Hypertension Control

How Well Are We Doing?

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Background: We compared blood pressure (BP) control in a recent cohort of hypertensive military veterans with BP control in a previous cohort and examined whether hypertension treatment practices, as defined by the frequency of antihypertensive medication dosage increases, have changed over time.

Methods: We abstracted 1999 outpatient chart data including visit type, BP measurements, comorbidities, and medication use for 981 randomly selected hypertensive veterans. We examined overall BP control and control in subgroups with diabetes mellitus and renal disease, and compared results with those of a sample of 800 veterans studied from 1990 to1995. We also compared the frequency of antihypertensive medication dosage increases in the 2 samples.

Results: Mean BPs were significantly lower in 1999. The mean systolic drop was 3.1 mm Hg and reached 13.7 mm Hg for the subgroups with diabetes and renal disease. Even larger decreases were seen in mean diastolic BPs. In 1999, 57% of patients had BP measurements of 140/90 mm Hg or higher, vs 69% of patients in the 1990-1995 study ($P<.001$). In 1999, the BP control of patients with diabetes was similar to that of patients without diabetes, as 60% of the former had BP measurements of 140/90 mm Hg or higher. Patients with renal disease had better control than those without, however, as only 43% had BP measurements of 140/90 mm Hg or higher. When comparing samples, patients with diabetes, renal disease, or both had better BP control in 1999 than their counterparts in the 1990-1995 study ($P<.003$ in all cases). In 1999, more medical visits were associated with medication dosage increases than in the 1990-1995 study.

Conclusions: Although overall BP control has improved, BP measurements still exceeded recommended levels in most patients. For patients with diabetes and renal disease BP was much better controlled in the more recent sample. However, BP control of patients with diabetes was similar to that of patients without diabetes, and not in agreement with the guideline-recommended tighter control. Thus, room for improvement remains, especially in this subgroup.

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IMPROVING HYPERTENSION care is a priority.[1] Hypertension is among the most prevalent diseases in the United States, affecting 24% of the adult population or nearly 50 million Americans, and is among the most common reasons for an outpatient medical visit.[2] In the Department of Veterans Affairs health care system (VA), hypertension is the most common chronic condition, with a prevalence of 37% (>1 million veterans are affected).[3] Although hypertension is usually asymptomatic, it may be associated with considerable morbidity and mortality. The higher the blood pressure (BP), the greater the risk for adverse outcomes, including the development of coronary artery disease, congestive heart failure, and stroke. Treatment of hypertension has been clearly shown to reduce this risk.[4-10]

Based on the available evidence, the current US guidelines, published in the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC VI), recommend maintaining BP at less than 140/90 mm Hg for most patients.[11] However, recent studies have shown that patients with diabetes mellitus and/or renal disease benefit from even lower BP levels.[12-14] Accordingly, the recommended BP maintenance targets for these 2 subgroups are less than 130/85 mm Hg or even lower, (<125/75 mm Hg if patients also have proteinuria).[11]

Notwithstanding the demonstrated importance of treating hypertension and the dissemination of national hypertension guidelines, studies have persistently shown that most patients have inadequate BP control.[2,15-19] In the 1988 to 1991 National

Health and Nutrition Examination Survey (NHANES III), 76% of patients with a diagnosis of hypertension had BP measurements of 140/90 mm Hg or higher.[2] In our previous study of VA patients, sampled from 1990 to 1995, more than 65% had BP measurements of 140/90 mm Hg or higher and almost 40% had BP measurements of 160/90 mm Hg or higher.[15] Our study also found that poor control was associated with health care providers' underaggressiveness in increasing the dosage of antihypertensive medications. Further, we found that patients with diabetes had worse BP control and received less aggressive BP management than patients without diabetes.[20]

The publication of studies such as these has resulted in an increased awareness, in both the general public and the medical profession, of the problem of poor BP control. Since most of them were based on data obtained prior to the mid-1990s and prior to the JNC VI guidelines, we wondered whether temporal changes and the more recent guidelines had resulted in better BP management.

Our study had the following objectives: (1) to determine the overall level of BP control in a 1999 sample of military veterans with hypertension; (2) to determine the level of BP control in subgroups with diabetes and renal disease; (3) to compare the whole sample and the subgroups with their counterparts from our previous hypertension study; and (4) to determine whether treatment practices, as measured by the frequency of antihypertensive medication dosage increases, differed in our 1999 and our previous sample.

