

## Addressing the Social Needs of Hypertensive Patients The Role of Patient–Provider Communication as a Predictor of Medication Adherence

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**Background**—Poor medication adherence is a pervasive problem in patients with hypertension. Despite research documenting an association between patient–provider communication and medication adherence, there are no empirical data on how the informational and relational aspects of communication affect patient’s actual medication-taking behaviors. The aim of this study was to evaluate the impact of patient–provider communication on medication adherence among a sample of primary care providers and their black and white hypertensive patients.

**Methods and Results**—Cohort study included 92 hypertensive patients and 27 providers in 3 safety-net primary care practices in New York City. Patient–provider encounters were audiotaped at baseline and coded using the Medical Interaction Process System. Medication adherence data were collected continuously during the 3-month study with an electronic monitoring device. The majority of patients were black, 58% women, and most were seeing the same provider for at least 1 year. Approximately half of providers were white (56%), 67% women, and have been in practice for an average of 5.8 years. Fifty-eight percent of patients exhibited poor adherence to prescribed antihypertensive medications. Three categories of patient–provider communication predicted poor medication adherence: lower patient centeredness (odds ratio: 3.08; 95% confidence interval: 1.04–9.12), less discussion about patients’ sociodemographic circumstances (living situation, relationship with partner; odds ratio: 6.03; 95% confidence interval: 2.15–17), and about their antihypertensive medications (odds ratio: 6.48; 95% confidence interval: 1.83–23.0). The effect of having less discussion about patients’ sociodemographic circumstances on medication adherence was heightened in black patients (odds ratio: 8.01; 95% confidence interval: 2.80–22.9).

**Conclusions**—The odds of poor medication adherence are greater when patient–provider interactions are low in patient centeredness and do not address patients’ sociodemographic circumstances or their medication regimen. (*Circ Cardiovasc Qual Outcomes*. 2017;10:e003659. DOI: 10.1161/CIRCOUTCOMES.117.003659.)

**Key Words:** antihypertensive agents ■ hypertension ■ patient-centered care  
■ patient compliance ■ primary health care

Despite advances in treatments for cardiovascular risk factors, such as hypertension, poorly controlled blood pressure (BP) continues to be a significant public health problem in the United States.<sup>1</sup> Medication nonadherence is a pervasive problem contributing to inadequate BP control.<sup>2</sup> The patient–provider relationship offers an ideal opportunity to address patient nonadherence because providers’ communication skills contribute to as much as 50% of the quality of care patients’ receive.<sup>3</sup> Many studies have shown that incorporating qualities of shared decision making, patient centeredness, adequate information exchange, and attending to patients’ general and disease-specific concerns<sup>4–6</sup> in medical visits is associated with improvements in medication adherence among patients with hypertension.<sup>7–9</sup> Indeed, 1 study has

shown that the odds of nonadherence can be reduced by as much as 23% if the provider has good communication and clinical decision-making skills.<sup>10</sup>

### See Editorial by Havranek and Daugherty

Despite this evidence, analyses of audiotaped patient–provider interactions have shown that providers rarely collaboratively discuss medication-taking behaviors with their hypertensive patients, regardless of BP control status.<sup>11</sup> When such conversations occur, most providers rely predominantly on closed-ended and declarative statements when asking about medications (eg, so you are taking) and spend little time explaining the need for the medications or assessing patient’s confidence to take them as prescribed.<sup>11–13</sup> The

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### WHAT IS KNOWN

- The quality of patient–provider communication is associated with patient-reported medication adherence.

### WHAT THE STUDY ADDS

- This study provides evidence of a link between the informational and relational aspects of patient–physician communication and patient’s actual medication-taking behaviors.
- Key attributes of patient–provider communication that were associated with poor medication adherence include lower patient centeredness, less discussion about their sociodemographic circumstances, and less discussion about their hypertension medicines.
- Discussion about patients’ social circumstances was an even stronger predictor of medication adherence among black patients.

infrequent use of collaborative communication strategies (eg, open-ended questions, using lay terminology, asking follow-up questions, joint decision making) to engage patients in discussions about their medication-taking behaviors limits providers ability to accurately understand and address medication nonadherence.<sup>11–15</sup>

Although these studies provide insight into the quality of medication dialogue in medical visits,<sup>11–13</sup> we still lack an understanding of how these communication strategies (eg, patient centeredness, collaborative information exchange) affect patients’ actual medication-taking behaviors. The goal of this study was to evaluate the impact of patient–provider communication on medication adherence among a sample of primary care providers (PCP) and their hypertensive patients. We hypothesized that interactions characterized by lower patient centeredness, less patient assertiveness, and less patient–provider information exchange along with higher provider verbal dominance would be associated with worse medication adherence as assessed by an electronic monitoring device (EMD). Given the importance of patient personal and social resources (ie, availability of social support, ability to afford medications) on adherence behaviors,<sup>16</sup> we also hypothesized that less discussion about patients’ sociodemographic circumstances (ie, living arrangements, employment details) would be associated with worse medication adherence. Finally, we hypothesized that patients would exhibit worse medication adherence when a lower proportion of the primary care visit was spent discussing their hypertension and antihypertensive medications.

