

Continuing Education

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Early to Rise: A.M. Hypertension and Home BP Monitoring

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Behavioral Objectives

After completing this continuing education article, the pharmacist should be able to:

1. Delineate the specific type of hypertension (eg, morning, masked, or white-coat hypertension) a patient may be experiencing.
2. Explain the neurohormonal imbalances as well as the possible dangers associated with morning hypertension.
3. Describe the pathophysiology behind the circadian rhythm of the body, particularly as it impacts the cardiovascular system.
4. Counsel a patient on appropriate blood pressure device selection, technique, and validation.
5. Communicate the clinical importance of monitoring blood pressure at home.

See Exam on Page 96

This educational lesson will be available to pharmacists online at www.pharmacytimes.com.

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Recently, home blood pressure (HBP) monitoring has become an acceptable and popular method for the diagnosis and assessment of hypertension. As technology regarding these devices has advanced, so has the amount of published data documenting its clinical value. Currently, more than 10 million HBP devices are produced annually worldwide. Compared with blood pressure (BP) measurements obtained in an office or clinic, HBP monitoring offers greater patient convenience, more accurate and reproducible BP readings, better prognostic value, and patient-centered involvement, which in turn enhances drug-therapy adherence.¹⁻³

HBP can also assist in the detection of various types of hypertension, such as white-coat, masked, and morning hyper-

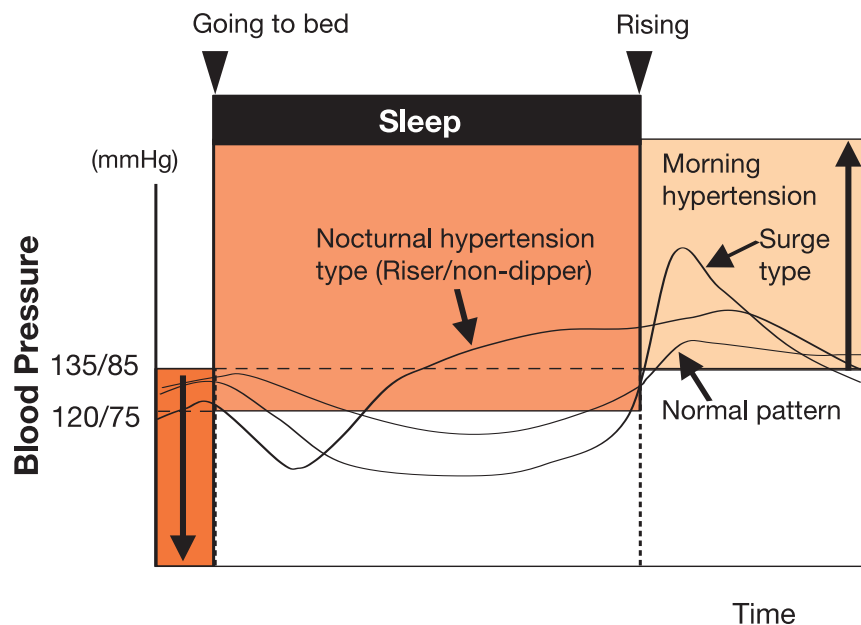
tension. In the case of morning hypertension, the "surge" type has been independently associated with elevated cardiovascular risks and can be deadly if not recognized and appropriately managed.^{1,3} Uncontrolled hypertension results in numerous deaths among Americans, and it is a serious risk factor for other deadly cardiovascular diseases; thus, the pharmacist is ideally positioned to assist with diagnosis and management of this public health concern. This continuing education lesson will explain the concepts of circadian rhythm of BP; the various types of morning hypertension; the dangers associated with morning hypertension, specifically the morning surge type; the clinical benefits that HBP monitoring can offer patients; and the pharmacist's role in appropriate HBP device selection.

Review of Chronobiology

A master clock resides deep within the anterior hypothalamus of the brain of all mammals, known as the suprachiasmatic nucleus.⁴ This nucleus is made up of positive and negative transcriptional and translational feedback loops that drive gene expression. This master clock is believed to ultimately oversee the coordination of biological and physiologic processes within a predictable-in-time cyclic variability also known as *circadian rhythm*. Over time, light/dark and other societal/environmental time cues train our master clock to a 24-hour time structure and stage the peaks and troughs of circadian rhythms to support the diurnal activity-nocturnal sleep routine. By communicating with other peripheral clocks located in tissues of the heart, liver, kid-

Figure 1

Morning Hypertension and Diurnal Blood Pressure Variation



Used with permission from reference 14.