METHODS

STUDY SUBJECTS AND SITES

The present sample and our prior study sample both comprised hypertensive patients who were receiving regular medical care at VA outpatient clinics. Our 1999 sample consisted of individuals receiving care at 10 VA sites across the United States. The selection of study sites was based on 4 criteria: (1) the sites had been entering BP measurements into the Veterans Health Information Systems and Technology Architecture (VISTA), the VA computerized patient record system, since at least January 1, 1999; (2) they had been using computerized physicians' notes at their primary care and medical subspecialty clinics as of January 1, 1999; (3) they represented various geographic regions of the country; and (4) they included hospitals with varying missions, including tertiary care, psychiatry, and long-term care.

Eligible patients met these 2 criteria: they had the diagnosis of hypertension, identified by the *International Classification of Diseases, Ninth Edition* codes 401, 402, or 405 listed at least once between January 1, 1998, and December 31, 1998; and they were regular users of VA health care, defined as having made at least 2 visits, at least 6 months apart, to a general medicine or subspecialty clinic between January 1 and December 31, 1999. The first visit during this period was considered the index visit and the last visit of the year was considered the outcome visit. We used a system-wide VA database, the OutPatient Clinic file, to identify these patients. The study sample was then randomly selected from among all eligible patients stratified by site. We sought 100 patients with hypertension per site and achieved a final sample size of 981.

The sample of 800 veterans from our earlier study has been described.[15] It differed from our 1999 sample in several important ways: previously, patients were sampled between 1990 and 1995; the index and outcome visits were 1.5 to 2.5 years apart; 5 VA sites in New England were included; only men were included; and the diagnosis of hypertension was based on chart review.

DATA COLLECTION AND SOURCES

For both samples, a nurse abstracted information on medical visit types and dates, BP measurements, diagnoses, and medications from the medical charts. Additional medication information was abstracted from local pharmacy records. We only included information from visits to medical (not surgical or psychiatric) clinics because medical clinics are where BP is more likely to be managed.

We recorded up to 4 BP measurements per visit from the chart and took as many measurements as were available from VISTA. When multiple measurements were available for a given day or visit we used their average. For visits at which BP was recorded, only 1 measurement was available for 79.5% and 80.5% of visits in the newer and older sample, respectively.

For the 1999 sample, we reviewed clinicians' notes for medical visits between January 1, 1999, and December 31, 1999. We obtained additional data from administrative sources. Demographics and dates of medical clinic visits were obtained from the OutPatient Clinic file and BP measurements were extracted from the vital signs package available from VISTA. The vital signs package represents the information recorded by clinic nurses and entered directly into the computer.

For the earlier sample, we reviewed medical records for a 1.5- to 2.5-year period between 1990 and 1995. All data except some medication information were obtained from the medical records.

STATISTICAL ANALYSES

Our outcome was the level of BP control for each patient at the last visit of the year for which a measurement was available. We calculated mean systolic and diastolic BPs for both samples and for subgroups with diabetes, renal disease, and both diabetes and renal disease. Within each sample, we then compared patients who had diabetes with patients without diabetes; patients who had renal disease with patients without renal disease; and patients who had diabetes and renal disease with patients who had diabetes but no renal disease using *t* tests. We also calculated the percentage of patients exceeding several recommended JNC VI BP thresholds (≥160/100 mm Hg; ≥140/90 mm Hg; and ≥130/85 mm Hg). We compared the previous groups using χ^2 tests. In addition, we divided the groups into 4 categories of BP control based on the JNC VI guidelines (≥160/100 mm Hg, stage 2 hypertension or higher; <160/100 mm Hg and ≥140/90 mm Hg, stage 1 hypertension; <140/90 mm Hg and ≥130/85 mm Hg, high normal BP; and <130/85 mm Hg, normal BP).[11] We compared the percentage of patients in each category using the Wilcoxon rank sum test, and then compared our newer sample with our previous one. We compared the whole groups and then subgroups using *t* tests, χ^2 tests, and nonparametric tests, as indicated.

