Beyond Medication Adherence: The Role of Patients' Beliefs and Life Context in Blood Pressure Control

Nancy R. Kressin, PhD[1,2]; A. Rani Elwy, PhD[1,3]; Mark Glickman, PhD[1,4];
Michelle B. Orner, MPH[1]; Gemmae M. Fix, PhD[1,5]; Ann M. Borzecki, MD, MPH[1,2,5];
Lois A. Katz, MD[6, 7]; Dharma E. Cortés, PhD[8,9]; Ellen S. Cohn, ScD[10];
Anna Barker, MS[1]; Barbara G. Bokhour, PhD[1,5]

Objectives: Despite numerous interventions to address adherence to antihypertensive medications, continued high rates of uncontrolled blood pressure (BP) suggest a need to better understand patient factors beyond adherence associated with BP control. We examined how patients' BP-related beliefs, and aspects of life context affect BP control, beyond medication adherence.

Methods: We conducted a cross-sectional telephone survey of primary care patients with hypertension between 2010 and 2011 (N=103; 93 had complete data on all variables and were included in the regression analyses). We assessed patient sociodemographics (including race/ethnicity), medication adherence, BP-related beliefs, aspects of life context, and used clinical BP assessments.

Results: Regression models including sociodemographics, medication adherence, and either beliefs or context consistently predicted BP control. Adding context after beliefs added no predictive value while adding beliefs after context significantly predicted BP control.

Conclusion: Including patients' BP beliefs after context had the strongest effects on BP control.

Practice Implications: Results suggest that when clinicians must choose a dimension on which to intervene, focusing on beliefs would be the most fruitful approach to effecting change in BP control. *Ethn Dis.* 2019;29(4):567-576; doi:10.18865/ed.29.4.567

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Introduction

Hypertension, or high blood pressure, is a major risk factor for cardiovascular, cerebrovascular, and renal disease. High BP affects a substantial proportion of the population, a disproportionate number of African Americans, and accounts for a significant share of racial differences in mortality.[1] Hypertension affects nearly one in three Americans – almost 67 million adults – and of these, an estimated 35.8 million (53.5%) have uncontrolled hypertension.[2] Despite the availability of efficacious therapies to treat hypertension, a high proportion of diagnosed patients do not have their blood pressure under control.

Many factors affect blood pressure (BP) control, including those stemming from the health care system, the physician and the patient.[3] Prior efforts to improve the quality of BP care by focusing on the system or the care provider have met with limited success.[4-6] While effective systems of care are crucial to good clinical hypertension management, even when patients receive appropriate care (eg, hypertension is diagnosed, monitored, and medication is prescribed), patients are still ultimately responsible for managing their hypertension outside the clinical setting, by either taking medications, and/or significantly altering

[1] Center for Healthcare Organization and Implementation Research (CHOIR), a VA HSR&D Center of Innovation, VA Boston Healthcare System and Edith Nourse Rogers Memorial Veterans Hospital; Bedford, MA
[2] Section of General Internal Medicine, Boston University School of Medicine; Boston, MA
[3] Department of Psychiatry and Human Behavior, Warren Alpert Medical School, Brown University; Providence, RI
[4] Department of Statistics, Harvard University; Boston, MA
[5] Boston University School of Public Health; Boston, MA
[6] VA New York Harbor Healthcare System; New York, NY
[7] New York University School of Medicine; New York, NY
[8] Cambridge Health Alliance; Cambridge, MA
[9] Harvard Medical School; Cambridge, MA
[10] Boston University, Sargent College of Health and Rehabilitation Sciences; Boston, MA

Address correspondence to Nancy R. Kressin, PhD; 150 S. Huntington Ave, (152c), Building 9, 4th floor, Boston, MA 02130; 857.364.6037; nkressin@bu.edu

their diet or physical activity. Most prior patient-focused efforts to improve BP control have used patient education approaches to foster adherence to medications, and changes in diet and exercise.[7-9] Although it is clear that such behaviors, especially medication adherence, can improve BP control,[10] patient education interventions oriented toward behavioral change have had inconsistent and limited success.[7] Evidence also suggests that physicians often do not inquire or provide counseling about hypertension or medication adherence.[11-13] A better understanding of patient-related factors affecting BP control, especially those beyond medication adherence, may help target existing interventions, physician counseling, or identify other or better ways to intervene.

