Cost and Quality Trade-offs in the Treatment of Hypertension

William B. Stason

The cost-effectiveness of treatment for hypertension is positively related to the level of pretreatment blood pressure and to the level of success in achieving patient adherence to prescribed medical regimens. Opportunities to improve the cost-effectiveness of treatment include limiting treatment to patients with well-documented sustained increases in blood pressure, giving higher priority to the treatment of patients with diastolic blood pressures of 100 mm Hg and above, and relying on lower-cost medications if clinical responses to treatment permit. In patients with mild hypertension, a comparison of strategies for initiating pharmacological treatment that takes into account potential side effects as well as the costs of medications indicates a difference of $270/patient-yr between the least and most expensive alternatives. Whether the additional costs of more expensive treatment strategies are “worth it” depend on any additional health benefits actually conferred. Moreover, higher-cost strategies may have negative influences on patients’ decisions to adhere to prescribed regimens or to continue in treatment. Cost is a particular problem for the treatment of chronic conditions like hypertension because of inadequate insurance coverage for medications, especially for the poor. (Hypertension 1989;13(suppl I):I-145-I-148)

The relation between systolic and diastolic levels of blood pressure and cardiovascular mortality and morbidity has been amply confirmed by epidemiological studies. Similarly, several clinical trials have provided convincing evidence of the benefits of reducing diastolic blood pressure above 100 mm Hg on the prevention of stroke and congestive heart failure. Benefits in patients with levels of blood pressure below 100 mm Hg and in the prevention of myocardial infarction, while encouraging, are less consistent. Residual uncertainty concerning the balance between the benefits and risks of treating mild hypertension creates a major challenge to clinicians, medical policy-makers, and educators alike.

Inclusion of cost as a variable in guiding clinical decision-making adds a new but important dimension. This article focuses on the economics of hypertension, first, from the perspective of societal costs, then from the viewpoint of the major determinants of the cost-effectiveness of treatment, and finally, from the standpoint of suggesting opportunities for reducing the costs of treatment without sacrificing health benefits.

Costs of Hypertension and Its Treatment

In 1986, the American Heart Association estimated that the societal costs of cardiovascular disease totalled $78.6 billion. Sixty-two percent of this amount was spent on patient care in hospitals or nursing homes, 15% for physicians and nursing services, and 6% ($5 billion) for medications. The remainder was accounted for by lost economic output due to disability. Hypertension, by increasing the risks of cardiovascular disease in the 40–60 million Americans it affects, directly or indirectly accounts for a substantial, although difficult to quantify, proportion of these costs. The estimated ambulatory care costs of treating hypertension in the United States is about $7.5 billion yearly, based on treatment costs for 15 million Americans and on an incremental annual cost of $500/patient-yr for medications, office visits, and laboratory tests. Any way they are measured, the economic implications of hypertension are impressive.

Cost-Effectiveness of Hypertension Treatment

Cost-effectiveness analysis provides a yardstick by which the costs of medical treatment can be examined in relation to the health benefits conferred. Alternative uses of health resources and different health care programs can thereby be compared.

We have examined the cost-effectiveness of hypertension treatment with particular attention to the age and sex of the patient, the pretreatment level of
diastolic blood pressure, and the degree of adherence to long-term medical regimens. Our analysis relies on the Framingham Heart Study for estimates of morbidity and mortality with respect to blood pressure levels. The costs included are those of antihypertensive treatment minus the savings from projected strokes and myocardial infarctions that have been prevented. The cost-effectiveness ratio is expressed in dollars/quality-adjusted life-year (QALY), a measure that explicitly acknowledges that a year of life with medication side effects or disability as the result of a stroke or heart attack is worth less than a year of full health. Results are shown in Figure 1.

