

**ORIGINAL RESEARCH**

# Blood Pressure Medication Side Effect Symptoms and Patient Treatment Satisfaction and Adherence

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**Background:** Side effect symptoms to blood pressure (BP) medications may be associated with medication nonadherence, treatment dissatisfaction, and worse BP control. This article describes the frequency and characteristics of BP medication side effect symptoms in a primary care population with poorly controlled hypertension and their relationships to treatment satisfaction and adherence.

**Methods:** Patients in a pragmatic trial were surveyed at baseline to identify and characterize 6 potential BP medication side effect symptoms (tiredness, dizziness, foot swelling, cough, frequent urination, sexual symptoms). Reported symptoms were rated on severity (not a problem, somewhat/moderate problem, big/very big problem) and perceived relatedness to medications (yes/no). Logistic regression models used symptom severity and perceived relatedness to medications to predict BP treatment satisfaction (very satisfied to very dissatisfied) and medication adherence (changing/stopping medications).

**Results:** Among survey responders (n = 1,719/3,071, 56%), 90% of respondents taking BP medications reported a symptom that was at least somewhat of a problem. Overall, 39% had at least one symptom that was a big or very big problem and 34% had at least one symptom that they perceived as related to their medication. For most symptoms, both higher problem severity and perceived relatedness to medication were significantly associated with lower BP treatment satisfaction and decreased adherence.

**Conclusions:** BP medication side effect symptoms were very common and often big problems for patients. Identifying and managing them could potentially improve BP outcomes. The brief symptom assessment developed for this study could help identify opportunities to address side effect symptoms and improve patient satisfaction and adherence.

Clinical trial registration: [www.clinicaltrials.gov](http://www.clinicaltrials.gov) NCT02996565 (J Am Board Fam Med 2025;38:312–329.)

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## Introduction

Blood pressure (BP) control is declining in the US, and only 48% of patients with hypertension

had BP controlled to <140/90 mmHg in 2017 to 2020 in a nationally representative longitudinal study.<sup>1</sup> In the same analysis, only 31% had BP controlled to <130/80 mmHg. Improving BP control for the population is a major national goal, including strategies to educate the population and medical profession about the importance of controlling hypertension and methods to improve its treatment.<sup>2–6</sup> Achieving better BP control requires a multifactorial approach aimed at barriers at the level of policies, clinicians, and patients.

One of the major patient factors contributing to uncontrolled hypertension is nonadherence to BP

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medications.<sup>7-9</sup> Among patients with hypertension, treatment dissatisfaction and nonadherence are highly correlated.<sup>10,11</sup> When elicited by surveys among patients taking antihypertensive treatment, patient-reported side effect symptoms are frequent, especially in those newly started on treatment, and are associated with nonadherence and worse health ratings.<sup>12,13</sup> Thus, gaining a greater understanding of patient perceptions about side effects to antihypertensive treatment has the potential to improve treatment satisfaction, adherence, and BP control. However, most information about side effects to BP medications comes from randomized controlled trials and from adverse drug event reporting systems in the inpatient setting; less is known about the frequency, severity, and patient perceptions of side effect symptoms in clinical practice and outpatient settings.<sup>14</sup>

Patient attribution of side effects to BP medications is important as these perceptions may prompt them to stop treatment or seek guidance from their clinician about stopping, which may in turn affect BP control and longer-term cardiovascular risk. However, many side effect symptoms that could be due to BP medications are nonspecific and could also be attributable to other causes. Thus, any effect on adherence might depend on symptom severity and whether the patient believes the symptoms are due to their BP medications. The objectives of this manuscript are 1) to describe the frequency and characteristics of patient-reported BP medication side effect symptoms in primary care practice, 2) to assess patient perceptions of whether side effect symptoms were related to BP medications, and 3) to assess the relationship of symptom severity and perceived relatedness to treatment satisfaction and medication adherence.

## Methods

### Setting

This cross-sectional analysis of baseline data were part of a pragmatic clinical trial called Hyperlink 3 (NCT02996565) comparing telehealth management of blood pressure with home BP monitoring and pharmacist management to best-practice clinic-based care in 21 clinics within an integrated care system in Minnesota and Western Wisconsin.<sup>15</sup>

### Population

Each patient was screened for study eligibility at all primary care encounters over an 18-month accrual

period using an automated algorithm. The inclusion criteria included the following: age 18 to 85, diagnosed hypertension, having a visit at the same clinic as the patient's assigned primary care clinician, and 2 consecutive visits with systolic BP >150 mmHg or diastolic BP >95 mmHg. Patients were considered enrolled if a study-generated order for hypertension follow-up was signed by the clinician. The study was reviewed by the HealthPartners Institutional Review Board, which granted a waiver of written informed consent.

### Measurements

To assess patient-reported baseline data for the study, all enrolled study participants were mailed a survey within one week of enrollment, with telephone outreach to initial nonresponders by trained interviewers (Appendix 2). A cover letter was included with the mailed survey that indicated that returning the survey implied consent to use their survey data for analysis. The total survey time was estimated at 10 to 15 minutes if completed by mail and 15 to 20 minutes if completed by interview in English (complete survey shown in supplement). Written surveys were also available in Spanish, and interviews were also available in a wide variety of languages via bilingual interviewers or a language line. About 10% of interviews were in languages other than English, and the most common languages in which interpreted interviews were conducted were Somali, Vietnamese and Hmong. The baseline survey mailing included a \$2 noncontingent cash incentive, and respondents also received a \$10 gift card for a completed survey or interview.<sup>16-18</sup>

Although we found longer instruments that assessed some related domains,<sup>12,19,20</sup> we were unable to identify established or validated instruments to briefly assess the presence of potential BP medication side effect symptoms, severity, or perceived relatedness to BP medications. We therefore developed our own brief series of questions to assess 6 common side effect symptoms (tiredness, dizziness, leg swelling, cough, frequent urination, and sexual symptoms) often attributed to BP medications and incorporated them into the larger survey. The questions were developed using best practice and reviewed for face validity by content experts.<sup>21</sup> To ensure that the questions were likely to be understood, valued, and useful to the patients and family members, 2 patient coinvestigators played a large role in developing the survey questions

(Figure 1).<sup>22</sup> The severity rating for each symptom was categorized into 3 levels: not a problem; somewhat or moderate; big or very big. Perceived relatedness to BP medications was dichotomized (yes; no or not sure) for symptoms that were rated as at least somewhat of a problem. The maximum rating across all symptoms was used as an overall measure of symptom severity.