## Methods

### Participants

Data for this study were collected as part of an observational research study, which evaluated the patient, provider, and clinic-level factors related to race, and healthcare quality that impact medication adherence among black and white patients with hypertension. In this article, we report on the quantitative analysis of the audiotaped clinical interactions between PCPs and their hypertensive patients.

Participants were recruited consecutively between January 2011 and April 2015 from 3 primary care practices, which serve a multiethnic, low-income population in New York City. Patient eligibility included (1) self-identification as black or white, (2) diagnosis of hypertension, (3) taking at least 1 antihypertensive medication, (4) aged  $\geq 18$  years, and (5) having attended at least 1 prior visit with the participating PCP. PCPs were either attending providers or nurse practitioners who provided care at the practices. All participants provided written informed consent approved by New York University’s Institutional Review Board.

### Data Collection

Data were collected at baseline and 3 months after the initial (index) audiotaped patient–provider clinic encounter. All encounters between PCPs and their patients were audiotaped (mean 3.4 patients per provider) at the baseline visit using a tape recorder placed in the examination room. PCPs and patients were instructed that they could turn off the tape recorder at any time during the encounter. Before the audiotaped visit, patients and PCPs completed a demographic questionnaire. Clinical data on medical comorbidity,<sup>17</sup> prescribed antihypertensive medications, and clinic BP readings were extracted from patients’ electronic medical records at the baseline and 3-month study visits. After the audiotaped encounter, a trained research assistant provided each patient an EMD to measure his or her medication-taking behavior for the duration of the 3-month study. EMDs are standard pill bottles with an electronic cap that records the date and time the bottle is opened. In the event that patients were prescribed multiple antihypertensive medications, PCPs were asked to choose 1 medication taken once daily to be placed in the bottle. Patients received a telephone call the day after the baseline visit to ensure they placed the correct medication in the bottle.

### Study Measures

#### *Patient–Provider Communication*

Audiotapes of the clinic visits were analyzed using the Medical Interaction Process System (MIPS), previously used in coaching communication skills and empirical research in patient–provider interactions. The MIPS has strong intercoder reliability and convergent validity when compared with the Roter Interaction Analysis System.<sup>18</sup> In contrast to other coding systems, MIPS allows for parallel and sequential coding such that the reciprocity between the patient and provider, as well as shifts in focus of the exchange, can be captured, providing a multidimensional view of the interaction.

The MIPS classifies patient–provider interactions as modes of exchange and content with the utterance as the basic coding unit. The mode of exchange refers to the function of the utterance (ie, asking questions), whereas content refers to the specific topic being addressed (ie, hypertension). Each utterance is assigned 1 content code and 1 mode of exchange code, which may be either patient initiated or provider initiated. During the study period, inter-rater reliability checks were performed after approximately every 4 coded visits by having the other rater code the same audiotaped visit. The inter-rater reliability was satisfactory across both coders, ranging from 0.91 to 0.94 for patient and provider modes and 0.88 to 0.96 for exchanges.

Six categories of patient–provider communication were computed using formulas driven by the content and mode combinations identified in previous studies that used MIPS<sup>19–21</sup>: (1) patient centeredness (ratio of all patient and provider biomedical and psychosocial partnership-building utterances to provider biomedical utterances); (2) patient assertiveness (ratio of patient biomedical directive utterances to provider closed, leading, and multiple biomedical questions and directives); (3) psychosocial focus (ratio of patient and provider psychosocial utterances to patient and provider biomedical utterances); (4) information exchange during the entire encounter and specific to antihypertensive medications (ratio of provider information-giving utterances to patient information-giving utterances); (5) provider disclosure-promoting behaviors (ratio of provider psychosocial questions, empathy/reassurance, checking, and summarizing information to provider biomedical directing/advising, false reassurance, and

leading questions); and (6) provider verbal dominance (ratio of total provider utterances to patient utterances). The formulas for the categories of patient–provider communication are included in the Appendix in the [Data Supplement](#). In addition, frequencies of content codes were calculated for the proportion of the discussion specific to hypertension, antihypertensive medications, and discussions about patients' sociodemographic circumstances (ie, living situation, employment). We also assessed visit length as the total time in minutes from the first utterance of the conversation spoken by the patient or PCP to the final utterance.

### Medication Adherence

Medication adherence was assessed with an EMD as noted above. To control for the occurrence of pocket dosing (ie, use of pill boxes, removing doses for travel), patients were also asked to keep diaries of such periods for the 3-month study period, which were accounted for in the analyses.<sup>22,23</sup>

### Sociodemographic Data

Sociodemographic data collected at the patient-level included age, sex, race, marital status, employment status, educational and income level, insurance status, length of relationship with current PCP, medical comorbidity, number of antihypertensive medications, and clinic systolic and diastolic BPs. Provider-level demographic data collected included age, sex, race, place of birth, duration of practice at the site, type of provider (ie, provider, nurse practitioner), and specialty.