Because of the prognostic significance of systolic hypertension, we further characterized BP control considering only systolic pressure.[21,22] We calculated the percentage of the whole sample with a systolic BP of 140 mm Hg or higher and, for patients with diabetes, renal disease, or both, the percentage who had a systolic BP of 130 mm Hg or higher. We compared these groups between samples using χ^2 tests. For the whole sample we further examined whether poor control (defined as a blood pressure ≥140/90 mm Hg) was due to a lack of systolic or diastolic control, or to both.

With our previous sample we developed a model, depicted as a bifurcation tree, that predicted antihypertensive medi-

Table 1. Baseline Characteristics of Hypertensive Patient Samples

Characteristic	1999 Sample (N = 981)	1990-1995 Sample (N = 800)	P Value
Age, mean ± SD, y	65.3 ± 11.1	65.5 ± 9.1	.68
Male sex, No. (%)	951 (97)	800 (100)	<.001
Nonwhite race, No. (%)	112 (11)	67 (8)	.005
No. of antihypertensive medications, No. (%)			
0	87 (9)	68 (8)	<.001
1	249 (25)	264 (33)	
2	309 (32)	254 (32)	
≥3	336 (34)	214 (27)	
Selected coexisting conditions, No. (%)			
Diabetes mellitus	322 (33)	274 (34)	.53
Renal disease*	73 (8)	68 (9)	.41
Diabetes and renal disease	31 (3)	23 (3)	.73
Coronary artery disease	339 (35)	297 (37)	.26
Cerebrovascular disease	79 (8)	87 (11)	.04
No. of antihypertensive medications, mean ± SD			
Patients with diabetes	2.4 ± 1.4	1.9 ± 1.2	<.001
Patients with renal disease	2.8 ± 1.2	2.3 ± 1.3	.02

*Definition of renal disease differs in the 2 samples. In the 1990-1995 sample the definition was based on creatinine values ≥2 mg/dL or receiving dialysis. In the 1999 sample, definition was based on chart diagnosis of renal failure or renal insufficiency. No patients in the 1990-1995 sample were receiving dialysis; only 1 patient in the 1999 sample was receiving dialysis according to *Current Procedural Terminology* codes.

Table 2. Comparison of Mean Blood Pressure (BP)

	Mean ± SD BP, mm Hg (n)		Mean BP Change Compared With 1990-1995 Sample*
	1999 Sample	1990-1995 Sample	
Systolic BP			
Whole sample†	142.2 ± 19.2 (980)	145.3 ± 19.2 (799)	−3.1
Diabetes	143.2 ± 18.7 (322)	148.2 ± 19.3 (274)	−5.0
Renal disease	139.7 ± 21.7 (73)	149.9 ± 21.2 (68)	−10.2
Diabetes + renal disease	144.0 ± 24.9 (31)	157.7 ± 21.3 (23)	−13.7
Diastolic BP			
Whole sample†	76.6 ± 12.1 (980)	82.6 ± 10.1 (799)	−6.0
Diabetes	75.1 ± 12.4‡ (322)	82.9 ± 10.1 (274)	−7.8
Renal disease	71.1 ± 13.2‡ (73)	83.7 ± 10.8 (68)	−12.6
Diabetes + renal disease	67.6 ± 12.5‡ (31)	83.6 ± 9.3 (23)	−16.0

*$P<.05$ based on 2-sample *t* tests.
†Based on sample size of 980 in 1999 and 799 in 1990-1995. Excludes 1 subject in each sample who had neither diabetes nor renal disease.
‡For 1999 sample: diastolic BP lower at $P<.05$ level for diabetes vs no diabetes, renal disease vs no renal disease, and diabetes + renal disease vs diabetes + no renal disease. Results for these comparisons are not shown but can be derived from values and sample sizes given.

cation dosage increases at a given visit.[15] That model found an association between medication dosage increases and BP level, the presence of coronary artery disease, a previous change in medication, and whether a visit was scheduled or not. We considered the dosage of an antihypertensive medication to have been increased if the dosage was increased or if a new type of antihypertensive medication was prescribed. We compared the frequency of dosage increases in our newer sample with that in our previous sample for all visits with a BP determination and at the various branch points of this model using simple descriptive statistics.

RESULTS

The baseline characteristics of both samples are shown in **Table 1**. The samples were similar in age. The newer sample included women and more nonwhites. Overall, the 1999 subjects were using more antihypertensive medications and were less likely to have cerebrovascular disease. Subgroups with diabetes and with renal disease were also taking more antihypertensive drugs in 1999.