BP treatment satisfaction was measured by responses on a 5-point Likert scale (very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, very dissatisfied) to the question “Taking all things into account, how satisfied or dissatisfied are you with the blood pressure medicine you have taken in the past 6 months?” Satisfaction responses were categorized into 3 levels: very or somewhat dissatisfied; neither satisfied or dissatisfied; somewhat or very satisfied. An adherence question focused on side

effect symptoms with a yes/no response was worded as follows: “In the past 6 months, have you changed or stopped your blood pressure medicine, even just for a few days, because of symptoms you think were related to your blood pressure medicine?”

### Analysis

The characteristics of survey respondents and non-respondents were compared using Chi-square statistics or general linear models. For each symptom, respondents who reported taking any blood pressure medications in the prior 6 months were categorized into whether they reported that the symptom was not a problem, somewhat or moderately a problem, or a big or very big problem. Data from those for whom a symptom was at least somewhat of a problem were included in analyses assessing

**Figure 1. Questions to assess blood pressure medication side effect symptoms.**

**9. The following questions are about common symptoms that may or may not be related to your blood pressure medicine. Please think back over the last 6 months when answering each of the following questions.**

**a. How much of a problem was tiredness to you?**

Not a problem  
 Somewhat of a problem  
 Moderate problem  
 Big problem  
 Very big problem

Do you think that this was related to your blood pressure medicine?  
 Yes    No    Not sure

**b. How much of a problem was feeling dizzy, lightheaded or faint to you?**

Not a problem  
 Somewhat of a problem  
 Moderate problem  
 Big problem  
 Very big problem

Do you think that this was related to your blood pressure medicine?  
 Yes    No    Not sure

**c. How much of a problem was swelling of feet or legs to you?**

Not a problem  
 Somewhat of a problem  
 Moderate problem  
 Big problem  
 Very big problem

Do you think that this was related to your blood pressure medicine?  
 Yes    No    Not sure

**d. How much of a problem was coughing to you?**

Not a problem  
 Somewhat of a problem  
 Moderate problem  
 Big problem  
 Very big problem

Do you think that this was related to your blood pressure medicine?  
 Yes    No    Not sure

**e. How much of a problem was frequent urination to you?**

Not a problem  
 Somewhat of a problem  
 Moderate problem  
 Big problem  
 Very big problem

Do you think that this was related to your blood pressure medicine?  
 Yes    No    Not sure

**f. How much of a problem were sexual symptoms to you?**

Not a problem  
 Somewhat of a problem  
 Moderate problem  
 Big problem  
 Very big problem

Do you think that this was related to your blood pressure medicine?  
 Yes    No    Not sure

**g. How much of a problem were other symptoms to you?**

Not a problem  
 Somewhat of a problem  
 Moderate problem  
 Big problem  
 Very big problem

Do you think that this was related to your blood pressure medicine?  
 Yes    No    Not sure

relationships between perceptions of symptom severity and medication relatedness; and whether perceptions of symptom severity and medication relatedness were associated with treatment dissatisfaction and lack of adherence. Unadjusted logistic regression models compared the likelihood that patients reported that each symptom was related to their medication from its rated severity. Unadjusted multinomial logistic regression models predicted higher treatment dissatisfaction from symptom severity ratings, and separately from ratings of medication relatedness, among those who reported on their treatment satisfaction. Unadjusted logistic regression models predicted the likelihood that respondents reported that they had changed or stopped blood pressure medications due to side effects from symptom severity ratings, and separately from medication relatedness ratings, among those who reported on medication adherence.

## Results

A total of 3,071 patients met the inclusion criteria, were enrolled in the study, and were sent a baseline survey. A total of 1,719 participants completed the surveys for a response rate of 56%. The mean age of respondents was 62 and mean BP was 158/91 mmHg, 54% were female, 73% were non-Hispanic White, 25% had diabetes, 19% had cardiovascular disease, and 56% were on 2 or more BP medications (Table 1). Compared with nonrespondents, respondents were more likely to be older, White, have cardiovascular disease, take hypertension medications, and were less likely to be Asian.

The proportion of symptoms in 1,601 respondents who reported taking any BP medication in the prior 6 months and reported on side effect symptoms is shown in Table 2. Only 10% of participants were completely without any symptom that they considered at least somewhat of a problem, 52% reported at least one moderate problem, and 39% reported at least one symptom that was a big or very big problem. Tiredness (70%) and urinary frequency (56%) were the most frequent symptoms reported, followed by dizziness (43%), leg swelling (37%), cough (34%), and sexual symptoms (24%). Tiredness (18%) and urinary frequency (12%) were also most likely to be rated as a big or very big problem, while cough (7%) and dizziness (7%) were the

least likely. See also Appendix 1 Table 1 for severity ratings of selected symptoms stratified by whether participants were taking the drug most commonly associated with the side effect. There were modest increases in patients noting moderate cough with ACE-inhibitors, both moderate and severe leg swelling with dihydropyridine CCBs, and moderate urinary frequency with thiazide diuretics, corresponding with the known side effect profile of these drug classes.