### Analysis

Descriptive statistics were generated for baseline patient, PCP, and visit characteristics. Means and SDs for the total patient sample were computed for patient–provider communication, adjusting for intra-provider correlation using linear mixed models. Significance levels were set at  $P \leq 0.05$ .

### Adaptive Statistical Modeling of EMD Data

Because the traditional methodology of using percent of doses taken overestimates medication adherence, we used adaptive statistical modeling (ASM) methods (ie, adapted to the data under analysis) based on likelihood cross-validation (LCV)<sup>24–26</sup> in this study to analyze the EMD data across the 3-month study period. We previously applied ASM methods to identify predictors of poor medication adherence among hypertensive black patients who participated in a behavioral intervention trial.<sup>27</sup>

We defined poor medication adherence as mean adherence and adherence variability of the adaptively generated adherence types using the ASM methods. Individual-patient adherence patterns (for mean adherence and adherence variability) over time were estimated using counts/rates of EMD cap openings during a patient's study participation. These counts/rates were adaptively modeled using Poisson regression models with a 2-phase process based on a heuristic search.<sup>25</sup> Specifically, the model is first expanded by systematically adding in possibly power transformed predictors (eg, patient centeredness, patient demographics) and then contracted by removing unneeded terms and readjusting the powers for the remaining transforms.<sup>28</sup> LCV scores are used to evaluate and compare alternative regression models for the same outcome. Tolerance parameters indicating tolerable decreases in the LCV scores at given stages of the adaptive modeling process (eg, how much of a penalty in reduced LCV scores can be tolerated at each phase to continue) are used to control that process. LCV ratio tests based on the  $\chi^2$  distribution<sup>29</sup> were used to determine the tolerance parameter settings. These tests were based on a threshold for a significant or substantial percent decrease in the LCV score generated by the model with the lower score compared with the model with the larger score. If the percent decrease is larger than the threshold, the model with the larger LCV score provides a substantial improvement over the model with the smaller LCV score. Otherwise, the model with the lower score is a competitive alternative, and if simpler (eg, based on fewer terms or not including interactions), it is then preferable as a parsimonious, competitive alternative.

Next, adherence types were created by clustering individual-patient adherence patterns for mean adherence and adherence variability at proportionally spaced times during patients' study participation. Clustering alternatives were restricted to those with at least 10% of the observations in each cluster, thereby avoiding sparse cases. Likelihoods for mixtures of multivariate normal distributions were used to compute LCV scores for alternative clustering approaches. The selected clustering procedure and number of clusters was the one generating the best LCV score.

### Risk Factors for Poor Medication Adherence

Individual baseline risk factors for poor adherence (as defined later) were determined adaptively using logistic regression models with LCV scores based on the Bernoulli distribution. Possible predictors included categories of patient–provider communication, visit length, and the patient and provider sociodemographic data. Each nominal level categorical predictor was reduced to a 2-level risk factor that generated the best LCV score, among possible combinations, for predicting poor medication adherence. Each ordinal and continuous predictor variable was reduced to 2 levels of values smaller or larger than an observed value; the associated risk factor was based on the observed value generating the best LCV score for predicting poor adherence. Odds ratio (OR)  $> 1$  was used to define the associated risk factor for poor medication adherence. Observations with missing values were combined with the nonrisk factor observations. Individually significant ( $P < 0.05$ ) risk factors of poor medication adherence were identified first. These individually significant risk factors were used to adaptively generate a multiple risk factor model for poor medication adherence (an adaptive approach to variable selection).

## Results

### Patient and PCP Characteristics

A total of 104 patients were recruited into this study, of which 92 (88%) had usable EMD data. There were no significant differences between patients with and without usable EMD data for all the demographic and communication variables. Of the 28 PCPs invited to participate, only one declined because of discomfort with being audiotaped. Thus, the analytic sample included 92 patients and 27 PCPs. Patient and PCP characteristics are shown in Tables 1 and 2, respectively. A majority of the patients were black, unemployed, and reported some college education. The mean age of patient participants was  $\approx 60$  years. Most of the patients had been seeing the same PCP for at least 1 year. One quarter of the patients were prescribed 1 antihypertensive; calcium channels blockers were the most frequently prescribed antihypertensive medication class. Most PCPs were internists and female with a mean age of 36.2 years.

### Patient–Provider Communication Characteristics

The average duration of the audiotaped clinic visits was 24.8 minutes (range: 8.4–51.9 minutes). The total number of utterances for the 92 audiotaped visits was 37257, of which 17185 (46%) were spoken by patients and 20072 (54%) by PCPs. Biomedical content categories accounted for 56% of all utterances, followed by administrative utterances (12%) and utterances that pertained to patients' sociodemographic circumstances (4%). Utterances that related to psychosocial factors (ie, patients' feelings/emotions) accounted for 2% of the interaction.