Associated conditions

Nocturnal hypertension type (Riser/non-dipper)

- Medicated hypertension
- Diabetes
- Post-stroke
- Congestive heart failure
- Sleep apnea syndrome
- Orthostatic hypotension

Surge type

- Increased arterial stiffness
- Impaired baroreflex
- Orthostatic hypertension

neys, and adrenal glands, the master clock modulates individual rhythms in the periphery via hormones or hemodynamic cues. The study of these circadian rhythms and how they impact physiology, disease, and outcomes is known as *chronobiology*. Data have suggested that human biochemistry and physiology are not constant, but rather vary in a predictable manner during the 24-hour time period.⁵⁻¹⁰

The sleep cycle is a prime example of biochemical and physiologic rhythms: just prior to sleep, basal gastric acid secretion, white blood cell count, and atrial natriuretic peptides (which are potent vasodilators) start to rise. As the sleep cycle progresses, growth and thyroid-stimulating hormone, blood lymphocyte and eosinophil number, and plasma concentrations of melatonin and prolactin also begin to peak, as do adrenocorticotropic hormone, follicle-stimulating hormone, and luteinizing hormone. By the early morning hours, plasma cortisol, renin, angiotensin, and aldosterone crest, leading to an increase in arterial compliance, vascular resistance, platelet aggregation, and blood viscosity. By the

afternoon, hemoglobin and insulin concentrations are at their highest levels, whereas serum cholesterol and triglycerides are at maximum concentration in early evening.^{5,6,10,11}

Circadian Rhythm of Blood Pressure

Cardiovascular hemodynamics also follows a circadian pattern. Heart rate (HR) and BP are the lowest during sleep and rise toward the end of the sleep cycle.¹²⁻¹⁴ On awakening, a change in posture is followed by systemic increases in catecholamines, cortisol, aldosterone, angiotensin, and renin, which accompany physical and psychological stress.^{15,16} Moreover, the body exhibits heightened sensitivity to such changes, as evidenced by the lower concentration of epinephrine needed to induce platelet aggregation or vessel vasoconstriction. All of these actions translate to increased HR, BP, coronary tone, and vessel caliber.^{5,13}