Conceptual Model

The patient dimension of factors affecting BP control is multi-dimensional.[12,14,15] It includes sociodemographic characteristics, health beliefs (hereafter, following Kleinman, we define 'beliefs' as referring to patients' understandings of the causes, pathophysiology, course of illness, symptoms and effects of treatment[16]), and daily lived experiences anchored in one's life context (hereafter referred to as 'context', including patients' social context, routines and habits, and competing health problems that might affect BP control). Our prior qualitative work suggested that patients' beliefs and context are strongly intertwined with each other, as in strands of yarn, and associated with adherence, which affects BP control.[12,17] How-

ever, we were not able to empirically test our hypothesized model with our prior qualitative data to evaluate the relative contributions of patient beliefs or context beyond the known effects of medication adherence, or to assess the order of such associations or their relative effects. Thus, how patient beliefs and life context affect BP control remains unclear, especially when accounting for medication adherence; without such an understanding, it is difficult for clinicians or health educators to know where to focus the limited time they have to help patients improve BP outcomes.

Using survey data, we now aim to quantify the relationships between beliefs, context, medication adherence and BP control among a diverse sample of patients with hypertension.

METHODS

Overview

We recruited a diverse sample of primary care patients between 2010-2011, for a telephone survey administered by a research assistant (RA). The survey included closed-ended items assessing sociodemographics (including race/ethnicity), medication adherence, beliefs, and life context. We examined the association of these dimensions with the outcome of BP measurements obtained from the medical record.

Participants and Recruitment

We recruited patients with hypertension from the primary care clinic at a large northeastern US Veterans Affairs (VA) Medical Cen-

ter serving diverse populations. This study was approved by the relevant VA Institutional Review Boards.

Patients were eligible to participate if they had at least two diagnoses of hypertension (ICD-9 codes 401.xx and 405.xx) on different dates in fiscal year 2010. The RA telephoned patients to invite participation, elicit informed consent, and administer the 45-minute survey.

We identified 761 eligible pa-

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tients, to whom we mailed recruitment letters. Ten letters were undeliverable by the post office, and 146 patients returned opt-out cards to request no contact. From May 2010 to February 2011, study staff attempted to contact the remaining 605 candidates by telephone, leaving voice mail messages when possible. We were unable to reach 318 veterans after at least three attempts (with a maximum of five attempts). Of the remaining 287 candidates, 103 agreed to be interviewed (36% response rate). As described below,

we only obtained BP data on 93 patients, so analyses with that variable were limited to that subsample.

Measures

Outcome Variable

BLOOD PRESSURE CONTROL

We calculated the number of visits for patients with an uncontrolled BP of ≥ 140/90 mm Hg among non-diabetics and a BP of >130/80 mm Hg among diabetics.[18] Patients with multiple BP readings were counted as uncontrolled, if they had at least two uncontrolled BP readings during this time period. However, patients with only one reading during this time period were categorized as having uncontrolled BP or not, based on this single reading. We only included those whose BP was measured within 90 days before or after their interview date (N=93). Forty-four patients out of 93 (47.3%), had uncontrolled BP in our time frame.

Independent Variables

SOCIODEMOGRAPHICS

We assessed age in years (dichotomized to aged ≥65 or <65 years), years of education (dichotomized to ≥13 years or <13 years) and income (dichotomized to >$20,000 or ≤$20,000). Race/ethnicity was assessed with survey questions following the US census protocol of identifying Hispanic heritage separately from race. Based on responses, we assigned patients to either White, African American (AA) or Hispanic groups, as follows: if the patient was White and not Hispanic, he/

she was assigned to White; if the patient was AA and not Hispanic, he/she was assigned to AA; if the patient was Hispanic, he/she was assigned to the Hispanic group.

