Determinants of JNC VI Guideline Adherence, Intensity of Drug Therapy, and Blood Pressure Control by Race and Ethnicity

LeRoi S. Hicks, David G. Fairchild, Mark S. Horng, E. John Orav, David W. Bates, John Z. Ayanian

Abstract—The relationship between blood pressure control and racial differences in the processes of hypertension care have not been well examined. We reviewed medical records of 15 768 visits to 12 general internal medicine clinics during July 1, 2001 to June 30, 2002 to determine whether visits were adherent to the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI) by identifying medications selected for hypertension therapy. We compared JNC adherence, blood pressure control, and intensification of therapy by patient characteristics. Using repeated measures logistic regression, we determined the adjusted odds of obtaining blood pressure control when therapy was intensified the visit before, and tested the interaction of intensification of therapy and patient race/ethnicity in predicting blood pressure control. JNC adherence was more frequent among blacks (83.7%) and Hispanics (83%) than whites (78.4%) (P<0.001). Blood pressure was controlled most often among whites (38.7% versus 34.8% for blacks and 33.3% for Hispanics; P<0.001). Blacks (81.5%) and whites (80.9%) were more likely than Hispanics (70.8%) to have therapy intensified (P=0.02). After adjustment for baseline blood pressure, intensifying therapy was associated with higher odds of subsequent blood pressure control (odds ratio, 1.55; P<0.001). There were no significant interactions between race/ethnicity and intensification in predicting control. We found that therapy intensification is associated with subsequent blood pressure control in all racial/ethnic groups and that Hispanics were least likely to have their therapy intensified. Interventions to reduce disparities in cardiovascular outcomes should consider the need to intensify drug therapy more aggressively among all high-risk populations. (Hypertension. 2004;44:429-434.)

Key Words: hypertension, detection and control■ blood pressure■ ethnic groups■ antihypertensive agents

Hypertension is among the most prevalent chronic diseases in the United States.1 Despite the availability of effective medications and well-published guidelines for the treatment of hypertension,1,2–4 the majority (≈75%) of hypertension in the United States remains poorly controlled.5 Blacks have been noted to be at higher risk for hypertension, less likely to be aware they have hypertension, and more likely to have target organ damage than whites.1,5,6 Furthermore, hypertension-related cardiovascular disease is the greatest contributor to previously documented racial differences in mortality.7 Some studies have demonstrated that blacks respond differently to some antihypertensive drugs than do age-matched white controls.8,9 These differences led the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI) to specify black patients as a special population in antihypertensive treatment.1

Improvement in rates of hypertension control and a reduction in the racial differences in outcomes from hypertension may be obtained by increasing providers’ compliance with JNC prescribing guidelines and encouraging them to aggressively intensify therapy when indicated.2,10 However, despite numerous studies of potential biological mechanisms for racial differences in hypertension prevalence and severity,10–13 there has been little examination of the patient characteristics that may be associated with physician adherence to the special populations recommendations in the JNC VI or the possible relationship between patient race/ethnicity and a provider’s aggressiveness in intensifying antihypertensive therapy. Furthermore, few data link such differences in care to racial differences in blood pressure (BP) control.

Methods

Study Sample and Procedures
We determined whether patient-centered characteristics are associated with processes of care for hypertension by examining the electronic medical records of a sample of 9601 patients with 15 768 hypertension-related outpatient visits (ICD-9: 401 to 401.9, 405 to
We examined the electronic medical records of each visit and developed an algorithm to determine physician adherence to published JNC guidelines. To determine BP at time of visit, we obtained BP readings from the encounter note for each visit. If >1 BP was recorded for the visit, we averaged them to obtain the mean systolic and diastolic BP at the visit. We also classified each mean BP as controlled (<130/85 for patients with diabetes or renal failure or <140/90 for other patients) or uncontrolled for each visit.

For a random subset of 1205 patients who had a minimum of 2 hypertension-related visits during the 1-year study period (totaling 3257 visits), we used an algorithm to determine whether providers intensified drug therapy for hypertension differentially for racial and ethnic groups. The study protocol was approved by the Human Studies Committee at the Brigham and Women’s Hospital. Expanded methods and algorithms are available in an online supplement at http://www.hypertensionaha.org.

