinical differences.²⁹ Also, lower rates of control are observed even though blacks are prescribed more antihypertensive medication on average compared with whites.³⁰ Another possible explanation for lower SBP in whites compared with blacks is that whites have better adherence to antihypertensive medication.^{31,32} Poor adherence can result in less effective BP control, exposing individuals to an increased risk of CVD events.³⁰ Improving antihypertensive medication adherence among blacks could result in additional cost savings and improvements in quality of life. Several strategies have been shown to be effective in improving adherence among black adults, including reductions in copayments for antihypertensive medication and building trust between physicians and patients through improved communication and/or race concordant physician/patient pairings.^{33–36}

In addition to medication adherence, lifestyle modification has been recommended by the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure to improve hypertension control in black adults.³⁷ While we did not consider lifestyle modification in the current model, it may provide a complement to antihypertensive medication. For instance, in a systematic review of intervention studies focused on lowering BP through improvements in physical activity, diet, and weight reduction among black adults in the US, health behavior modification was associated with lower BP levels and improved BP control.³⁸ International studies have demonstrated the cost-effectiveness of a combination of antihypertensive medication treatment and lifestyle interventions.³⁹

Results remained consistent during one-way sensitivity analyses. In all cases, treatment dominated no-treatment and remained cost-saving in the analyses. While researchers argue that one-way sensitivity analysis is sufficient to deal with uncertainty in model estimates,²⁷ we also conducted probabilistic sensitivity analysis and treatment remained cost-saving. Even using the most pessimistic values for all costs and the most optimistic values for QALYs during the worst-case scenario analyses, the model results remained robust with treatment resulting in cost savings and increased QALYs.

The current study has several strengths. First, we use race and sex specific model inputs derived from the REGARDS study and previously validated published literature sources. Second, the results of the study were robust, remaining consistent in sensitivity analyses. Additionally, we included multiple CVD and renal events associated with hypertension in

the analyses, and allowed the STM to account for increased risk of suffering future events following stroke, MI, HF, CKD, and ESRD. However, this study should be interpreted in the context of its limitations. One such limitation is related to stroke and CHD risk calculation. While Framingham stroke and CHD estimates have been validated and previously used in cost-effectiveness studies of antihypertensive treatment, McClure et al. 2014 find that Framingham stroke risk equations overestimate stroke risk compared with observed strokes in the REGARDS dataset. Therefore it is possible that our model inflates the event rate for both those receiving treatment and those with no-treatment, potentially overestimating the benefits of treatment.⁴⁰ The recent American College of Cardiology/American Heart Association Pooled Cohort risk equations may have provided a more accurate estimate of CVD risk in both black and white adults in our study as they were derived from a more racially diverse dataset compared with the Framingham Stroke and CHD risk equations.⁴¹ However, the Pooled Cohort equations also overestimate predicted versus observed risk of CVD in REGARDS,⁴² and do not estimate stroke and CHD risk separately, but rather the risk of either a stroke or CHD event. There are important differences in the incidence, costs, and disutilities of stroke and CHD, therefore, we did not use the Pooled Cohorts risk equations in this analysis. Finally, because our model was not designed to determine comparative effectiveness of medications, we were unable to provide comparisons of the cost-effectiveness of different antihypertensive medication classes.

Conclusions

In this study, treatment of hypertension with antihypertensive medication was cost saving for all race and sex groups considered in the model. Treatment among black adults resulted in the most cost savings and QALYs gained. Given the findings of this study, under-treatment of hypertension potentially represents a lost opportunity for lowering healthcare costs while improving quality of life for both black and white adults with hypertension. Also, increasing treatment rates and adherence among black adults may allow third-party payers and healthcare providers to align themselves with the National Academies of the Sciences - Health and Medicine Division's commitment to addressing racial disparities in care.⁴³

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Meredith Kilgore receives research support from Amgen.

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Figure 1.

Simplified State Transition Model structure comparing the cost-effectiveness of hypertension treatment with antihypertensive medication versus no-treatment. **A.** shows a black women entering a decision tree to determine either treatment or no-treatment. Subsequently, the number of medications taken, for the treatment scenario, or the number of medications that should have been taken, for the no-treatment scenario, are assigned (Supplemental Methods). **B.** shows the markov node structure for the “treatment with 1 antihypertensive medication” branch. Once a participant suffers an event and enters a new health state, they remain in that health state until suffering another event or death. All

markov nodes for treatment with 2, 3, or 4 or more antihypertensive medications as well as for the no-treatment branches are identical to the “treatment with 1” medication node. HTN=hypertension; TX=treatment; RX=prescription; CKD=chronic kidney disease; HF=heart failure; ESRD=end-stage renal disease; MI=myocardial infarction; QALYs=quality-adjusted life-years.