MEDICATION ADHERENCE

We used Morisky's 8-item measure[19] to assess adherence, which has been validated against BP control and pharmacy refill data.

QUANTITATIVE MEASURES OF HEALTH-RELATED BELIEFS AND LIFE CONTEXT

In our previous qualitative work,[12] we identified two major domains that affect hypertension self-management – beliefs and context. We constructed Likert scale survey items, based on themes in each domain identified through our prior qualitative analysis,[12] drawing upon the language used by interview participants. These items were pilot-tested to assess clarity, comprehensibility and face validity. Items that were unclear were reworded prior to conducting the survey. Based on results from exploratory factor analyses using principal components factor analysis with orthogonal (varimax) rotation, we constructed scale scores by calculating means of the items when the Cronbach's alpha met or exceeded .60.

BELIEFS

Survey items assessed different aspects of beliefs (following Kleinman[16]), including patients' beliefs regarding the causes of hypertension, hypertension symptoms, the illness course (including whether they thought hypertension was

chronic or intermittent), treatment value and effects. As many of the beliefs we had qualitatively identified mapped onto items from the previously standardized and validated "Illness Perceptions Questionnaire-Revised" (IPQ-R),[20] we used items comprising several subscales of that questionnaire, including those for illness identity, cause, timeline, consequences, cure/control, coherence and emotional responses to symptoms. We created new quantitative belief items for qualitatively identified concepts that did not map specifically to the IPQ-R subscales, including patients' subjective beliefs about the etiology of their high BP, personal and health consequences of hypertension, and prevalence of hypertension in one's social network. An appendix of all items, possible responses, and the internal consistency reliability (Cronbach's alpha) for each dimension for which we combined items into a scale, is available from the lead author.

LIFE CONTEXT

Survey items to assess life context were also created to assess patients' lives and typical days, routines and practices related to BP, including having competing health problems or other priorities, lack of habits and routines, barriers to exercise and other healthy behaviors, and lifestyle choices that might affect BP self-care or outcomes. Based on the finding from our qualitative work that patients living alone often eat out in restaurants to gain social contact,[21] and the fact that restaurant food frequently has high sodium content, we also included

items assessing this specific behavior, as an indicator of high sodium consumption (known to affect BP control). As with the health beliefs items, we created scales with acceptable internal consistency reliability to assess some of these dimensions.

DEVELOPMENT OF COMPOSITE MEASURES

To reduce the number of survey items comprising the different belief domains, we performed an additional variable reduction step, to identify, for each domain with multiple items (beliefs, context), a single independent variable with the greatest predictability for uncontrolled BP among all linear predictors for our main analyses.

Thus, for each domain (beliefs, context), we performed a logistic regression of uncontrolled BP as the dependent variable on the entire set of scale and item scores for that domain. For each observation, we retained the linear combination of the estimated logistic regression coefficients and the scale/item scores, ie, the maximum-likelihood estimated linear predictor on the log-odds scale. We summed the product of each estimated beta with each scale score (ie, computing $b1x1 + b2x2 + ... + bJxJ$) to create the composite score. This univariate composite score for each domain (beliefs, context) was then used as an independent variable in our subsequent regression analyses for predicting the effects of blocks of variables on uncontrolled BP. To check for multicollinearity, we computed variance inflation factors for each predictor in the model, including composite scores, and

checked whether any were greater than 10, a conventional threshold above which collinearity is conventionally considered problematic.[22]

Analyses

Our goal was to quantify the relative contributions of beliefs and life context, over and above the known effects of sociodemographic factors and medication adherence, on BP control among a diverse sample of patients with hypertension.