### Data Analysis

We compared patients’ demographic and clinical characteristics by race/ethnicity (Table 1) and by JNC visit type (Table 2). We estimated the association of BP control at a visit with JNC adherence and with patients’ demographic and clinical characteristics (Table 2). We also compared mean systolic and diastolic BP levels in patients with diabetes and/or renal failure and those without using Student t test. We report 2-tailed probability values with statistical significance set at \(P\leq0.05\) for all analyses.

Using logistic regression and adjusting for all measured confounders, we assessed whether race/ethnicity was associated with JNC adherence or BP control. Data were available on every variable for 97% of the visits for multivariate analyses. We report adjusted odds ratios with 95% confidence intervals for JNC-adherent visits and for BP control by patient race/ethnicity.

For the subset of 1205 patients with multiple hypertension-related visits, we estimated the association of intensifying therapy (intensiﬁed case versus nonintensiﬁed case) during the study period with race/ethnicity and estimated the association between intensifying therapy at a visit and obtaining BP control at a subsequent visit, adjusting for race/ethnicity and baseline systolic and diastolic BP using repeated measures logistic regression. In a secondary analysis, we included interaction terms for race/ethnicity and intensity of therapy to determine whether the association of intensity of therapy with subsequent BP control differed by race. All nonsignificant interaction terms were removed from the final model.

Data were available on every variable for 59% of the visits for multivariate analyses. All analyses used SUDAAN statistical software to adjust for within-patient correlation of visits and within-provider correlation of visits.14 Repeated measures models were estimated with the SAS procedures Proc GenMod and Proc Mixed.

### Results

#### Patient and Clinical Characteristics

We were able to determine JNC adherence for a total of 6109 patients with 13,127 visits. Demographic and clinical differences between racial/ethnic groups are presented in Table 1. During the 1-year study period, 45.2% of patients had 1 hypertension-related visit, 85.2% of patients had 3 or fewer visits, and nearly all patients (96.0%) had <5 visits.

Diuretics were the most commonly prescribed medication, with 5928 (45.2%) visits including a diuretic during the study period, followed by 5724 (43.6%) visits including a \(\beta\) blocker, 5154 (39.3%) visits with an angiotensin-converting enzyme inhibitor, 3547 (27.0%) visits with a calcium channel blocker (CCB), and 1206 (9.2%) visits with an angiotensin-receptor blocker. Among patients who were receiving antihypertensive medications at a visit, black patients were 10% more likely to be using a diuretic and 12% more likely to be using a CCB than white patients (\(P\leq0.001\) (Figure 1). Hispanic patients were 6% more likely to be using an angiotensin-converting enzyme inhibitor than white patients, likely because of the significantly higher prevalence of diabetes among Hispanics (Table 1).

#### JNC Adherence

In unadjusted analyses, JNC-adherent visits were signiﬁcantly more common among black and Hispanic patients compared with white patients (Table 2). JNC-adherent visits were less common among men, older patients (mean age 61.3 years for nonadherent compared with 60.4 for adherent visits; \(P=0.02\), and those with higher median household income...
($46,600 for adherent versus $48,300 for nonadherent visits; $P<0.001$).

After adjustment for race/ethnicity, sex, age, income, insurance status, and comorbid disease, JNC-adherent visits remained significantly more common among patients who were black (odds ratio [OR], 1.36 [1.15 to 1.62]) or Hispanic (OR, 1.31 [1.07 to 1.59]) than among whites. JNC-adherent visits were less likely among men (OR, 0.80 [0.70 to 0.92]) than women and more likely among younger patients (OR, 1.27 [1.02 to 1.59] for those younger than 50 years) than older patients (older than 50 years), and among patients with than without a diagnosis of coronary artery disease (CAD) (OR, 1.33 [1.04 to 1.71]). No other demographic or clinical characteristic was associated with adjusted JNC adherence among our sample.

