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William B. White

For patients with hypertension and their physicians who care for them, assessment of blood pressure (BP) over 24 hours with an automated monitor has considerable appeal. When done properly, ambulatory BP recordings yield far more reproducible values over fairly long periods of time compared with the doctor's office BP.¹ Because ambulatory BP monitoring yields multiple readings during all of a patient's activities, including the sleeping period and time at work, this method gives a more comprehensive representation of the vascular burden of hypertension than a small number of BP readings in the office of a clinician.^{2,3} In fact, recent analyses of cohorts of patients with both untreated and treated hypertension followed for up to a decade have typically shown that ambulatory BP has better predictive values for future cardiovascular events than clinical measurements of BP.^{4,5}

When the usefulness of ambulatory BP monitoring became recognized early on by hypertension specialists, the focus of its use was for the evaluation of white-coat hypertension. Unfortunately, the definition of white-coat hypertension has varied a great deal in the medical literature because of arbitrary differences between clinical measurements and various components of the ambulatory BP, such as 24-hour mean, daytime, or awake periods.⁶ The variability of the definition of white-coat hypertension in the prognostic studies and the duration of follow-up for cardiovascular outcomes has made direct comparisons among these studies difficult, if not impossible. Clearly though, the appropriate trend for defining white-coat hypertension in untreated patients has been to use lower out-of-office values, such as daytime BPs of <130/80 mm Hg.^{2,7} Even with these lower ambulatory BP values, there is mounting evidence that over time, some white-coat hypertensive patients will progress to sustained hypertension and ultimately an increase in cardiovascular events.⁷ Nevertheless, there are also patients who do not progress from their white-coat hypertensive status within a period of many years. For this particular subgroup of patients,

ambulatory BP monitoring is the critical test for proper assessment and long-term management.

In this issue of *Hypertension*, Krakoff⁸ reports on the cost-effectiveness of ambulatory blood pressure using updated published information from the past decade on the prevalence of white-coat hypertension, the likelihood of transitioning from white-coat hypertension to a sustained form of hypertension that would require antihypertensive drugs, and the cost of care for the management (including drug therapy) of patients with hypertension. The focus of his analysis is for patients in the United States, because the national insurance policy (Centers of Medicare and Medicaid Services) has been covering the cost of ambulatory BP monitoring in its beneficiaries (primarily men and women aged >65 years) for the evaluation of white-coat hypertension since 2002.⁹

Krakoff's analysis is both meticulous and thoughtful as it takes a relatively conservative and cautious approach that concludes that using ambulatory BP monitoring specifically to diagnose and direct the management of white-coat hypertension will be cost-effective. The conditions of the economic presentation are: 1) between 15% and 25% of patients with newly diagnosed and untreated hypertension will have white-coat hypertension; 2) of those patients diagnosed with white-coat hypertension, approximately 5% to 20% will transition to a sustained hypertensive status annually; and 3) the less expensive therapies could be prescribed to most of these patients. In the model involving 1000 new patients, ambulatory BP monitoring yields a cost savings of 3% to 14% over 5 years of observation. The implication of these findings is that ambulatory BP monitoring is cost-effective for the diagnosis and management of newly diagnosed hypertension, with the understanding that this model is limited by a maximum of 5 years of patient follow-up.

There are a few caveats, however, for this sort of economic analysis. First, an assumption is being made that the prevalence of white-coat hypertension is, on average, 20% of newly diagnosed patients with hypertension. This has been an assumption for quite some time using daytime ambulatory BP averages between 130/85 to 135/90 mm Hg with office BPs of >140/90 mm Hg for the definition of white-coat hypertension.^{6,10} However, this high proportion may no longer be realistic considering the worrisome findings from Verdecchia et al⁷ that even when 130/80 mm Hg is the cut-off for normal ambulatory BP, stroke events are increased compared with the normotensive population at ≈8 years of observation. If one used the values of a daytime mean of <130/80 mm Hg and a nighttime BP of <120/70 mm Hg considered optimal

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by recent American Heart Association guidelines,¹¹ the proportion of patients who would be diagnosed with white-coat hypertension would probably be quite a bit lower than 20%.

The economic model of Krakoff⁸ is based on established and somewhat fixed costs for ambulatory BP measurement per patient. However, physicians or clinical practices also have to consider their own personal costs for initiating ambulatory BP monitoring in a hypertension specialty practice; the startup costs for new ambulatory BP monitoring labs with at least 2 high-quality recorders and software with a dedicated computer will cost a practice ≈\$7 to \$10 000. Thus, on a more microeconomic (and personal) level, ambulatory BP recordings may not be quite so cost-effective for the provider as it would be for the health care system during the first year or two of operation.

There are 2 other major uses of ambulatory BP monitoring in clinical practice that deserve consideration: first, the usefulness of ascertaining the white-coat effect in the *treated* hypertensive patient and second, the evaluation of high-risk patients on antihypertensive therapy for whom the measurement in the doctor's office may be inadequate or misleading. In clinical practice, it is often quite difficult to verify whether the much lower home BP values obtained by a patient on treatment compared with the values by the physician in the office are, in fact, valid. This situation is commonplace in cardiovascular medicine; ambulatory BP monitoring is very helpful in both discerning the patient who may not require additional antihypertensive therapy and those who will require up-titration of present therapy or addition of new pharmacological modalities.¹² In addition, as was clearly demonstrated by the results of the Office versus Ambulatory Blood Pressure Study,⁵ patients who have elevated 24-hour ambulatory BP values were nearly twice as likely to have a cardiovascular event compared with patients with normal 24-hour ambulatory BP values, including in those patients whose office BP was normal. This finding is of particular concern, considering that a substantial proportion of high-risk patients under treatment by cardiovascular specialists may

have uncontrolled hypertension when they are outside of the medical care environment (eg, masked hypertension). The cost-effectiveness of ambulatory BP monitoring in these 2 common clinical scenarios is not known at the present time; however, clinical consensus supports the use of ambulatory BP monitoring in these types of patients, although insurance coverage for the procedure may be absent.

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