To summarize characteristics of our sample, we calculated univariate descriptive statistics, reporting percentages represented in the various sociodemographic categories and with uncontrolled BP.

To determine the relative effects of patients' beliefs and life context over and above medication adherence on BP control, we examined the simultaneous effect of each domain in a series of regression analyses. Using the previously developed composite scores as independent variables in the regression models, we fit a sequence of least-squares regressions with increasing collections of predictors in a blockwise manner; for the binary items we fit a sequence of logistic regressions with the same predictors. The initial models consisted of sociodemographic variables (including race/ethnicity) and adherence; we then added the univariate composite measure of patients' beliefs, and then added the composite measure of context. The improvements in the models with the addition of extra blocks of variables were measured through partial F tests for the scales; we present p-values for these tests. Second, we fit a sequence

of logistic regression models to predict uncontrolled BP consisting of increasing numbers of factors. The initial models consisted of sociodemographic variables only (including race), and to this we added adherence, followed by the composite belief then context measures. The improvement in model fit due to the addition of independent variables was measured through chi-squared likelihood ratio tests; in the tables we present p-values for these tests. Once we identified the combination of factors which best predicted BP control, we recalculated the model including the original items/scales representing each dimension, rather than including the composite scores, so that we could interpret the direction and strength of individual variables' associations with BP control.

For the final model, we present the coefficients and standard errors of the uncontrolled BP model as a function of sociodemographics (and race/ethnicity), adherence, patients' beliefs, and context, along with the significance of each variable through chi-squared tests.

RESULTS

Descriptive Results

The sample included 43 Whites, 40 African Americans, and 20 Hispanics. Most participants were male (96.1%), 47.6% were aged ≥65 years; 70% had ≥13 years of education, and 53.1% had incomes >$20,000 (Table 1). Table 2 shows the means for the beliefs and context scales and additional individual items; additional psychometric de-

tails are in an appendix (available from lead author). On average, patients strongly agreed with the view that BP is a serious, long-term condition, that BP therapy is efficacious, and that patients' self-management of the condition can help control it. Moreover, most scores among the context variables indicated that patients felt they had few competing priorities in their daily lives to controlling their high BP, and few barriers to healthy behaviors. Thus, overall, the context assessments indicated that most study participants reported their daily lives do not interfere with their self-management of BP.

Table 1. Characteristics of the study population

Sociodemographic variables	%
Race	
White	41.8
African American	38.8
Hispanic	19.4
Age, ≥65 years	47.6
Education, ≥13 years	70.0
Income, >$20,000	53.1
Sex, male	96.1
Blood pressure control	**%**
Uncontrolled blood pressure	47.3

Factors Associated with BP control

We examined the relative contributions of beliefs and life context, beyond the effects of sociodemo-graphic factors including race/ethnicity, and medication adherence, on BP control. The first model, including only sociodemographics and race/ethnicity, showed that together,

Table 2. Descriptive statistics for items and scales assessing patient beliefs and context