Our study resulted in three major conclusions. The first is that hypertension treatment does not pay for itself in medical cost savings from strokes or heart attacks prevented. Only 22% of the cost of treating moderate hypertension (diastolic blood pressure 105 mm Hg) and only 15% of the costs of treating mild hypertension (diastolic blood pressure in the range 90–104 mm Hg) appear to be recovered. The value of treating hypertension, therefore, must be measured in human terms; in lives that are saved and in reduced levels of disability. Second, the cost-effectiveness of treatment is directly related to the pretreatment level of diastolic blood pressure. In 1984 dollars, we calculate cost-effectiveness ratios, assuming full adherence to medical regimens, of about $45,000, $22,000, and $9,000 per QALY, respectively, for pretreatment diastolic blood pressures of 90–94, 95–104, and 105 mm Hg or higher. Hence, treatment of mild hypertension, assuming such treatment is effective, is much less cost-effective than is treatment for higher levels of blood pressure. Finally, inevitable problems with adherence compromise the cost-effectiveness of treatment. Ratios for each blood pressure level are increased by about one third because of expected failures in medication-taking or continuity of care.

Whether cost-effectiveness ratios of the magnitude that we have identified represent good values depend on comparisons with other uses of health resources. Such comparisons indicate that treatment of mild hypertension (90–104 mm Hg) appears about equally cost-effective as coronary artery bypass surgery (CABG) in patients with two-vessel disease and who are unresponsive to medications; less cost-effective than CABG for three-vessel or left-main disease, or the use of β-blockers in patients who had suffered myocardial infarctions; and more cost-effective than CABG for one-vessel disease or treatment of hypercholesterolemia with cholestyramine resin in men with serum cholesterol levels of 265 mg/dl or higher.

Opportunities to Improve the Cost-Effectiveness of Hypertension Treatment

Opportunities to improve the "payoff" of hypertension treatment center around decisions on which patients to treat and on the treatment to be prescribed. A few examples will highlight some opportunities (Table 1).

**Limit Treatment With Medications to Patients With Sustained Hypertension**

Evidence from a recent Gallup survey indicates that as many as 43% of physicians in the United States consider treatment of mild hypertension (90–104 mm Hg) to be about equally cost-effective as coronary artery bypass surgery (CABG) in patients with two-vessel disease and who are unresponsive to medications; less cost-effective than CABG for three-vessel or left-main disease, or the use of β-blockers in patients who had suffered myocardial infarctions; and more cost-effective than CABG for one-vessel disease or treatment of hypercholesterolemia with cholestyramine resin in men with serum cholesterol levels of 265 mg/dl or higher.

**Table 1. Opportunities for Increasing Cost-Effectiveness of Hypertension Treatment**

<table>
<thead>
<tr>
<th>Increase effectiveness</th>
<th>Reduce costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiate treatment only after verifying sustained blood pressure elevations</td>
<td>Initiate treatment with lower-cost medications</td>
</tr>
<tr>
<td>Consider the false-positive potential of &quot;white-coat hypertension&quot;</td>
<td>Reserve higher-cost medications for patients who fail to respond to lower-cost medications or who experience adverse side effects</td>
</tr>
<tr>
<td>Give higher priority to treating patients with diastolic blood pressure of 100 mm Hg or above</td>
<td>Limit office visits and laboratory examinations to those that are medically necessary</td>
</tr>
</tbody>
</table>
States who treat hypertensive patients start medications based on diastolic blood pressures of 90–99 mm Hg measured at a single office visit. At least one third of such patients will not have sustained hypertension.12 If these results are representative of clinical practice in the United States, a large number of patients are receiving treatment (and bearing its risks and costs) without reasonable expectation of corresponding benefits. A related issue is the phenomenon of “white-coat hypertension.” In one study, 21% of patients with persistently elevated clinical pressures did not meet the criteria for hypertension during 24-hour blood pressure monitoring.13 If this is a general finding, some patients are being treated needlessly although they have “sustained hypertension” as traditionally defined. Further study is needed to determine whether we should consider revising our criteria for diagnosing hypertension in patients with mildly elevated blood pressures.

Assess the Risks Versus Benefits of Treatment

The dilemma of whether to treat mild hypertension raises additional questions. Even if we accept that clinical trials demonstrate reduced cardiovascular morbidity and mortality in treated patients whose diastolic blood pressures are in the range 90–99 mm Hg, the balance between the benefits and risks of treatment may be a narrow one. Deleterious effects on the quality of life and the implications of metabolic changes, like the tendency of diuretic agents to increase serum cholesterol, need to be factored into the risk–benefit algorithm. Prudence suggests that we should be conservative in offering pharmacological treatment to patients with very mild hypertension on risk–benefit grounds, if not on cost-effectiveness ones.

Reduce the Costs of Treatment

Opportunities to reduce the cost of treatment should also be pursued, provided that cost reductions can be achieved without sacrifice in blood pressure control or increased medication side effects. In a study of a national network of hypertension clinics in the Veterans Administration, a detailed microcosting study found that the cost of ambulatory care was about $325/patient-yr of treatment (1981 dollars).14 Forty-nine percent of costs were for office visits, 36% for medications, and 15% for laboratory examinations. Medication costs in this study significantly underestimate those in the private sector, because the Veterans Administration is a bulk purchaser from the pharmaceutical industry. Costs of treatment can be reduced through changes in any one of these major components, but medication costs are perhaps the most tractable.

The cost/yr of treatment varies widely for different antihypertensive agents, ranging from about $15/yr for generic hydrochlorothiazide or reserpine to $560/yr for calcium channel blockers (Table 2). Coupled with evidence that physicians are prescribing the newer and more expensive angiotensinase converting enzyme inhibitors and calcium channel blockers more frequently, and, in many cases, are substituting these agents for diuretic agents or /3-blockers as initial therapy,15 the question should be raised as to whether the resulting increases in cost are accompanied by greater patient benefits. The answer is probably affirmative for those patients whose blood pressures are not adequately controlled on less expensive agents and for patients who, for one reason or another, cannot tolerate the lower-cost drugs. Reliance on these new agents as initial treatment, however, is more difficult to justify.

Cost-Saving Treatment Strategy

A reasonable approach to initiating pharmacological treatment may be to use generic hydrochlorothiazide (unless contraindicated) as initial therapy, to add supplemental potassium or to substitute a potassium-sparing combination if hypokalemia develops, and to substitute another agent if important subjective or metabolic side effects occur. Addi-

### TABLE 2. Approximate Cost of Antihypertensive Medications, 1987*

<table>
<thead>
<tr>
<th>Drug</th>
<th>Cost/yr on average doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic hydrochlorothiazide</td>
<td>$15</td>
</tr>
<tr>
<td>Potassium supplements</td>
<td>$85–225</td>
</tr>
<tr>
<td>Potassium-sparing diuretic agents</td>
<td>$58–327</td>
</tr>
<tr>
<td>Propranolol</td>
<td>$170</td>
</tr>
<tr>
<td>Other /3-blockers</td>
<td>$240</td>
</tr>
<tr>
<td>Angiotensinase converting enzyme inhibitors</td>
<td>$410</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>$560</td>
</tr>
</tbody>
</table>

*Red Book Update, April 1987, plus 10%, plus pharmacy fee /100 units dispensed. Based on average therapeutic doses and prices provided.

### Table 3. Cost Comparisons for Antihypertensive Treatment Strategies

<table>
<thead>
<tr>
<th>Initial treatment</th>
<th>Cost/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic diuretic agent</td>
<td>$108–128</td>
</tr>
<tr>
<td>Potassium-sparing diuretic agent</td>
<td>$128–344</td>
</tr>
<tr>
<td>/3-Blockers</td>
<td>$201–262</td>
</tr>
<tr>
<td>Angiotensinase converting enzyme inhibitor</td>
<td>$378</td>
</tr>
</tbody>
</table>

