POPULATIONS AT RISK

The Effect of Patient Race and Blood Pressure Control on Patient-Physician Communication

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BACKGROUND: Racial disparities in hypertension control contribute to higher rates of cardiovascular mortality among blacks. Patient-physician communication quality is associated with better health outcomes, including blood pressure (BP) control. Both race/ethnicity and BP control may adversely affect communication.

OBJECTIVE: To determine whether being black and having poor BP control interact to adversely affect patient-physician communication more than either condition alone, a situation referred to as "double jeopardy."

DESIGN, SETTINGS, AND PATIENTS: Cross-sectional study of enrollment data from a randomized controlled trial of interventions to enhance patient adherence to therapy for hypertension. Participants included 226 hypertensive patients and 39 physicians from 15 primary care practices in Baltimore, MD.

MEASUREMENTS: Communication behaviors and visit length from coding of audiotapes.

RESULTS: After controlling for patient and physician characteristics, blacks with uncontrolled BP have shorter visits (B=−3.9 min, p<0.01) with less biomedical (B=−24.0, p=0.05), psychosocial (B=−19.4, p< 0.01), and rapport-building (B=−19.5, p=0.01) statements than whites with controlled BP. Of all communication outcomes, blacks with uncontrolled BP are only in "double jeopardy" for a patient positive affect—coders give them lower ratings than all other patients. Blacks with controlled BP also experience shorter visits and less communication with physicians than whites with controlled BP. There are no significant communication differences between the visits of whites with uncontrolled versus controlled BP.

CONCLUSIONS: This study reveals that patient race is associated with the quality of patient-physician communication to a greater extent than BP control. Interventions that improve patient-physician communication should be tested as a strategy to reduce racial disparities in hypertension care and outcomes.

KEY WORDS: patient-physician communication; hypertension; blood pressure control; racial disparities; double jeopardy.
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INTRODUCTION

Hypertension is common and contributes substantially to cardiovascular morbidity, mortality, and resource use.[1,2] Rates of hypertension awareness and treatment have increased;[2] however, control rates remain less than 50%, even among patients receiving regular care.[2,3] Among blacks, hypertension develops earlier in life, is more severe, and causes more complications including stroke, heart disease, and end-stage renal disease.[1,4,5] Cardiovascular disease (CVD) accounts for 35% of excess overall mortality in blacks, largely because of hypertension.[6] Compared with whites, blacks are more likely to have hypertension, be aware of it, and be treated with antihypertensive medications, but less likely to achieve blood pressure (BP) control.[2] Despite declining overall CVD mortality, rates have declined less among blacks than whites, and continue to be almost 50% higher.[2,7]

Although racial disparities in coronary heart disease treatment are well documented,[8] there is no evidence for disparities in physician prescribing behaviors for hypertension.[9] However, blacks report lower rates of adherence to antihypertensive treatments.[10,11] Adherence barriers that may contribute to racial disparities in CVD outcomes include socioeconomic factors,[12–14] patient factors,[15–17] health-care access,[13,14,18] and physician communication skills.[19,20]

Patient-physician communication is the primary process by which medical decisions are made and patients are diagnosed and treated. It is viewed by the Institute of Medicine[21] as an indicator of patient-centered care, a key measure of quality. The quality of patient-physician communication is associated with better processes and outcomes, including patient self-management behaviors, adherence, satisfaction, health status, and BP control.[19,22,23–27] Racial disparities in patient-

physician communication have been documented.[28–32] Physicians provide less information,[32] engage in more narrowly biomedical conversations,[31] spend less time building rapport,[27,30,32] and are more verbally dominant and less patient-centered with black patients.[28] Only one study showed that black patients self-reported greater frequency of counseling by their physician about hypertension and medication adherence compared with whites.[33]

Blood pressure control could be considered a measure of health status. Data on the relationship between overall health status and quality of care are inconsistent.[34–38]

Some studies show that individuals in poor health receive better *technical* care than healthier individuals;[35,36] others suggest that less healthy patients rate their doctors lower on *interpersonal* quality.[34,38] It is unknown whether patients with uncontrolled BP experience poorer communication with physicians. In the usual course of care, BP is obtained before the patient sees the provider. Thus, it is reasonable to assume that the provider's knowledge of the patient's BP might impact the communication that subsequently occurs.

Independently, black race/ethnicity and poor BP control may adversely affect communication quality. However, the combined effect of being black and having poor BP control on patient-physician communication is unknown. We hypothesize that being black *and* having uncontrolled BP interact to adversely affect patient-physician communication more than either condition alone, a situation called "double jeopardy." This hypothesis would be supported if we find that blacks with uncontrolled BP have worse communication with their physicians than whites with uncontrolled BP, blacks with controlled BP, and whites with controlled BP. Figure 1 outlines a conceptual model showing the relationships between study variables.

METHODS

Study Design and Population

We analyzed enrollment data from the Patient-Physician Partnership (Triple P) study, which was approved by the institutional review board of the Johns Hopkins Medical Institutions. Triple P was a randomized controlled trial of patient and physician interventions to improve adherence to therapy among hypertensive patients in 15 community-based primary care clinics in Baltimore, MD, serving low income and/or ethnic minority patients; details regarding physician and patient enrollment are reported elsewhere.[39]

Data Collection

All participants gave informed consent. At the beginning of each visit, research assistants set up a tape recorder in the physician's exam room and left. Patients were interviewed before the visit and answered questions about their health status, measured with the Medical Outcomes Study Short Form 12,[40] demographic and clinical characteristics, health literacy, measured by the Rapid Estimate of Adult Literacy in Medicine (REALM),[41] and self-reported medication non-adherence, measured with the Hill Bone Compliance to High Blood Pressure Therapy Scale-Medication Compliance subscale.[42] Physicians

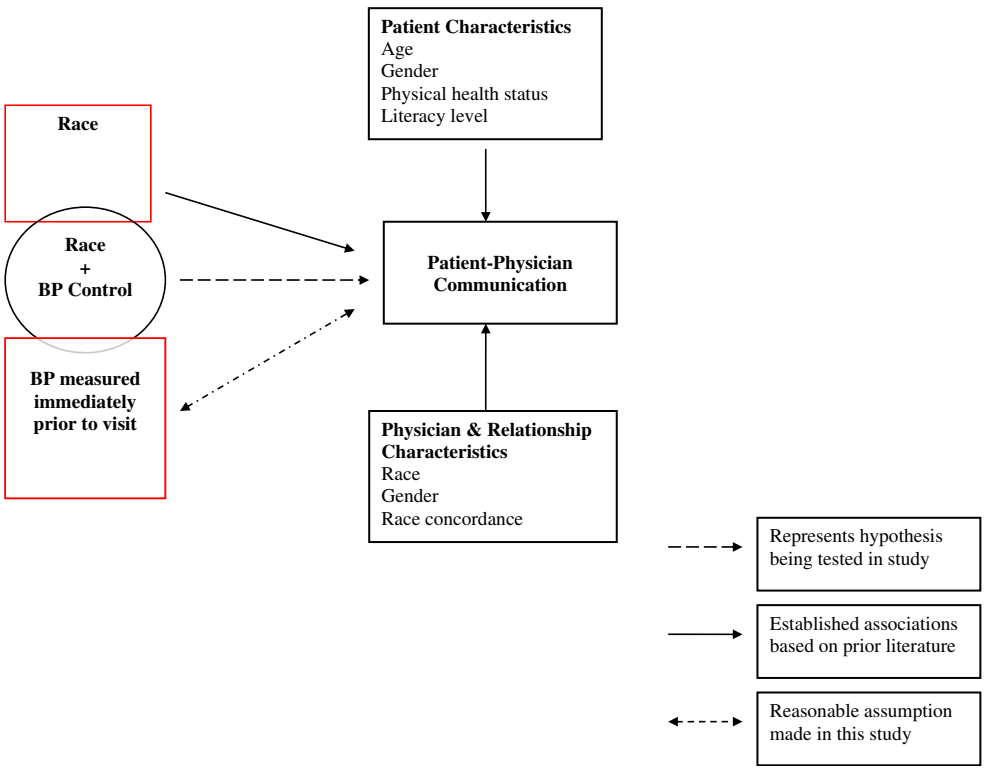

Figure 1. Conceptual model showing relationships between study variables.

completed a background survey about demographic and training characteristics and a post-visit questionnaire assessing how well they knew the patient.