Dimensions of beliefs	Response Range	Mean (SD)
Health consequences of hypertension care are serious[d]	1-5[a]	4.1 (.4)
Personal consequences of hypertension are serious[d]	1-5[a]	3.6 (.8)
Social consequences of hypertension care are serious[d]	1-5[a]	2.4 (.8)
It seems like everyone I know has high BP	1-5[a]	2.8 (1.1)
There is very little which can help control my high BP[d]	1-5[a]	1.1 (.6)
My treatment will be effective in curing my high BP (Item from IPQ-R)	1-5[a]	3.0 (1.0)
The negative effects of my high BP can be prevented by my treatment (IPQ-R)	1-5[a]	3.7 (.8)
My treatment can control my high BP (IPQ-R)	1-5[a]	4.0 (.5)
BP is a long term problem[d]	1-5[a]	3.6 (.6)
BP and its symptoms come and go[d]	1-5[a]	2.5 (.8)
I understand my high BP[d]	1-5[a]	3.6 (.8)
My high BP is associated with negative feelings like anxiety, depression and fear[d]	1-5[a]	2.5 (.8)
I have personal control over my high BP	1-5[a]	3.9 (.4)
Dimensions of context		
Competing priorities[d]	0-4[b]	1.3 (.9)
Barriers to healthy behaviors[d]	0-4[b]	1.2 (.9)
I think about high BP when I choose what foods to buy	0-4[b]	1.8 (1.5)
I go to restaurants and bars to be around people [therefore eating foods with higher salt content]	0-4[b]	0.4 (.7)
I have a set time to take my meds	0-4[b]	3.5 (1.0)
I get my meals from restaurants [therefore eating foods with higher salt content]	0-4[b]	1.3 (1.1)
In a typical week, I spend time with family or friends	0-4[b]	1.4 (1.3)
I keep my meds in the same spot	0-4[b]	3.9 (.3)
I keep my meds in a place that will remind me to take them	0-4[b]	3.8 (.8)
Adherence (Morisky)		
Adherence score	0-8[c]	6.8 (1.4)

a. higher score=greater agreement; response range: 1 (strongly disagree) - 5 (strongly agree).
b. higher score=more of the dimension; response range is 0 (never) – 4 (always).
c. higher score=greater adherence; response range is 0 (low adherence) – 8 (high adherence).
d. dimension includes multiple items (an appendix with the full list is available from the lead author).

Table 3. Predictors of Uncontrolled Blood Pressure

Models	P[a]
Sociodemographic + Race[b]	.0498
Sociodemographic + Race + Adherence[b]	.1415
Sociodemographic + Race + Adherence +Belief[b]	<.0001
Sociodemographic + Race + Adherence +Belief[c] + Context[b]	.0687
Sociodemographic + Race + Adherence + Context[b]	.0078
Sociodemographic + Race + Adherence + Context[c] +Belief[b]	<.0001

a. P for testing the significance of the variables b and c.

they were significantly predictive of uncontrolled BP (Table 3). Next, adding medication adherence to the model, we found that after controlling for sociodemographics and race/ethnicity, adherence was not significantly associated with BP control. However, adding beliefs to that model did contribute significantly to BP control; similarly, adding context (without beliefs) contributed significantly to BP control. While the addition of context did not contribute significantly to BP control after accounting for adherence and beliefs, the reverse was not true; adding beliefs after context did contribute significantly to explaining BP control.

To pinpoint which individual variables were significantly predictive of BP control, we examined in detail the results from the model including sociodemographics, adherence, race, context, and beliefs (Table 4). We found that, controlling for other factors in the model, there was no evidence that African Americans were more likely to have uncontrolled BP than Whites, but Hispanics were less likely to have uncontrolled BP than Whites. Greater endorsement of health consequences and lesser endorsement of personal consequences of BP were

associated with lower probability of BP control, as were perceptions of little control over BP. Conversely, beliefs that BP therapy will be effective were associated with greater probability of BP control. Beliefs that BP and its symptoms come and

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go were associated with lower probability of BP control, and considering BP when choosing foods was associated with lower probability of BP control. Stronger beliefs that the negative effects of high BP can be prevented through treatment were associated with lower probability of uncontrolled BP. None of the individual contextual variables were significantly associated with BP control.

Discussion

Understanding the extent to which patient factors such as sociodemographics (including race/ethnicity), medication adherence, beliefs, and context contribute to hypertension control is critical to developing effective interventions. We employed detailed survey measures of beliefs and context to better understand these relationships.

In our final model, we found that sociodemographics, race/ethnicity, medication adherence and either beliefs or context predicted BP control. Including beliefs after context did significantly predict BP control, but the inclusion of context after beliefs did not. The fact that context did not help further explain uncontrolled BP beyond the impact of beliefs suggests that patients' beliefs may be a relatively more important factor in ultimately determining their BP control. Thus, in an effort to improve BP control, a focus on patients' beliefs about hypertension may be the most important pathway for clinicians and health educators to pursue with patients, .