Assumptions include: 1) Drugs are equally effective in controlling diastolic blood pressure. 2) Hypokalemia occurs in 20% of patients taking diuretic agents. 3) Intolerable side effects (subjective or metabolic) occur in 20% of patients taking diuretic agents, 13% taking /3-blockers, and 8% taking angiotensinase converting enzyme inhibitors. The latter two figures are from Croog et al.,16 and the estimate for diuretic agents is a worst-case assumption set equal to the findings of this same study for alphamethyldopa. 4) In the case of strategies starting with a diuretic agent or /3-blocker, change is to an angiotensinase converting enzyme inhibitor. For the strategy starting with an angiotensinase converting enzyme inhibitor, change is to a diuretic agent. In each case, the change in regimen is assumed to relieve side effects. 5) Costs/yr of therapy for an individual agent are shown in Table 1. and 6) Change in treatment regimen, where required, occurs immediately.
tion of medications may, of course, be added subsequently to achieve the desired blood pressure goal.

Cost comparisons of this strategy to other strategies that involve starting treatment with potassium-sparing diuretic agents, β-blockers, or angiotensinase converting enzyme inhibitors and the assumptions underlying these comparisons are shown in Table 3. All analyses refer to single-drug regimens. Any added costs of laboratory tests needed to identify the potential metabolic effects of diuretic agents have been excluded because such tests are indicated mainly during the initial period of treatment titration and thereafter are likely to be obtained with approximately equal frequency (often yearly) in all patients. Other reasonable assumptions can be substituted but would probably not greatly affect the conclusions of the analysis.

Cost differences among alternative strategies are impressive. From a national perspective, the difference of $270/patient-yr between the least and most expensive strategies would amount to more than $250 million dollars for every one million hypertensive patients treated. Is this difference in cost worth it and, if so, for which patients and for what measures of outcome?

Arguments for low-cost treatment strategies stem not only from societal concerns about the high and rising cost of medical care but also from the problems individual patients experience with paying for care. Potential consequences include patients who “skimp” on treatment to save money or drop out of care altogether. A recent Gallup poll indicated that cost was the most important attribute of antihypertensive medications for 14% of patients, and that problems in paying for medications were more common than side effects (25% vs. 14%). Inadequate insurance compounds the problem. This same survey found that only 59% of patients have insurance policies that cover medications. For patients with incomes less than $15,000, this figure was 44%. Patients who are at highest risk from hypertension (the poor and blacks) are least able to pay for its treatment.

In conclusion, guidelines for hypertension treatment need to identify a clear set of decision rules for clinicians that explicitly take into account the costs of treatment as well as its benefits. These guidelines should reflect the vicissitudes of blood pressure measurements used to classify patients as being hypertensive and should target treatment at patients who are most likely to benefit. There is an ever-increasing need in medical care to justify the added costs of new and expensive technologies by providing convincing evidence of resulting health benefits. In the case of new antihypertensive agents, better blood pressure control, improved quality of life, and a reasonable presumption that reduced morbidity and mortality will result are relevant measures.

Concerns about the cost-effectiveness of medical care, as well as the total costs of health care, are highly germane policy issues. Treatment of hypertension raises some important and difficult questions with respect to cost and quality trade-offs.

Acknowledgment

The author acknowledges the valuable perspectives of Mark V. Pauly, PhD, on the economics and public policy issues addressed in this article.

References

1. Veterans Administration Cooperative Study Group on Antihypertensive Agents: Effects of treatment on morbidity in hypertension. I: Results in patients with diastolic blood pressure averaging 90-114 mm Hg. JAMA 1970;213:1143-1152
4. Hypertension Detection and Follow-up Program Cooperative Group: Five-year findings of the Hypertension Detection and Follow-up Program: II. Mortality by race, sex and age. JAMA 1979;242:2572-2576

Key Words: • costs • cost-effectiveness • antihypertensive agents
Cost and quality trade-offs in the treatment of hypertension.
W B Stason

Hypertension. 1989;13:I145
doi: 10.1161/01.HYP.13.5_Suppl.I145

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://hyper.ahajournals.org/content/13/5_Suppl/I145

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Hypertension can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Hypertension is online at:
http://hyper.ahajournals.org//subscriptions/