In each sample, no BP measurement was available for 1 individual who was thus dropped from subsequent analysis. In neither sample did the dropped patient have diabetes or renal disease.

Analysis of the 1999 sample revealed no significant differences in mean systolic BP between subgroups, although the mean systolic pressure of patients with renal disease was 2.7 mm Hg lower than it was for patients without renal disease ($P=.24$) (**Table 2**). Mean diastolic pressures were significantly lower in patients with diabetes or renal disease than in patients without diabetes and patients without renal disease, respectively. Further, patients with both diabetes and renal disease had the lowest diastolic pressures of all the subgroups, and these diastolic pressures were significantly lower than those of patients with diabetes but no renal disease.

In the 1999 sample, 18% of patients had a BP of 160/100 mm Hg or higher and 57% had a BP of 140/90 mm Hg or higher. For the subgroup analysis, the percentage of patients with renal disease exceeding the thresholds of 130/85 and 140/90 mm Hg was statistically lower than the percentage of patients without renal disease (**Table 3**). More patients with diabetes had a BP above these thresholds than patients without diabetes, but the differences were not significant. Patients with both diabetes and renal disease appeared to have better BP control than those with diabetes but no renal disease. Patient numbers, however, were small in the group with both combinations, and the differences were only significant for the percentage of patients with a BP of 130/85 mm Hg or higher (61% vs 79%).

When we stratified patients into 4 categories by level of control and compared the distributions using the Wilcoxon rank sum test we found results similar to those of our 2×2 χ^2 analysis. Hypertensive patients with renal disease had better BP control than hypertensive patients without renal disease ($P=.003$). The differences between patients with and without diabetes were not significant. However, patients with diabetes and renal disease had better control than those with diabetes but no renal disease ($P=.04$). **Table 4** shows an example of the 2×4 table for patients with diabetes generated from the information contained in Table 3.

Table 3. Percentage of Patients Exceeding Blood Pressure (BP) Thresholds: Comparison of Both Samples*

BP Level, mm Hg	Whole Sample 1999 (n = 980)	Whole Sample 1990-1995 (n = 799)	Diabetes 1999 (n = 322)	Diabetes 1990-1995 (n = 274)	Renal Disease 1999 (n = 73)	Renal Disease 1990-1995 (n = 68)	Diabetes + Renal Disease 1999 (n = 31)	Diabetes + Renal Disease 1990-1995 (n = 23)
≥160/100	18	26	19	30	12	43‡	16	57‡
≥140/90	57	69	60	73‡	43§	74	45	87
≥130/85†	76	86	77	90‡	60§	88‡	61†	96

*Individuals with a BP ≥160/100 mm Hg are also included in the percentage with a BP ≥140/90 mm Hg. Similarly the percentage with a BP ≥130/85 includes individuals with a BP ≥140/90. By 2 × 2 χ^2 analyses, $P<.003$ for all comparisons between 1999 and 1990-1995 samples.

†BP ≥130/85 is not a standard threshold used to judge BP control in patients without diabetes or renal disease. It is shown here for the whole group so that results for the appropriate comparison subgroups, ie, those without diabetes or those without renal disease, may be calculated.

‡For the 1990-1995 sample, $P<.05$ diabetes vs no diabetes, renal disease vs no renal disease, and diabetes + renal disease vs diabetes + no renal disease by 2 × 2 χ^2 analysis. Control is worse in groups with these conditions than without. Results for comparison groups are not shown but can be derived from values and sample sizes given above.

§For the 1999 sample, $P<.05$ comparing renal disease vs no renal disease, and diabetes + renal disease vs diabetes + no renal disease by 2 × 2 χ^2 analysis. Control is better in groups with these conditions than without. Results for comparison groups are not shown but can be derived from values and sample sizes given.

Table 4. Example of 2 × 4 Table for Blood Pressure (BP) Cut Point Analysis: 1999 Sample, Diabetes vs No Diabetes*

Group	BP Level, mm Hg	No. (%)† Diabetes (n = 322)	No. (%)† No Diabetes (n = 658)
4: Stage 2 or higher	≥160/100	62 (25)	115 (24)
3: Stage 1 hypertension	≥140/90 and <160/100	131 (35)	249 (31)
2: High normal‡	≥130/85 and <140/90	56 (17)	129 (21)
1: Normotensive§	<130/85	73 (23)	165 (24)

*This table can be derived from information in Table 3. Similar tables can be derived for other 1999, 1990-1995, and 1999 vs 1990-1995 comparisons described in the text from Table 3.

†$P = .21$ from the Wilcoxon rank sum test.

‡This category actually represents high BP in those with diabetes and renal disease.

§For the purpose of this study we did not consider patients with proteinuria in whom a BP of ≥125/75 and <130/85 would be considered elevated.

Comparison of the newer and older samples revealed significantly lower mean systolic and diastolic BP levels in 1999 than in the 1990-1995 study (Table 2). This was seen for the whole population, with even larger decreases in the subgroups with diabetes, renal disease, and diabetes plus renal disease. The mean systolic pressure decrease varied from 3.1 mm Hg for the whole group to as much as 13.7 mm Hg for the group with diabetes and renal disease. Even larger decreases were seen in mean diastolic pressures, with a drop of 6.0 mm Hg for the whole group and a drop of 16.0 mm Hg for patients with diabetes and renal disease. In the older sample patients with diabetes and patients with renal disease had higher mean systolic pressures than those without diabetes and those without renal disease (148 vs 144 mm Hg and 150 vs 145 mm Hg, respectively). Patients with diabetes and renal disease had the highest systolic pressure of any of the subgroups, and it was significantly higher than in patients with diabetes but no renal disease (158 vs 147 mm Hg). The same trends held for mean diastolic pressures.

When we compared BP thresholds, we found that in all cases the percentage of patients in the newer sample whose BP was higher than a given threshold was significantly lower than in the older sample ($P<.003$ for all comparisons) (Table 3). These associations held for both χ^2 and nonparametric analyses (Table 4). In the older sample, 26% of patients had a BP of 160/100 mm Hg or higher, while 69% had a BP of 140/90 mm Hg or higher. Similar to the results found for mean pressures, patients with diabetes, renal disease, or both were more likely to have poor BP control in the 1990-1995 study than patients without these conditions. Stratifying by level of control, we found the same results in our older sample (Table 4). Patients with diabetes had worse control than patients without diabetes ($P=.01$). Patients with renal disease had worse control than patients without renal disease ($P=.02$). Diabetic patients with renal disease had worse control than diabetic patients without renal disease ($P=.007$). Tables of cutpoint comparisons for the 1990-1995 study are not shown but can be derived from Table 3.

Considering only systolic BP, 55% of patients had a systolic BP of 140 mm Hg or higher in 1999, vs 65% in the 1990-1995 study ($P<.001$). Using a systolic threshold of 130 mm Hg or higher for those with diabetes, renal disease, or both, more patients were above this threshold between 1990 and 1995 than in 1999 ($P<.003$ for all comparisons) (**Figure 1**).When we examined the pattern of poor control among patients with a BP of 140/90 mm Hg or higher, in both samples isolated elevation of systolic pressure was the most common finding (76% of patients with elevated BP in the newer sample had only elevated systolic pressure compared with 57% in the older sample). More subjects in the older sample had elevation of both systolic and diastolic pressures (38% of patients had uncontrolled BP in the 1990-1995 study vs 21% in 1999). Less than 5% in each sample had only diastolic pressure elevation. Of those with only systolic pressure elevation in both samples, approximately 75% had a systolic pressure in the 140-159 mm Hg range; for the remaining 25%, it was 160 mm Hg or higher.

Lastly, we compared the number of visits with medication increases in both samples using our previous model[15] (**Figure 2**). The total numbers of potentially hypertension-related visits were 6097 in 1999 and 11 567 in 1990-1995. The respective numbers of patients with a BP determination were 4350 and 6391. The mean number of visits per year per patient at which a BP measurement was taken was somewhat lower in the newer sample (4.4 ± 2.5 vs 5.1 ± 2.5). However, such visits in our newer sample were substantially more likely to result in a medication increase. Overall, medications were increased at 21% of recent visits with a BP determination, vs 11% in the old sample. When we tried to fit the 1999 sample to our model (generated from the older sample) predicting antihypertensive medication increases at a given visit, the newer sample had higher rates of medication increases at all branch points and terminal nodes. For example, medications were increased at 40% of the 1999 visits with a recorded diastolic pressure of 90 mm Hg or higher, compared with 21% for the older sample. Also, 43% of the 1999 visits with a recorded systolic pressure of 165 mm Hg or higher showed a medication increase, compared with 22% for the older sample.