Morning Hypertension

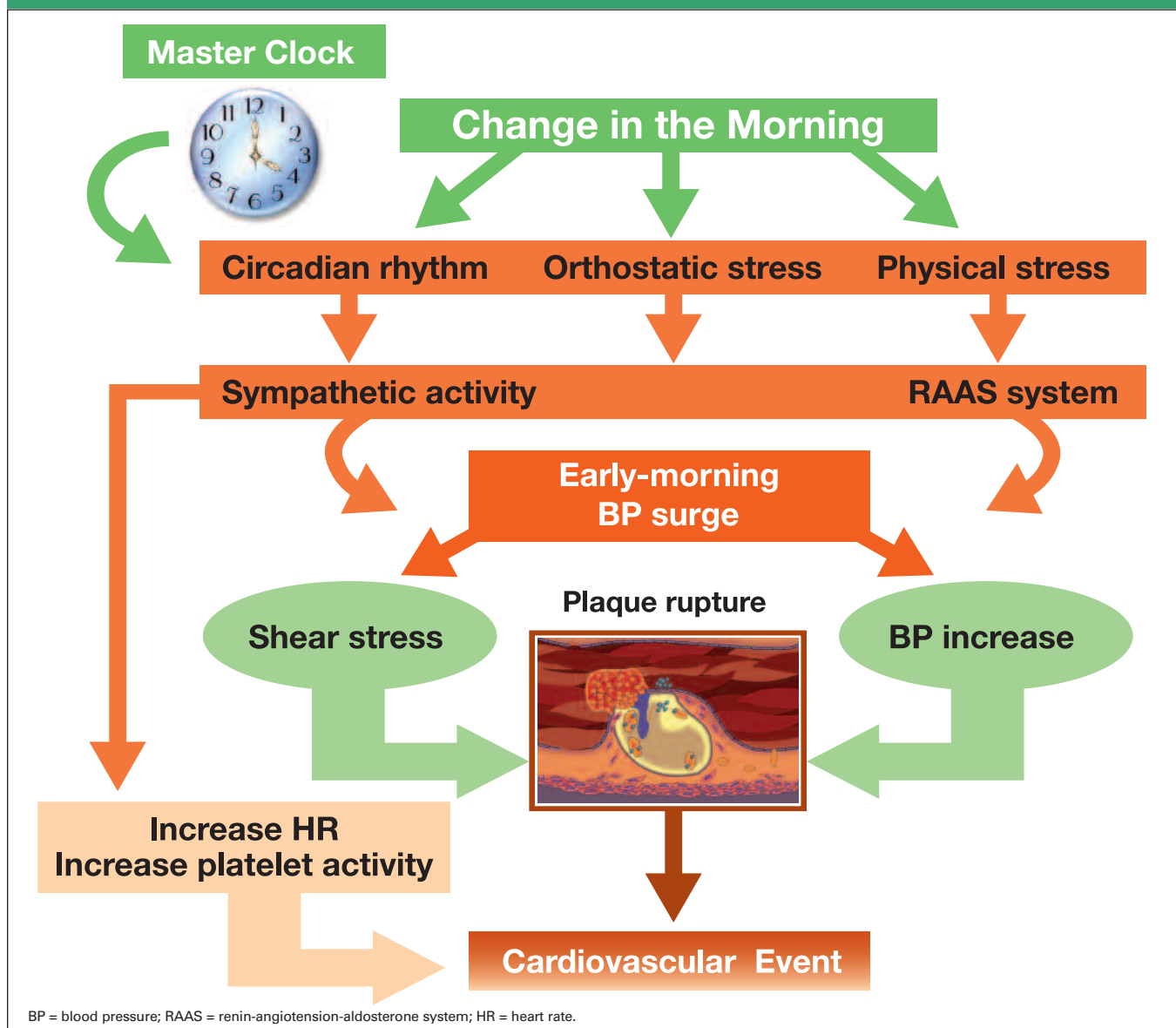
Definitions

Due to these neurohormonal changes, the typical circadian variation in BP for

the majority of patients with hypertension includes a nadir that occurs during the nighttime hours and a surge that occurs during the early-morning period when people typically arise for the day. This is referred to as *morning hypertension*. Although not validated, morning hypertension has been defined as a morning BP exceeding 135/85 mm Hg. Morning hypertension is classified according to 2 types (Figure 1). Patients who demonstrate persistently high BP from nighttime to morning are referred to as “nondippers,” because their BP remains elevated all night. This type of morning hypertension is also called *sustained* or *nocturnal hypertension*. Sustained hypertension occurs in about 10% to 30% of patients with hypertension and is associated with a high risk of target-organ (brain, kidney, heart) damage and cardiovascular events.¹⁷ *Morning surge hypertension* (MSH) is the second type and is characterized by extreme dips of nocturnal BP. For these 10% to 20% of patients also known as “extreme dippers,” nighttime BP is >20% lower than daytime BP. In healthy individuals, this morning BP surge is just 1 of the components of the

Figure 2

Mechanisms Leading to Early-Morning BP Surge and Possible Cardiovascular Events



diurnal variation in BP and is associated with morning stress on rising, which normalizes within a few hours of awaking. For the MSH patient, however, this excessive, sudden elevation in BP can be deadly and is an independent risk factor for cardiovascular disease, particularly in older adults who may have impaired autoregulation.

Pathogenesis of MSH

During the early-morning hours, many different neurohormonal systems are activated (Figure 2). With a change in

posture, the sympathetic nervous system (SNS) becomes stimulated, causing the release of epinephrine and norepinephrine into the circulation. Just prior to awaking, the renin-angiotensin-aldosterone system (RAAS) is also stimulated, thereby increasing the production of angiotensin II.^{18,19} As mentioned earlier, in a healthy individual, these processes are merely physiologic adjustments to compensate for the change from a horizontal to a vertical position and the consequent increase in cardiovascular demand. In the patient with hypertension, however,

these systems are dysregulated. For example, in patients with MSH, the increase in angiotensin II can be on the order of 200% of normal. Such a large abrupt elevation brings about vascular inflammation, endothelial damage, and vasoconstriction.²⁰ When accompanied by heightened platelet activity and greater blood viscosity, these actions translate to increased HR and systemic vascular resistance, which disrupt the equilibrium between myocardial oxygen demand and supply.

Pathophysiologic processes associat-

ed with MSH can also result in rupture of vulnerable atherosclerotic plaques. Atherosclerotic plaques start to emerge as early as the teenage years. Because these plaques are asymptomatic, most people have no concept of what may be building within their vasculature until it is too late. With an increase in arterial pressure and vasoconstriction brought on by the SNS and RAAS, shear stress can cause an initial disruption of an atherosclerotic plaque, which initiates a cascade of inflammatory processes. Once intimal collagen is exposed, platelet aggregation and inflammatory mediators cause thrombus formation around the disrupted plaque. Macrophages release proteases, which further degrade the thin fibrous cap surrounding the plaque's lipid core, resulting in full-blown rupture. Minor ruptures can lead to asymptomatic mural thrombus characterized by unstable angina or non-ST-segment-elevation myocardial infarction (MI). A major rupture can culminate in a potentially fatal occlusive coronary thrombus with the addition of other external stimuli (such as an early-morning cigarette, cold weather, Monday-morning stress) to the increased coagulability and vasoconstriction.^{14,21-23}

With this in mind, it seems plausible that timing of certain life-threatening emergencies may parallel these physiochemical circadian variations, especially in patients with underlying cardiovascular disease. This hypothesis has been validated by large database analyses, and epidemiologic studies have found the incidence of cardiovascular events (eg, MI, sudden cardiac death, thrombotic stroke, and angina) occur several-fold more frequently during the early-morning hours (ie, 6 AM-12 PM), compared with any other time of the day or night.^{24,25} Data from the JICHI Morning Hypertension Research study (J-MORE) suggest that, even in medicated patients with hypertension, the presence of older age (≥ 65 years), regular alcohol consumption, and smoking may increase surges in morning BP.²⁶⁻²⁸ Other risk factors associated with MSH include metabolic syndrome, renal disease, and diabetes.^{29,30} As

with many chronic diseases, MSH may be genetically linked. Curtis and colleagues have identified various genes (*Bmal1*^{-/-}, *Clock*^{mut}, and *Npas2*^{mut}) from the master clock in the brain that play a role in the regulation of enzymes relevant to the synthesis and disposition of catecholamines, resulting in alterations in norepinephrine and epinephrine throughout the day, as well as changes in these variables in response to stress.³¹ Although the clinical onset of vascular events occurs more frequently in the morning, it is unknown whether this increase is the result of this "molecular" master clock or merely the physical and emotional stress of getting up and becoming active after slumber.

