Goal-Oriented Hypertension Management
Translating Clinical Trials to Practice
Gregory M. Singer, Munavvar Izhar, Henry R. Black

Abstract—Several clinical trials using a blood pressure (BP) treatment algorithm focused on a predetermined goal have achieved better control rates than those of national survey data. These trials reached the Sixth Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI) diastolic blood pressure (DBP) goal of <90 mm Hg in >90% of volunteers and systolic blood pressure (SBP) goal of <140 mm Hg in >60% of volunteers. We evaluated BP control of 437 consecutive patients after at least one year of follow up in a specialist clinic which employed “goal-oriented management,” ie, treating to a specific BP goal without a formal drug treatment algorithm, to determine whether JNC VI goals could be achieved. Overall, 276 (63%) patients achieved SBP goal, with 376 (86%) at DBP goal and 358 (59%) at both goals. Only 23% of patients were on monotherapy, with 34% requiring 2 drugs and 37% requiring 3 or more medications. There was no substantial difference in BP control rates among age, gender, and ethnicity subgroups. However, in the 20% of patients who were diabetic, only 52% had a BP of <140 mm Hg and <90 mm Hg, whereas fewer (22% and 15%, respectively) achieved the more stringent goals of JNC VI and the American Diabetic Association (ADA)/National Kidney Foundation (NKF). Goal-oriented management achieved dramatically better control rates than what is reported. Although DBP control was easy to achieve, achieving SBP goal still remained difficult. Employing goal-oriented management can translate BP control results achieved in clinical trials into outpatient practice. (Hypertension. 2002;40:464-469.)

Key Words: hypertension, detection and control ■ blood pressure monitoring ■ antihypertensive therapy ■ antihypertensive agents

The report of the Sixth Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI) highlighted the distressing fact that only 27.4% of hypertensives aged 18 to 74 in the United States were at the recommended target for goal blood pressure (BP) (<140 mm Hg systolic [S] and <90 mm Hg diastolic [D]). Other surveys have shown lower control rates worldwide. Even fewer older Americans are at that goal, and it is probable that the minority of hypertensives with diabetes will have the JNC VI recommended BP of <130 mm Hg systolic and <85 mm Hg diastolic, with fewer still at the more stringent American Diabetic Association (ADA) and National Kidney Foundation (NKF) goals of <130 mm Hg systolic and <80 mm Hg diastolic.

By contrast, results from several long-term, multicenter clinical trials that employed a treatment algorithm designed to reduce BP to a predetermined goal have achieved much better BP control rates. Three-year data from the Hypertension Optimal Treatment study (HOT), the Controlled Onset Verapamil Investigation of Cardiovascular Events (CONVINCE), and the Antihypertensive Lipid Lowering Trial to Prevent Heart Attack (ALLHAT) show the achievement of a DBP goal of <90 mm Hg in 90% or more of the volunteers. In CONVINCE and ALLHAT, where a SBP goal of <140 mm Hg was also mandated, 60% or more of the participants reached that target. These are effectiveness trials done primarily in practice-based settings using currently marketed antihypertensive medications, usually in multidrug regimens. All 3 trials have achieved the DBP goal in 90% of volunteers, and ALLHAT and CONVINCE achieved the SBP goal in 60% of volunteers, an achievement we chose to call the “60/90” rule.

A goal is the “object to which effort or ambition is directed.” In clinical trials the treatment protocol and goal are prespecified, and the therapy is mandated using an algorithm designed to achieve a target BP. Because there is no consensus on the best clinical pathway for the outpatient management of hypertension, we choose to focus the priority of treatment on reaching a predetermined goal as is done in clinical trials. In this strategy, “goal-oriented management,” the construction of the drug regimen remains the prerogative of the practitioner. The choice of initial and subsequent therapy depends on his or her assessment of the drugs’ appropriateness in the individual patient, based on tolerability, affordability, demography, and comorbidity.
Because of the disparity between poor BP control rates worldwide and the clear success in achieving goals in clinical trials, we evaluated BP control rates in a specialist clinic that used goal-oriented management. The clinic is staffed primarily by clinical hypertension specialists who are certified by the American Society of Hypertension. These data show that the goals recommended by JNC VI and met in clinical trials could be reached in a specialist clinic. Despite treating more complex and, likely, more difficult-to-manage hypertensive patients, hypertension specialists achieved substantially higher BP control rates than those reported in national surveys and matched the 60/90 rule observed in clinical trials. We also found that reaching goal DBP was not difficult; however, our results for SBP control still fell far short of what we feel we need to accomplish.