Study Measures

Our independent variable was combined race and BP control status. This classification resulted in four categories: (1) uncontrolled blacks, (2) uncontrolled whites, (3) controlled blacks, and (4) controlled whites.

Patients self-identified as belonging to one of six racial/ethnic groups (Asian, Latino/Latin American or Hispanic, Native American/American Indian or Indigenous people, Pacific Islander, Black/African American, and White). We limited our analysis to Black/African Americans and Whites.

Blood pressure was measured before the visit by trained and certified observers using an automatic oscillometric monitor (Omron HEM 907). This device programs a 5-min delay before activation and has a 30-s delay between the triplicate measurements. Baseline BP was the average of three measurements, obtained before randomization. BP control was dichotomized as uncontrolled (SBP $\geq$140 mmHg or DBP $\geq$90 mmHg) or controlled (SBP <140 mmHg and DBP <90 mmHg).

Communication behaviors were assessed by analyzing audiotapes from the enrollment visit for each patient. These visits were part of ongoing patient care. Audiotapes were coded using the Roter Interaction Analysis System (RIAS), a widely used coding system for the assessment of patient-physician communication. The system has established reliability and predictive validity.[43,44] The RIAS provides a framework for understanding communication dynamics during a medical visit. Each complete thought expressed by the patient or physician is coded in 1 of 37 mutually exclusive and exhaustive RIAS categories.

We created composites of individually coded categories that relate broadly to informational and affective dimensions of the visit.[45] Informational behaviors include technical skills used to exchange information about patients' biomedical and psychosocial problems, while affective behaviors include elements of rapport and interpersonal relationship. Additionally, RIAS coders rate the global affect (emotional tone) of the dialogue across several affect dimensions and assign numeric scores to the patient and physician on a scale of 1–6 (1 = low/none, 6 = high). Two experienced raters performed all coding. Inter-rater reliability on a subset of interviews (n=23) averaged 85% (range 63%–96%, calculated by Pearson's correlations coefficients) for verbal communication codes with mean counts >2.0 and 87–100% agreement within one point for global affect ratings.

Main outcome variables included: (1) two summary informational composites: *biomedical exchange* (biomedical questions, biomedical information-giving and counseling regarding medical history, symptoms, and therapeutic regimen) and *psychosocial exchange* (psychosocial questions, information giving and counseling regarding social and family relations at work and home, performance of activities and functions related to daily living and exchanges related to feelings and emotions); (2) two summary affective composites: *rapport-building* (empathy, legitimization, partnership statements, concern or worry and reassurance/optimism statements, compliments, laughter, approvals and agreements, criticisms and disagreements, and chit-chat) and *patient activation* (physicians' asking for the patients' opinion, permission to proceed, reassurance, understanding, back-channeling, and paraphrasing or checking for the patient's understanding; and patients' requests for service, reassurance, understanding, or clarification from the physician); (3) two global affect measures: *physician positive affect* (sum of ratings of physicians' interest, friendliness, engagement, sympathy, and non-hurried behaviors) and *patient positive affect* (sum of ratings of patients' interest, friendliness, engagement, sympathy and assertiveness behaviors); and (4) one overall process measure, *duration of visit*—the amount of time in minutes from the beginning to the end.

In secondary analyses, we examined whether or not physicians met five communication proficiencies related to hypertension treatment adherence. These included: (1) eliciting the full spectrum of patient's concerns, (2) probing for high blood pressure knowledge/beliefs, (3) monitoring adherence and identifying problems with high blood pressure medications, (4) probing for compliance-related lifestyle and psychosocial factors, and (5) eliciting patient's commitment to the plan. We describe some of these findings in the text, but they are not reported in the tables.