Effects on Cardiovascular Events

The effects of MSH on target organs can be devastating, particularly in vulnerable populations such as patients with diabetes and the elderly. In type 2 diabetes, MSH is strongly related to both microvascular and macrovascular complications, especially nephropathy, compared with other patients with hypertension and diabetes. Other investigators have determined that MSH at the moment of rising is more strongly related to organ damage as measured by the presence of cardiac hypertrophy and albuminuria independent of other BP measurements, especially in older adults.³²

In a subanalysis of the Ohasama study, 1766 patients with hypertension were assigned to 1 of 4 categories based on home BP values: normotensive (both morning and evening BP <135/80 mm Hg); MSH (morning BP $\geq 135/85$ mm Hg and evening BP <135/85 mm Hg); evening hypertensive (morning BP <135/85 mm Hg and evening BP >135/85 mm Hg); and sustained hypertensive (both morning and evening BP $\geq 135/85$ mm Hg).³³ Compared with normotensive patients, the investigators found that patients with morning surge and sustained hypertension had a 2.66 and 2.38 times higher risk of a stroke, respectively ($P < .0001$). In fact, for patients with MSH currently receiving antihypertensive

therapy, the stroke risk was even higher (risk hazard, 3.55, $P < .0001$).

Kario and colleagues prospectively evaluated stroke prognosis in 519 older patients with hypertension in which ambulatory BP monitoring was performed.^{34,35} The morning BP surge was defined as the difference between the mean systolic BP during the 2 hours after waking and arising minus the mean sys-

MSH is strongly related to both microvascular and macrovascular complications.

tolic BP during the hour that included the lowest BP during sleep. Over the 41-month study period, 44 strokes occurred. Patients were divided into 2 groups: morning surge (≥ 55 mm Hg) and non-morning surge (< 55 mm Hg).

The investigators found that those in the morning-surge group had a higher baseline prevalence of multiple cerebral infarcts (57% vs 33%, $P = .001$) and a higher incidence of stroke (19% vs 7.3%, $P = .004$), compared with the non-morning-surge group, respectively. Moreover, the morning surge was associated with stroke events independent of 24-hour BP, nocturnal BP dipping status, and baseline prevalence of silent infarcts ($P = .008$).

MSH also has been correlated with left ventricular hypertrophy (LVH).³⁶ If left untreated, LVH can ultimately lead to the development of heart failure, ventricular arrhythmias, atrial fibrillation, and even sudden death.

Ikeda and colleagues evaluated 297 patients with hypertension who were treated with amlodipine for at least 1 year. Patients were divided into 2 groups: MSH (morning BP $\geq 135/85$ mm Hg and evening BP <135/85 mm Hg) and evening hypertension (morning BP <135/85 mm Hg and evening BP >135/85 mm Hg). At 3 months, all patients received echocardiography.

Compared with a control group, those in the MSH group had a significantly greater left ventricular mass

Table

Selected List of Validated Automated Upper-Arm and Wrist Devices for Self-measurement of Blood Pressure

Company	Specific Device
A&D	UA-705
	UA-767
	UA-767 Plus
	UA-774
	UA-787
Microlife BP	3AC1-1
	3AC1-1 PC
	3AC1-2
	3AG1
	3BTO-A
	3BTO-A(2)
	3BTO-AP
Omron	HEM-432
	HEM-712
	HEM-711
	HEM-711 DLX*
	HEM-775*
	HEM-780
	HEM-790IT
	HEM-629 (wrist)
	HEM-637 (wrist)
	HEM-650 (wrist)
HEM-670IT (wrist)	
Seinex	SE-9400

*These products are clinically equivalent to HEM-780.

index ($P = .001$). After a multivariate regression analysis was conducted, morning rise in BP was the dominant predictor of LVH.

The totality of the evidence surrounding the association between target-organ damage and MSH logically suggests that HBP should be incorporated into the diagnosis and assessment of hypertension.