**Methods**

We reviewed the charts of 542 consecutive patients seen at the Rush University Hypertension Service from August 1998 to February 2000, adopting the currently used and validated Health Plan Employer Data and Information Set (HEDIS) 2000 criteria for evaluation and control (Table 1).12,13

We modified only the age criteria used in HEDIS (46 to 85 years) to include all patients seen by our service. Fifty patients were outside of the HEDIS age range. Only 105 (20%) patients were excluded, either because they did not have a diagnosis of hypertension (n = 21), because their charts could not be found (n = 37), or because they did not have a visit in the measurement year (n = 36) (Figure 1). Eleven patients were followed for less than 1 year and were sent back to their primary physician with their BP at goal. This study was approved by the Institutional Review Board at the Rush-Presbyterian St. Luke’s Medical Center.

As in HEDIS 2000, the BP goal was defined as a SBP <140 mm Hg and DBP <90 mm Hg. For a patient’s BP to be considered controlled, both SBP and DBP must be below these values at the visit used for analysis. The lowest sitting BP reading was used if available. If not, the supine value or the standing BP was employed.14 In our clinic, BP was measured by a physician, nurse, or medical assistant who had been certified as capable of measuring BP accurately using a mercury sphygmomanometer (taking the 1st and the 5th Korotkoff sound as SBP and DBP values, respectively).

The Rush University Hypertension Service is composed of 4 physicians, 3 of whom are certified as specialists in clinical hypertension. All patients were seen by the attending physician at each visit. Most of the patients were referred by physicians because of difficult-to-manage hypertension. Each physician managed his or her patients as deemed appropriate. There was no specific protocol followed, and only commercially available antihypertensive medications were used. Each physician was well versed and committed to the goals of hypertension treatment (<140 mm Hg and <90 mm Hg) promulgated by JNC VI. We evaluated the use of drug classes, not specific drugs. We did not, however, judge the appropriateness of the doses selected, the drug titration, or visit schedule each physician used. We did not specifically compare our results against those of another specialty or primary care practice. We did, however, benchmark our data with the recent report from HEDIS 2000 and National Health and Nutrition Examination Survey (NHANES) III.14,15

**Results**

This analysis includes 437 patients, 387 of whom would also have qualified by HEDIS 2000 criteria and the 50 patients who would have been excluded only because of age. The average age of the patients in our cohort was 61 ± 13 (SD) years, of whom 216 (49%) were men, 57% white, 38% African American, and 5% of other ethnic backgrounds. Diabetes (virtually all type 2) was present in 20% of the patients (Table 2). The mean BP when first presenting to the clinic was 152 ± 24/90 ± 12 mm Hg, with 28% at goal (<140/90 mm Hg).

After at least 1 year of treatment in the clinic, the mean systolic BP dropped to 137 ± 15/79 ± 9 mm Hg (Table 3). Blood pressure was below both 140 mm Hg systolic and 90 mm Hg diastolic in 259 (59%) of patients, more than double those at goal at presentation (28%). An additional 117

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**TABLE 1. HEDIS 2000 Criteria for Hypertension Control**

- Diagnosis of hypertension between 46 and 85 years of age
- One year of continuous enrollment with no more than one gap of up to 45 days
- Diagnosis of hypertension is determined by at least one outpatient encounter with an ICD-9 diagnosis code of 401 during the first 6 months of the measurement year
- Confirmation of a diagnosis for hypertension, a notation of “hypertension,” “HTN,” “high BP,” “HBP,” or “†BP,” in the medical record on or before the first 6 months of the measurement year, including prior to the measurement year. ICD indicates International Classification of Diseases.

**TABLE 2. Demographics**

| Age (y)±SD | 64±11 |
| Gender | |
| Male, n (%) | 216 (49.4) |
| Female, n (%) | 221 (50.6) |
| Race | |
| White, % | 57 |
| Black, % | 38 |
| Other, % | 5 |
| Diabetes, n (%) | 87 (20) |

**TABLE 3. Blood Pressures (n=437)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean initial clinic BP (mean±SD)</td>
<td>153 ± 24/90 ± 12 mm Hg</td>
</tr>
<tr>
<td>Mean clinic BP at eligible visit</td>
<td>137 ± 15/79 ± 9 mm Hg</td>
</tr>
<tr>
<td>Controlled (&lt;140/90 mm Hg at initial presentation)</td>
<td>122 (28%)</td>
</tr>
</tbody>
</table>

**Figure 1.** Selection of consecutive patients presenting to the Rush University Hypertension Service from August 1998 to February 2000 using HEDIS 2000 criteria. Patients referred back to their primary physician did not complete a continuous year of enrollment in the clinic.
(27%) were at only DBP goal at the visit used for analysis but had a SBP >140 mm Hg. In 17 (4%) of the patients, SBP was at goal (<140 mm Hg), but DBP remained ≥90 mm Hg. Neither goal was reached in only 44 (10%) of the patients. Overall, 276 (63%) of the patients were at SBP goal, with 376 (86%) patients at DBP goal, an improvement over the 35% and 51% at SBP and DBP goal, respectively, at the first visit (Figure 2).