Statistical Analyses

To identify potential confounders, we performed descriptive analyses with chi-square tests for categorical variables and analyses of variance for continuous variables to associate patient and physician characteristics with patient race-BP control status and our communication outcomes. We used linear regression to assess the presence, strength, and statistical associations between race-BP control and our outcomes. We identified covariates for the multivariate analysis on the basis of theoretical considerations (patient gender, patient and physician intervention assignment) or if they were associated with race-BP control and at least two of the communication outcomes at a P value <0.10. All covariates considered for inclusion are shown in Table 1. Our analyses of race-BP control with communication outcomes used generalized estimating equations to account for the within-group correlations among patients seeing the same physician.[46]

For our main analyses, the four category patient race-BP control status variable was the predictor of interest. "Uncontrolled blacks" served as the reference group. We also conducted post-estimation testing of the three remaining pairwise combinations of race-BP control groups. We examined whether racial differences in patient-physician communication were modified by BP control status in two ways. First, we analyzed the data by including patient race and BP control as main effects and an interaction term (race-by-BP control) in the same model. Second, we conducted analyses of associations of race with communication behaviors stratified by BP control status. Results of these two approaches were comparable to using the four-category variable for patient race-BP control status and are not presented in this paper.

All analyses were performed using STATA statistical software, version 9.0 (Stata Corp., College Station, Texas).

RESULTS

Enrollment of Physicians and Patients

Two hundred seventy-nine patients and 41 physicians were enrolled in the parent study. We excluded patients without audiotape data (n=43) or BP control data (n=6), and those who

Table 1. Baseline Sample Characteristics by Race-Blood Pressure Control Status

Characteristic	Overall sample (n=226)	Uncontrolled blacks (n=63)	Uncontrolled whites (n=28)	Controlled blacks (n=74)	Controlled whites (n=61)	P-value
Mean age (SD), years	62 (12.0)	60±11.8	64±12.0	61±12.3	64±11.5	0.22
Female gender, %	65.9	69.8	50.0	64.9	70.5	0.24
Mean education (SD), years	11.8±2.3	11.5±2.4	10.9±2.5	11.7±2.5	12.5±2.0	0.02
Mean literacy (REALM) score (SD)	54.1±19.6	50.7±21.6	52.5±21.4	51.9±19.7	60.9±14.7	0.02
Annual household income <$10,000, %	31.9	47.6	24.0	36.2	22.4	0.02
Diabetes, %	44	54.8	35.7	54.8	26.2	0.001
Mean medication non-adherence score(SD)[a]	10.3±1.9	11.1±2.3	10.0±1.3	10.2±1.8	9.7±1.3	<0.001
Mean blood pressure medications (SD), n	1.7±0.9	1.7±1.0	2.0±0.9	1.7±0.9	1.7±0.8	0.57
Mean PC_SF12[b] score (SD)	39.7±12.1	41.6±11.4	40.5±11.5	38.6±12.7	38.6±12.2	0.44
Seen by female doctor, %	52.7	58.7	28.6	51.3	59.0	0.04
Race of doctor seen, %						
White	50.0	34.9	60.7	48.7	62.3	<0.01
Black	24.3	38.1	3.6	27.0	16.4	
Other	25.7	27.0	35.7	24.3	21.3	
Mean time doctor spent in clinical practice (SD), years	12.0±7.1	11.3±6.6	12.6±6.4	11.7±7.5	12.7±7.4	0.65
How well doctor knows patient, %						
Very or moderately well	77.4	79.7	73.1	91.0	90.6	0.056
Somewhat, slightly or not at all	13.3	20.3	26.9	9.0	9.4	
Dr. completed CME[c] in communication, %	50.9	44.4	46.4	48.7	62.3	0.20
Dr. completed CME[c] in HTN, %	59.7	69.5	71.4	54.1	55.7	0.15
Race concordant relationship, %	43.8	38.1	60.7	27.0	62.3	<0.001
Gender concordant relationship, %	58.4	57.1	57.1	54.1	65.6	0.58

[a]*Measured using the Hill Bone Compliance to High Blood Pressure Therapy Scale-Medication Taking Subscale*
[b]*PC_SF12 = Physical component of Medical Outcomes Study Short Form*
[c]*CME = Continuing medical education*

were neither white nor black (n=4), leaving 226 patients who were seen by 39 physicians in the analytic sample. Included patients were somewhat older, had higher income, lower diastolic blood pressure, and were more likely to be in race-concordant relationships than those who were missing audiotape data.

Characteristics of Study Sample

Table 1 describes study participants. Forty-six percent of blacks and 31% of whites had uncontrolled BP (P=0.03). Patients were 62.0 years on average, and 66% were female. Literacy score differed by race-BP control (p=0.02) with controlled whites having the highest score and uncontrolled blacks, the lowest score. More blacks had an annual household income of <$10,000 or were diabetic. Controlled whites reported the lowest levels of non-adherence and uncontrolled blacks, the highest. More white patients were in race-concordant relationships.

Covariates related to at least two of our communication outcomes at a p value <0.10 included patient age, literacy (REALM) score, physical health status, physician gender, physician race, and race concordance.

Relationship of Race-blood Pressure Control Status and Verbal Communication Measures

Table 2 shows the results of linear regression models. Biomedical exchange accounted for most of the conversation while statements related to patient activation accounted for the least. In the adjusted model, there were significant differences between uncontrolled blacks and controlled whites for psychosocial exchange and rapport-building.

Post-estimation testing. In the *adjusted* analyses, there were differences between controlled whites and controlled blacks for psychosocial talk (B=15.2, p=0.03) and rapport-building (B=18.0, p=0.02). No statistically significant differences were found between controlled blacks and uncontrolled whites or between controlled and uncontrolled whites.

Relationship of Race-Blood Pressure Control Status with Global Affect Measures and Visit Length

Table 3 shows the results of linear regression models.

Global Affect. There were no significant differences in coders' average ratings of *physician* positive affect between uncontrolled blacks and any other groups. In the *adjusted* model, ratings of patient positive affect were significantly lower for uncontrolled blacks than for all other patients.

Visit Length. In adjusted models, blacks with uncontrolled BP had the shortest office visits; however, this difference was only statistically significant when compared to controlled whites (Table 3).

Post-estimation testing. In adjusted analyses, there were differences in patient positive affect between controlled whites

Table 2. Relationship Between Race-Blood Pressure Control Categories and Verbal Communication Behaviors

Communication measure	Uncontrolled blacks (n=63)	Uncontrolled whites (n=28)	Controlled blacks (n=74)	Controlled whites (n=61)
Biomedical exchange				
Unadjusted mean no. of statements (SD)	162.3 (13.1)	183.5 (17.2)	176.7 (12.6)	204.7 (14.5)
p-value	Reference	0.24	0.17	<0.01
Adjusted mean no. of statements, (SD)	168.4 (13.4)	183.3 (12.4)	171.3 (11.8)	192.4 (11.8)
p-value	Reference	0.33	0.79	0.10
Psychosocial exchange				
Unadjusted mean no. of statements (SD)	47.0 (6.0)	65.9 (8.6)	53.7 (6.1)	67.4 (6.7)
p-value	Reference	0.04	0.293	<0.01
Adjusted mean no. of statements, (SD)	46.4 (6.6)	65.9(9.8)	50.5(5.9)	65.8(5.6)
p-value	Reference	0.09	0.62	<0.01
Rapport-building				
Unadjusted mean no. of statements (SD)	78.1 (7.4)	93.0 (9.1)	85.3 (7.2)	106.7 (10.1)
p-value	Reference	0.10	0.39	0.01
Adjusted mean no. of statements, (SD)	80.5 (7.3)	95.3 (8.7)	81.9 (6.6)	100.0 (7.7)
p-value	Reference	0.06	0.87	0.03
Patient-activation				
Unadjusted mean no. of statements (SD)	26.3 (2.3)	29.9 (4.1)	28.7 (2.8)	34.4 (2.7)
p-value	Reference	0.47	0.43	0.03
Adjusted mean no. of statements, (SD)	27.2 (2.2)	30.4 (4.0)	26.8 (2.5)	32.3 (2.2)
p-value	Reference	0.50	0.88	0.13

Adjusted model: Adjusted for patient's age, gender, literacy score, PC_SF12, physician gender, patient and physician intervention group, race concordance

and controlled blacks (B=0.60, p=0.02). In the adjusted model, visits with controlled whites were longer than with controlled blacks (B=3.72 min, p<0.001). No statistically significant differences were found between controlled blacks and uncontrolled whites or between controlled and uncontrolled whites.

Additional analyses. Formal tests revealed no statistically significant interactions of race and BP control status on communication composites. Among the five communication proficiencies examined, we found: doctors elicited the full spectrum of patients' concerns in 53% of visits; probed patients' knowledge and beliefs about hypertension in 8% of visits; monitored medication adherence in 70% of visits, probed lifestyle and psychosocial barriers to adherence in 52% of visits; and asked for commitment to the therapeutic plan in 12% of visits. Only one proficiency—"doctor elicits the full spectrum of the patient's concerns"—occurred significantly more often in visits with controlled whites (69%) and blacks (53%) than in visits with uncontrolled whites (39%) and blacks (44%), overall chi-square p-value=0.02.

DISCUSSION

This study is, to our knowledge, the first to empirically test the "double jeopardy hypothesis" for influences of race and hypertension control on patient-physician communication. We found support for this hypothesis for one outcome only—*patient positive affect*. For this measure, uncontrolled blacks were in "double jeopardy"—they had less positive emotional tone in their visits with physicians than uncontrolled whites, controlled blacks, and controlled whites. Uncontrolled blacks experienced worse communication than controlled whites for

Table 3. Relationship Between Race-Blood Pressure Control Categories and Global Affect Measures and Visit Length

Communication measure	Uncontrolled blacks (n=63)	Uncontrolled whites (n=28)	Controlled blacks (n=74)	Controlled whites (n=61)
Physician positive affect				
Unadjusted mean score (SD)	7.3 (0.21)	7.6 (0.41)	7.0 (0.28)	7.6 (0.29)
p-value	Reference	0.44	0.27	0.33
Adjusted mean score (SD)	7.3 (0.21)	7.5 (0.41)	7.1 (0.28)	7.5 (0.19)
p-value	Reference	0.67	0.32	0.40
Patient positive affect				
Unadjusted mean score (SD)	12.7 (0.30)	14.1 (0.40)	13.2 (0.22)	14.1 (0.19)
p-value	Reference	<0.01	0.13	<0.001
Adjusted mean score (SD)	12.8 (0.30)	14.1 (0.43)	13.4 (0.17)	14.0 (0.21)
p-value	Reference	0.01	0.03	<0.001
Visit length				
Unadjusted mean no. minutes (SD)	14.3 (1.29)	17.1 (1.36)	15.4 (1.26)	19.1 (1.36)
p-value	Reference	0.07	0.37	<0.001
Adjusted mean no. minutes, (SD)	14.7 (1.30)	17.2 (1.14)	14.9 (1.17)	18.6 (1.21)
p-value	Reference	0.10	0.86	<0.001

Adjusted model: Adjusted for patient's age, gender, literacy score, PC_SF12, physician gender, patient and physician intervention group, race concordance

all but one measure, physician positive affect. Also, controlled blacks had less communication with physicians than controlled whites on several measures. There were no significant differences in communication between uncontrolled and controlled whites. Thus, patient race influenced patient-physician communication more than BP control did.

Our finding of less psychosocial and rapport-building behaviors along with lower levels of patient positive affect in medical office visits of blacks supports findings of other studies.[27,28,47] Affect, which is conveyed primarily by voice tone, can be considered the unspoken subtext of the medical dialogue.[48] The "double jeopardy" finding for uncontrolled blacks for patient positive affect is likely to be clinically important, since patient global affect ratings are associated with patient satisfaction and return visits.[48]

Contrary to our hypothesis and previous work, physician positive affect was not lower for uncontrolled or controlled blacks than for the other comparison groups.[28,47] There are at least two potential explanations for these findings. First, physicians might have lower expectations that blacks will achieve BP control and therefore be less inclined to judge them negatively or convey disapproval through non-verbal cues. Alternatively, there may be actual differences in physician positive affect by patients' BP status or race that we failed to detect because of limited statistical power. Given the highly reciprocal nature of affect between speakers, our findings of less patient positive affect among uncontrolled and controlled blacks, compared to controlled whites, may indicate that these patients are better able than coders to detect less positive affect from their physicians and respond accordingly by exhibiting less positive affect themselves.