Overview of HBP Monitoring

Initially, HBP measurements were done using the auscultation method with either mercury sphygmomanometers or aneroid manometers, as typically used in physician offices. For the patient, however, these devices are difficult to use and require extensive training and skill. The automated cuff-oscillometric devices, which record pressure from the brachial artery, have become popular due to ease of use and the incorporation of digital readout and computer memory. Presently, several organizations have guidelines addressing established procedures for HBP measuring; these include the International Consensus Conference of

Self BP Monitoring (ICCSBM), the American Heart Association (AHA) recommendations for BP measurement, the European Society of Hypertension recommendations for BP measurement, and the Japan Society of Hypertension (JSH) guidelines for self-monitoring of BP at home.^{1,37-40}

Indications and Contraindications

The American Society of Hypertension (ASH) recommends the use of HBP monitoring for the majority of patients with hypertension, pointing to 4 potential benefits:

- Differentiating sustained from white-coat hypertension
- Assessing the response to antihypertensive therapy
- Improving compliance
- Reducing costs⁴¹

Very little has been written regarding contraindications. Studies have suggested that patients with a low education level often report inaccurate HBP readings.⁴² Those with severe mental or physical disabilities may also not be appropri-

ate candidates for HBP monitoring. Irregularity of the pulse may render the results less accurate, so atrial fibrillation may be a contraindication.⁴³

Types of Monitors

Three different categories of cuff-oscillometric devices exist: the upper-arm cuff, the wrist cuff, and the finger cuff. The finger-cuff device is not recommended due to measurement inaccuracies related to vasoconstriction, alteration in BP the more distal the site of the recording, and limb positioning. Traditional wrist-cuff devices are subject to the same problems as the finger cuff in addition to problems with changing the position of the wrist. However, certain wrist BP monitors with positioning technology that only allow them to inflate when they are at heart level have been proven accurate in recently published clinical studies among adults, obese adults, and the elderly. Currently, the upper-arm cuff device has been shown to be most reliable.

Validation of Individual Monitors

The home BP monitor market is presently flooded, with a multitude of manufacturers offering closely competitive products. These products continue to evolve with respect to their complexity, variety of functions, and cost. Accuracy should be the primary goal for device selection. Only monitors that have been subjected to proper validation tests should be used in clinical practice. The original 2 protocols with the widest acceptance were developed by the Association for the Advancement of Medical Instrumentation in 1987, revised in 2002, and the British Hypertension Society in 1990, revised in 1993.^{44,45} Unfortunately, only a few oscillometric devices have been subject to these tests.

An up-to-date list of validated monitors is available at www.dableducational.com/accuracy_criteria.html or www.bhsoc.org/blood_pressure_list.st. The Table provides a list of selected, validated upper-arm devices for self-measurement.^{46,47}

The fact that a monitor has passed a validation test does not always ensure

100% accuracy in individual patients. This is particularly concerning for older adults and patients with diabetes. In these patients, error with a device can be as high as 5 mm Hg. For this reason, all patients should validate their device on themselves before recording BP readings. No formal protocol has been developed for doing this, but 2 methods have been suggested: the sequential method and the simultaneous method. With the sequential method, the automated-cuff-

As with office BP measurements, HBP measurements should be performed under controlled conditions.

oscillometric device readings are compared with the alternating readings of a traditional mercury sphygmomanometer on the same arm. With the simultaneous method, the readings from simultaneous measurements are compared. First, the automated device is used on one side and the sphygmomanometer on the other side. Next, each measurement is done using the contralateral arm. Regardless of the method used, at least 2 measurements by both automated device and mercury sphygmomanometer are recommended, and the device should be validated if both readings taken are within at least 5 mm Hg of each other. Monitors should be checked for accuracy every 1 to 2 years.^{1,37-40}

It is further recommended that devices with memory or those that can download data to a personal computer are used, as some patients may have poor reporting accuracy. In 2 studies, >50% of patients who used HBP monitors either omitted or fabricated their readings.^{1,37-40}

User Procedure

As with office BP measurements, HBP measurements should be performed under controlled conditions with the procedure of measurement standardized, as mentioned early. The ASH and JSH recommend that 1 or 2 home BP measure-

ments be obtained in the morning and evening. In the JSH guidelines, *morning* is defined as 1 hour after arising from sleep, after micturition, before breakfast, and before taking medications; whereas *evening* suggests just prior to bedtime. On all occasions, HBP should be taken in the same position after a period of a few minutes. The AHA recommends 3 to 5 minutes of rest before measurement.¹

The number of HBP measurements on each occasion remains a matter of debate. The guidelines of the ICCSBM suggest 2 consecutive measurements in the morning and evening. The AHA recommends that 2 or 3 readings be taken in succession, separated by ≥ 1 minutes, whereas the JSH guidelines suggest at least 1 measurement on each occasion.^{1,39} Kario and colleagues have assessed the association between the number of measurements and the level of hypertensive organ damage, brain natriuretic peptide (BNP), and urinary albumin excretion (UAE). In this study, second or third readings demonstrated significantly higher correlation with both BNP and UAE than first readings.⁴⁸ In a study of 1491 patients with hypertension, Ohkubo and colleagues evaluated the optimum number of BP self-measurements in relation to the predictive value for stroke risk. The investigators found that no actual threshold existed for the number of HBP measurements within the range of 1 to 14 measurements, suggesting that "as many as possible" measurements should be obtained for better prediction of stroke risk.⁴⁹ Based on the present evidence, HBP measurements should be performed multiple times and all values recorded without selection.

Home BP Readings

What is considered a normal HBP reading? HBP readings are typically lower than clinical BP readings in most patients. In population surveys, the difference is shown to be approximately 10/5 mm Hg. Several studies have assessed at what level the home pressure corresponds to a normal clinic pressure of 140/90 mm Hg. The largest trial to date,

the Ohasama study, has suggested an upper limit of normal to be 137/84 mm Hg.^{3,50} The Ohasama investigators found that, above this level of BP, a significant increase in cardiovascular risk was established. After reviewing the current available published evidence, an ad hoc committee of the ASH has suggested 135/85 mm Hg as an acceptable upper limit of normal.⁵¹ This BP limit is also recommended by the AHA.¹ Although a normal BP threshold for home monitoring has been suggested, the treatment goal for HBP values has never been truly established. Additional large-scale studies will be needed to establish this BP range. As with office-based BP readings, the AHA also suggests that a lower HBP goal be recommended for certain patient populations: patients with diabetes, pregnant women, and patients with renal failure. Unfortunately, no specific goals have been defined specifically for HBP monitoring.¹

Prognostic Value of HBP Monitoring

For many years, office BP has been used as the gold standard for clinical BP measurement. In the past 5 years, however, the value of HBP monitoring in combination with office measurements has been documented.

Widespread adoption of self-monitoring BP in clinical practice has been slow due to lack of prognostic data. Two prospective studies have found that HBP monitoring better predicts morbid events, compared with conventional office measurements. The Ohasama study was a prospective study evaluating the relation between initial BP levels (home and clinic) and subsequent all-cause mortality in a cohort of 1789 rural Japanese. The mean duration of follow-up was 6.6 years. The investigators found that HBP was more strongly predictive of later mortality than clinical BP. Analyzing both systolic and diastolic levels of clinical BP, initial (first 2 readings) HBP, and multiple (>3 readings, mean number 20) HBP measurements, only the mean multiple home systolic BP was significantly correlated with subsequent mortality.³

In the Self-Measurement of Blood

Pressure at Home in the Elderly study, 4939 patients with hypertension aged 60 years or older were followed for a mean of 3.2 years and evaluated for cardiovascular mortality based on their method of BP measurements (ie, HBP or office monitoring).² The investigators found that inclusion of HBP self-measurements better defined the prognosis of cardiovascular morbidity and mortality, compared with office visits alone. For example, 9% of patients with well-controlled hypertension at home, but poorly controlled hypertension in the physician's office, also known as *white-coat hypertension*, were detected and appropriately diagnosed. The authors also noted that, in a very small subset of patients, HBP monitoring detected the phenomenon known as *reverse white-coat syndrome*, or *masked hypertension*. In this case, BP readings are normal in the provider's office but abnormal at home. These findings have also been validated by other large cross-sectional studies.⁵²⁻⁵⁴

Furthermore, increasing evidence shows that HBP also better predicts hypertensive organ damage more closely than clinical BP measurements.⁵⁵⁻⁵⁷ Mule and colleagues evaluated 38 patients with hypertension by clinical, ambulatory, and HBP measurements. Each patient recorded HBP for 2 days with a digital BP monitor 3 times daily, the first time on the same day during which ambulatory monitoring was simultaneously performed. They concluded that HBP measurements, especially those recorded on the second day, correlated significantly, and more tightly than clinical BP, with LVH, renal function, and global target-organ damage.⁵⁵

HBP and Compliance with Medication Therapy

Several studies have indicated that

HBP monitoring not only is effective at increasing patient drug adherence but may lead to better BP control.⁵⁸⁻⁶⁰

A crucial aspect of self-monitoring is properly fitting the BP cuff to the individual patient.

In some situations, self-monitoring increased medication adherence from 0% to 70%.^{58,59} An HBP monitor provides a visual reminder and a positive reinforcement tool for drug adherence. Self-monitoring can also help to determine correct drug-dose intervals while patients are awake and to assess the efficacy of therapeutic modifications. This in turn reinforces the advantages of maintaining BP within specified goals, possibly motivates lifestyle changes, and allows patients a better overall understanding of the disease.

HBP and Limitations

Unfortunately, several limitations exist with HBP monitoring. First, some HBP devices can be expensive and not easily affordable for patients. Second, because of the lack of large studies, HBP monitoring cannot be used to decide whether treatment is indicated. The treatment decision must still be based on repeated clinic BP readings. Once established, the HBP reading can be used to exclude individuals who are at risk for side effects due to low out-of-office BP readings and to precisely monitor the BP response to therapy. Third, goal HBP for special populations such as those with renal disease or who are pregnant have not been clearly defined. Finally, accurate BP measurements are only possible when patients have an

excellent understanding of the device and its correct use. Erroneous HBP readings due to inappropriate device use could potentially mislead a patient and a provider.

Implications for Pharmacists Role of the Pharmacist

As pharmacists, it is important not only to identify appropriate patients who warrant HBP monitoring but also to assist patients in identifying a monitor that is suitable to their needs. A patient should feel content with all aspects of the monitor, including cost, user-friendliness, quality, and mobility of the unit. If unsatisfied, a patient might stop using the device.

A crucial aspect of self-monitoring is properly fitting the BP cuff to the individual patient. Unless fitted correctly, the device fails to maintain accuracy and patient comfort during use. A cuff bladder that is too narrow or too short produces a falsely elevated BP, and a bladder that is too long or wide will underestimate the actual value. The recommended cuff sizes are as follows¹:

- For arm circumference of 22 to 26 cm, the cuff should be "small adult" size: 12 × 22 cm
- For arm circumference of 27 to 34 cm, the cuff should be "adult" size: 16 × 30 cm
- For arm circumference of 35 to 44 cm, the cuff should be "large adult" size: 16 × 36 cm
- For arm circumference of 45 to 52 cm, the cuff should be "adult thigh" size: 16 × 42 cm

Patient Counseling

After an HBP monitor has been selected, it is up to the pharmacist to communicate appropriate device use. High-quality and accurate BP measurements are



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possible only if patients use the device correctly. Although the simplicity of digital monitors diminishes the potential for errors, the pharmacist must explain to the patient the specific instructions included by the manufacturer and demonstrate proper BP measuring technique.¹ The following should be communicated to the patient:


- The patient should be seated in a comfortable chair with the back fully supported and the upper arm free of constrictive clothing
- Both feet should be on the floor and legs not crossed
- The cuffed arm should be supported and placed at the level of the heart, and the cuff should encircle at least 80% of the arm circumference
- The patient should not smoke, eat, exercise, or consume caffeine for ≥30 minutes prior to measuring BP
- Measurements should be taken after


the patient has remained quietly seated for 3 to 5 minutes

- The patient should not talk during the measurement
- Typically, 3 measurements should be obtained 1 minute apart in the morning on awakening and again prior to bedtime. Timing and frequency may be patient-specific, however.
- Patients should either store all HR and BP measurements in the memory of the device or keep a carefully documented written record with the time and date of measurements
- The patient should always take the device and/or measurement to all health care provider visits
- The patient should be encouraged to validate the device readings with office or clinical readings

Conclusions

The use of HBP monitoring continues

to gain popularity and acceptance by both patients and providers as an essential and vital component of the control of hypertension. The value and impact of self-monitoring, particularly in the detection and management of certain hypertension subtypes (eg, morning hypertension) continues to be appreciated and documented in the literature. Combined with the increasing trend for patients to take a more active role in their health care and the expanding role of the pharmacist in therapeutic management, HBP monitoring should become more commonplace over the next 5 to 10 years, thereby putting a dent in the number of patients who might succumb to the morbidity and mortality associated with hypertension. 

 For a list of references, go to: www.pharmacytimes.com.

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CEReviewQUESTIONS

Early to Rise: A.M. Hypertension and Home BP Monitoring

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(Based on the article starting on page 88) Choose the 1 most correct answer.

1. Where does the "master clock" that controls circadian rhythm exist in the body?
 - a. Pituitary gland
 - b. Suprachiasmatic nucleus
 - c. Limbic system of the brain
 - d. Adrenal gland
2. What specific genes have been isolated that may control morning-surge hypertension (MSH)?
 - a. *Bmal1*^{-/-}
 - b. *Clock*^{mut}
 - c. *Npas2*^{mut}
 - d. All of the above
3. A patient with hypertension checks his morning blood pressure (BP) after awaking, again around 3 PM in his doctor's office, and again prior to bedtime (10:30 PM). His BP readings are as follows: 150/90 mm Hg, 148/85 mm Hg, and 155/93 mm Hg, respectively. This is suggestive of what type of hypertension?
 - a. Masked
 - b. Sustained
 - c. Morning
 - d. White-coat
4. A patient with hypertension checks his morning BP after awaking, again around 3 PM in his doctor's office, and again prior to bedtime. His BP readings are as follows: 130/80 mm Hg, 160/95 mm Hg, and 135/75 mm Hg, respectively. What type of hypertension is this patient exhibiting?
 - a. Masked
 - b. Sustained
 - c. Morning
 - d. White-coat
5. A patient with hypertension checks his morning BP after awaking, again around 3 PM in his doctor's office, and again prior to bedtime. His BP readings are as follows: 180/100 mm Hg, 140/80 mm Hg, and 130/82 mm Hg, respectively. What type of hypertension is this patient exhibiting?
 - a. Masked
 - b. Sustained
 - c. Morning
 - d. White-coat
6. If the hypertension for the patient in Question 5 is not controlled, which of the following could potentially occur?
 - a. Decrease in urine albumin excretion
 - b. Decrease in left ventricular size
 - c. Increase in risk of stroke
 - d. Increase in risk of neuropathy
7. If a patient is using a home blood pressure (HBP) monitor to evaluate his or her pressure, what would the upper limit of *normal* be for his or her BP?
 - a. 130/85 mm Hg
 - b. 135/85 mm Hg
 - c. 140/90 mm Hg
 - d. 145/95 mm Hg
8. What are some of the consequences of the large, abrupt elevation in BP in patients with MSH?
 - a. Vascular inflammation
 - b. Endothelial damage
 - c. Vasoconstriction
 - d. All of the above