Though others have underscored the importance of considering the context of patients' daily lives with regard to medication adherence,[23] our results did not support attending to context over and above the impact of beliefs.

Practice Implications

These results add new knowledge regarding the relative effects of potentially modifiable factors associated with patients' BP control. The results demonstrate the

Table 4. Detailed model summary of uncontrolled BP as a function of sociodemographics, race, adherence, beliefs and context

Parameter	DF	Estimate	Standard error	Wald chi-square	Pr > ChiSq
Intercept	1	-6.4168	9.3733	.4687	.4936
Sociodemographics					
Age (≥65 years)	1	1.2141	1.2860	.8912	.3451
Income (>$20,000)	1	-4.2742	2.1363	4.0031	.0454
Education (≥13 years)	1	-1.8457	1.2762	2.0916	.1481
Black race (ref White)	1	1.4819	1.4068	1.1096	.2922
Hispanic race (ref White)	1	-3.7514	1.9909	3.5503	.0595
Adherence (Morisky)	1	1.6147	0.6222	6.7343	.0095
Beliefs					
Health consequences of hypertension are serious	1	-6.6777	2.8796	5.3777	.0204
Personal consequences of hypertension are serious	1	4.2709	2.0016	4.5530	.0329
Social consequences of hypertension are serious	1	-.6426	1.1845	.2943	.5874
It seems like everyone I know has high blood pressure	1	-.5168	0.5227	.9776	.3228
There is very little which can help control my high BP	1	4.8688	2.0796	5.4813	.0192
Treatment will be effective in curing my high BP	1	1.6729	.8694	3.7020	.0543
The negative effects of my HBP can be prevented by my treatment	1	-5.0046	1.7301	8.3675	.0038
My treatment can control my HBP	1	-.9764	1.3576	.5173	.4720
BP is a long-term problem	1	-3.3742	1.6086	4.3999	.0359
BP and its symptoms come and go	1	-1.1180	.9423	1.4076	.2355
I understand my high BP	1	.7708	1.0701	.5188	.4714
My high BP is associated with negative feelings like anxiety, depression and fear	1	2.3189	1.3071	3.1473	.0761
I have personal control over my high BP	1	4.1608	2.1466	3.7570	.0526
Context					
Competing priorities	1	-.9883	.8480	1.3582	.2438
Barriers to healthy behaviors	1	.7555	.9436	.6411	.4233
I think about high BP when I choose what foods to buy R[a]	1	1.3936	.5451	6.5370	.0106
I go to restaurants and bars to be around people [and thus eat foods high in sodium]	1	-1.6434	1.0765	2.3306	.1269
I have a set time to take my meds R[a]	1	2.4750	1.5532	2.5391	.1111
I get my meals from restaurants [and thus eat foods high in sodium]	1	.5020	.4827	1.0817	.2983
In a typical week, I spend time with family or friends	1	-.4943	.4696	1.1082	.2925
I keep my meds in the same spot R[a]	1	-1.4013	2.0879	.4505	.5021
I keep my meds in a place that will remind me to take them	1	-1.6492	1.4630	1.2708	.2596

a. R denotes items where responses were reversed to keep consistent direction across all items.

importance of understanding the impact of patients' beliefs on their BP control. The role of health beliefs in patients' hypertension has long been recognized,[8,9,12,14,24,25] but our findings highlight their salience over and above other mutable factors like context.