We found that blacks, regardless of BP control, have shorter office visits than controlled whites, even after adjusting for factors known to be associated with longer visits. This finding differs from previous studies.[27,28,49] Physicians and patients believe visit duration is important for quality of care.[50,51] Longer visits are associated with higher communication quality,[52] greater ease of discussing problems,[53,54] and more participatory decision-making[54] by patients. Constraining visit length to reduce health-care costs may place minorities and patients with suboptimal disease control at higher risk for poorer quality communication and disease outcomes.[20]

One explanation for poorer communication between physicians and black patients may lie in potential differences in illness perceptions.[55,56] While physicians see hypertension as a chronic, asymptomatic condition needing lifelong pharmacologic therapy, patients may view it as an intermittent, but acutely symptomatic condition that can be treated intermittently or with non-pharmacologic therapies or home remedies.[55,57,58] Clinicians' attempts to replace patients' views with the "professional" view may exacerbate black patients' feelings of distrust and emotional distance. Blacks may perceive physicians as being insensitive to their needs and therefore communicate less with them.

Contrary to previous work linking poor health status to worse interpersonal care,[34,59] we found little evidence of the independent influence of BP control (as a proxy for health status) on communication. Patients may not consider BP control as indicative of their overall health status. Indeed, self-rated physical health status did not differ significantly across BP control groups in this study. Larger studies of disease control, health status, and interpersonal health-care quality may help elucidate these relationships.

Our study has limitations. First, due to the cross-sectional design, we cannot determine direction of causality between BP control and communication. Second, missing audiotape data from 15% of visits could have biased our results since these excluded patients who differed from our study sample with regard to age, income, and race concordance. Because we demonstrated differences in patient-physician communication that are consistent with other studies, we are confident our results are valid. Third, relatively small sample sizes may have limited our ability to detect differences for particular outcomes or groups (uncontrolled whites). Fourth, we did not conduct a qualitative analysis of hypertension-specific communication; however, we examined five communication proficiencies and found that discussion about hypertension beliefs was uncommon regardless of race or BP control. Finally, unmeasured variables (e.g., patient and physician attitudes and knowledge of hypertension, organizational functioning, or cultural competence) may have affected our results. Clustering by site instead of physician yielded qualitatively similar results.

Our study contributes new knowledge to evidence linking patient race with communication quality during primary care visits[27,29,31,49] and has implications for system interventions, clinical care, and future research. Interventions that engage ethnic minorities and those with suboptimal disease control to participate more fully in the health-care process are promising strategies to improve hypertension care. Examples of effective strategies include home BP monitoring; in-person, telephone, or web-based motivational strategies delivered by a nurse and/or a pharmacist; collaborative management by primary care-pharmacist teams;[60,61] and involvement of community health workers as members of the care team.[62] Physician-directed interventions such as continuing medical education, academic detailing, quality review and feedback, and computer decision support/reminders to change prescribing behaviors, when used alone, have not shown improvements in health outcomes,[63–68] and few studies have focused on communication skills training skills for providers.[39,61] If shown to be effective in well-designed studies, integrating the best of these strategies will provide models that may be disseminated into practice to improve quality of care and reduce disparities in cardiovascular disease outcomes.

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Conflict of Interest: *Dr. Debra Roter is the author of the Roter Interaction Analysis System (RIAS) and holds the copyright for the system. Johns Hopkins University also has rights to enhancements of the system. Neither Debra Roter nor Johns Hopkins collect royalties for use of the system in research conducted at the Johns Hopkins University and Medical Institutions. Debra Roter is owner of RIASWorks LLC, a company that provides RIAS coding services to*

clients outside of the Johns Hopkins University System. It may be possible that the company will benefit indirectly from dissemination of the current research. Dr. Lisa Cooper received a grant, and Ms. Kathryn Carson received salary support, from AMGEN, a human therapeutics company in the biotechnology industry.

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