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- A Review of Federal Legislation Affecting Pharmacy Practice

9. Which of the following may be responsible for MSH?
- Increased renin-angiotensin-aldosterone activity
 - Decreased sympathetic nervous system surges
 - Decreased vascular sensitivity to norepinephrine
 - Increased plasma calcium concentrations
10. Compared with BP readings obtained in a doctor's office, which of the following is *true* regarding HBP monitoring?
- It is less accurate and reproducible.
 - It may improve drug therapy adherence.
 - It is not as prognostic.
 - It may reduce cardiovascular mortality.
11. Which of the following cuff-oscillometric devices has/have been shown to be more reliable?
- upper-arm cuff
 - traditional wrist cuff
 - finger cuff
 - All are equally reliable
12. At what time of day should patients check their HBP?
- In the morning after waking up
 - In the morning after waking up and after lunch
 - In the morning after waking up and after eating supper
 - In the morning after waking up and prior to bedtime
13. According to the American Heart Association (AHA), at a minimum, how long should a patient wait between BP measurements?
- 1 minute
 - 3 minutes
 - 5 minutes
 - 10 minutes
14. A patient has purchased an HBP monitor. How often would you recommend that he or she check the monitor for accuracy?
- Every 6 months
 - Every 1 to 2 years
 - Every month
 - Every 3 to 4 years
15. Which of the following patient populations may *not* benefit from an HBP monitor?
- Patients with white-coat hypertension
 - Patients with type 2 diabetes
 - Patients with atrial fibrillation
 - Patients with heart failure
16. A list of updated validated monitors can be obtained from the American Heart Association.
- True
 - False
17. A patient with hypertension checks his morning BP after awaking, again around 3PM in his doctor's office, and again prior to bedtime. His BP readings are as follows: 180/100 mm Hg, 135/85 mm Hg, and 160/90 mm Hg, respectively. What type of hypertension is this patient exhibiting?
- Masked
 - Sustained
 - Morning
 - White-coat
18. What risk factors can increase surges in morning hypertension?
- Age ≥ 65 years
 - Regular alcohol consumption
 - Smoking
 - All of the above
19. A patient has an arm circumference of 36 cm. What type of arm cuff should be selected for the patient?
- Small-adult cuff
 - Adult cuff
 - Large-adult cuff
 - Thigh cuff
20. According to the AHA, how long should a patient remain quietly seated before a BP measurement should be obtained?
- 1 to 2 minutes
 - 3 to 5 minutes
 - 10 to 20 minutes
 - 30 to 40 minutes

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MAY 2007

PROGRAM 290-000-07-005-H01

Early to Rise: A.M. Hypertension and Home BP Monitoring

(TEST VALID THROUGH MAY 1, 2010.)

NO CREDIT WILL BE GIVEN AFTER THIS DATE.)

1.	a	b	c	d	8.	a	b	c	d	15.	a	b	c	d
2.	a	b	c	d	9.	a	b	c	d	16.	a	b	c	d
3.	a	b	c	d	10.	a	b	c	d	17.	a	b	c	d
4.	a	b	c	d	11.	a	b	c	d	18.	a	b	c	d
5.	a	b	c	d	12.	a	b	c	d	19.	a	b	c	d
6.	a	b	c	d	13.	a	b	c	d	20.	a	b	c	d
7.	a	b	c	d	14.	a	b	c	d					

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PROGRAM EVALUATION

Please mark your level of agreement with the following statements. (4 = Strongly Agree; 0 = Strongly Disagree)

- | | | | | | |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|
| 1) Met its stated objectives | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 1. Delineate the specific type of hypertension (eg, morning, masked, or white-coat hypertension) a patient may be experiencing. | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 2. Explain the neurohormonal imbalances as well as the possible dangers associated with morning hypertension. | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 3. Describe the pathophysiology behind the circadian rhythm of the body, particularly as it impacts the cardiovascular system. | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 4. Counsel a patient on appropriate blood pressure device selection, technique, and validation. | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 5. Communicate the clinical importance of monitoring blood pressure at home. | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 2) Work of instructor was high-quality | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 3) Instructional materials were high-quality | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 4) Case study aided learning | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 5) Presented information in a fairly balanced and noncommercial manner | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 6) Offered information useful in my professional practice | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 7) Provided new insights into contemporary pharmacy practice | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