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Table 1

State Transition Model inputs.

Model characteristics		Model inputs		
Event/health state	Cost			
	Initial	Annual		
Coronary Heart Disease				
Non-fatal myocardial infarction (MI)	\$46,927 ⁴⁴	\$4,209 ⁴⁵		
Fatal MI	\$23,463 ⁴⁴			
Stroke				
Mild	\$17,409 ⁴⁴	\$2,892 ^{45,46}		
Severe	\$69,642 ⁴⁴	\$2,892 ^{45,46}		
Fatal	\$31,294 ⁴⁴			
Heart failure (HF)				
Non-fatal	\$37,778 ^{5,47}	\$6,645 ^{5,45,47}		
Fatal	\$5,537 ^{5,45,47}			
Chronic kidney disease (CKD)	\$5,251 – \$8,130 depending on age ²²			
End stage renal disease (ESRD)	\$82,394 ²²	\$68,289 ²²		
Medication				
Drug type	Name	Monthly cost [†]		
Diuretic	Hydrochlorothiazide	\$3.96		
Beta blocker	Atenolol	\$5.05		
Angiotensin converting enzyme inhibitor	Lisinopril	\$6.24		
Calcium channel blocker	Amlodipine	\$7.60		
Aldosterone receptor antagonist	Spironolactone	\$10.53		
Alpha blocker	Prazosin	\$13.38		
Angiotensin receptor blocker	Losartan	\$15.79		
Yearly Transition Probabilities		Incidence per 1000 person years		
		White		
		Women	Men	
		Black		
		Women	Men	
HF ⁴⁸	3.4	6.0	8.1	9.1
‡CKD ²³				
<65 years of age	5.0		5.6	
65 years of age	43.0		48.0	
‡ESRD ²²	0.28		0.95	
Quality-adjusted life-years (QALYs)				
Health state/event	QALYs			
CKD	0.93 – 0.99 ⁴⁹ (Varies by age)			

Model characteristics	Model inputs
Post MI	0.88 ^{50,51}
HF	0.69 ^{45,52,53}
Post mild stroke	0.64 ^{5,8,54}
ESRD	0.63 ²²
Post severe stroke	0.35 ^{8,55}

[†]We utilized Medicare claims data from 2012 to estimate drug costs.

[‡]Yearly transition probabilities for CKD and ESRD were not estimated separately for women and men.

Baseline demographic characteristics of REasons for Geographic and Racial Differences in Stroke participants taking antihypertensive medication by sex and race (n=18,036).

Table 2

Characteristics	Women n=10,005 (55.5%)		Men n=8,031 (44.5%)	
	White n=4,536 (45.3%)	Black n=5,469 (54.7%)	White n=4,882 (60.8%)	Black n=3,149 (39.2%)
Age, years mean (SD)	67.3 (9.3)	65.0 (9.1)	68.3 (8.8)	65.8 (8.9)
SBP, mm Hg mean (SD)	127.1 (15.7)	131.8 (17.2)	129.4 (16.0)	133.6 (17.0)
Total cholesterol, mg/dL mean (SD)	196.4 (39.9)	195.0 (41.1)	173.4 (35.0)	179.4 (38.7)
HDL cholesterol, mg/dL mean (SD)	54.6 (16.0)	55.9 (15.6)	42.8 (12.7)	47.0 (14.0)
Current smoker, %	11.8	15.2	10.4	17.2
Diabetes, %	20.7	37.0	26.1	40.4
Afib, %	13.0	10.0	14.3	8.8
LVH, %	5.9	10.8	2.6	5.6
Number of antihypertensive medications, %				
1	43.8	33.9	41.0	33.6
2	35.5	38.4	35.4	35.5
3	16.5	20.0	17.6	20.6
4	4.2	7.7	6.1	10.3
SBP by number of antihypertensive medications, mm Hg mean (SD)				
1	126.1 (15.7)	130.5 (16.6)	128.4 (15.6)	132.8 (16.8)
2	127.4 (15.4)	131.4 (16.9)	129.8 (15.9)	133.2 (16.7)
3	128.7 (16.1)	133.4 (17.5)	131.0 (17.0)	134.4 (16.8)
4	131.8 (17.2)	135.8 (19.8)	129.4 (17.6)	136.6 (18.5)

SD=standard deviation; SBP=systolic blood pressure; HDL=high-density lipoprotein; Afib=atrial fibrillation; LVH=left ventricular hypertrophy.