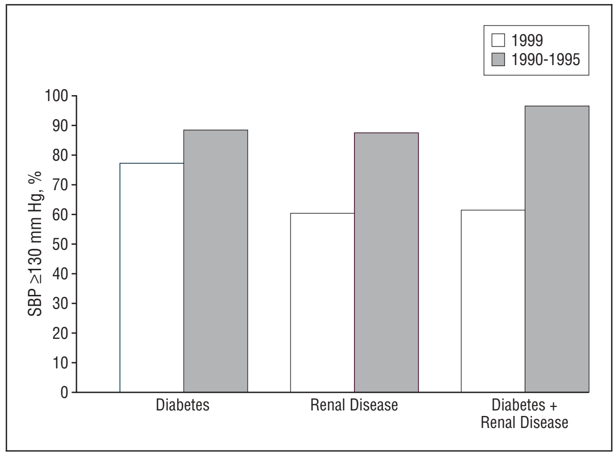

Figure 1. Subgroup comparisons showing the percentage of patients whose systolic blood pressure (SBP) was 130 mm Hg or higher ($P<.003$ for all between-sample subgroup comparisons, χ^2 analyses).

COMMENT

We studied BP control in 2 separate groups of VA patients sampled at different times. Given the increasingly recognized importance of aggressive treatment of hypertension in patients with diabetes and/or renal disease, we also examined these specific groups. Our results are encouraging in that we found significant and substantial improvements in hypertension control in 1999 compared with 1990-1995, in terms of both mean BP control and percentage of patients achieving recommended targets. These improvements were seen in the whole sample and in subgroups with diabetes and renal disease. The significance of these findings should be emphasized because the literature suggests that even small improvements in BP control are important: a 5–mm Hg decrease in diastolic blood pressure, for instance, reduces the risk of stroke by nearly 50%.[6] We found improvements at least of this magnitude. We also found that patients in the newer sample were receiving more antihypertensive medications and prescribed more medication increases, which suggests more aggressive treatment of hypertension as the reason for this improvement.

However, there is still room for improvement. In 1999, 57% of patients still had BP measurements exceeding the recommended goal of less than 140/90 mm Hg, and most of them had uncontrolled systolic pressures. Further, despite recommendations for tighter control in patients with diabetes, the BP control of these patients was similar to the control of patients without diabetes (77% had a BP≥130/85 and 60% had a BP≥140/90).

Several previous studies, including ours, have highlighted the problem of poor BP control.[2,15-19] Most are based on samples from the mid-1990s or earlier. Two recent studies compared BP control rates over time. The Cardiovascular Health Study enrolled 5775 adults 65 years or older, of whom 2828 had a history of hypertension at entry.[23] They followed these individuals from 1990 through 1999 with annual BP measurements. At baseline 63% of them had a BP of 140/90 mm Hg or higher, and this improved to 51% by 1999. The absolute value of improvement over time in their study was identical to that in ours. Similar to us, they found that most patients had only isolated systolic elevations, with pressures of 140 to 159 mm Hg. A second study compared 1994 and 1998 data from the Health Survey for England involving hypertensive adults.[24] They also found improved control rates for 1998 although these were relatively modest, as the percentage of patients with BP maintained below 140/90 mm Hg increased from 6% to 9%. Such low control rates even in 1998 are likely because British Hypertension Society guidelines are more conservative with respect to management of systolic pressure than the JNC VI ones (with the former, BPs of 140 to 159 mm Hg may warrant observation only).[25]

Recent studies have also highlighted the lack of tight BP control in patients with diabetes. Chin et al[26] found that 85% of 531 patients with diabetes followed at an urban medical center between 1996 and 1998 had BPs higher than 130/85 mm Hg. It is difficult to compare this percentage with that of our study patients because these authors' denominator is patients with diabetes, not patients with hypertension and diabetes. We would expect that the percentage of their patients with BPs higher than 130/85 mm Hg would be even higher in this subgroup. Harris[27] used NHANES data from 1991 to 1994 and found that 59% of patients with diabetes and hypertension had a BP of 140/90 mm Hg or higher. This is comparable to the results found for our later sample but better than the 73% of patients with a BP of 140/90 mm Hg or higher seen in our earlier sample from a similar period—presumably because of the younger average age of the NHANES population.