Our results that showed that accounting for context (beyond the effects of beliefs and adherence) did not help to predict BP control are somewhat contrary to prior research, which has suggested (in the absence of detailed assessments of context) that patient self-management behaviors such as adherence are the key leverage point to BP control.[8,26] Instead, the present findings suggest that in the setting of a range

of patient-related factors including adherence, BP control may be best addressed through a focus on beliefs about the condition, rather than frequent entreaties by providers for patients to engage in more positive behaviors such as medication adherence. As a corollary, if clinicians must make choices as to the dimension on which to intervene, a focus

on beliefs would be the most fruitful approach to effecting change in BP management. Thus, patient-centered counseling[27] or motivational interviewing[28] may be best enhanced by an approach with a concurrent focus on patients' beliefs.

In contrast to the frequent "information-giving" approaches to patient education and counseling,[11] our results underscore the critical importance of first understanding patients' perspectives. As Kleinman suggested, clinicians can learn best about patients' health beliefs by asking questions such as, "What do you think has caused your problem?" "What do you call it?" "Why do you think it started when it did?" "How does it affect your life?" "How severe is it?" "What worries you the most?" and "What kind of treatment do you think would work?"[16] Insofar as patient counseling is a negotiation process, and to the extent that all successful negotiations are characterized by a central focus on understanding the factors that influence the other person with whom one is communicating,[29] our results suggest that understanding the patient's underlying belief system about their condition is critical. Further, only when patients' beliefs are well-understood by clinicians does it become clear if they are inaccurate, or interfere with hypertension self-management behaviors, and thus should be addressed.

Our extensive assessments of aspects of patients' lives, which may impact their hypertension outcomes, is consistent with other recent calls for a more patient-centered focus.[30-33] Indeed, data from

Weiner et al[31] demonstrate that clinicians make fewer errors (and patients have better outcomes) when clinicians or health educators account for patients' cues about possible contextual barriers to chronic disease self-management. While results from our model including only context showed that it significantly predicted BP control, we found that beliefs had additional impact on the outcome after accounting for context. Our results support the notion that while patients may benefit from providers' attention to cues about patients' context, that is added value only after attending to their beliefs.

This study was limited by its relatively small sample size, relatively low response rate (though better than other recent national telephone surveys),and focus on a sample of mostly older male veterans, all of which limit its generalizability. Also, for some patients, we based our assessment of BP control on a single blood pressure reading. Hispanics were particularly reluctant to engage in study participation, despite repeated attempts to recruit them; we are not alone in facing this challenge.[24] However, these limitations were offset by an extensive range of measurements on a racially/ethnically diverse sample, and these methods and findings can be replicated in future research with larger and more generalizable samples. Further, our detection of statistically significant findings, even with a limited participant group, provides further evidence for the importance of a new perspective on the relevance of patients' beliefs to their behaviors and ultimately, their BP outcomes.

Conclusion

In summary, while many clinicians might be familiar with the concept that health beliefs affect patients' BP outcomes, the results from this study suggest that such beliefs provide additional impact over and above patients' context, and that efforts to counsel patients about beliefs might have greater value and impact on BP control than the more frequent focus on adherence behaviors. As the organization of health care increasingly changes to models of Accountable Care Organizations subsequent to the implementation of the Affordable Care Act (with payments based on performance such as blood pressure control), clinicians are likely to be increasingly vigilant about ensuring that patients' BP outcomes are optimized. These findings provide new understandings to help with that process.

Conflict of Interest
No conflicts of interest to report.

Author Contributions
Research concept and design: Kressin, Cortés, Cohn, Bokhour; Acquisition of data: Kressin, Cortés, Cohn, Barker; Data analysis and interpretation: Kressin, Elwy, Glickman,

Orner, Fix, Borzecki, Katz, Barker, Cortés, Cohn, Bokhour; Manuscript draft: Kressin, Elwy, Glickman, Orner, Fix, Borzecki, Katz, Cortés, Cohn, Barker; Statistical expertise: Glickman, Orner;Acquisition of funding: Kressin, Glickman, Bokhour; Administrative: Elwy, Fix, Borzecki, Katz, Cortés, Cohn, Barker; Supervision: Kressin, Cohn

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