Among the subset of 1,446 participants who had reported at least one symptom of any severity, Table 3 shows the association between severity of each side effect symptom and whether the respondent answered “Yes” to the question about whether they thought that the symptom was related to their BP medication. For example, from Table 2, tiredness was rated as a somewhat/moderate problem by 828 (51.7%), and a big/very big problem by 293 (38.5%). In Table 3, among the 1,121 who reported that tiredness was at least somewhat of a problem, 82% felt that it was unrelated to their BP medication and 18% thought it was related (first column, “Total with symptom”). Those who rated tiredness as a big/very big problem were more likely than those who rated it as a somewhat/moderate problem to answer that they thought the tiredness was related to their BP medication (26.3% vs 15.1%,  $P < .001$ ). Conversely, those who rated tiredness as only a moderate problem were more likely than those who rated it as a big/very big problem to answer that they thought tiredness was unrelated to their BP medication (84.9% vs 73.7%,  $P < .001$ ). Similarly, the group of participants who rated dizziness, leg swelling, and cough to be a big or very big problem were significantly more likely than those who rated it as less severe to believe that the symptoms were related to their BP medications. Tiredness that was a big or very big problem was least likely to be attributed to medications (26%), while the proportion attributing big problems with dizziness, leg swelling and cough to medications was higher (39% to 49%). The relationship between symptom severity and perceived relatedness was not statistically significant for urinary frequency and sexual symptoms.

Of the 1,365 participants who had at least one of the symptoms that was a problem and answered the question about BP medication treatment satisfaction, both higher symptom severity (Figure 2A) and perceived relatedness to BP medication (Figure 2B) were associated with

**Table 1. Participant Characteristics by Baseline Survey Response Status (n = 3,071)**

	Non-Respondents	Respondents	<i>p</i>
N	1,352	1,719	
Age, M (SD)	58.3 (14.5)	61.7 (14.0)	<0.001
Age <60, n (%)	711 (52.6)	708 (41.2)	<0.001
Female, n (%)	705 (52.1)	934 (54.3)	0.23
BMI (kg/m <sup>2</sup> ), M (SD)	32.5 (8.1)	32.5 (7.8)	0.93
<b>Race</b>			
White, n (%)	876 (64.8)	1,256 (73.1)	<0.001
Black, n (%)	265 (19.6)	329 (19.1)	0.75
Asian, n (%)	143 (10.6)	70 (4.1)	<0.001
All else, n (%)	68 (5.0)	64 (3.7)	0.08
Diabetes, n (%)	340 (25.1)	433 (25.2)	0.98
Cardiovascular disease, n (%)	192 (14.2)	320 (18.6)	0.001
SBP (mm Hg), M (SD)	158.1 (16.0)	158.0 (14.8)	0.82
DBP (mm Hg), M (SD)	93.0 (13.8)	90.6 (13.9)	<0.001
<b>Number of BP medications</b>			
0, n (%)	235 (17.4)	231 (13.4)	0.002
1, n (%)	427 (31.6)	524 (30.5)	0.51
2, n (%)	380 (28.1)	520 (30.3)	0.19
3+, n (%)	310 (22.9)	444 (25.8)	0.06
<b>Drug classes used</b>			
ACE-inhibitor, n (%)	402 (29.7)	527 (30.7)	0.58
ARB, n (%)	294 (21.7)	414 (24.1)	0.13
Diuretic, thiazide, n (%)	413 (30.5)	546 (31.8)	0.47
Diuretic, loop, n (%)	82 (6.1)	125 (7.3)	0.19
Beta blocker, n (%)	466 (34.5)	675 (39.3)	0.006
CCB DHP, n (%)	342 (25.3)	453 (26.4)	0.51

*Abbreviations:* ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker, BMI, body mass index; CCB, calcium channel blocker; DHP, dihydropridine.

a higher likelihood of treatment dissatisfaction (see also Appendix 1 Table 2 for complete data). For example, 173/586 (29.5%) with any symptom that was a big or very big problem reported

being somewhat or very dissatisfied with treatment, while 151/779 (19.4%) with a somewhat or moderately severe symptom reported being dissatisfied (*P* = .001). Similarly, 187/628 (29.8%)

**Table 2. Severity Rating of Each Hypertension Medication Side Effect Symptom Among Patients Reporting Taking Any Blood Pressure Medications in the Prior 6 Months (n = 1,601)**

	Not a Problem	Somewhat/Moderate	Big/Very Big
ANY symptom	155 (9.7%)	828 (51.6%)	618 (38.5%)
Tiredness, n (%)	480 (30.0%)	828 (51.7%)	293 (18.3%)
Dizziness, n (%)	913 (57.0%)	570 (35.6%)	118 (7.4%)
Leg swelling, n (%)	1,011 (63.1%)	435 (27.2%)	155 (9.7%)
Cough, n (%)	1,057 (66.0%)	431 (26.90%)	113 (7.1%)
Urinary frequency, n (%)	709 (44.3%)	702 (43.8%)	190 (11.9%)
Sexual symptoms, n (%)	1,214 (75.8%)	244 (15.2%)	143 (8.9%)

*Notes:* Symptom and Severity: The following questions are about common symptoms that may or may not be related to your blood pressure medicine. Please think back over the past 6 months when answering each of the following questions. Options for severity rating were not at all a problem, somewhat of a problem, moderate problem, big problem, or very big problem.

