Original Paper

Understanding Uncontrolled Hypertension: Is It the Patient or the Provider?

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The relative contributions of adherence and treatment intensity to blood pressure (BP) control are not well understood. The authors studied patients with uncontrolled hypertension (N=410) from 3 primary care clinics in the Veterans Affairs (VA) medical system. A questionnaire was used to assess patient adherence to therapy, and VA system pharmacy fills were used to assess the intensity of the antihypertensive regimen. At baseline, an inadequate antihypertensive regimen was implicated as the most probable reason for uncontrolled BP in a majority of patients (72%), while nonadherence could only be implicated in 13%. In multivariate longitudinal analyses, patients who had an increase in their medical treatment during the study had lower final diastolic BP levels compared with the patients who did not (–3.70 mm Hg; P<.05). While patient adherence to therapy plays a role, vigorous clinical management by the clinician is a more important contributor to BP control. (J Clin Hypertens. 2007;9:937–943) ©2007 Le Jacq

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Despite concerted efforts to improve the treatment of hypertension, only 64% of the hypertensive patients in the United States who were treated in 2003 and 2004 had controlled blood pressure (BP) (<140/90 mm Hg).[1] There are 3 main causes of failure to control BP despite therapy: patient nonadherence, insufficient titration of therapy, and resistant disease. A large body of research has documented the contribution of patient nonadherence to poor control in many chronic conditions, including hypertension.[2–4] More recently, a growing body of literature has also documented clinician failures to escalate therapy to bring a chronic condition under control.[5–7] Hypertension is only one of many chronic conditions to be affected by this failure to appropriately titrate therapy, which Phillips and colleagues[8] have called "clinical inertia." Finally, it has long been recognized that some patients have resistant hypertension, which is defined as a BP level that remains >139/89 mm Hg despite apparently adequate adherence and therapeutic intensity.[9,10] Understanding the relative contributions of these factors to uncontrolled hypertension is important for designing effective interventions to improve hypertension control; however, no previous study has addressed this issue in a primary care population.

We undertook this prospective cohort study of a group of patients from the Veterans Affairs (VA) medical system with uncontrolled hypertension to address 2 questions. First, what proportion of patients with uncontrolled hypertension had poor adherence, inadequate management, or neither of these? Second, would patient adherence and treatment intensity predict BP control at the end of the study? By addressing these questions, we sought to address the relative impact of poor adherence and treatment intensity on BP control.

Table I. Questions Used to Assess Adherence to Therapy

1. Some people have difficulty in taking blood pressure medication as prescribed. Do you have difficulty with this?
2. How many days in the past week did you forget to take your blood pressure medication?
3. How many days in the past week did you not take your medication on purpose?
4. How many days in the past week did you add an extra pill?
5. Did you ever take less medicine because you felt you needed less?
6. Sometimes if you feel worse when you take the medicine, do you stop taking it?

METHODS

The Cohort

Our sample was drawn from a larger study of VA system patients with hypertension conducted between January 1, 2002, and April 21, 2004.[11] We identified all non-Hispanic white and non-Hispanic black patients with outpatient diagnoses of hypertension on at least 2 separate occasions in 2001 at 3 urban tertiary care VA medical centers (*International Classification of Diseases, Ninth Revision [ICD-9]* diagnosis codes: 401, 401.0, 401.1, 401.9, 405–405.11, 405.19, 405.9, 405.91, 405.99). The study was approved by the institutional review board of all participating facilities, and patients provided informed consent.

Using this "universe" of 11,731 hypertensive patients, study staff tracked these patients' primary care visits over a 14-month period and, as they presented for care, invited 1210 of them to complete a questionnaire regarding their self-care for hypertension. Of these 1210, 204 (17%) were excluded from the study: 18 because their race was other than non-Hispanic white or non-Hispanic black, 41 because of impaired cognition, 59 because they denied having hypertension, 6 because they were already enrolled in another hypertension study, and 80 for miscellaneous reasons including being too ill to participate or moving or dying before they could be enrolled in the study. Of the 1006 eligible patients, 793 (79%) completed the survey, and the remainder refused to participate. Research associates verbally administered the questionnaire to patients and recorded the responses.

Of those 793 patients, we studied only the patients whose initial BP, as recorded in the electronic medical record (EMR), was uncontrolled based on the definition in the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI) guidelines (≥140/90 mm Hg).[12] Because such a small portion of our sample (1%) comprised women, we excluded them from our analyses. Thus, our final sample was composed of 410 male patients with uncontrolled BP at baseline who had completed the questionnaire.

Dependent Variable: BP

Patient BP values were our dependent variables. We used the BP level as recorded in the EMR rather than obtaining BP using a standardized research protocol; we reasoned that this was the figure that would guide clinician decisions regarding therapy. When multiple BP measurements were taken on the same day, we used the one with the lowest systolic BP.

The BP level of each patient was measured within 3 days of enrolling in the study; this constituted the initial BP. The study ended on April 21, 2004; the last BP reading obtained for each patient before this date became his outcome BP. We analyzed systolic and diastolic BP values as continuous measures of BP control. In addition, we dichotomized all BP values into 2 categories: controlled and not controlled, based on whether they were >139/89 mm Hg. If either the systolic or the diastolic BP was in excess of this goal, the BP was considered uncontrolled. While guidelines such as JNC VI and JNC 7 have called for lower BP targets in patients with diabetes and renal disease,[12,13] VA clinical guidelines continued to support a formal goal of 140/90 mm Hg for all patients throughout our study period.[14]

Independent Variable: Adherence

We measured adherence using the portion of the patient questionnaire asking about issues with adherence to therapy. The 6 questions in this portion of the instrument (Table I) were adapted from the work of Choo and associates[15] and Morisky[4] and colleagues. Such self-reported measures of adherence have been demonstrated to correlate with end points such as BP control in our cohort and others.[4,11] Among the 793 patients who completed the questionnaire, patients who endorsed at least 2 of the 6 items were significantly more likely to have uncontrolled BP at baseline (odds ratio, 1.86; $P<.001$). We took this to imply validity of this as a measure of patient adherence, which relates to BP control. Therefore, we classified patients as adherent or nonadherent with therapy based on whether they endorsed at least 2 of the 6 items.

Independent Variable: Treatment Intensity

There were 2 variables used to capture the concept of treatment intensity, one that we used at baseline

and the other that we used for the longitudinal analysis. At baseline, we divided all patients into 2 groups based on whether their regimen met our definition for adequacy. We defined adequate therapy as a regimen containing drugs from at least 3 different classes of antihypertensives, at least 1 of which had to be a loop or thiazide diuretic. Inadequate use of diuretics has been particularly identified as a common reason for uncontrolled hypertension.[10,16–19]

All 3 drugs had to be prescribed in at least a moderate dosage. Minimal dosages to satisfy this definition and the division of drugs into different classes were defined for all agents used in this study; the list in Table II was discussed among several clinicians who agreed that it had validity. This definition of an adequate regimen for difficult-to-control hypertension is based on the JNC VI guidelines,[12] which were current at the inception of this study and are echoed by the VA guidelines for the management of hypertension,[14] both now and at the time of the study.

For the longitudinal analysis, we determined for each patient whether therapy was increased between the beginning and the end of the study. The regimen was considered to have been augmented if the patient was receiving an increased number of antihypertensive medications at the end of the study than the beginning or if any of the medication doses were increased during the study.

Covariates

We adjusted for the known predictors of BP control to isolate the effects of adherence and therapy on BP. Race was based on patient self-report and was divided into 2 groups: non-Hispanic black and non-Hispanic white. Patient age was recorded in the EMR and was divided into 3 categories: 64 years or younger, 65 to 74 years and 75 years and older. Borzecki and colleagues[20] have shown that the effect of age on the management and control of hypertension is categoric rather than linear; therefore, we categorized age to capture this effect. The *ICD-9* codes for diabetes mellitus, renal disease, and coronary artery disease were taken from the EMR. Body mass index was calculated from height and weight as recorded in the EMR, and patients with a body mass index ≥30 were considered obese. We also adjusted for the frequency of clinical visits using the average number of BP values per month as a proxy measure. In all analyses, we adjusted for the clustering of outcomes by the site of care, modeling site as a random effect. Finally, in all analyses, we adjusted for the effect of baseline BP on final BP.

Table II. Antihypertensive Agents Used in Our Study, Divided by Class, With Adequate Dosages

Angiotensin-converting enzyme inhibitors
Captopril 150 mg/d
Enalapril 20 mg/d
Fosinopril 20 mg/d
Lisinopril 20 mg/d
Aldosterone antagonists
Spironolactone 25 mg/d
α-Blockers
Doxazosin 4 mg/d
Prazosin 10 mg/d
Terazosin 5 mg/d
Angiotensin receptor blockers
Candesartan 16 mg/d
Irbesartan 150 mg/d
Valsartan 160 mg/d
β-Blockers
Atenolol 50 mg/d
Carvedilol 25 mg/d
Labetalol 600 mg/d
Metoprolol 100 mg/d (either formulation)
Propranolol 80 mg/d
Calcium channel blockers (dihydropyridines)
Amlodipine 5 mg/d
Felodipine 5 mg/d
Nifedipine 60 mg/d
Calcium channel blockers (nondihydropyridines)
Diltiazem 180 mg/d
Verapamil 180 mg/d
Centrally acting vasodilators (each is a unique drug class)
Clonidine
Patch 0.2 mg
Tablets 0.6 mg/d
Hydralazine 100 mg/d
Minoxidil 20 mg/d
Diuretics (loop)
Bumetanide 1 mg/d
Furosemide 40 mg/d
Diuretics (thiazide)
Chlorthalidone 25 mg/d
Hydrochlorothiazide 25 mg/d
Metolazone 0.5 mg/d

Statistical Analyses

We began with a cross-sectional analysis of the correlates of uncontrolled hypertension at baseline. We divided our sample into 3 groups: those whose uncontrolled hypertension at baseline could be attributed to poor adherence, inadequate management, or physiologic resistance, respectively. Our first group contained the patients reporting poor

Table III. Baseline Characteristics of the Cohort[a]

Characteristic	Group 1 (n=410)	Group 2 (n=338)
Age, y		
64 or younger	173 (42)	136 (40)
65–74	131 (32)	109 (32)
75 or older	106 (26)	93 (28)
Initial systolic BP, mean (SD), mm Hg	155.0 (13.9)	155.0 (13.8)
Initial diastolic BP, mean (SD), mm Hg	80.2 (11.9)	80.6 (11.9)
<0.5 BP measurements per month	131 (32)	117 (35)
Race/ethnicity		
Non-Hispanic black	236 (58)	191 (57)
Non-Hispanic white	174 (42)	147 (43)
Obesity (body mass index ≥30)	200 (50)	152 (46)
Diabetes mellitus	189 (46)	145 (43)
Coronary artery disease	192 (47)	151 (45)
Renal disease	105 (26)	78 (23)

Values are expressed as No. (%) unless otherwise indicated.
[a]Group 1 is all patients with uncontrolled blood pressure (BP) at baseline, while group 2 is the subset of group 1 who also had inadequate therapy at baseline considering their uncontrolled BP.

adherence to therapy; if adherence is sufficiently poor, even the best management may not succeed in controlling BP. We then divided the remaining patients into those who were receiving an adequate regimen and those who were not, according to the definition discussed earlier. By process of elimination, patients whose BP was poorly controlled despite apparently adequate adherence and therapy were considered to have physiologically resistant hypertension.

We then examined the predictors of final BP using the subset of patients with uncontrolled BP at baseline whose initial therapy was also inadequate and thus presented an opportunity for intensification. We used linear regressions to measure the ability of our independent variables to predict the final systolic BP and diastolic BP levels, controlling for covariates and the site of care. We used logistic regression to measure the ability of our independent variables to predict whether the final BP would be controlled, controlling for covariates and the site of care. We performed all analyses using SAS 9.1 (SAS Institute Inc, Cary, NC).

RESULTS

There were 410 patients with baseline uncontrolled hypertension (group 1) in our study cohort (Table III). Of these 410 patients, 17% were on adequate regimens, while 67% were on <3 medications and 16% were on ≥3 medications but at inadequate doses or without the use of a diuretic. The 338 patients whose therapy was inadequate at baseline in light of their uncontrolled BP formed a second group for analysis (group 2). During the 2-year study period, 51% of the patients experienced a change in their medical regimens with an increase in medication.

The average patient was followed for 438 days, with 95% of the sample having at least 221 days of data. The median patient had 12 BP values during the study; 95% of the sample had at least 5 BP values. The average age was 66.5 years, and more than half of the patients (58%) were black. The prevalence of comorbid conditions was high; only 27% of the patient population did not have at least 1 of 3 comorbidities, namely diabetes, renal disease, and coronary artery disease. Also, 49% of the sample was obese.

Fifty-two (13%) patients endorsed ≥2 of the adherence questions and were thus labeled as poorly adherent with their therapy. Of the adherent patients, 297 (72%) were on an inadequate regimen of antihypertensive medications considering their BP. Sixty-one patients (15%) with uncontrolled hypertension did not report poor adherence and were on an adequate regimen of medications. These patients were considered to have resistant hypertension, presumably due to physiologic factors.

The mean final BP level in the entire sample was 142/75 mm Hg, a marked improvement from the initial mean level of 155/80 mm Hg. When we examined the subset of patients with inadequate therapy at baseline despite their uncontrolled hypertension (n=338), none of our independent variables significantly predicted the final systolic BP. Higher treatment intensity, however, significantly predicted a lower diastolic BP level in adjusted analyses (Table IV).

Controlled BP (<140/90 mm Hg) was achieved in a substantial proportion of the cohort (46%) by the end of the study. In bivariate analyses, BP control was achieved in patients with poor adherence 33% of the time by the end of the study, compared with 47% for the other patients (P=.04). In patients with inadequate therapy at baseline, after adjustment for covariates (Table V), this result was no longer statistically significant (odds ratio, 0.52; 95% confidence interval, 0.25–1.09; P=.08).

DISCUSSION

We compared the effects of patient adherence and clinician management of hypertension on the initial

Table IV. Predictors of Follow-Up Systolic and Diastolic BP Levels in Patients With Uncontrolled BP and Inadequate Therapy at Baseline[a]

	SBP (95% CI)	DBP (95% CI)
Poor adherence to medication	0.19 (–6.18 to 6.56)	0.18 (–3.49 to 3.85)
Any change in therapy vs none	–2.83 (–7.05 to 1.38)	–3.70 (–6.13 to –1.28)[b]
Baseline SBP or DBP (per mm Hg)	0.43 (0.27 to 0.58)[b]	0.35 (0.24 to 0.46)[b]
<0.5 BP measurements per mo	1.78 (–2.86 to 6.42)	–0.15 (–2.75 to 2.46)
Age (oldest vs youngest)	3.61 (–4.11 to 11.33)	–5.48 (-10.07 to –0.89)[b]
Age (moderate vs youngest)	–0.95 (–8.06 to 6.17)	–5.49 (–9.66 to –1.33)[b]
Body mass index ≥30	0.68 (–3.59 to 4.95)	0.78 (–1.68 to 3.24)
Diabetes mellitus	2.89 (–1.53 to 7.30)	–1.12 (–3.67 to 1.42)
Coronary artery disease	–0.93 (–5.17 to 3.32)	0.26 (–2.20 to 2.72)
Renal disease	1.50 (–3.75 to 6.75)	–1.41 (–4.42 to 1.60)
Black race	0.03 (–4.57 to 4.63)	0.50 (–2.09 to 3.09)

[a]Results from multivariate linear regression models, accounting for site of care as a random effect.[b]Results are significant at the .05 level (n=338). β-Coefficients are expressed in units of mm Hg; a β-coefficient of +1.0 indicates a 1.0-mm Hg increase in final blood pressure (BP). Abbreviations: CI, confidence interval; DBP, diastolic BP; SBP, systolic BP.

and follow-up BP of a group of patients in the VA medical system. Our baseline analysis suggests that inadequate treatment intensity, or clinical inertia, is the most common reason for uncontrolled hypertension (72%). In addition, in longitudinal analyses, increased treatment intensity was associated with a lower final diastolic BP level, while the effects of adherence were not statistically significant.

Only limited research has compared the relative contributions of patient adherence, clinical inertia, and resistant hypertension with the failure to control the BP in hypertensive patients receiving pharmacotherapy. Two case series document the experience of a single hypertension referral center.[17,21] These studies found that an inadequate medical regimen was the most common cause of uncontrolled hypertension on referral to their clinic (58%), followed by poor adherence as the second most common cause (16%); these proportions are similar to what we found. In a smaller but intriguing study, Javors and Bramble[22] reviewed the care of 30 patients with various chronic conditions to investigate the relative effects of guideline-based management and patient adherence on long-term control. In their study, BP in the majority of patients was not well controlled, and clinician failure to adhere to guideline-based management was strongly predictive of uncontrolled disease. Patient adherence was generally high in their sample and did not predict control of the chronic conditions. Like their study, ours suggests that vigorous clinical management may contribute more to the control of chronic conditions than patient adherence to therapy.

It is of interest to note that in a recent Harris Survey, >90% of hypertensive patients reported that they were receiving antihypertensive therapy

Table V. Predictors of Follow-Up BP Control in Patients With Uncontrolled BP and Inadequate Therapy at Baseline[a]

	OR	95% CI
Poor adherence to medication	0.52	0.25–1.09
Any change in therapy vs none	1.23	0.77–1.96
Initial systolic BP (per mm Hg)	0.965	0.947–0.983[b]
Fewer than 0.5 BP measurements per mo	0.99	0.60–1.64
Age (oldest vs youngest)	0.65	0.27–1.53
Age (moderate vs youngest)	1.23	0.56–2.67
Body mass index ≥30	0.82	0.52–1.32
Diabetes mellitus	0.84	0.52–1.37
Coronary artery disease	1.08	0.68–1.73
Renal disease	1.22	0.68–2.19
Black race	1.23	0.75–2.03

[a]Results of a multivariate logistic regression analysis accounting for site of care as a random effect. [b]Results are significant at the .05 level (n=338). Odds ratios (OR) >1.0 indicate a higher likelihood of controlled blood pressure (BP) at the end of the study. Abbreviation: CI, confidence interval.

but, consistent with other reports, >30% did not have their medication increased despite continued elevated BP levels.[23]

In part, our study examined clinician adherence to JNC 6 guidelines, which were current at the time of this study, regarding BP goals and what constitutes a reasonable regimen for resistant hypertension.[12] JNC guidelines have been widely disseminated for many years, but there is some evidence that clinicians may not be aware of them or may not agree with all of their recommendations. In a physician questionnaire study published in 2000, Hyman and Pavlik[24] showed that in contrast to the JNC 6 recommendation to intensify therapy

when the BP level exceeds 139/89 mm Hg, 25% of physicians would not intensify therapy for a diastolic BP level of 94 mm Hg and 33% would not intensify for a systolic BP level of 158 mm Hg. In their study, 41% of physicians were not familiar with the JNC guidelines, and such nonfamiliarity was associated with higher treatment thresholds.[24] Recent improvements in meeting BP targets in the VA system[25] may attest to increasing clinician acceptance of the 140/90 mm Hg threshold to intensify therapy.

Some strengths of our study should be noted. Ours was a multisite study including many practitioners, extending the generalizability of the results. In addition, unlike previous studies on this issue, our patients were seen in a primary care environment, the setting in which most hypertension is managed.

Our study also had several limitations, however. First, we analyzed only male patients due to the predominantly male patient population in the VA system and a high percentage of patients were black. Similarly, the VA population tends to be older and have more comorbidities than the US population, and our study is no exception.

Second, our adherence data were collected by patient report, which is a limitation although this has been shown to be a reliable measure of adherence.[4,15] There are other ways to measure patient adherence to medication, including medication possession ratios, which are derived from the frequency of pharmacy fills. Recent reports have cast doubt on the continued validity of such measures in the VA system, however, especially because many prescriptions are refilled automatically by mail and thus are not a reflection of patient adherence.[26]

Third, we used clinical BP values, rather than obtaining BP through a standardized research protocol. Since we were studying clinician behavior, however, it makes sense that we should analyze the same BP values that guided the actual decisions about whether to escalate therapy. Fourth, sample size limited our ability to detect some effects, especially with regard to systolic BP.

Fifth, regression to the mean, as well as secular trends of improving BP control at the VA, probably accounted for some of the impressive reduction in mean BP level during the study (ie, from 155/80 mm Hg to 142/75 mm Hg). The VA has incorporated BP control to <140/90 mm Hg as a performance measure during the past 5 years, and the attainment of this goal in the VA has increased during this period.[25] Since all patients would be equally affected by secular trends and regression artifact, however, this does not lessen the validity of our results.

Sixth, many of our patients had only moderately uncontrolled BP; the mean BP level was 155/80 mm Hg at study inception and 142/75 mm Hg at the end of the study. We might have found a different relationship between the effects of adherence and treatment intensity on BP control in a population with more severely uncontrolled hypertension, and our results may not apply to such patients.

Finally, our methods of analysis might have muted the effects of some predictors. For example, many studies have found that patients on more vigorous regimens actually have higher BP due to confounding by indication.[27] One way around this limitation is to compare observed with expected treatment intensity, as was done by Berlowitz and colleagues[6] We did not have the data to pursue such a strategy. Although we found that any increase in the therapy was associated with a lower final diastolic BP, we might have found a more robust effect had we used methods to limit confounding by indication.

CONCLUSIONS

We studied a group of VA system patients with hypertension to elucidate the determinants of uncontrolled hypertension. Inadequate medical regimens could be blamed for a majority of uncontrolled hypertension at baseline, followed by poor adherence by the patient as the next most common reason. In longitudinal analyses, vigorous clinical management also seemed to exert a greater effect than patient adherence on BP control. The key to better BP control may, in fact, lie with the clinician.

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REFERENCES

1 Ong KL, Cheung BM, Man YB, et al. Prevalence, awareness, treatment, and control of hypertension among United States adults 1999–2004. *Hypertension.* 2007;49:69–75.
2 DiMatteo MR, Giordani PJ, Lepper HS, et al. Patient adherence and medical treatment outcomes: a meta-analysis. *Med Care.* 2002;40:794–811.
3 Haynes RB, Taylor DW, Sackett DL, et al. Can simple clinical measurements detect patient noncompliance?

Hypertension. 1980;2:757–764.
4 Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*. 1986;24:67–74.
5 Becker DM, Raqueno JV, Yook RM, et al. Nurse-mediated cholesterol management compared with enhanced primary care in siblings of individuals with premature coronary disease. *Arch Intern Med*. 1998;158:1533–1539.
6 Berlowitz DR, Ash AS, Hickey EC, et al. Inadequate management of blood pressure in a hypertensive population. *N Engl J Med*. 1998;339:1957–1963.
7 el-Kebbi IM, Ziemer DC, Musey VC, et al. Diabetes in urban African-Americans. IX. Provider adherence to management protocols. *Diabetes Care*. 1997;20:698–703.
8 Phillips LS, Branch WT, Cook CB, et al. Clinical inertia. *Ann Intern Med*. 2001;135:825–834.
9 Kaplan NM. Resistant hypertension. *J Hypertens*. 2005;23:1441–1444.
10 Moser M, Setaro JF. Clinical practice. Resistant or difficult-to-control hypertension. *N Engl J Med*. 2006;355:385–392.
11 Kressin NR, Wang F, Long J, et al. Hypertensive patients' race, health beliefs, process of care, and medication adherence. *J Gen Intern Med*. 2007;22:768–774.
12 The sixth report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure. *Arch Intern Med*. 1997;157:2413–2446.
13 The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA*. 2003;289:2560–2572.
14 Department of Veterans Affairs. *Clinical Practice Guidelines: Hypertension*; 2006.
15 Choo PW, Rand CS, Inui TS, et al. Validation of patient reports, automated pharmacy records, and pill counts with electronic monitoring of adherence to antihypertensive therapy. *Med Care*. 1999;37:846–857.
16 Appel LJ. The verdict from ALLHAT–thiazide diuretics are the preferred initial therapy for hypertension. *JAMA*. 2002;288:3039–3042.
17 Garg JP, Elliott WJ, Folker A, et al. Resistant hypertension revisited: a comparison of two university-based cohorts. *Am J Hypertens*. 2005;18:619–626.
18 Kaplan NM. Diuretics as a basis of antihypertensive therapy. An overview. *Drugs*. 2000;59(suppl 2):21–25 [discussion 39–40].
19 Moser M. Why are physicians not prescribing diuretics more frequently in the management of hypertension? *JAMA*. 1998;279:1813–1816.
20 Borzecki AM, Glickman ME, Kader B, et al. The effect of age on hypertension control and management. *Am J Hypertens*. 2006;19:520–527.
21 Yakovlevitch M, Black HR. Resistant hypertension in a tertiary care clinic. *Arch Intern Med*. 1991;151:1786–1792.
22 Javors JR, Bramble JE. Uncontrolled chronic disease: patient non-compliance or clinical mismanagement? *Dis Manag*. 2003;6:169–178.
23 Moser M, Franklin S. Hypertension management: results of a new national survey for the hypertension education foundation: Harris interactive. *J Clin Hypertens (Greenwich)*. 2007;9:316–323.
24 Hyman DJ, Pavlik VN. Self-reported hypertension treatment practices among primary care physicians: blood pressure thresholds, drug choices, and the role of guidelines and evidence-based medicine. *Arch Intern Med*. 2000;160:2281–2286.
25 Jha AK, Perlin JB, Kizer KW, et al. Effect of the transformation of the Veterans Affairs Health Care System on the quality of care. *N Engl J Med*. 2003;348:2218–2227.
26 Rothendler J, Fincke G, Reisman J, et al. Problems in calculating medication adherence from refill intervals [Abstract]. *VA Health Services Research & Development Meeting*; 2007.
27 Rubin HR, Pronovost P, Diette GB. The advantages and disadvantages of process-based measures of health care quality. *Int J Qual Health Care*. 2001;13:469–474.