Afib was defined by self-report of physician diagnosis or electrocardiogram evidence.⁴⁰

LVH was identified by electrocardiogram evidence using the Sokolow-Lyon criteria.^{40,56}

Table 3

Average systolic blood pressure and one year probability (expressed as a percent) of stroke and coronary heart disease in REasons for Geographic and Racial Differences in Stroke study participants by age, race, sex, and number of antihypertensive medications.

Number of antihypertensive medications	Treatment				No-treatment [†]									
	Average SBP (SD)	1-year stroke probability (%)			1-year CHD probability (%)	Average SBP: estimated	1-year stroke probability (%)			1-year CHD probability (%)				
		45-64	65-74	75			45-64	65-74	75					
<i>White men</i>														
1	128.4 (15.6)	0.7	1.2	2.0	1.1	1.5	2.0	137.4	0.7	1.3	2.2	1.2	1.7	2.2
2	129.8 (15.9)	0.9	1.4	2.4	1.1	1.5	2.2	147.8	1.0	1.5	2.5	1.7	2.1	2.9
3	131.0 (17.0)	1.0	1.7	2.8	1.1	1.7	1.5	158.0	1.2	2.1	3.0	1.7	2.3	3.0
4	129.4 (17.6)	1.1	1.9	2.6	1.2	2.6	2.0	165.4	1.5	2.7	3.5	2.2	2.6	3.8
<i>White women</i>														
1	126.1 (15.7)	0.4	1.0	1.9	0.5	0.8	0.9	135.1	0.5	1.0	2.1	0.5	0.6	0.7
2	127.4 (15.4)	0.6	1.1	2.2	0.6	0.8	0.9	145.4	0.7	1.3	2.5	0.9	1.2	1.2
3	128.7 (16.1)	0.6	1.3	2.6	0.7	0.9	0.9	155.7	0.9	1.8	3.1	1.0	1.2	1.4
4	131.8 (17.2)	0.7	1.8	3.3	0.8	1.1	1.3	167.8	1.3	2.2	3.8	1.4	1.8	1.8
<i>Black men</i>														
1	132.8 (16.8)	0.8	1.3	2.2	1.1	1.7	2.5	141.8	1.0	1.7	2.5	1.5	2.3	2.8
2	133.2 (16.7)	1.0	1.5	2.2	1.2	1.6	2.3	151.2	1.4	2.1	3.2	1.6	2.2	3.3
3	134.4 (16.8)	1.2	1.7	2.4	1.2	1.8	2.5	161.4	1.8	2.5	3.4	1.8	2.9	3.3
4	136.6 (18.5)	1.4	2.1	3.1	1.2	1.8	2.2	172.6	1.8	2.5	3.4	1.8	2.9	3.3
<i>Black women</i>														
1	130.5 (16.6)	0.6	1.2	2.3	0.7	1.0	1.0	139.5	0.8	1.6	3.0	1.1	1.3	1.4
2	131.4 (16.9)	0.7	1.4	2.5	0.8	1.0	1.1	149.4	1.2	2.2	3.2	1.2	1.3	1.4
3	133.4 (17.5)	0.8	1.6	3.0	0.8	1.0	1.2	160.4	1.4	2.7	4.4	1.4	2.0	2.0

Number of antihypertensive medications	Treatment			No-treatment [†]										
	Average SBP (SD)	1-year stroke probability (%)	1-year CHD probability (%)	Average SBP; estimated	1-year stroke probability (%)	1-year CHD probability (%)								
4	135.8 (19.8)	1.1	1.9	3.4	0.8	1.3	1.3	171.8	1.4	2.7	4.4	1.4	2.0	2.0

SBP=systolic blood pressure; SD=standard deviation; CHD=coronary heart disease; MI=myocardial infarction.

CHD consisted of non-fatal MI and fatal CHD.

[†]Number of antihypertensive medications for participants receiving no-treatment represent the number they should have been receiving. Average SBP was estimated for this group as described in the *Treatment strategies* section of the methods.

Table 4

Cost-effectiveness analysis results in dollars per quality-adjusted life-year.

	Lifetime Cost	Incremental Cost	QALYs	Incremental QALYs
White men				
No-treatment	\$61,464	-	15.05	-
Antihypertensive medication treatment	\$54,077	−\$7,387	16.19	1.14
White women				
No-treatment	\$53,114	-	16.89	-
Antihypertensive medication treatment	\$45,318	−\$7,796	17.78	0.89
Black men				
No-treatment	\$67,078	-	13.81	-
Antihypertensive medication treatment	\$58,678	−\$8,400	15.48	1.66
Black women				
No-treatment	\$63,268	-	14.77	-
Antihypertensive medication treatment	\$53,020	−\$10,249	16.56	1.79

QALY=quality-adjusted life-year.