Regarding the modes of exchange, the most frequent PCP mode was gives information to the patient, an average of 106.4

**Table 1. Patient Characteristics**

Characteristic*	
Age, mean (SD)	59.7 (10.6)
Female, n (%)	53 (57.6)
Black, n (%)	56 (60.9)
Marital status, n (%)	
Single	37 (40.2)
Married	17 (18.5)
Divorced/separated	24 (26.1)
Widowed	14 (15.2)
Education, n (%)	
Less than high school	10 (10.9)
High school/technical school	28 (30.4)
Some college	54 (58.7)
Unemployed, n (%)	62 (67.4)
Income <\$40 000, n (%)	21 (28.8)
Insurance, n (%)	
Private	15 (16.3)
Medicare	23 (25.0)
Medicaid	36 (39.1)
None	18 (19.6)
Diabetes mellitus, n (%)	41 (44.6)
Stroke, n (%)	13 (14.1)
Kidney disease, n (%)	7 (7.6)
Baseline systolic BP, mean (SD)†	131.2 (16.4)
Baseline diastolic BP, mean (SD)†	77.5 (12.4)
No. of antihypertensive medications, mean (SD)	2.3 (1.2)
Monotherapy, n (%)	24 (26.0)
Medication class, n (%)	
ACE inhibitor	31 (34.1)
Angiotensin receptor blocker	12 (13.2)
β-Blocker	8 (8.8)
Calcium channel blocker	24 (26.4)
Diuretic	11 (12.1)
Other	5 (5.5)
Years with PCP, n (%)	
Less than 1 y	33 (35.9)
1–5 y	31 (33.7)
>5 y	28 (30.4)

ACE indicates angiotensin-converting enzyme; BP, blood pressure; and PCP, primary care provider.

\*For 92 patients unless otherwise indicated.

†For 62 patients.

utterances per consultation (51% of PCP utterances). The second and third most common modes for the PCP were asking close-ended questions (mean 22.8 utterances per visit; 11% of PCP utterances), followed by checks information provided by

**Table 2. Primary Care Provider Characteristics**

Characteristics*	
Age, mean (SD)	36.2 (6.0)
Female, n (%)	18 (66.7)
Race, n (%)	
White	15 (55.6)
Black	5 (18.5)
Latino	2 (7.4)
Indian	1 (3.7)
Asian	4 (14.8)
Type of provider, n (%)	
Physician	26 (96.3)
Nurse practitioner	1 (3.7)
Specialty, n (%)	
Internal medicine	23 (85.2)
Other (geriatric, nurse practitioner)	5 (14.8)
Born in United States, n (%)	25 (92.6)

\*For 27 providers.

the patient (mean 19.3 utterances per visit; 9% of PCP utterances). Only 1% of PCP utterances were open-ended questions (mean 1.1 utterances per visit). The most common mode for patients was gives information to the PCP (mean 137.4 utterances per visit; 82% of patient utterances), followed by checks information given by the PCP (mean 5.7 utterances per visit; 3% of patient utterances) and asking close-ended questions (mean 4.31 utterances per visit; 3% of patient utterances).

Means and SDs for the categories of patient–provider communication are shown in Table 3. Although clinic visits were characterized as patient centered (value >1), there was a greater focus on patient’s biomedical issues than psychosocial

**Table 3. Mean Values for Patient–Provider Communication Characteristics**

MIPS Communication Characteristic*	Mean (SD; n)
Patient centeredness	3.0 (1.6)
Patient assertiveness	0.4 (0.4)
Psychosocial focus	0.3 (0.3)
Information exchange, all	0.8 (0.4)
Information exchange, medications only	0.9 (0.5)
Disclosure promoting†	0.6 (1.0)
Verbal dominance	1.3 (0.5)
Sociodemographic circumstances	4.1 (6.3)
Discussion about hypertension	7.6 (9.7)
Discussion about antihypertensive medications	7.3 (9.1)
Visit length, min	24.1 (8.6)

MIPS indicates Medical Interaction Process System.

\*For 88 patients unless otherwise indicated. Using linear mixed models accounting for within-provider correlation with a random intercept.

†For 87 patients.

**Table 4. Description of Adherence Types**

Cluster	%	Adherence Types		Average % Prescribed Doses Taken	Range % Prescribed Doses Taken
		Mean Adherence	Adherence Variability		
1	14.1	High	Low	97.0	91.0–101.0
2	28.3	High to moderately high	Low to moderate	93.4	80.4–104.0
3	20.7	High to moderate	Moderate	86.4	87.9–115.0
4	16.3	High to low	Low to moderate to low	75.2	60.0–90.8
5	20.7	Moderate to low	Moderate to low	35.2	5.1–62.7
Total	100.0				

issues, and there was a high level of provider directedness and verbal dominance, with low use of disclosure-promoting behaviors.

### Medication Adherence

Five adherence types (clusters) were adaptively generated using ASM methods. As shown in Table 4, clusters 1 and 2 (42% of sample) correspond to very high and high adherence (average percent doses taken [% PDT] were 97% and 93%) while clusters 3 to 5 (58% of sample) correspond to deteriorating and low adherence (average % PDT: 86%, 75%, and 35%, respectively). Consequently, poor adherence as defined with clusters corresponds to lower average % PDT scores, but as indicated in Table 4, ranges of % PDT scores can overlap, indicating that the adherence types are different from using distinct ranges of % PDT scores.

### Role of Patient and PCP Sociodemographic Characteristics As Well As Patient–Provider Communication on Medication Adherence

Overall, black patients were more likely to have poor adherence to medications compared with white patients (Table 5; OR: 1.98; 95% confidence interval [95 CI]: 1.04–3.77). The racial differences in adherence could not be explained by differences in the categories of patient–provider communication (Table 6). Patients with comorbid diabetes mellitus were 3.3× more likely to exhibit poor adherence than those

without diabetes mellitus (OR: 3.26; 95 CI: 1.47–7.21). Patients were 2× more likely to exhibit poor adherence when the antihypertensive medication monitored by the EMD was not an angiotensin-converting enzyme inhibitor (OR: 2.09; 95 CI: 1.04–4.20). Discussions about psychosocial factors (ie, patient’s feelings) and about hypertension increased as length of the conversation increased ( $P=0.03$ ). However, there was no impact of visit length on adherence. No other covariates were associated with medication adherence.

### Relationship Between Patient–Provider Communication and Medication Adherence

As shown in Table 5, the strongest individual risk factor for poor medication adherence based on the OR was discussions about patient’s sociodemographic circumstances. Patients were 4× more likely to exhibit poor adherence when the discussions with their PCPs were less focused on sociodemographic circumstances (OR: 4.04; 95 CI: 1.42–11.5). Discussions characterized by lower patient centeredness, less patient directedness, less psychosocial focus, and less discussion about patients’ antihypertensive medications (ie, discussions about medication changes) were associated with ≈3-fold increased odds of poor medication adherence.

In the adaptive logistic regression model based on multiple risk factors (Table 6), the major risk factors for poor medication adherence were less discussion about patients’ sociodemographic circumstances and about their antihypertensive

**Table 5. Individual Risk Factor Model for Poor Medication Adherence\***

Variable	Risk Factor	At-Risk Group, n (%)†	P Value‡	OR	95% CI‡
Patient race	Black vs white	56 (60.9)	0.039	1.98	1.04–3.77
Diabetes mellitus	Yes vs no	41 (44.6)	0.004	3.26	1.47–7.21
ACE inhibitor monitored by EMD	No vs yes	61 (66.3)	0.040	2.09	1.04–4.20
Lower patient centeredness	≤2.33 vs >2.33 or missing	34 (37.0)	0.039	2.89	1.05–7.93
Less patient assertiveness	≤0.22 vs >0.22 or missing	32 (34.8)	0.014	3.23	1.26–8.25
Less psychosocial focus	≤0.48 vs >0.48 or missing	67 (72.8)	0.007	3.31	1.38–7.95
Less discussion about patients’ sociodemographic circumstances	≤4.7 vs >4.7 or missing	61 (66.3)	0.009	4.04	1.42–11.5
Less discussion about antihypertensive medications	≤1.53 vs >1.53 or missing	31 (33.7)	0.037	3.26	1.08–9.89

ACE indicates angiotensin-converting enzyme; CI, confidence interval; EMD, electronic monitoring device; and OR odds ratio.

\*Poor medication adherence is defined as mean adherence and adherence variability of the adaptively generated adherence types.

†Of 92 patients.

‡P values and CIs using empirical z tests based on generalized estimating equations estimation and exchangeable intraphysician correlations.

**Table 6. Multiple Risk Factor Model for Poor Medication Adherence\***

Variable	Risk Factor	At-Risk Group, n (%)†	P Value‡	OR	95% CI‡
Patient race	Black vs white	56 (60.9)	0.064	2.70	0.95–7.74
Less discussion about patients' sociodemographic circumstances	≤4.7 vs >4.7 or missing	61 (66.3)	0.001	6.03	2.15–17.0
Less discussion about antihypertensive medications	≤1.53 vs >1.53 or missing	31 (33.7)	0.011	5.64	1.49–21.3

CI indicates confidence interval; and OR, odds ratio.

\*Poor medication adherence is defined as mean adherence and adherence variability of the adaptively generated adherence types.

†Of 92 patients.

‡P values and CIs using the empirical z tests with generalized estimating equations and exchangeable intraphysician correlations.

medications. These factors were each associated with an ≈6-fold increased odds of poor medication adherence. Although patient race was no longer significant when added to the multiple risk factor model (Table 6;  $P=0.064$ ; using an empirical z test), its inclusion resulted in a substantial decrease in the LCV score (using a LCV ratio test), suggesting a better model fit. This anomalous result suggested the possibility that patient race (black versus white) created an interaction effect with the other risk factors in the multiple risk factor model. For this reason, an adjusted multiple risk factor model was generated, considering the individually significant risk factors in Table 5 along with their interactions with patient race. This model (Table 7) generated an improved LCV score over the model of Table 6 with all terms now significant. In this model, the interaction between being a black patient and less discussion about sociodemographic circumstances was associated with 8-fold increased odds of poor medication adherence (95 CI: 2.80–22.9). The interactions between patient race and less discussion about antihypertensive medications and lower patient centeredness did not improve model fit; however, both variables (less medication discussions and lower patient centeredness) remained individual risk factors for poor adherence.

