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## Significance of ambulatory and home blood pressure monitoring in hypertension management: An Indian perspective

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### Abstract

It is estimated that in India, one in four individuals have hypertension. However, only about 12% of these individuals achieve adequate blood pressure (BP) control. Uncontrolled BP is a major risk factor for cardiovascular diseases including myocardial infarction and stroke. Along with an appropriate management plan, regular BP monitoring is the key. Traditional methods of monitoring BP in the clinical setting may not adequately reflect an individual's BP outside of that setting and higher BP in a non-clinical setting is linked to an increased risk of cardiovascular disease. Ambulatory BP monitoring (ABPM) and home BP monitoring (HBPM) are both recognized methods for measuring BP outside of the clinic. ABPM and HBPM have been recognized by several guidelines and are an effective adjunct to office-based monitoring to measure white-coat and masked hypertension. This review includes the perspectives of Indian specialists and discusses the merits and limits of the ABPM and HBPM in an Indian context.

**Keywords:** Ambulatory blood pressure monitoring, home-based blood pressure monitoring, hypertension, cardiovascular disease

### Introduction

According to estimates, hypertension affects at least one in four adults in India (approximately 200 million) <sup>[1, 2]</sup>. Yet only approximately 12% of these individuals achieve adequate blood pressure (BP) control. One of the primary risk factors for cardiovascular diseases (CVDs) including myocardial infarction and stroke, is uncontrolled BP. CVDs are the leading cause of deaths and diseases worldwide and they account for one-third of all deaths in India <sup>[2]</sup>. To prevent severe complications related to hypertension, it is crucial to engage in accurate monitoring of BP and implement appropriate management strategies.

Focused group discussions were arranged with Indian cardiologists to better understand the importance of ambulatory BP monitoring (ABPM) and home-based BP monitoring (HBPM) from the Indian perspective.

Experts opined that hypertension management is a growing challenge. Several new therapies for hypertension management and tools like ambulatory BP monitors, wrist BP monitors and mHealth apps for measuring BP have been explored in the last two decades. In clinical practice, four methods for measuring BP are available (office BP, automated office BP [AOBP], home-based BP monitoring [HBPM] and ambulatory BP monitoring [ABPM]). ABPM and HBPM are on the rise these days.

Despite the known benefits of ABPM and HMBP, there might be a gap in the implementation and utilization of these techniques within the healthcare ecosystem. This unmet need could involve exploring barriers and challenges that hinder the widespread incorporation of ABPM and HMBP into routine management protocols in India. This review summarizes the literature on ABPM and HBPM and presents the views of Indian cardiologists on the management and control of BP.

### Blood pressure variability

Measuring BP in the clinic is widely considered the most prevalent medical procedure. Nonetheless, the inherently dynamic nature of BP is often overlooked. On a beat-to-beat basis, BP levels can fluctuate significantly in response to external and behavioural factors, as

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described below [3]. Moreover, the extent of BP variability among individuals both in the short and long term keeps changing. Findings from a survey conducted to gather the perspectives of Indian clinicians regarding the burden, measurement and management of BP variability in hypertensive patients revealed that over 80% of the clinicians reported that 10%-40% of their hypertensive patients encounter BP variability. These clinicians strongly advocated for a combination of home and office BP monitoring as the preferred method for measuring BP variability [4].

External and behavioural factors that cause BP variability [5], include physiological variables, e.g. recent meal ingestion, bladder extension, cold exposure or recent caffeine intake; posture, i.e. standing or lying; procedural variables such as legs crossed at knees, insufficient rest periods or unsupported arm; and clinic setting i.e. the effect of a clinical office setting and presence of an observer.

BP variability changes in both the short and long term; therefore, distinguishing BP levels from other components of absolute cardiovascular risk calculation such as age, gender, smoking status and cholesterol levels which remain constant or steady is important.

Many people show a difference in BP when measured inside and outside of a clinical setting [6]. A study conducted by Adman and Gold shire in 1940 discovered that BP measured at home was consistently lower than that BP measured in a clinical environment.[7] This is attributed to the "white-coat effect," in which BP levels are increased due to anxiety associated with the clinical setting. Standardized measurements and regular visits can help to reduce the effect, although it still exists in many people. Furthermore, office BP assessments may overlook cases of masked hypertension in which BP levels are normal in the office but excessive outside of the professional context. All experts agreed that in their clinical practice, white-coat hypertension is seen in 10%-12% of patients and masked hypertension is seen in 10%-20% of patients. According to research and meta-analysis studies, out-of-office BP is more significantly connected to target end-organ damage and cardiovascular disease events than office BP [8, 9]. Most guidelines advocate out-of-office BP monitoring to validate the existence or absence of high workplace BP [10, 11].

ABPM and HBPM are the two main methods of out-of-office BP monitoring. ABPM, which has been around for over 50 years, is an automated system for measuring BP over 24 hours. A recent approach, HBPM, includes an individual measuring his or her BP at home for many days to a week [12]. Experts suggested that it is important to emphasize the importance of ABPM and HBPM among primary care clinicians so that the optimum benefit of these techniques is transferred to patients.

### Home-Based Blood Pressure Monitoring

HBPM is becoming more popular among patients with various guidelines suggesting its use for hypertension therapy [13]. It is well-accepted by patients and a French study showed it is effective in lowering BP in the elderly population [14].

### HBPM Indications and Scope [15, 16]

When validated equipment is utilized and the measurement is conducted correctly, HBPM is an accurate adjunct for diagnosing hypertension and leads to more suitable therapy targeting rather than depending solely on clinical measures. HBPM is an effective adjunct to office BP measurement in a

variety of situations but not limited to white-coat hypertension and masked hypertension

HBPM can be useful in assessing the efficacy of antihypertensive treatment, rationalizing medication dosages, and assisting with dose management, especially in individuals with the white-coat effect or those who have previously been misdiagnosed or over-treated. HBPM can also help in assessing BP management in patients who have just begun or have had their therapy adjusted, as well as for improving treatment adherence, lifestyle improvements and patient knowledge of hypertension.

Patients with difficult-to-treat/resistant hypertension can be monitored and managed with HBPM. It may prove beneficial for patients who require close monitoring of BP regulation such as those with diabetes or chronic kidney disease, as well as pregnant women who are at a high risk of developing hypertension.

It can also be used for monitoring and following up on pre-hypertension patients.

### Benefits of HBPM [17]

HBPM allows multiple BP readings over a period of days to months [16]. Morning hypertension can be evaluated using both ABPM and HBPM. However, HBPM has an advantage over ABPM in that it allows for frequent assessment of morning BP control which is not feasible with ABPM devices [16].

According to a study conducted in India, HBPM is useful for tracking night time BP in treatment-naive individuals. The findings demonstrated that HBPM can efficiently detect nocturnal BP drops and early symptoms of left ventricular hypertrophy [18].

It can aid in the diagnosis of white-coat hypertension and may be used to anticipate hypertension-related problems.[17]

It is more practical for long-term monitoring, is more widely available and is more convenient for patients [17].

When compared to typical office-based monitoring, HBPM may enhance treatment adherence and hypertension control rates [17].

Experts speculated that HBMP could be effective in young patients with hypertension, wherein it is unclear whether treatment or lifestyle changes should be initiated.

In some circumstances, HBPM may be more useful than 24-hour continuous ABPM [17].

HBPM can aid in the timing of antihypertensive medication delivery [17].

Compared to office BP monitoring, HBPM is a more accurate predictor of cardiovascular risk and has a superior predictive value. Furthermore, HBPM has been demonstrated to reduce therapeutic inertia and result in a considerable reduction in BP [19].

HBPM encourages better control of BP, motivating individuals with hypertension to adopt healthier lifestyle choices including improved nutrition, increased physical activity and consistent medication adherence [20].

By improving BP control and prognostic value, HBMP may also help to reduce healthcare costs [21].

### Limitations of HBPM

With HBPM, differences in readings can occur due to equipment errors or an untrained operator [16]. HBPM is ineffective for monitoring BP while working or resting [17]. HBPM may be unable to detect changes in BP readings over a short period of time [17]. The possibility of missing or self-

medicating due to errors in readings with HBPM can result in panic reactions [16]. Patients' abusive or compulsive use of HBMP can be a limitation [21]. Experts opined that practising HBPM may not be possible in all patients, especially in the ones who are borderline hypertensives. Experts also suggested that repeated readings can give anxiety in patients; hence, proper counseling is required.

### Ambulatory Blood Pressure Monitoring

ABPM is a type of BP monitoring that occurs outside of a medical setting, typically during 24 hours [6]. ABPM delivers more readings than office BP measurements and can help diagnose disorders such as white-coat hypertension, masked hypertension and other BP abnormalities. ABPM is also used to monitor the efficacy of antihypertensive treatment and can assess different forms of drug-induced hypotension. According to research, higher BP on ABPM is a better predictor of end-organ damage and cardiovascular events than office BP [22].

### Indication and Scope of ABPM

ABPM is suggested by Joint National Committee 7 recommendations and the guidelines of the European Society of Hypertension/European Society of Cardiology (ESH/ESC) for the following indications [23, 24].

- White-coat hypertension is suspected in patients with hypertension but without target organ damage
- A significant difference between BP measurements taken at the doctor's office and those taken at home
- Autonomic dysfunction
- Episodic hypertension
- Evaluation of BP dipping patterns
- Apparent drug resistance (office resistance)
- Symptoms of low BP caused using antihypertensive medications
- Concerns over the presence of nocturnal hypertension
- Absence of BP dipping, as seen in patients with sleep apnea, chronic kidney disease or diabetes, for evaluation of BP variability
- Hypotension is caused by autonomic, postural, postprandial, siesta and drug-induced causes.

According to experts, ABPM can be used to collect data on obstructive sleep apnea.

### Benefits of ABPM [22, 25]

ABPM has various advantages over other ways of measuring BP [25]. Readings acquired using ABPM relate to an individual's BP in their regular everyday surroundings; therefore, ABPM can provide insight into the effects of environmental and emotional factors affecting BP. ABPM has the ability to capture multiple readings, estimate mean 24-hour BP and examine BP fluctuation. ABPM can help in the improved prediction of cardiovascular morbidity and mortality. It is beneficial in detecting ambulatory episodes of hypotension. ABPM is also useful in assessing elevated BP in patients with moderate to severe kidney impairment. Repeating ABPM measurements within 2-3 weeks of treatment initiation would be important for high-risk individuals to determine whether enough BP decrease has been achieved. After achieving control of both daytime and night-time ambulatory BP, ABPM might be useful every 6-12 months to confirm goal BP maintenance. In a study conducted by Indian experts aimed to compare office BP monitoring (OBPM) and ABPM in relation to age and to explore age-related changes in 24-hour BP patterns among 27,472 treated and untreated Indian patients, it was found that

night-time BP becomes increasingly relevant as individuals age, regardless of whether they are receiving treatment or not. This suggests that older patients, in particular, would benefit from the use of ABPM [26].

### Limitations of ABPM [25]

Cost and accessibility are potential barriers to the usage of ABPM. Because ABPM might be inconvenient for patients, acceptance may be an issue. Furthermore, concerns have been expressed about the dependability of ABPM devices. Experts also suggested that ABPM could be inconvenient to patients and needs technical expertise.

### Conclusions

Office BP measurement is the mainstay of hypertension management but HMBP and AMBP are important supplements that can provide accuracy in the diagnosis of hypertension and help in detecting white-coat hypertension and masked hypertension. Both HMBP and AMBP are indicated in distinct contexts and each has advantages and disadvantages.

### Author Contributions

The author made significant contributions to the advisory board meetings inception, documented the conversations and substantively evaluated and approved all versions of the manuscript for submission.

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### Conflicts of Interest

For their involvement in the focused group discussion, the authors received an honorarium. Rajeev Garg is a member of the Association of Physicians of India, the Paediatric Cardiology Society of India, the ECHO Cardiologist Society of India, and Asia Pacific Society of Interventional Cardiology. