Misperceptions About β-Blockers and Diuretics

A National Survey of Primary Care Physicians

Peter A. Ubel, MD, Christopher Jepson, PhD, David A. Asch, MD, MBA

BACKGROUND: **Based on a series of clinical trials showing no difference in the effectiveness or tolerability of most major classes of antihypertensive medications, the Joint National Commission on High Blood Pressure Treatment recommends that physicians prescribe β-blockers or diuretics as initial hypertensive therapy unless there are compelling indications for another type of medication. Nevertheless, many physicians continue to favor more expensive medications like angiotensin-converting enzyme (ACE) inhibitors and calcium channel blockers as first line agents. The persistent use of these agents raises questions as to whether physicians perceive ACE inhibitors and calcium channel blockers to be better than β-blockers and diuretics.**

METHODS: **We surveyed 1,200 primary care physicians in 1997, and another 500 primary care physicians in 2000, and asked them to estimate the relative effectiveness and side effects of 4 classes of medication in treating a hypothetical patient with uncomplicated hypertension: ACE inhibitors, β-blockers, calcium channel blockers, and diuretics. In addition, we asked them to indicate whether they ever provided free samples of hypertension medications to their patients.**

RESULTS: **Perceptions of the relative effectiveness and side effects of the 4 classes of hypertension medications did not significantly change over the 3 years, nor did prescription recommendations. Physicians perceive that diuretics are less effective at lowering blood pressure than the other 3 classes ($P < .001$). They also perceive that β-blockers are less tolerated than the other 3 classes ($P < .001$). In a multivariate model, perceptions of effectiveness and tolerability displayed significant associations with prescription preference independent of background variables. The only other variable to contribute significantly to the model was provision of free medication samples to patients.**

CONCLUSIONS: **Despite numerous clinical trials showing no difference in the effectiveness or side-effect profiles of these 4 classes of drugs, most physicians believed that diuretics were less effective and β-blockers were less tolerated than other medications. Moreover, their prescription practices were associated with their provision of free samples provided by pharmaceutical representatives, even after adjusting for other demographic characteristics. Efforts to increase physicians' prescribing of β-blockers and diuretics may need to be directed at overcoming misunderstandings about the effectiveness and tolerability of these medicines.**

KEY WORDS: **hypertension treatment; physician survey; pharmaceutical promotion.**
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Address correspondence and requests for reprints to Dr. Ubel: Director, Program for Improving Health Care Decisions, 300 North Ingalls, Room 7C27, Ann Arbor, MI 48109–0429 (e-mail: paubel@umich.edu).

Beta blockers and diuretics are inexpensive, effective, and well-tolerated antihypertensive medications. They are recommended as first line agents for the treatment of uncomplicated hypertension by the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.[1] A number of randomized controlled trials have shown that β-blockers and diuretics are as effective at lowering blood pressure as newer, more expensive agents such as angiotensin-converting enzyme (ACE) inhibitors and calcium channel blockers.[2–6] Moreover, a number of randomized controlled trials show that β-blockers and diuretics are equally tolerated or better tolerated than ACE inhibitors or calcium channel blockers.[2–4,7–9] Yet the use of β-blockers and diuretics has declined steadily in the past 15 years in favor of these newer and more expensive medicines.[10,11]

Experts have speculated that the decline in β-blocker and diuretic use is related to misperceptions among physicians about their efficacy and tolerability. Specifically, physicians may be hesitant to prescribe β-blockers and diuretics as first line agents because they believe, contrary to published reports, that these medications are either less effective or less tolerated than newer, more expensive medications. Physicians may also preferentially prescribe newer medications because these agents are actively promoted by pharmaceutical companies, whose sales representatives might influence beliefs about the relative merits of various medications[12,13] or might influence prescribing patterns by providing free drug samples of newer antihypertensive medicines.[14–21] To date, we know of no studies assessing physicians' perceptions of the effectiveness and tolerability of antihypertensive medications, nor any studies that explore the relationship between availability of pharmaceutical samples and physicians' beliefs and practices about antihypertensive medications.

We surveyed primary care physicians in the United States in 1997 to determine their beliefs about the relative effectiveness and tolerability of ACE inhibitors, β-blockers, calcium channel blockers, and diuretics, and to see whether these beliefs were associated with physicians' self-reported willingness to prescribe each class of medications as first line therapy for uncomplicated hypertension. In addition,

we explored the relationship between provision of free pharmaceutical samples to patients and attitudes and practices toward these 4 classes of antihypertensive medications. The 1997 survey was conducted shortly after circulation of the Joint National Committee (JNC) report that recommended β-blockers and diuretics as first line agents. Given the short time between circulation of the JNC report and circulation of our survey, we repeated the survey in 2000 (with minor modifications described below) to learn how attitudes and practices had changed in the interim.

METHODS

Subjects

We conducted an anonymous mail survey of primary care physicians in the United States (general internists, family medicine specialists, and general practitioners), randomly selected from the AMA master file, the most comprehensive mailing list of U.S. physicians, that includes both members of the AMA and nonmembers. We mailed questionnaires to 1,200 physicians in 1997 and 500 physicians in 2000. We included a small incentive in the first mailing ($1 in 1997 and $2 in 2000) and mailed a second instrument, without financial incentive, to all nonresponders.

QUESTIONNAIRE DESIGN

Clinical Vignette

We Asked Physicians to Consider the Following Vignette. A 55-year-old white male presents to you with a BP = 170/105. He has no other medical problems, is on no medications, and has completed a 1-year trial of diet and exercise to control his hypertension, but his BP remains elevated.

Effectiveness, Tolerability, and Prescription Recommendations. Physicians were asked to estimate the effectiveness and tolerability of ACE inhibitors, β-blockers, calcium channel blockers, and diuretics in this type of patient:

> *"In your experience, what percent of the time will each of the following drugs (as monotherapy) achieve a normal blood pressure (< 140/90) in patients like this?*
>
> *In your experience, what percent of the time do patients like this have to discontinue each of the following drugs due to side effects?"*

Physicians were then asked what medication or class of medication they would prescribe for this patient as initial monotherapy. They were told that their choice was not limited to the 4 classes of medications listed. In the 1997 survey, 19% of physicians recommended more than 1 medication. The instructions were revised in 2000 to emphasize that we wanted them to list the first medication or class of medications they would prescribe.

Perceived Prescribing Influences

Physicians were then asked to rate the importance of several factors in their choice of antihypertensive agent "in patients without other medical problems." The factors were cost, number of doses per day, likelihood of achieving normal blood pressure with monotherapy, side effects, prevention of stroke or heart attack, and availability of free samples. Subjects rated the importance of each factor on a 5-point scale, ranging from "not at all important" to "extremely important."

Background Characteristics

After answering the questions described above, physicians provided basic demographic information, including age and gender, and answered a set of questions about their practice. Physicians were also asked, "Do you ever provide patients free sample medications from pharmaceutical representatives to treat their high blood pressure?" with a response mode of yes or no.

Randomization Scheme for the 1997 Survey

In the 1997 survey, we randomized physicians to 1 of 2 questionnaire versions, out of concern that asking physicians to rate the effectiveness and tolerability of the 4 classes of medications would influence their ensuing prescription recommendations. One group of physicians provided a prescription recommendation without providing effectiveness and tolerability estimates, and a second group responded to all 3 types of questions. We found no differences in prescription recommendations based on questionnaire version. Thus we include data from both groups. Because of this randomization scheme, the number of physicians providing answers to various components of our questionnaire varies.

Data Analysis

We tested for differences in survey responses across the 2 groups of physicians (1997 vs 2000) using χ^2 tests for categorical variables and t tests for continuous variables. Responses to the 4 questions about effectiveness were significantly lower in 2000 than in 1997. When the effectiveness data were normalized, however (i.e., converted to deviations from the subject's mean effectiveness rating across all 4 classes of medication), differences became nonsignificant, indicating that beliefs about the effectiveness of each class of medication relative to the other 3 classes did not change significantly from 1997 to 2000. Of the other 21 variables examined, a significant difference between the 2 years was found for only 1—public practice setting ($P = .027$). This is what would be expected by chance. Subsequent analyses therefore pooled data from these 2 years.

One-way repeated-measures analyses of variance were used to test differences in: 1) perceived effectiveness of the 4 classes of medication; 2) perceived tolerability of the 4 classes of medication; and 3) perceived importance of various factors on prescription preference. Within each of these 3 sets of variables, differences between specific subsets of variables were tested using difference contrasts.

(Contrasts are specific linear combinations of variables; they are used in multivariate analysis to test whether certain subsets of variables are associated in expected ways. Difference contrasts were used here because they allow a test of whether scores on one variable differ significantly from the mean of all other variables in the set, e.g., whether physicians think diuretics are less effective than the other 3 classes of medication combined.)

Bivariate analyses (χ^2 tests for categorical variables and *t* tests for continuous variables) were also used to identify 1) differences in perceived effectiveness and tolerability between the class of medication preferred by the respondent and the other classes; 2) differences in background characteristics between physicians who did not offer patients free samples and those who did; and 3) factors associated with prescription recommendations. In addition, 2 logistic regressions of prescription recommendations (coded as 0 for those who prescribed ACE inhibitors or calcium channel blockers and 1 for those who prescribed β-blockers or diuretics) were performed. In the first, the predictors were the variables representing perceived effectiveness and tolerability of each class of medication; as described above, these were continuous variables, denoting respondents' estimates of the percentages of patients who would achieve normal blood pressure with that class of medication, or discontinue it due to side effects. In the second logistic regression, the predictors were the perceived effectiveness and tolerability variables plus age, sex, and all other background variables that displayed bivariate associations with prescription recommendations at $P < .10$.

Of the 647 subjects, 81 (12.5%) indicated more than 1 class of drug on the prescription preference item. As indicated earlier, 74 of these were physicians who responded to the 1997 survey. These 81 subjects were excluded from all analyses involving prescription preference. We compared these subjects to the rest of the sample on all survey responses, an analysis involving a total of 26 variables; significant differences ($P < .05$) were found on 2—perceived effectiveness of calcium channel blockers ($P = .03$), and importance of preventing stroke or heart attack ($P = .01$).

Table 1. Physicians' Characteristics

Characteristic	Value
Age, mean (SD)	46.6 (11.2)
Male, %	75.7
Years in practice, mean (SD)	18.7 (11.7)
Specialty, %	
General internal medicine	47.3
Family medicine	51.3
Other generalist	1.4
Type of practice, %	
Solo	29.7
Group	70.3
Practice setting, %*	
Private practice	70.4
Public practice	9.9
Academic	14.2
Other	12.9
Hours per week in patient care, mean (SD)	44.3 (17.2)
Provide samples, %	86.4
Percent of patients in managed care, mean (SD)	42.6 (30.0)

** Percentages do not add up to 100% because subjects could choose multiple categories.*

RESULTS

Of the 1,700 questionnaires mailed, 64 were undeliverable because of bad addresses, and 17 were returned blank with valid reasons for nonresponse (e.g., deceased, not a generalist, not in practice), leaving 1,619. We received completed questionnaires from 670 physicians for an overall response rate of 41%. Sixteen subjects were excluded because they indicated they had subspecialty training and 7 others because they indicated they were not in practice, leaving a final sample of 647 respondents. Physicians' characteristics are shown in Table 1.

Perceived Effectiveness and Tolerability of Antihypertensive Agents

Table 2 shows physicians' perceptions of the effectiveness and tolerability of the 4 classes of antihypertensive

Table 2. Mean Perceived Effectiveness and Tolerability of Antihypertensive Agents

Medication Class	Perceived Effectiveness*, Mean (SD) (*N* = 443)†	Perceived Likelihood of Side Effects†, Mean (SD) (*N* = 438)†	Physicians Recommending a Medication from This Class as First Line Agent, % (*N* = 537)§
ACE inhibitor	55.9 (25.9)	13.5 (10.8)	37.6
β-blocker	54.1 (25.2)	21.9 (15.4)	28.7
Calcium channel blocker	55.1 (25.9)	14.7 (11.1)	11.0
Diuretic	37.0 (25.2)	12.5 (12.0)	18.4

** Percent chance of hypothetical patient achieving blood pressure less than 140/90.*
† Percent chance of hypothetical patient discontinuing due to side effects.
‡ Subjects who were not asked the effectiveness and tolerability questions (n = 195) are excluded.
§ Subjects who chose more than 1 class of medication (n = 81) and subjects who gave no choice (n = 29) are excluded. Percentages do not add up to 100% because 4.3% of subjects chose a medication not in the 4 specified classes.
ACE, angiotensin-converting enzyme inhibitor.

Table 3. Self-reported Importance of Factors Influencing Choice of Antihypertensive Medication

Factor	Importance Rating, Mean (SD)* (N = 647)
Prevention of stroke or heart attack	4.2 (0.8)
Likelihood of side effects	4.1 (0.7)
Number of doses per day	4.0 (0.7)
Likelihood of achieving normal blood pressure as monotherapy	4.0 (0.8)
Cost	3.6 (0.8)
Availability of free samples	2.5 (1.2)

* *Mean importance rating on a scale from 1 for not at all important to 5 for extremely important.*

agents. Perceived effectiveness differed significantly across the 4 classes ($F_{99,5}$, $P < .001$). The mean perceived effectiveness of diuretics was significantly lower than the mean effectiveness of the other 3 classes of medication combined ($F_{299,0}$, $P < .001$). Mean perceived tolerability also differed significantly across the 4 classes of medication ($F_{73.0}$, $P < .001$). Perceived tolerability of β-blockers was significantly lower than the mean tolerability of the other 3 classes of medication combined ($F_{215,0}$, $P < .001$).

Prescription Recommendations

Table 2 also shows which class of medications physicians stated they would prescribe for the hypothetical patient. Thirty-eight percent of physicians recommended ACE inhibitors as first line agents, 29% recommended β-blockers, 18% recommended diuretics, and 11% recommended calcium channel blockers. The remaining 4% chose medications not in these 4 classes.

Factors Perceived to Influence Choice of Antihypertensive Medication

Table 3 shows physicians' self-reports of the importance various factors play in influencing their choice of antihypertensive medication in patients with no other medical problems. Perceived importance differed significantly across the 6 factors assessed ($F_{237,6}$, $P < .001$). Perceived importance of the availability of free samples was significantly lower than the mean importance of the other 5 factors combined ($F_{1032,5}$, $P < .001$).

Factors Empirically Associated with Choice of Antihypertensive Medication

As described earlier, we performed bivariate analyses to identify factors actually associated with prescription recommendations (as distinct from factors perceived by physicians to be important). Prescription recommendations were associated with the perceived effectiveness and tolerability of antihypertensive medications. The mean perceived effectiveness of the recommended medication was significantly greater than the mean combined effectiveness of the other medications (61% efficacy vs 47%; t (paired) = 14.96, $P < .001$). The mean perceived likelihood of side effects was significantly lower for recommended medications (14% discontinuation rates vs 16%, t (paired) = 3.00, $P = .003$). As shown in Table 4, subjects who recommended ACE inhibitors or calcium channel blockers perceived those classes of medication to be significantly more effective than did subjects who recommended β-blockers or diuretics; they also perceived β-blockers and diuretics to have a higher likelihood of side effects. A logistic regression of prescription preference (coded as 0 for those who prescribed ACE inhibitors or calcium channel blockers and 1 for those who prescribed β-blockers or diuretics) on physicians' perceptions of effectiveness and tolerability was highly

Table 4. Perceived Effectiveness and Tolerability of Antihypertensive Agents by Prescription Choice

		Physicians Prescribing ACE Inhibitor or Calcium Channel Blocker (N = 190)*	Physicians Prescribing β-blocker or Diuretic (N = 176)*	P Value for Comparison Between Physician Groups
Effectiveness	Mean (SD) percent of time drug expected to be effective			
ACE inhibitor		62 (23)	49 (27)	<.001
β-blocker		53 (26)	55 (24)	.46
Calcium channel blocker		58 (24)	51 (27)	.006
Diuretic		35 (23)	39 (26)	.12
Side effects	Mean (SD) percent of time drug expected to be discontinued due to side effects			
ACE inhibitor		13 (11)	13 (11)	.68
β-blocker		24 (16)	19 (14)	.006
Calcium channel blocker		14 (9)	14 (12)	.85
Diuretic		14 (13)	10 (10)	.002

* *Subjects who were not asked the effectiveness and tolerability questions, chose more than 1 class of medication, chose a medication not in the 4 specified classes, or gave no choice are excluded.*

ACE, angiotensin-converting enzyme inhibitor.

Table 5. Adjusted Odds Ratio for Perceptions as Predictors of Prescription Choices*

Predictor	Odds Ratio	*P* Value
Effectiveness of ACE inhibitors†	0.96	<.001
Effectiveness of β-blockers†	1.05	<.001
Effectiveness of calcium channel blockers†	0.98	.009
Effectiveness of diuretics†	1.02	.014
Side effects of ACE inhibitors‡	0.99	.369
Side effects of β-blockers‡	0.98	.038
Side effects of calcium channel blockers‡	1.04	.016
Side effects of diuretics‡	0.97	.022

* *Prescription choice coded as 0 for those who prescribed ACE inhibitors or calcium channel blockers and 1 for those who prescribed β-blockers or diuretics. Subjects who chose more than 1 class of medication (n = 81), chose a medication not in the 4 specified classes (n = 23), or made no choice (n = 29) are excluded.*

† *Percent chance of hypothetical patient achieving blood pressure less than 140/90.*

‡ *Percent chance of hypothetical patient discontinuing due to side effects.*

ACE, angiotensin-converting enzyme inhibitor.

significant ($\chi^2 = 84.0$, $P < .001$). All predictors contributed significantly to the model except for the perceived likelihood of side effects with ACE inhibitors (see Table 5).

Table 6 presents the bivariate associations of prescription preference with the background variables measured in this study. Subjects who recommended ACE inhibitors or calcium channel blockers were significantly more likely to be in solo practice and private practice settings, and less likely to be in "other" practice settings (i.e., not private, public, or academic), than were subjects who recommended β-blockers or diuretics; they also reported more hours per week spent in patient care, and more years in practice. Finally, they were significantly more likely to report providing their patients with free samples of antihypertensive medications provided by pharmaceutical companies.

To assess the association of perceived effectiveness and tolerability with prescription preference independent of background variables, we performed a multivariate logistic regression of prescription recommendations (coded as 0 for those who prescribed ACE inhibitors or calcium channel blockers and 1 for those who prescribed β-blockers or diuretics), using the following variables as predictors: 1) the 8 variables denoting perceived effectiveness and tolerability of the 4 classes of drug; 2) the 2 demographic variables measured in the study (age and sex); and 3) all other background variables that displayed bivariate associations with prescription recommendations at $P < .10$—that is, hours per week spent in patient care, years in practice, and dichotomous variables indicating solo practice, private practice setting, other practice setting, and provision of samples. The results are shown in Table 7. The overall model was significant ($\chi^2 = 104.7$, $P < .001$). Of the 8 variables denoting perceived effectiveness and tolerability, all contributed significantly ($P \leq .012$) except perceived tolerability of ACE inhibitors and β-blockers. The only other variable to contribute significantly to the model was provision of samples ($P = .001$).

Overall, 86% of physicians said they offered samples to their patients. Physicians using samples spent more hours per week in patient care (45.6 vs 36.2; $t = 4.84$, $P < .001$), reported having a lower percentage of managed care patients (39.2% vs 63.9%; $t = 5.37$, $P < .001$), were more likely to practice family medicine (54% vs 34%; $\chi^2 = 11.55$, $P = .003$), were more likely to be in private practice (78% vs 22%;

Table 6. Physicians' Characteristics by Prescription Choice

Characteristic	Value Among Physicians Prescribing: ACE Inhibitor or Calcium Channel Blocker (*N* = 261)*	Value Among Physicians Prescribing: β-blocker or Diuretic (*N* = 253)*	*P* Value for Comparison Between Physician Groups
Age, mean (SD)	47.1 (11.0)	46.3 (11.3)	.39
Sex, % male	77.8	74.1	.33
Years in practice, mean (SD)	19.7 (11.6)	17.9 (11.7)	.09
Specialty, % in family medicine	52.1	51.4	.87
Type of practice, % solo	34.6	22.1	.002
Practice setting, % in:†			
Private practice	75.3	64.1	.006
Public practice	9.7	11.2	.58
Academic	13.5	15.1	.60
Other	9.7	15.9	.03
Hours per week in patient care, mean (SD)	46.1 (18.5)	41.7 (16.0)	.005
Provide samples, %	91.9	78.9	<.001
Percent of patients in managed care, mean (SD)	43.9 (29.2)	43.2 (31.4)	.78

* *Subjects who chose more than 1 class of medication (n = 81), chose a medication not in the 4 specified classes (n = 23), or made no choice (n = 29) are excluded.*

† *Percentages do not add up to 100% because subjects could choose multiple categories.*

Table 7. Adjusted Odds Ratios for Physician Characteristics and Perceptions as Predictors of Prescription Choices*

Predictor†	Odds Ratio	P
Effectiveness of ACE inhibitors‡	0.96	<.001
Effectiveness of β-blockers‡	1.05	<.001
Effectiveness of calcium channel blockers‡	0.97	.006
Effectiveness of diuretics‡	1.02	.010
Side effects of calcium channel blockers§	1.05	.006
Side effects of diuretics§	0.96	.012
Provision of samples‖	0.18	.001

* *Prescription choice coded as 0 for those who prescribed ACE inhibitors or calcium channel blockers and 1 for those who prescribed β-blockers or diuretics. Subjects who chose more than 1 class of medication (n = 81), chose a medication not in the 4 specified classes (n = 23), or made no choice (n = 29) are excluded. The analyses are adjusted for perceived effectiveness and tolerability of the 4 classes of drugs, age, gender, hours per week spent in patient care, years in practice, practice setting, and provision of samples.*

† *Only those predictors that contributed to the model at* $P \leq .10$ *are shown.*

‡ *Percent chance of hypothetical patient achieving blood pressure less than 140/90.*

§ *Percent chance of hypothetical patient discontinuing due to side effects.*

‖ *Coded as 0 = no samples, 1 = samples.*

ACE, angiotensin-converting enzyme inhibitor.

$\chi^2 = 114.76$, $P < .001$), and were more likely to be male (77% vs 65%; $\chi^2 = 6.01$, $P = .02$). Age and number of years in practice did not differ among physicians according to whether they provided free samples ($P = .32$ and .77, respectively). Perceptions of the effectiveness and tolerability of antihypertensive medications also differed little among physicians who did and did not offer free samples. Compared to physicians not using samples, physicians using samples perceived ACE inhibitors to be more effective (56.9% efficacy vs 48.2%; $t = 2.15$, $P = .04$), and also displayed a marginally significant tendency to perceive diuretics to have a lower likelihood of side effects (12.12% vs 15.95%; $t = 1.86$, $P = .07$), but the 2 groups did not differ significantly on perceived effectiveness or tolerability of the other classes of medication ($P = .21$ to .99).

DISCUSSION

In this study, we explored physicians' attitudes toward antihypertensive medications in 1997, shortly after the release of the JNC guidelines, and again in 2000. Attitudes toward antihypertensive medications were consistent over the 3-year period. Physicians believed that diuretics were less effective than the other 3 classes of medication and that β-blockers were less likely to be tolerated. We also found that physicians who recommended β-blockers or diuretics as first line agents were significantly less likely than other physicians to provide free samples.

Why do many physicians recommend newer, more expensive antihypertensive medications as first line agents ahead of β-blockers and diuretics? Our data suggest that physicians' beliefs about the effectiveness and tolerability of β-blockers and diuretics contribute to their unwillingness to prescribe these agents. With so many medications proven to be effective in treating high blood pressure, small differences in the perceived effectiveness or tolerability of medications may be all it takes for physicians to favor one class of drugs over another. Why do physicians perceive that β-blockers and diuretics are either not as effective or not as well tolerated as other antihypertensive medications, despite randomized controlled trial evidence to the contrary? Our study does not provide a definitive answer to this question. Our study provides evidence that these prescribing habits are associated with the practice of providing sample medications, but that misperceptions about effectiveness and side effects are not strongly related to whether physicians provided free medication samples from pharmaceutical representatives.[12]

Our study does not show whether the association between the availability of free samples and physicians' hypothetical prescribing habits is a causal relationship. Physicians who provide free samples to patients may already be less inclined to prescribe β-blockers and diuretics than are other physicians. Similarly, physicians who prescribe β-blockers and diuretics may not give out sample hypertension medications because samples of these inexpensive medications are not typically available. Nevertheless, medication samples have been shown to increase the adoption rate of new drugs,[22] and make physicians more likely to prescribe expensive (rather than inexpensive) medications.[19,23]

Our study has several limitations. First, we had a response rate of 41%. Our results could have been influenced by nonrespondent bias. However, the major findings of this study were highly statistically significant, meaning that nonresponse bias would have to have been extensive to alter our major conclusions. Moreover, although the response rate in the 2000 survey was substantially higher than the 1997 survey (55% vs 36%), there were no significant demographic or attitudinal differences between respondents in 1997 and 2000. This suggests that increasing our overall response rate to the 2000 level would not have substantially influenced our results. Second, we observed only hypothetical prescription practices, not actual prescription practices. However, research suggests that response to hypothetical vignettes can be an accurate predictor of physicians' actual practices.[24] Moreover, by using a clinical vignette we were able to isolate physicians' attitudes toward the treatment of uncomplicated hypertension, a task that would have been extremely difficult using a secondary database. Third, we did not assess physicians' interactions with pharmaceutical representatives, because pilot testing had shown that such queries were not well received. The provision of free drug samples is an imperfect proxy for physicians' interactions with pharmaceutical representatives.

CONCLUSION

Physicians perceive that diuretics are less effective than other antihypertensive medications and that β-blockers are less tolerated. In addition, their willingness to prescribe β-blockers or diuretics is associated with whether they offer free samples of medications from pharmaceutical representatives, even after adjusting for demographic characteristics, although it is impossible to determine from our data whether this association is a causal relationship. Efforts to increase the use of β-blockers and diuretics in patients with uncomplicated hypertension may require efforts to reeducate physicians about the effectiveness and tolerability of β-blockers and diuretics.

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REFERENCES

1. Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med. 1997;157:2413–46.
2. Hansson L, Hedner T, Lund-Johansen P, et al. Randomised trial of effects of calcium antagonists compared with diuretics and beta-blockers on cardiovascular morbidity and mortality in hypertension: the Nordic Diltiazem (NORDIL) study. Lancet. 2000;356:359–65.
3. Brown M, Palmer CR, Castaigne A, et al. Morbidity and mortality in patients randomised to double-blind treatment with a long-acting calcium-channel blocker or diuretic in the International Nifedipine GITS study: intervention as a goal in hypertension treatment (INSIGHT). Lancet. 2000;5:366–72.
4. Neaton J, Grimm R, Prineas R, et al. Treatment Mild Hypertension Study: final results. JAMA. 1993;270:713–24.
5. Materson B, Reda D, Cushman W. Department of Veterans Affairs Cooperative Study Group on Antihypertensive Agents. Department of Veterans Affairs single-drug therapy of hypertension study: revised figures and new data. Am J Hypertens. 1995;8:189–92.
6. Hannsson L, Lindholm LH, Niskanen L, et al. Effect of angiotensin-converting-enzyme inhibition compared with conventional therapy on cardiovascular morbidity and mortality in hypertension: the Captopril Prevention Project (CAPPP) randomized trial. Lancet. 1999;353:611–6.
7. Croog SH, Levine S, Testa MA, et al. The effects of antihypertensive therapy on the quality of life. N Engl J Med. 1986;314:1657–64.
8. Materson B, Reda D, Cushman W, et al. Single-drug therapy for hypertension in men: a comparison of six hypertensive agents with placebo. N Engl J Med. 1993;328:914–21.
9. Ogihara T, Kuramoto K. Effect of long-term treatment with antihypertensive drugs on quality of life of elderly patients with hypertension: a double-blind comparative study between a calcium antagonist and a diuretic. Hypertens Res. 2000;23:33–7.
10. Manolio T, Cutler J, Furberg C, Psaty B, Whelton P, Applegate W. Trends in pharmacologic management of hypertension in the United States. Arch Intern Med. 1995;155:829–37.
11. Siegel D, Lopez J. Trends in antihypertensive drug use in the United States: do the JNC V recommendations affect prescribing? JAMA. 1997;278:1745–8.
12. Avorn J, Chen M, Hartley R. Scientific versus commercial sources of influence on the prescribing behavior of physicians. Am J Med. 1982;73:4–8.
13. Chren M-M, Landefeld CS. Physicians' behavior and their interactions with drug companies: a controlled study of physicians who requested additions to a hospital drug formulary. JAMA. 1994;271:684–9.
14. Moser M. Why are physicians not prescribing diuretics more frequently in the management of hypertension? JAMA. 1998;279:1813–6.
15. Wang TJ, Ausiello JC, Stafford RS. Trends in antihypertensive drug advertsing, 1985–96. Circulation. 1999;99:2055–7.
16. Lurie N, Rich EC, Simpson DE, et al. Pharmaceutical representatives in academic medical centers: interaction with faculty and housestaff. J Gen Intern Med. 1990;5:240–3.
17. Bowman MA. The impact of drug company funding on the content of continuing medical education. Mobius. 1986;6:66–9.
18. Bowman MA, Pearle DL. Changes in drug prescribing patterns related to commercial company funding of continuing medical education. J Contin Educ Health Prof. 1988;8:13–20.
19. Chew LD, O'Young TS, Hazlet TK, Bradley KA, Maynard C, Lessler DS. A physician survey of the effect of drug sample availability on physicians' behavior. J Gen Intern Med. 2000;15:478–83.
20. Shaughnessy A, Bucci K. Drug samples and family practice residents. Ann Pharmacother. 1997;31:1296–1300.
21. Morelli D, Koenigsberg M. Sample medication dispensing in a residency practice. J Fam Pract. 1992;34:42–8.
22. Peay MY, Peay ER. The role of commercial sources in the adoption of a new drug. Soc Sci Med. 1988;26:1183–9.
23. Caudill ST, Johnson MS, Rich EC, McKinney PW. Physicians, pharmaceutical sales representatives, and the cost of prescribing. Arch Fam Med. 1996;5:201–6.
24. Peabody JW, Luck J, Glassman P, Dresselhaus TR, Lee M. Comparison of vignettes, standardized patients, and chart abstraction. A prospective validation study of 3 methods for measuring quality. JAMA. 2000;283:1715–22.