**Blood Pressure Control**

In unadjusted analyses, BP control was more likely to be obtained when the patient was younger (mean age 59.7 years compared with 61.0 years for uncontrolled patients; $P<0.001$) or had a higher income (median income $47,812 compared with $46,431 for uncontrolled patients; $P<0.001$). BP control was attained more often among the white patients, men, and the privately insured (Table 2). Patients with a history of CAD were more likely to have their BP controlled, whereas those with diabetes were less likely to have their BP controlled. When comparing patients with diabetes and/or renal failure to those without, we found similar mean systolic BP (143.2 for patients with diabetes/and or renal failure compared with 141.6 for patients without; $P=0.10$) and mean diastolic BP (84.1 for patients with diabetes/and or renal failure compared with 97.4 for patients without; $P=0.30$) between groups.

After adjustment for JNC adherence, race/ethnicity, sex, age, income, insurance status, diabetes, and CAD, younger age continued to be associated with BP control (OR, 1.35 [1.15 to 1.58] for those aged 50 years or younger; OR, 1.37 [1.17 to 1.61] for age 51 to 60; and OR, 1.19 [1.02 to 1.38] for age 61 to 70; compared with age older than 70 years). Men were more likely to have their BP controlled than

<table>
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<th>Variable</th>
<th>% Guideline Adherent Visit</th>
<th>% BP Controlled Visit</th>
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<td></td>
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<td>N=4726 (36% of visits)</td>
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*Using $\chi^2$ tests for categorical variables.
women (O.R. 1.13 [1.03 to 1.25]). Hispanic patients continued to be less likely to have their BP controlled than white patients (OR, 0.86 [0.75 to 0.99]). Patients with free care/self-pay were less likely to have their BP controlled than patients with private insurance (OR, 0.80 [0.65 to 0.98]). Diabetic patients continued to be less likely to have their BP controlled (OR, 0.45 [0.40 to 0.51]) than nondiabetic patients, and patients with CAD were more likely to have their BP controlled (OR, 1.28 [1.05 to 1.56]) than patients without CAD.

Intensification of Therapy
Of the subset of 1205 patients evaluated for intensification of therapy, 500 (41.5%) were black, 448 (37.2%) were white, 221 (18.3%) were Hispanic, and 36 (3%) were classified as other. Among those patients with multiple visits whose BP was uncontrolled at 2 or more visits (N=850), there were 671 (78.9%) who had their medications intensified. Hispanic and other patients were significantly less likely to have their medications intensified than white and black patients (Figure 2).

After adjustment for race/ethnicity and baseline systolic and diastolic BP at each visit, patients who had their therapy increased at a visit were significantly more likely to obtain BP control at the follow-up visit than those who did not (OR, 1.55 [1.21 to 1.98]). There were no significant interactions between race and intensification in the multivariate model, suggesting that the association between intensification of therapy and subsequently improved BP control does not differ by race.

Discussion
In this population, BP control was achieved more often among white patients than among other racial/ethnic groups, despite higher rates of JNC VI guideline adherence among blacks and Hispanics. However, Latinos were significantly less likely to have their drug therapy intensified than other racial/ethnic groups. Most importantly, we found that the association of intensifying drug therapy with obtaining subsequent BP control did not differ by patient race/ethnicity, suggesting that equal treatment in terms of aggressiveness in managing hypertension might overcome any potential biological mechanisms that contribute to racial differences in BP outcomes.

Numerous studies have demonstrated racial/ethnic differences in rates of BP control, but the processes that may mediate these differences are not well understood. Our data suggest that some of these differences could be caused by differences in rates of intensification of antihypertensive drug therapy. Previous research has shown an association between low intensity of antihypertensive drug therapy and poor BP control. In a 1998 publication assessing the quality of care for hypertensive Veterans Affairs patients, Berlowitz et al documented that only 25% of the patients provided with a regular source of care and frequent visits to their providers were found to have BP levels of <140/90 and that physicians frequently failed to increase the dose of antihypertensive medications or to try new treatments in patients with elevated BP.

In a 2003 publication comparing a cohort of similar Veterans Affairs patients receiving care in 1999 with an earlier cohort from 1990 to 1995 showed a significant improvement in rates of BP control (defined as BP <140/90) associated with a significant increase in the number of visits during which medication doses were increased. These studies, however, did not describe racial/ethnic differences in intensity of therapy, likely because the Veteran’s Affairs cohorts were 90% white.