In HOT, CONVINCE, and ALLHAT, the protocol strongly encouraged increasing doses or adding treatment in patients not at study goal. Our charts, however, were not periodically monitored nor were our physicians required to titrate treatment if patients were not at goal. They were also not obligated to use any specific classes or doses of medication. For the purposes of this study, drugs were reported by class, with fixed-dose combination drugs counted for each component of the tablet.

Only 23% of the patients were treated with single-drug therapy, with 34% and 37% requiring 2 and 3 or more medications, respectively. Only 6% were treated without drugs, though lifestyle modifications of salt reduction and improved exercise activity were strongly and unambiguously recommended to all.

Of the 102 patients who were on a single drug, 41 received calcium antagonists; 24, diuretics; 17, angiotensin converting enzyme (ACE) inhibitors; 10, beta blockers; 5, alpha blockers; and 5, angiotensin receptor blockers (ARBs). Patients on monotherapy achieved the SBP goal in 71% of cases, DBP goal in 89%, and both goals in 67%.

We also analyzed our data for important subgroups. With the exception of diabetics, there was no important difference in control rates, the distribution of drug classes, or the need for multidrug therapy (Table 4, Figures 3 and 4). As expected, a greater proportion of older patients had lower diastolic blood pressures and achieved the DBP goal. However, systolic blood pressure remained more difficult to control, and fewer achieved the SBP goal compared with younger patients. In the subgroup of African Americans, it was more difficult to reach goal compared with nonblacks (56% versus 62%). More African Americans received diuretics (65% versus 54%) and calcium antagonists (64% versus 52%) and needed multidrug regimens (78% versus 67%) (Table 4). More men were at SBP goal than women (68% versus 59%), though DBP was better controlled in women (89% versus 83%) than in men.

Twenty percent of our patients were diabetic (n=87), a population where the recommendation for goal differs among guideline committees. JNC VI advocates a goal of <130/85 mm Hg for patients with diabetes, and the ADA/NKF recently established guidelines recommending an even lower goal BP (<130/80 mm Hg). HEDIS 2000 does not use different goals for diabetics compared with nondiabetics and classifies as controlled those at <140 mm Hg and <90 mm Hg. Blood pressure control was achieved in 52% of the diabetics according to the HEDIS 2000 goal. However, only 22% and 15%, respectively, reached the more stringent goals of JNC VI and the ADA/NKF (Figure 5).

Only 13% of the diabetics were treated with single-drug therapy, with 33% and 51% requiring 2 and 3 or more medications, respectively. Only 3% were treated without drugs. In the diabetics, 54 received calcium antagonists; 52, ACE inhibitors (ACEIs); 48, diuretics; 28, alpha blockers; 26, beta blockers; and 16, ARBs. ACEIs and ARBs were included in the regimen of 76% diabetic patients compared with 43% of nondiabetics (Figure 3).

Discussion

Despite the unequivocal fact that lowering BP below 140/90 mm Hg significantly reduces morbidity and mortality, the majority of patients are not treated to a goal BP in a variety of practice venues.\textsuperscript{1,16,17} This is especially the case in the elderly and in those with systolic hypertension.\textsuperscript{18,19} However, even though we did not employ a protocol that required treatment to a goal BP (as is done in clinical trials), we reached the recommendations of JNC VI in the large majority of patients treated in a hypertension specialist clinic employing goal-oriented management.

HOT, ALLHAT, and CONVINCE are examples of contemporaneous effectiveness trials that compare treatment approaches of different initial therapy or different BP goals.\textsuperscript{9–11} These studies were primarily performed by practitioners who are not specialists in hypertension. All studies provided a drug treatment algorithm and, more importantly, a prespecified treatment goal. These trials achieved much better results than had been seen in routine practice.\textsuperscript{15–17}

We were interested in identifying whether our specialist clinic, which sees almost exclusively patients referred for difficult-to-manage high BP, could match those results. We were concerned that the complexity of the patients we treat would impair our ability to reach goal, but we expected that our specific expertise would improve our performance.

There are 2 sources of data on BP control that are appropriate for comparing our results. The reported 27.4% control from NHANES III and the 39±10% goal success rate found in 257 managed care organizations representing approximately 10 000 hypertensives patients evaluated by HEDIS 2000 characterize benchmarks for reaching goals in the outpatient treatment of hypertension.\textsuperscript{15,16} Management of hypertension in this specialist clinic yielded 63% of patients with SBP at goal, 86% with DBP at goal, and 59% with both at goal, approaching the 60/90 rule seen in clinical trials using a similar goal-oriented management approach. These results
show that BP control rates obtained in clinical trials could indeed be translated into outpatient clinical practice.

We further analyzed our data in 3 demographic subgroups: age, gender, and ethnicity, as well as in patients with diabetes. Our analysis of these demographic subgroups did not show any important differences. In older persons, the DBP goal was reached in 93%, perhaps reflecting the fall in DBP as populations age.\textsuperscript{18} Systolic BP, which characteristically rises with age, remained much more difficult to treat successfully. Only 58% of those \textgeq 61 years of age had an SBP \textless 140 mm Hg compared with 69% of those \textless 61 years. The difficulty that we, the HOT, CONVINCE, ALLHAT studies, and others had in reducing SBP is a critical problem, even with the large array of pharmacologic options available. This gap in our ability to successfully treat hypertension is particularly disturbing in view of 2 recent meta-analyses of clinical trials that demonstrated the dramatic benefit of treating isolated systolic hypertension in older individuals and of lowering SBP in hypertensives.\textsuperscript{1,20,21}

Contrary to some other studies, African Americans were not substantively more difficult to get to goal than nonblacks, though they needed multiple drug therapy more often.\textsuperscript{22} A greater percentage received diuretics and calcium antagonists than nonblacks, consistent with current recommendations.\textsuperscript{1} Likewise, ACEIs and ARBs were part of the regimen in 76% of our diabetic patients, compared with in 43% of nondiabetics.

Our analysis of diabetics showed that, whereas 52% reached the HEDIS 2000 goal of \textless 140/90 mm Hg, only 22% reached the \textless 130/85 mm Hg goal set by JNC VI, and even fewer by newer and stricter ADA/NKF recommendations of \textless 130/80 mm Hg, though more than half received \geq 3 drugs. Though these data suggest that these latter goals may be too strict at this time with current available medications, the clear benefit from lowering BP in diabetics demands that we must be more aggressive in our clinic and that we must educate all clinicians to do the same. Whether we can safely reach these goals in a substantially higher percentage of diabetics remains to be demonstrated. If we can, the benefits are likely to be enormous.

\begin{table}[h]
\centering
\begin{tabular}{ |c|c|c|c|c|c|c| }
\hline
Characteristic & n & Baseline SBP \textless 140 mm Hg (%) & Baseline DBP \textless 90 mm Hg (%) & Baseline SBP/DBP \textless 140 mm Hg/90 mm Hg (%) & Analyzed Visit SBP \textless 140 mm Hg (%) & Analyzed Visit DBP \textless 90 mm Hg (%) & Analyzed Visit SBP/DBP \textless 140 mm Hg/90 mm Hg (%) \\
\hline
Age, y & & & & & & & \\
\textlt 61 & 210 & 44 & 48 & 36 & 69 & 80 & 62 \\
\textgeq 61 & 227 & 26 & 54 & 21 & 58 & 93 & 57 \\
Ethnicity & & & & & & & \\
Nonblack & 269 & 37 & 57 & 31 & 65 & 90 & 62 \\
Black & 168 & 31 & 42 & 23 & 60 & 80 & 56 \\
Gender & & & & & & & \\
Male & 216 & 40 & 45 & 30 & 68 & 83 & 63 \\
Female & 221 & 29 & 56 & 26 & 59 & 89 & 56 \\
Diabetes & & & & & & & \\
Yes & 87 & 23 & 52 & 21 & 55 & 73 & 52 \\
No & 350 & 37 & 51 & 30 & 63 & 87 & 59 \\
\hline
\end{tabular}
\caption{Blood Pressure Control by Subgroup}
\end{table}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{drug_class_distribution}
\caption{Drug class distribution by population subgroup. ACE-I indicates angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; and Central, central acting agents.}
\end{figure}
We learned, as in HOT and CONVINCE, that single-drug therapy can effectively get only a minority of hypertensive patients to goal. Over two-thirds of our patients needed 2 or more drugs to achieve BP goal. After 3 years, only 30% of the participants in CONVINCE and 32% of the participants in HOT were on a single drug. In our study, only 67% of patients on monotherapy achieved goal, with an additional 22% having a DBP <90 mm Hg. Whereas clinical trials formally add multiple classes of antihypertensive drugs when patients remain uncontrolled, goal-oriented management dictates that patients who remain uncontrolled on single-drug therapy should have their therapy augmented, and we are now turning our attention to these patients.