## Discussion

Findings from this study demonstrated that patient–provider communication is an important predictor of medication adherence. Specifically, patient–provider interactions characterized by lower patient centeredness, a focus on biomedical issues, and more provider directedness were associated with an ≈3-fold increase in the risk for poor medication adherence among hypertensive patients. The odds of poor medication adherence were ≈6-fold higher when patient–provider interactions did

not attend to patients' sociodemographic circumstances or fully address their antihypertensive medication regimen. The negative impact of having less discussion about sociodemographic circumstances was heightened in black patients. In these patients, there was an 8-fold increase in the risk for poor adherence when such discussions were infrequent. In addition, we found that hypertensive patients with diabetes mellitus were 3× more likely to exhibit poor adherence compared with those without diabetes mellitus.

Our findings add to the growing body of literature examining the effect of patient–provider communication on medication adherence in patients with hypertension. Lim and Ngah<sup>30</sup> found that hypertensive patients who were nonadherent to their medications were more likely to report that the provider showed less concern for patients' perceptions of their health and did not provide adequate information about their medications during clinical encounters. In a previous study of blacks with hypertension, we found that provider communication perceived as noncollaborative by the patients (ie, did not address patients' concerns or provide clear instructions on how to take medications) was associated with worse self-reported medication adherence.<sup>8</sup> Finally, a meta-analysis reported a 1.47 higher risk of poor adherence among patients whose providers were categorized as poor communicators compared with patients whose providers were better communicators.<sup>31</sup>

Our data suggest several reasons why a provider's inquiry into patients' sociodemographic circumstances (ie, unemployment, unstable housing) might be associated with adherence. One possibility is that such discussion signals to the patient genuine caring and concern by the provider, which strengthens patient's ability to cope with their life and illness, along with motivation and confidence related to self-management of their disease.<sup>32</sup>

**Table 7. Adjusted Multiple Risk Factor Model for Poor Medication Adherence\***

Variable(s)	Risk Factor	At-Risk Group, n (%)†	P Value‡	OR	95% CI‡
Patient race×less discussions about patients' sociodemographic circumstances	Black and sociodemographic circumstances ≤4.7 vs white or sociodemographic circumstances >4.7	37 (40.2)	<0.001	8.01	2.80–22.9
Less discussion about antihypertensive medications	≤1.53 vs >1.53 or missing	31 (33.7)	0.004	6.48	1.83–23.0
Lower patient centeredness	≤2.33 vs >2.33 or missing	34 (37.0)	0.042	3.08	1.04–9.12

CI indicates confidence interval; and OR, odds ratio.

\*Poor medication adherence is defined as mean adherence and adherence variability of the adaptively generated adherence types.

†Of 92 patients.

‡P values and CIs using the empirical z tests with generalized estimating equations and exchangeable intraphysician correlations.

Importantly, by attending to patients' health-related social needs, some which could represent adherence barriers, providers are able to assist patients in developing plans to meet those needs (ie, by identifying and resolving difficulties with transportation to the pharmacy, medication costs, etc.).<sup>33,34</sup> The interaction with race suggests an intriguing possibility that this expression of caring might be particularly important for black patients where social distance is greater.<sup>35</sup> Another possibility is that discussions about patients' sociodemographic circumstances might be a marker for other good communication behaviors by the provider that promote adherence that was not captured in this study (ie, responding to patient emotion). Future research should test the plausibility of these hypotheses to help elucidate the pathways through which conversations about sociodemographic circumstances ultimately improve patient adherence. Such mechanistic work is sorely needed if we develop effective interventions to help providers address and attend to the broader social determinants of health that pose as significant risk factors for medication adherence.

Our finding that patients with concomitant hypertension and diabetes mellitus exhibited worse adherence may result from an imbalance between the burden associated with having multiple chronic conditions and a patient's capacity to adequately manage their health.<sup>36</sup> Specifically, living with multiple chronic conditions requires adherence to several significant self-management behaviors (including taking medications as prescribed), which creates a burden of managing one's chronic illnesses that often outweighs patients' capacity to do so. Related to our above finding, the complexity of one's sociodemographic circumstances can disrupt patients' ability to manage their health further compounding the treatment burden associated with having multiple chronic conditions and increasing the likelihood of nonadherence. In addition, diabetes mellitus is associated with cognitive impairment that is associated with worse medication adherence.<sup>37,38</sup> Thus, as suggested by this study, collaborative discussions about patient's sociodemographic circumstances may serve to mitigate poor adherence because they allow patients to discuss limitations in their capacity to self-manage and for providers to try to balance the burden of chronic disease management that is placed on patients. Discussion of medications may also prompt patients to find ways to remind themselves.