One study that examined a more diverse group of participants was the Antihypertensive and Lipid-Lowering treatment to prevent Heart Attack Trial (ALLHAT), which found that black (African-American and foreign) hypertensive participants had 31% lower odds of having their BP controlled and 10% lower odds of being treated with >1 antihypertension...
tive medication at 3 years’ follow-up than whites. An examination of participants with a history of hypertension in the 1992 Health and Retirement Study also found that only 53% of Hispanics reported current medication use compared with 64% of whites and 72% of blacks. However, these studies were limited because the investigators were not able to assess practice patterns such as the frequency with which individual antihypertensive drugs were intensified in response to uncontrolled BP. We found that Hispanic patients in our cohort were also less likely to have their antihypertensive medications intensified at least once in response to repeatedly uncontrolled BP than were other racial/ethnic groups.

We noted that patients with diabetes were significantly less likely to have their BP controlled to the JNC VI recommended level than patients without diabetes. Our findings are consistent with several other studies that have documented similarly low rates of BP control among diabetics.

We also noted that patients with a history of CAD were more likely than those without CAD to have their BP controlled to <140/90 after adjustment for sociodemographic and clinical characteristics previously associated with BP control. We were unable to determine whether patients with CAD were more likely to have their care comanaged by a subspecialist, which may lead to more aggressive adjustment of their antihypertensive therapy. We were also unable to test the association between having CAD and being an intensified case because of the limited sample size of patients with multiple visits with uncontrolled BP who had a diagnosis of CAD.

We found significantly higher rates of physician adherence to JNC guidelines than have been published in prior studies. These higher rates may be because we included patients who were receiving multiple antihypertensive medications in our cohort. Our inclusion of these patients may have allowed more opportunities for a patient to receive a JNC recommended drug class, but their inclusion gives more a representative sample of patients receiving care for hypertension in other settings. Our adherence rates may also be higher because blacks who were receiving CCB in our study were classified as JNC adherent because the special populations section of the JNC VI allows for use of CCB as alternate first-line therapy for hypertension among blacks without a compelling indication for another drug class.

Our study has several limitations. We were unable to collect measures of patient adherence to prescribed therapy from the electronic medical records. Previous studies have documented racial differences in patients’ health literacy about antihypertensive medications and patient adherence to antihypertensive therapy. Theoretically providers may not willing to intensify therapy at the same rate for patients they know are less compliant with therapy. Future examinations of racial differences in processes of hypertension care should attempt to adjust for measures of patient adherence.

We could not determine JNC drug class adherence for patients who were not receiving antihypertensive medications if they had no clear indication for drug treatment based on medical record review (comorbid diabetes or evidence of target organ damage). As a result, any data surrounding such visits were not included in our multivariate analyses examining the relationship of JNC drug class adherence to BP control. However, these visits were eligible for our examination of intensification of therapy, and any such patients who were administered drug therapy during the study period were identified as intensified cases.

There may have been significant differences in processes of care before the study period, such as the number of visits to a provider or intensity of therapy, which may also have influenced differences in rates of BP control. Theoretically, white patients may have had better BP control because they received more aggressive therapy or had more visits with their providers before our study, we were unable to account for these possible differences in our study.

We examined patients who received their care at primary care practices affiliated with a single large urban teaching hospital, and there was substantial socioeconomic diversity in our sample; however, our results, may not be generalizable to smaller, rural, or nonteaching hospitals in which there may be providers without strong ties to the academic community and with different experiences caring for a multiethnic patient population.

**Perspectives**

We found significant racial and ethnic differences in 2 measures of hypertension care (JNC adherence and intensification of drug therapy). We suspect that in comparison to the type of drug class prescribed, the level of aggressiveness in managing hypertension may be more predictive of obtaining BP control. We also found that BP control was poorest among arguably the highest-risk populations, racial/ethnic minorities, and diabetic subjects. Our findings suggest that equal treatment in terms of aggressiveness of drug therapy should reduce disparities in hypertension outcomes. Future interventions should include increasing physician recognition of uncontrolled hypertension among diabetic subjects and raising physician awareness of the need to intensify drug therapy more aggressively among high-risk populations.

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**References**


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