The strengths of this study include the fact that care was given in a traditional office setting, though by hypertension specialists. We enrolled an adequate number of consecutively seen patients and adequately ascertained the blood pressure and vital status of our patients. Furthermore, a goal-oriented management approach is both flexible and potentially generalizable because we used only commercially available medications and imposed no restrictions on the choice of drug.

The major limitation of this study is the lack of a control group with which we could make direct comparisons. Several alternative approaches could have served as a control. For example, pharmacologic management using different priorities, such as ones based on pathophysiology or strictly cost, or different practice venues, such as clinics staffed by generalists or disease management nurse specialists, could have been evaluated. We chose instead to compare our rates of BP control with NHANES III and other quality assurance initiatives (HEDIS 2000). We were not necessarily interested in how the goal is achieved, rather if it could be achieved when it was the primary treatment focus.

We cannot conclude, nor do we mean to suggest, that specialists are necessary to achieve these results. However, we do feel that the data on managed care organizations (MCOs) from HEDIS 2000 provide an adequate comparison of BP control rates in general practice. Blood pressure data were obtained from only a single encounter; however, this is similar to clinical trials and national surveys, as well as in the validated HEDIS 2000 criteria. Additionally, baseline blood pressures could be argued as being artificially elevated because patients tend to have higher BP at the initial clinic visit. However, our initial BP control rates were similar to those in NHANES III, ALLHAT, and Veterans Administration hospitals.

We acknowledge that this is a specialty referral clinic, receiving patients from primary care physicians for difficult-to-manage hypertension. Patients analyzed in this study may not reflect the general population and our visits, which are focused on hypertension management, are not necessarily representative of the typical encounter in the primary care setting where a myriad of problems are addressed. We feel that our goal-oriented approach to hypertension management, however, can simplify the clinician’s task, just as the mandated increases in drug therapy make it possible for investi-
TABLE 5. Potential Benefits of Participating in Clinical Trials

- Patients more likely to take their medicine as prescribed
- Patients more likely to keep their appointments
- Patients less likely to be lost to follow-up
- Better outcomes than are seen in practice
- Patients receive timely and convenient visits and assistance with transportation
- Trained ancillary staff focused on collecting outcome and side-effect data

in clinical trials to achieve the 60/90 rule. Because hypertension represents a significant contributor to morbidity and mortality and the benefits of lowering BP are clear, this approach could reap enormous benefits.

We conclude that physicians not only can match the 60/90 rule seen in clinical trials using an approach focused on reaching goals, but also can do so even in difficult-to-manage hypertensives. The goals for hypertension management that have been suggested by guideline committees and quality assurance organizations are reasonable and achievable. Monotherapy will control hypertension in only a minority of patients, confirming the role of multidrug regimens to achieve these goals. The initial choice is still important because certain classes of agents (ACEIs or ARBs in diabetics, for example) should almost always be included in the regimen and not all patients will need multiple drugs. Diastolic BP control is easy to achieve, especially in the elderly, but getting SBP to goal still remains a daunting task. And, despite their increased risk and the greater use of multidrug regimens, diabetic hypertensives remain very difficult to control and to get to lower goals.

Perspectives

Despite the other likely advantages to those who volunteer to participate in clinical trials (Table 5), the primary similarity between our clinic’s results and those seen in clinical trials is our focus on reaching a prespecified goal. We feel that practitioners can translate clinical trial results simply by employing goal-oriented management. It is time to shift our approach to managing hypertension from one based on pharmacology, pathophysiology, or cost to one based on achieving the benefits of lowering BP in the largest number of patients.

Acknowledgments

We are indebted to William J. Elliott, MD, PhD, George L. Bakris, MD, Gilberto Neri, MD, and Amy Smith, ND, and her staff of the Rush University Hypertension Service for their superb patient care.

References


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Hypertension. 2002;40:464-469; originally published online September 23, 2002;
doi: 10.1161/01.HYP.0000035858.04434.03
Hypertension is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2002 American Heart Association, Inc. All rights reserved.
Print ISSN: 0194-911X. Online ISSN: 1524-4563

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
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