**Table 3. Associations Between Severity of Symptoms and Perceived Relatedness to Blood Pressure Medications, Among Those Reporting That at Least One Symptom Was at Least Somewhat of a Problem (n = 1,446)**

	Total with Symptom	Somewhat/Moderate Problem	Big/Very Big Problem	<i>p</i>
Tiredness	1,121	828	293	
Unrelated to meds	919 (82.0%)	703 (84.9%)	216 (73.7%)	<0.001
Related to meds	202 (18.0%)	125 (15.1%)	77 (26.3%)	
Dizziness	688	570	118	
Unrelated to meds	4,537 (65.8%)	393 (69.0%)	601 (50.8%)	<0.001
Related to meds	235 (34.2%)	177 (31.0%)	58 (49.2%)	
Leg swelling	590	435	155	
Unrelated to meds	429 (73.0%)	338 (77.7%)	91 (58.7%)	<0.001
Related to meds	161 (27.0%)	97 (22.3%)	64 (41.3%)	
Cough	544	431	113	
Unrelated to meds	427 (78.5%)	358 (83.1%)	69 (61.2%)	<0.001
Related to meds	117 (21.5%)	73 (16.9%)	44 (38.9%)	
Urinary frequency	892	702	190	
Unrelated to meds	596 (66.8%)	469 (66.8%)	127 (66.8%)	0.99
Related to meds	296 (33.2%)	233 (33.2%)	63 (33.2%)	
Sexual symptoms	387	244	143	
Unrelated to meds	281 (72.6%)	181 (74.2%)	100 (69.9%)	0.36
Related to meds	106 (27.4%)	63 (25.8%)	43 (30.1%)	

who perceived that any symptom was related to medications reported being dissatisfied, while 137/737 (18.6%) who did not think that their symptom was related to medications were dissatisfied ( $P = .001$ ). These relationships were statistically significant for individual symptoms, except for symptom severity with leg swelling, cough, and urinary frequency.

Both higher symptom severity (Figure 3A) and perceptions of relatedness to BP medications (Figure 3B) were also associated with a higher likelihood of responding “Yes” to the question about changing or stopping medications due to side effects (see also Appendix 1 Table 3 for complete data). The differences were large and statistically significant for symptom severity of tiredness and dizziness, and for all symptoms felt to be related to medications except urinary frequency.

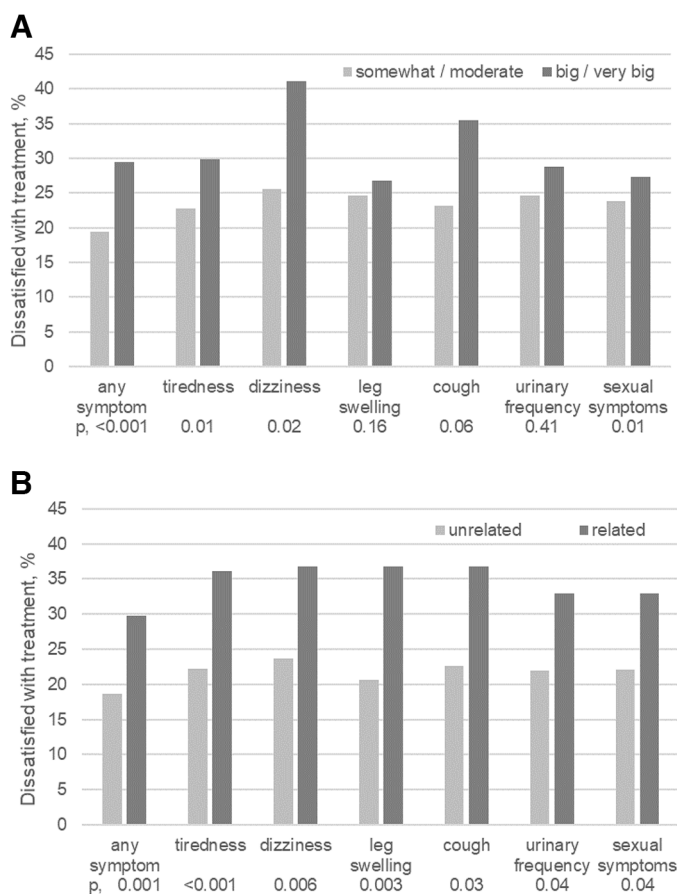
## Discussion

In this primary care population with poorly controlled hypertension 90% of participants had at least one potential side effect symptom, and 39% of the participants considered at least one symptom to be a big or very big problem. Tiredness, urinary frequency and leg swelling were the most commonly reported problems. However, only between a quarter and a half of participants with big or very

big problems perceived a relationship between the symptom and their medication, least often for tiredness (26%) and most often for dizziness (49%). Both a higher symptom severity and a perceived relationship of symptoms to their BP medication were independently associated with lower treatment satisfaction and self-reported nonadherence.

The frequency of side effect symptoms we observed was higher than reported in some previous studies that framed the question specifically about medication side effects rather than about symptoms in general. For example, in a study from a hypertension clinic in Hong Kong, when asked directly about adverse drug effects, 33% of patients reported side effects from antihypertensive medication.<sup>23</sup> The most common were dizziness (9%), ankle swelling (7%), fatigue (4%), and cough (3%). Among inhabitants of Uppsala County in Sweden, 20% of those using antihypertensive drugs reported perceived side effects, including most of the ones we asked about (dizziness, cough, tiredness, leg swelling, and impotence in men).<sup>13</sup> At the low end of the range, only 8.7% of patients in a large cohort of older people living independently in the community in Melbourne, Australia, 43% of whom had hypertension, reported having medication side effects.<sup>24</sup>

**Figure 2. (A) Association between side effect symptom severity (somewhat/moderate problem vs. big/very big problem) and blood pressure treatment dissatisfaction. (B) Association between perceived relatedness to medication (related vs. unrelated) and blood pressure treatment dissatisfaction.**

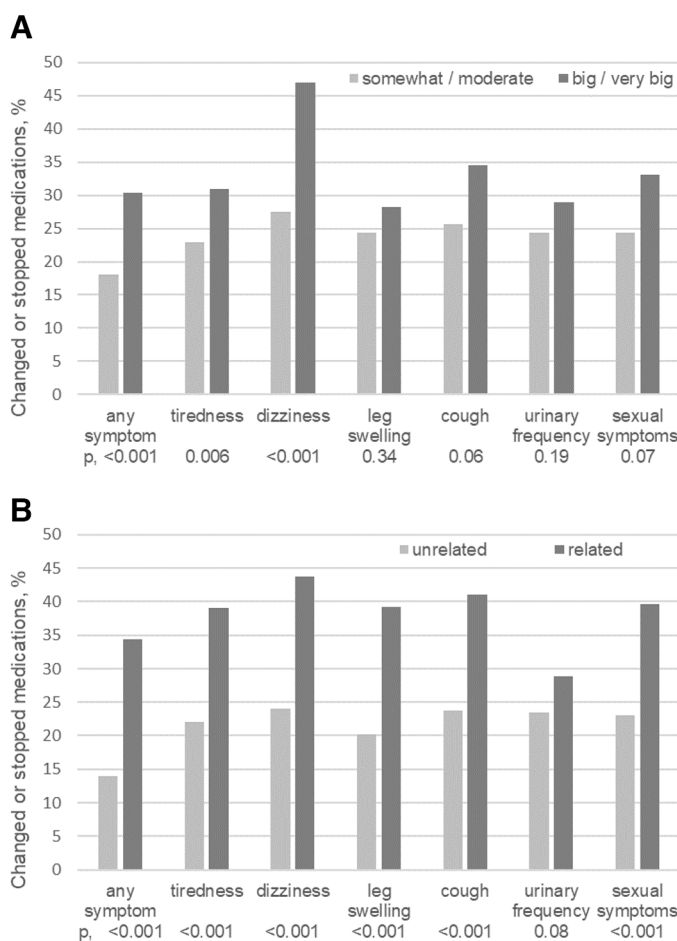


While selection of patients with moderately severe uncontrolled hypertension may have contributed to the high rates of reported symptoms, our study was also unusual in having screening methods designed to recruit typical patients who would be unlikely to volunteer for studies requiring burdensome enrollment procedures. Furthermore, we asked participants about general symptoms they experienced, not just those they believed were medication side effects. A similar approach was used in the Treatment of Mild Hypertension Study, a blinded randomized placebo-controlled trial comparing 5 classes of antihypertensive drugs with placebo.<sup>25,26</sup> It used a 49-item symptom checklist that included related items on our survey to compare changes in symptoms over one year of treatment. An overall symptom score was not different from placebo over one year. Among the most common worsening symptoms in the placebo group were fatigue (34%), increased urination (30%), cough

(23%) and dizziness (21%). A high frequency of side effect symptoms similar to our study was observed in a study of patients being newly started on antihypertensive medications.<sup>12</sup> In response to a survey that included a checklist of 24 side effect symptoms, 85% endorsed one or more symptoms and the median number of symptoms was 4.

We previously reported that the participants with poorly controlled hypertension in our study (mean BP of 158/92 at enrollment) were also substantially less likely to report high satisfaction with hypertension care (only 29% chose 9 to 10 on a scale from 0 to 10) compared with the contemporary rating of physician care among the general primary care population from the same care system (82%).<sup>27</sup> The low level of satisfaction with hypertension care is mirrored in the data reported here about low rates of medication treatment satisfaction, particularly among patients who experienced more severe side effect symptoms or felt the

**Figure 3. (A) Association between side effect symptom severity (somewhat/moderate problem vs. big/very big problem) and adherence to blood pressure treatment (changing or stopping medications due to side effects). (B) Association between perceived relatedness to medication (related vs. unrelated) and adherence to blood pressure treatment (changing or stopping medications due to side effects).**



symptoms were related to their antihypertensive treatment. Side effect symptom severity and beliefs about relatedness to medications were also correlated with lower treatment adherence in our study. Others have found that self-reported antihypertensive medication nonadherence is in turn associated with higher BP<sup>28</sup> and worse cardiovascular outcomes.<sup>29</sup> Thus, the results of this study suggest that there probably are large numbers of uncontrolled hypertensive patients in clinical practice experiencing treatment dissatisfaction due to side effect symptoms, and that better management of these symptoms could improve medication adherence, BP control and long-term cardiovascular health.

Time pressures and competing priorities in primary care can be a barrier to the routine assessment of side effect symptoms, but several

short questions such those in this survey could help to identify people with perceived side effects who need those problems addressed before intensifying treatment to improve BP control. This could occur during the review of systems or medication history in a clinical encounter. In addition, in many care systems nurses or medical assistants are conducting previsit and/or standardized visit questions based on pre-existing conditions such as diabetes or hypertension. It may be feasible to use these opportunities to ask about common side effect symptoms in patients with uncontrolled hypertension or suspected medication nonadherence. When asking patients about side effects, a quick assessment of severity and perceived relatedness to medications (exemplified in Figure 1), at least for those with poorly controlled

hypertension, could provide additional helpful information to the health care team to recognize those most likely to also have adherence issues and treatment dissatisfaction. The instrument developed in this study could also be useful for future research to better assess the impact of quality improvement interventions on medication side effects, adherence, and control.

The results in this analysis are subject to several important limitations. First, this was a cross-sectional analysis of baseline data from a randomized trial and we cannot attribute directionality or causality to the associations. We chose to look at baseline data since the randomized trial did not show an effect of the pharmacist-led telehealth intervention versus clinic-based care on side effect symptoms over 6 months of follow-up, and symptoms were generally comparable at the 6-month follow-up time point to baseline in both groups.<sup>30</sup> Second, we used a single question to inquire about changing or missed doses due to side effects to better understand that specific issue, so the responses likely underestimated adherence problems due to other common reasons such as cost and trouble remembering. Nevertheless, about a quarter of the respondents reported side effects that precipitated changed or missed doses. Some patients may also have been instructed by a clinician to stop medication due to side effect symptoms, so some medication stopping may not have been nonadherence. In addition, due to constraints on survey length we did not ask which specific medicine may have been changed or stopped. We might have seen different relationships if we had asked about specific classes of medication. Third, we conducted this analysis in a large patient population with poorly controlled hypertension and do not know if the findings would translate to a population with better BP control. Fourth, the response rate to the study baseline survey was relatively low in this pragmatic trial that relied principally on electronic health record data to measure outcomes and safety. Although this could have led to volunteer and nonresponse bias, the respondents were generally representative of the overall study participants and are likely similar to patients with poorly controlled hypertension in primary care practice. Finally, the side effect symptoms we asked about are commonly observed in controlled trials in patients randomized to placebo and were asked in the context of a survey that focused mainly on blood pressure management.

A new and brief approach to evaluating side effect symptoms to antihypertensive medications was used in this study. In this patient population with poorly controlled hypertension, it revealed very high rates of side effect symptoms that were often seen by patients as big or very big problems and were significantly related to treatment dissatisfaction and medication nonadherence. More research is needed to explore whether better and more direct ways to identify and manage side effects in primary care practice settings could improve hypertension care and outcomes.

To see this article online, please go to: <http://jabfm.org/content/38/2/312.full>.

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## Appendix 1.

**Appendix 1 Table 1. Associations Between Severity Ratings of Select Hypertension Medication Side Effect Symptoms and Specific BP Medications Current at the Index Visit, Among Patients Reporting Taking Any Blood Pressure Medications in the Prior 6 Months (n = 1,601)**

	Not a Problem	Somewhat/Moderate	Big/Very Big
Tiredness, n (%)			
All	480 (30.0%)	828 (51.7%)	293 (18.3%)
Not taking beta blocker	286 (30.2%)	494 (52.1%)	168 (17.7%)
Taking beta blocker	194 (29.7%)	334 (51.1%)	125 (19.1%)
Cough, n (%)			
All	1,057 (66.0%)	431 (26.9%)	113 (7.1%)
Not taking ACE inhibitor	726 (66.4%)	<b>287 (26.2%)</b>	81 (7.4%)
Taking ACE inhibitor	331 (65.3%)	<b>144 (28.4%)</b>	32 (6.3%)
Leg Swelling, n (%)			
All	1,011 (63.1%)	435 (27.2%)	155 (9.7%)
Not taking CCB (DHP)	770 (66.0%)	<b>304 (26.0%)</b>	<b>93 (8.0%)</b>
Taking CCB (DHP)	241 (55.5%)	<b>131 (30.2%)</b>	<b>62 (14.3%)</b>
Urinary Frequency, n (%)			
All	709 (44.3%)	702 (43.8%)	190 (11.9%)
Not taking thiazide diuretic	479 (44.6%)	<b>458 (42.7%)</b>	136 (12.7%)
Taking thiazide diuretic	230 (43.6%)	<b>244 (46.2%)</b>	54 (10.2%)
Sexual symptoms, n (%)			
All	1,214 (75.8%)	244 (15.2%)	143 (8.9%)
Not taking thiazide diuretic	809 (75.4%)	162 (15.1%)	102 (9.5%)
Taking thiazide diuretic	405 (76.7%)	82 (15.5%)	41 (7.8%)
Not taking beta blocker	726 (76.6%)	139 (14.7%)	83 (8.8%)
Taking beta blocker	488 (74.7%)	105 (16.1%)	60 (9.2%)

*Abbreviations:* CCB, calcium channel blocker; DHP, dihydropyridine.

**Appendix 1 Table 2. Associations Between Symptom Severity and Perceived Relatedness to Medication to Blood Pressure Treatment Dissatisfaction (n = 1,365)**

	Symptom Severity			Perceived Relationship to Medications			p
	Total with Symptom	Somewhat or Moderate	Big or Very Big	Unrelated to Meds	Related to Meds		
ANY symptom	1,365	779	586	737	628		0.001
Somewhat or very satisfied	712 (52.2%)	443 (56.9%)	269 (45.9%)	402 (54.6%)	310 (49.4%)		
Neither satisfied nor dissatisfied	329 (24.1%)	185 (23.7%)	144 (24.6%)	198 (26.9%)	131 (20.9%)		
Somewhat or very dissatisfied	324 (23.7%)	151 (19.4%)	173 (29.5%)	137 (18.6%)	187 (29.8%)		
Tiredness	1060	779	281	869	191		<0.001
Somewhat or very satisfied	533 (50.3%)	408 (52.4%)	125 (44.5%)	454 (52.2%)	79 (41.4%)		
Neither satisfied nor dissatisfied	265 (25.0%)	193 (24.8%)	72 (25.6%)	222 (25.5%)	43 (22.5%)		
Somewhat or very dissatisfied	262 (24.7%)	178 (22.8%)	84 (29.9%)	193 (22.2%)	69 (36.1%)		
Dizziness	650	538	112	422	228		0.006
Somewhat or very satisfied	325 (50.0%)	276 (51.3%)	49 (43.7%)	222 (52.6%)	103 (45.2%)		
Neither satisfied nor dissatisfied	141 (21.7%)	124 (23.0%)	17 (15.2%)	100 (23.7%)	41 (18.0%)		
Somewhat or very dissatisfied	184 (28.3%)	138 (25.6%)	46 (41.1%)	100 (23.7%)	84 (36.8%)		
Leg swelling	553	411	142	401	152		0.003
Somewhat or very satisfied	276 (49.9%)	214 (52.1%)	62 (43.7%)	210 (52.4%)	66 (43.4%)		
Neither satisfied nor dissatisfied	138 (25.0%)	96 (23.4%)	42 (29.6%)	108 (26.9%)	30 (19.7%)		
Somewhat or very dissatisfied	139 (25.1%)	101 (24.6%)	38 (26.8%)	83 (20.7%)	56 (36.8%)		
Cough	517	410	107	403	114		0.03
Somewhat or very satisfied	252 (48.7%)	205 (50.0%)	47 (43.9%)	202 (50.1%)	50 (43.9%)		
Neither satisfied nor dissatisfied	132 (25.5%)	110 (26.8%)	22 (20.6%)	110 (27.3%)	22 (19.3%)		
Somewhat or very dissatisfied	133 (25.7%)	95 (23.2%)	39 (35.5%)	91 (22.6%)	42 (36.8%)		
Urinary frequency	845	668	177	665	280		0.04
Somewhat or very satisfied	410 (48.5%)	327 (48.9%)	83 (46.9%)	280 (49.6%)	130 (46.4%)		
Neither satisfied nor dissatisfied	219 (25.9%)	176 (26.3%)	43 (24.3%)	161 (28.5%)	58 (20.7%)		
Somewhat or very dissatisfied	216 (25.6%)	165 (24.7%)	51 (28.8%)	124 (22.0%)	92 (32.9%)		
Sexual symptoms	374	235	139	271	103		0.04
Somewhat or very satisfied	191 (44.7%)	119 (50.6%)	48 (34.5%)	128 (47.2%)	39 (37.9%)		
Neither satisfied nor dissatisfied	113 (30.2%)	69 (25.5%)	35 (88.1%)	38 (30.3%)	30 (29.1%)		
Somewhat or very dissatisfied	94 (25.1%)	65 (23.8%)	38 (27.3%)	69 (22.1%)	34 (33.0%)		

**Appendix 1 Table 3. Associations Between Symptom Severity and Perceived Relatedness to Medication Adherence to Blood Pressure Treatment Adherence (Changing or Stopping Medications Due to Side Effects) and (n = 1,423)**

	Symptom Severity			Perceived Related to Medication		
	Total with Symptom	Somewhat or Moderate	Big or Very Big	Unrelated to Meds	Related to Meds	p
Any symptom	1,423	811	612	769	654	
No adherence issue	1,090 (76.6%)	664 (81.9%)	426 (69.6%)	661 (86.0%)	429 (65.6%)	<0.001
Yes adherence issue	333 (23.4%)	147 (18.1%)	186 (30.4%)	108 (14.0%)	225 (34.4%)	
Tiredness	1,102	812	290	905	197	<0.001
No adherence issue	826 (75.0%)	626 (77.1%)	200 (69.0%)	706 (78.0%)	120 (60.9%)	
Yes adherence issue	276 (25.0%)	186 (22.9%)	90 (31.0%)	199 (22.0%)	77 (39.1%)	
Dizziness	675	560	115	442	233	<0.001
No adherence issue	467 (69.2%)	406 (72.5%)	61 (53.0%)	336 (76.0%)	131 (56.2%)	
Yes adherence issue	208 (30.8%)	154 (27.5%)	54 (47.0%)	106 (24.0%)	102 (43.8%)	
Leg swelling	583	431	152	425	1,589	<0.001
No adherence issue	435 (74.6%)	326 (75.6%)	109 (71.7%)	339 (89.8%)	96 (60.8%)	
Yes adherence issue	148 (25.4%)	105 (24.4%)	43 (28.3%)	86 (20.2%)	62 (39.2%)	
Cough	541	428	113	424	117	<0.001
No adherence issue	392 (72.5%)	318 (74.3%)	74 (65.5%)	323 (76.2%)	69 (59.0%)	
Yes adherence issue	149 (27.5%)	110 (25.7%)	39 (34.5%)	101 (23.8%)	48 (41.0%)	
Urinary frequency	886	696	190	592	294	0.08
No adherence issue	692 (77.9%)	527 (75.7%)	135 (71.0%)	453 (76.5%)	209 (71.1%)	
Yes adherence issue	224 (25.3%)	169 (24.3%)	55 (29.0%)	139 (33.5%)	85 (28.9%)	
Sexual symptoms	384	242	142	278	106	>0.001
No adherence issue	278 (72.4%)	183 (75.6%)	95 (66.9%)	214 (77.0%)	64 (60.4%)	
Yes adherence issue	106 (27.6%)	59 (24.4%)	47 (33.1%)	64 (23.0%)	42 (39.6%)	

## Appendix 2.

### Blood Pressure Care Survey



### Blood Pressure Care Survey

The following questions are about your health and health care that you receive. There are no right or wrong answers, please answer based on your personal experience. If you are not comfortable answering a question, you can skip it.

**1. In general, how would you rate your overall health?**

- Excellent
- Very good
- Good
- Fair
- Poor

**2. Using any number from 0-10, where 0 is the worst possible health care for your blood pressure and 10 is the best possible health care for your blood pressure, what number would you use to rate your health care for your blood pressure in the past 6 months?**

0      1      2      3      4      5      6      7      8      9      10  
*Worst* *Best*

**3. We would like to learn about the type of help with your blood pressure you get from your health care team. This might include your doctors, nurses, clinical pharmacists or other staff involved in planning or delivering your care.<sup>1</sup>**

Over the past 6 months, when you received care for my blood pressure, were you...	Almost never	Generally not	Sometimes	Most of the time	Almost always
a. Asked for your ideas when you and your healthcare team made a treatment plan.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Given choices about treatment to think about.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Asked to talk about any problems with your medicines or their effects.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Asked to talk about your goals in caring for your blood pressure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Satisfied that all the people involved in your care were "on the same page."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**4. We are interested in knowing what activities you found most helpful in managing your blood pressure over the last 6 months. For each of the following items choose the response that best reflects how helpful each activity has been for you. If you did not use an activity, choose "not applicable".**

In the last 6 months, how helpful was...	Not at all helpful	Somewhat helpful	Moderately helpful	Very helpful	Extremely helpful	Not applicable
a. Increasing your physical activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Decreasing the amount of salt you eat.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Watching your weight.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Reducing or managing stress.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Limiting your alcohol use (for example, beer, wine, or liquor).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**5. In the last 6 months, on average how many times did you measure your blood pressure outside of a clinic visit? (For example: at home or work.)**

- Never (skip to question 6)
- 1 time or less per month
- 2-3 times per month
- About 1 time a week
- 2-3 times per week
- 4 or more times per week

**a. In the last 6 months, have you shared your outside blood pressure measurements with your doctor, nurse or a pharmacist?**

- Yes       No (skip to question 6 on the next page)

**b. How do you share your blood pressure measurements? (Check all that apply)**

- At clinic visits
- By telephone
- By secure e-mail
- Electronically (smartphone app, computer, wirelessly)
- Other, specify: \_\_\_\_\_

**c. Has anyone on your healthcare team ever started you on or changed your blood pressure medicine because of the blood pressure measurements you took outside of clinic visits?**

Yes  
 No

**6. How confident are you in your ability to do each of the following related to health care and managing your blood pressure?**

How confident are you that you can...	Not at all confident	Somewhat confident	Moderately confident	Very confident	Extremely confident
a. Contact your health care team from home when you have a question or concern?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Include measuring your blood pressure at home in your weekly routine?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Know your blood pressure target numbers?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Keep your blood pressure below your target number?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Include taking blood pressure medicine in your daily routine?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**7. In the last 6 months have you taken any medicines for your blood pressure?**

- Yes  
 No (skip to question 12 on page 5)

**8. Are you currently taking any medicines for your blood pressure?**

- Yes  
 No

**9. The following questions are about common symptoms that may or may not be related to your blood pressure medicine. Please think back over the last 6 months when answering each of the following questions.**

**a. How much of a problem was tiredness to you?**

- Not a problem
- Somewhat of a problem
- Moderate problem
- Big problem
- Very big problem

**Do you think that this was related to your blood pressure medicine?**

- Yes
- No
- Not sure

**b. How much of a problem was feeling dizzy, lightheaded or faint to you?**

- Not a problem
- Somewhat of a problem
- Moderate problem
- Big problem
- Very big problem

**Do you think that this was related to your blood pressure medicine?**

- Yes
- No
- Not sure

**c. How much of a problem was swelling of feet or legs to you?**

- Not a problem
- Somewhat of a problem
- Moderate problem
- Big problem
- Very big problem

**Do you think that this was related to your blood pressure medicine?**

- Yes
- No
- Not sure

**d. How much of a problem was coughing to you?**

- Not a problem
- Somewhat of a problem
- Moderate problem
- Big problem
- Very big problem

**Do you think that this was related to your blood pressure medicine?**

- Yes
- No
- Not sure

**e. How much of a problem was frequent urination to you?**

- Not a problem
- Somewhat of a problem
- Moderate problem
- Big problem
- Very big problem

**Do you think that this was related to your blood pressure medicine?**

- Yes
- No
- Not sure

**f. How much of a problem were sexual symptoms to you?**

- Not a problem
- Somewhat of a problem
- Moderate problem
- Big problem
- Very big problem

**Do you think that this was related to your blood pressure medicine?**

- Yes
- No
- Not sure

**g. How much of a problem were other symptoms to you?**

- Not a problem
- Somewhat of a problem
- Moderate problem
- Big problem
- Very big problem

**Do you think that this was related to your blood pressure medicine?**

- Yes
- No
- Not sure

**10. In the last 6 months, have you changed or stopped your blood pressure medicine, even just for a few days, because of symptoms you think were related to your blood pressure medicine?**

- Yes
- No

**11. Taking all things into account, how satisfied or dissatisfied are you with the blood pressure medicine you've taken in the last 6 months?**

- Very dissatisfied
- Somewhat dissatisfied
- Neither satisfied nor dissatisfied
- Somewhat satisfied
- Very satisfied

**12. Please consider everything you have to do to take care of your blood pressure. How much of a problem are each of the following? If you do not do an activity, choose "not applicable".**

How much of a problem is the following:	Not a problem	Somewhat of a problem	Moderate problem	Big problem	Very big problem	
a. Measuring your blood pressure: frequency, time spent or inconvenience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Clinic visits: frequency or time spent for these visits (including travel).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Phone visits: frequency or time spent for these visits.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Scheduling clinic visits, phone visits, or other appointments and reorganizing your schedule around these.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Time away from work or your normal routine for activities related to your blood pressure care.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. Following recommendations to increase physical activity (for example: walking, jogging, swimming.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. Lifestyle changes (for example: avoiding certain foods or alcohol, quitting smoking.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. The costs associated with your blood pressure care and medicine (for example: copays or other expenses not covered by insurance.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Our final questions will help us understand more about who you are. As a reminder, your responses will be kept confidential and will not be associated with your name in any way.**

**13. What language do you usually speak at home?**

- English
- Spanish
- Other, specify: \_\_\_\_\_

**14. Do you consider yourself to be Hispanic or Latino?**

- No, not Hispanic/Latino
- Yes, Hispanic/Latino

**15. Which of the following do you consider yourself? (Mark all that apply.)**

- Asian
- Black or African American
- White
- American Indian or Alaskan Native
- Native Hawaiian or other Pacific Islander
- Other, specify: \_\_\_\_\_

**16. What is the highest level of school you have completed or the highest degree that you have received?**

- Less than 8 years
- Some high school
- High school diploma or GED
- Technical training or Associate degree
- Some college
- College degree
- Graduate studies

**17. What best describes your current employment status? If more than one applies, please choose the one category that best describes your employment status.**

- Employed
- Unemployed
- In school or vocational training
- Retired
- Homemaker
- Disabled
- Other, specify: \_\_\_\_\_

**Are you employed full-time or part-time?**

- Full-time
- Part-time

**18. What is your best estimate of the total income of all family members living in your household from all sources before taxes in the last calendar year?**

- Less than \$20,000
- Between \$20,000 and \$49,999
- Between \$50,000 and \$99,999
- More than \$100,000

**19. We will be reaching out to you 3 more times over the next 2 years so that you can take this survey again. You will receive another \$10 Target gift card for each of the surveys that you complete. When it is time for you to complete the next survey, we can either mail the survey to you, send it to you via email or call you to complete it over the phone. Which would you prefer?**

Mail

Email →

Phone →   -  -   
*and*  
When is the best time to call? (check all that apply)  AM  PM  Sat.

**Thank you for your time. Your responses are important to the Blood Pressure Care Study. Your \$10 gift card will be mailed to you within a few days.**