With regard to hypertension and renal disease the available studies use different methods, samples, and, in some cases, different target pressures, and are thus difficult to compare with our study. The largest study, by Coresh et al,[28] again used NHANES III data from 1988 to 1994 to examine the incidence of renal disease (defined by serum creatinine levels) and its association with hypertension. In that study, 64% of 334 treated hypertensive subjects with elevated creatinine levels had a BP of 140/90 mm Hg or higher; in agreement with our earlier sample, 86% of these subjects had BPs of 130/85 mm Hg or higher. Schwenger and Ritz[29] studied BP control in 201 patients referred to a nephrology clinic in 1997. At referral, they had a median creatinine level of 2.3 mg/dL

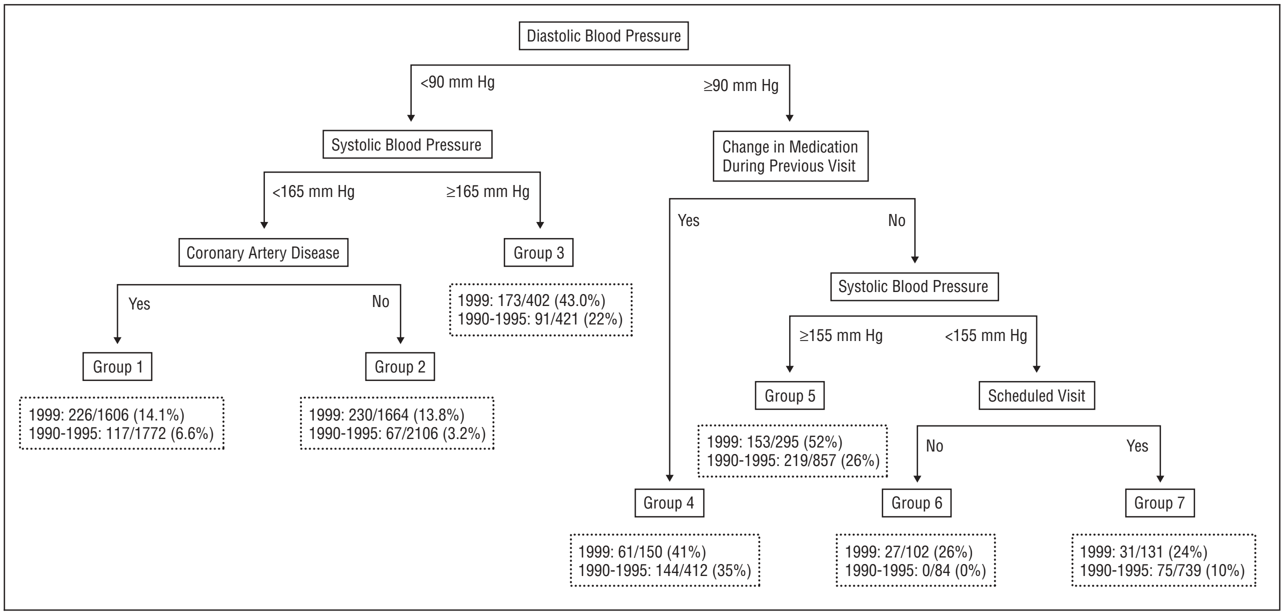

Figure 2. Original model describing factors associated with medication increases and comparing percentage of visits with medication increase for each sample.[15] For the 1990-1995 sample, this model was based on 6391 hypertension-related visits with a blood pressure determination. It was compared with the 4350 visits for the 1999 sample. For each group, the ratio of the number of visits with an increase in antihypertensive medication to the total number of visits with a blood pressure determination is given as percentages. Visits to urgent care, and emergency or clinic add-on visits were considered unscheduled visits.

(203 µmol/L), a median systolic BP of 160 mm Hg, and a median diastolic BP of 95 mm Hg. We do not know how many had a diagnosis of hypertension before referral but more than 90% were receiving antihypertensive treatment when initially seen. After short-term treatment of their BP by nephrologists, 15% had achieved a target BP of 125/75 mm Hg. Dasgupta et al[30] retrospectively studied BP in a cohort of 107 hypertensive patients initiating dialysis between 1994 and 1997. In this study, BP control was averaged from the time of hypertension diagnosis to dialysis, a period that spanned 0.2 to almost 30 years. In the 12 months prior to dialysis, 27% of patients had a diastolic pressure higher than 90 mm Hg and 47% had a systolic pressure higher than 160 mm Hg.

Both of our samples were made up of veterans who were all or mostly all male and mostly white, which may limit the generalizability of our findings. In addition, the samples were obtained by slightly different methods. For the 1990-1995 study, sample patients were first identified as regular VA users at 5 sites in New England; then, those with hypertension were selected from the chart review of randomly selected regular users. For the 1999 sample, 10 VA sites were first selected; then, patients with hypertension who were regular users were selected from these sites. Although this may limit the comparability of the 2 groups, they were similar except that the older groups had fewer nonwhites.

Patients with renal disease were also identified differently in the 2 samples. In the older sample, identification of renal disease was based on laboratory parameters or use of dialysis. In the newer sample, identification was based on a diagnosis written in the clinician's notes. There was only 1 patient receiving dialysis in 1999 and none in our previous study. It is possible that differences in subspecialty care (eg, a patient might be more likely to be followed up by a nephrologist in 1999) could account for the improvements. We cannot determine from our data if this is the case. Even if it were, it would still highlight the fact that patients with renal disease were better treated in 1999.

Our measure of BP control was based on the average of the available measurements for the last visit of the year and used the target recommendations of the JNC VI. Both the Health Plan Employer and Data Information Set and the VA External Peer Review Program (EPRP) use the lowest single BP measurement at the visit. The EPRP first started collecting information on VA BP control in 1999 and used a BP higher than 140/90 mm Hg as the threshold. (This was changed to ≥140/90 mm Hg in 2000, although the Health Plan Employer and Data Information Set still uses >140/90 mm Hg.) Since 80% of visits had only 1 BP measurement listed in both samples, using only 1 measurement instead of the average would not have appreciably affected our results. We were also consistent in our methods, and this would not have affected our secular comparisons.

A strength of our study was that we were able to compare 2 fairly large and similar samples of hypertensive patients assembled at different times. Both studies were based on chart review, which strengthens the validity of our data. Further, despite potentially different samples, the data of our 1990-1995 study are consistent with levels of control found in other studies of that period.[2,17] Our 1999 data are also consistent with those of contemporaneous studies[23,31-33] as well as with national EPRP data. Graves et al[31] sampled 2352 patients in 1999 and found that, overall, 51% had a BP of 140/90 mm Hg or higher. A small study of 176 patients from a health maintenance organization sampled in 1998 found that 65% had a BP of 140/90 mm Hg or higher. By 1999 EPRP data, 56% of all VA patients with hypertension and 57% of patients with diabetes had a BP of 140/90 mm Hg or higher (if we used the same threshold of 140/90 mm Hg or higher for our data, our results would be similar, at 52% and 54%, respectively).

Our data are already more than 2 years old. However, EPRP data show that the trend in VA improvement of BP control continues but is slowing down. In 2000, 54% of all hypertensive patients and 48% of hypertensive patients with diabetes had BPs of 140/90 mm Hg or higher. In 2001 these numbers were 48% and 45%, respectively.[33] We await the analysis of NHANES IV, conducted from 1999 through 2001, to see if similar trends hold in the general population.

Our study shows that hypertension control in the VA has improved over time. Control of patients with coexisting renal disease and diabetes has also improved. However, most patients' BP remain uncontrolled, with measurements above recommended treatment target levels. Our study suggests that the gap between hypertension practice guidelines and achieved BP control is narrowing, although it is still fairly wide. Reasons for this gap are likely to be both patient and provider related. However, clinical inertia, or "the failure of health care providers to initiate or intensify therapy when indicated," has been noted as a prominent problem.[34] Despite knowledge of guidelines and increased recognition of the importance of systolic hypertension, studies of providers have also shown a willingness to tolerate higher systolic pressures than are recommended.[21,22,35,36] Effective interventions to improve providers' adherence to hypertension guidelines are still needed.

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