There are several strengths of our study: First, to our knowledge, this study is the first to connect what is discussed in the patient–provider interaction to what patients actually do outside of the clinic encounter using objective measures of both patient–provider communication and medication adherence. Second, by using ASM methods to analyze the adherence data, we were able to characterize patients' medication-taking behaviors into several distinct adherence patterns that were in contrast to the usual dichotomy of high adherence  $\geq 80\%$ . This methodology provides novel insights into patterns of patients' medication-taking behaviors overtime and a better understanding of how the quality of patient–provider communication relates to poor adherence.

We should note the following limitations: Our study was comprised predominately low-income black and white patients; thus, the findings may not generalize to higher income patients or other racial/ethnic groups. Although patients who

participate in clinical trials are reported to be more adherent than nonparticipants, the nonadherence rates in our study (58%) were similar to the estimated 50% to 70% nonadherence rates documented by the World Health Organization.<sup>18</sup> Because of cost constraints, this study only allowed for the patient's primary antihypertensive medication to be monitored by the EMD. Although this does not reflect adherence rates to other medications, there is evidence that the pattern of adherence to 1 antihypertensive medication often reflects adherence to others.<sup>39</sup> Moreover, it is possible that allowing providers to choose the medication that was monitored in the study may have introduced bias in our adherence outcome. In the individual risk factor model, we found that patients with an angiotensin-converting enzyme inhibitor monitored by the EMD were less likely to have poor adherence than patients with other classes of antihypertensive medications. However, this association was no longer significant when included in multiple risk factor models, indicating that it does not have a substantial impact on adherence. Although a strength of the study was the use of EMDs, which are currently considered the gold standard of adherence measurement, they are still limited in that they do not provide a direct confirmation that a dose is actually taken.<sup>40</sup> Moreover, the devices are bulky, easily lost, or subject to malfunctions, which may increase bias.<sup>41</sup> In this study, 12% of the data were unusable because of cap malfunctions (50%), nonuse by the patient (33%), and patients' failure to return the EMD (17%). Medication nonadherence is a complex multifaceted behavior; thus, we may not have accounted for all potential variables that affect adherence in this study. Future research should test additional patient (eg, beliefs, health literacy, perceived side effects), physician (eg, prescribing behaviors, therapeutic inertia), healthcare system (eg, medication costs), and disease-related (eg, complexity of the medical regimen) factors to provide a more comprehensive understanding of the role of patient–provider communication on medication adherence in this patient population. Finally, it is plausible that a performance bias in response to audio-taping may have altered patient and provider communication behaviors during the audiotaped clinic visit. However, previous studies of performance bias have found a minimal effect on patients' and providers' communication behavior or quality of discussion during the visit.<sup>42,43</sup>

These findings together with the robust literature on patient-centered communication, including both affect and style, provide a reasonable basis for recommending improved continuous training for patient-centered communication throughout undergraduate and graduate medical education, as well as continuing medical education for practicing providers. Encouraging trainees and PCPs to ask about patients' social circumstances represents a potential means for improving adherence and for identifying adherence barriers, such as financial stressors, unstable housing, etc. Thus, to make a true population health impact, providers must develop competencies in patient-centered communications that are sensitive to the nonmedical social factors that greatly inhibit patient behavior.<sup>34,44</sup> This will require a new system of care delivery that integrates effective screening and referral for patients' unmet social needs into standard practice.<sup>45,46</sup> Systems-level approaches that leverage the rapidly expanding role of registered nurses, pharmacists,

medical assistants, and community health workers in the care team represent a potentially cost-effective method to assist providers in screening for the social determinants of health and providing linkages to community services that can help address the complex social needs of nonadherent patients (ie, connecting patients to low-cost transportation services).<sup>47</sup> Leveraging technology—by capturing patient-reported outcomes using mHealth platforms or creating registries via the electronic health record—also offer a potential means to collect data and act on patients’ social needs.<sup>48</sup>

Although only in its nascence, initiatives, such as the Centers for Medicare & Medicaid Accountable Health Communities,<sup>44</sup> and community linkage programs, such as Health Leads<sup>49</sup> and Kaiser Permanente’s Total Health,<sup>46</sup> may provide some insight into best practices for translating this ideal into practice. The data gleaned from projects such as these will be vital in understanding whether transforming care to focus on the whole patient can produce substantial improvements in quality and health from the perspectives of patients, partners, practices, and payers.

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None.

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## Addressing the Social Needs of Hypertensive Patients: The Role of Patient–Provider Communication as a Predictor of Medication Adherence

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**SUPPLEMENTAL MATERIAL**

## Appendix. MIPS Ratio Formulas

	Patient direction: A. Patient's biomedical questions, directions, checking, seeking, requests/prefs
<b>Patient Directedness</b>	<hr/> <p>Physician direction: B. Physician's closed, leading, &amp; multiple biomedical questions, directions, interrupts</p> <p>A. Patient's biomedical questions, directions, checking, seeking, requesting/prefs – speaker=patient, with any of the following:</p> <ul style="list-style-type: none"><li>○ Content = drugs, med, omed, side effects, tests, and treatment</li><li>○ Mode = closed, checks info, seeks info, directs/advises, checks understanding, requests/prefs</li></ul> <p>B. Physician's closed biomedical questions, directions – speaker=doctor, with any of the following:</p> <ul style="list-style-type: none"><li>○ Content=drugs, med, omed, side effects, tests, and treatment</li><li>○ Mode=closed, leading, multiple, directs/advises, interrupts</li></ul>
<b>Patient Centeredness</b>	<hr/> <p>(A + B) A. Patients biomedical and psychosocial questions, directions, checking, seeking, request/prefs</p> <p>B. Physician's partnership building (biomedical and psychosocial): open and focused open questions, gives reassurance, checks info, checks understanding, summarizes, seeks information, orients, facilit. speech, positive resp., empathy, laughs pos., gratitude, apology</p> <hr/> <p>C. Physician's closed, leading, &amp; multiple questions, false reassurance, negative response, interrupts, irritation, inapprop.behvr</p> <p>A. Patient's biomedical &amp; psychosocial questions, directions, checking, seeking, requesting/prefs - speaker=patient, with any of the following:</p> <ul style="list-style-type: none"><li>○ Content=biomed (drugs, med, omed, side effets, tests, and treatment), + psychosocial (psy/med, psych, l.Style, soc/dem, soc/con)</li><li>○ Mode = closed, checks info, seeks info, directs/advises, checks understanding, requests/prefs</li></ul> <p>B. Physician's patient-centered biomedical and psychosocial questions and responses - speaker=doctor, with any of the following:</p> <ul style="list-style-type: none"><li>○ Content=biomed (drugs, med, omed, side effets, tests, and treatment), + psychosocial (psy/med, psych, l.Style, soc/dem, soc/con)</li><li>○ Mode=open and focused-open questions, gives reassurance, checks info, checks understanding, summarizes, seeks information, orients, facilit. speech, positive resp., empathy, laughs positive, gratitude, apology</li></ul> <p>C. Physician's inappropriate biomedical and psychosocial questions and responses - speaker=doctor, with any of the following:</p> <ul style="list-style-type: none"><li>○ Content=biomed (drugs, med, omed, side effets, tests, and treatment), + psychosocial (psy/med, psych, l.Style, soc/dem, soc/con)</li><li>○ Mode=closed, leading, multiple questions, false reassurance, neg. response, interrupts, irritation, inapprop. Behvr</li></ul>

**Psychosocial =** (A + B) Physician-patient psychosocial exchange  
**Focus** (C + D) Physician-patient biomedical exchange

- A. Psychosocial info from Physician - speaker=doctor, with any of the following:
  - Content=psy/med, psych, l.Style, soc/dem, soc/con
  - Mode= any mode
- B. Psychosocial info from patient - speaker=patient, with any of the following:
  - Content= psy/med, psych, l.Style, soc/dem, soc/con
  - Mode=any mode
- C. Biomedical info from Physician - speaker=doctor, with any of the following:
  - Content=drugs, med, omed, side effects, tests, and treatment
  - Mode= any mode
- D. Biomedical info from patient - speaker=patient, with any of the following:
  - Content=drugs, med, omed, side effects, tests, and treatment
  - Mode=any mode

**Information =** A. All Physician information-giving utterances  
**Exchange** \_\_\_\_\_  
B. All Patient information-giving utterances

- A. Information given by the Physician - speaker=doctor, with any of the following:
  - Content=biomed (drugs, med, omed, side effects, tests, and treatment), + psychosocial (psy/med, psych, l.Style, soc/dem, soc/con)
  - Mode= gives info
- B. Information given by the Patient - speaker=patient, with any of the following:
  - Content=biomed (drugs, med, omed, side effects, tests, and treatment), + psychosocial (psy/med, psych, l.Style, soc/dem, soc/con)
  - Mode= gives info

**Physician Disclosure =** A. Physician psychosocial questions, empathy/reassurance, checking  
**Promoting Behaviors** and summarizing information/understanding  
B. Physician biomedical directing/advising, false reassurance, and leading questions

- A. Psychosocial questions and responses from Physician - speaker=doctor, with any of the following:
  - Content=psy/med, psych, l.Style, soc/dem, soc/con
  - Mode=open and focused-open questions, gives reassurance, empathy, checks info, checks understanding, summarizes information
- B. Physician's biomedical questions and directions – speaker=doctor, with any of the following:

- Content=drugs, med, omed, side effects, tests, and treatment
- Mode= leading questions, directs/advises, interrupts, false reassurance

**Verbal =  
Dominance**

A. All Physician utterances

---

B. All Patient utterances

- A. Physician info, questions, responses- speaker=doctor, with any of the following:
  - Content=biomed (drugs, med, omed, side effects, tests, and treatment), + psychosocial (psy/med, psych, l.Style, soc/dem, soc/con)
  - Mode= all
- B. Patient info, questions, responses- speaker=doctor, with any of the following:
  - Content=biomed (drugs, med, omed, side effects, tests, and treatment), + psychosocial (psy/med, psych, l.Style, soc/dem, soc/con)
  - Mode= all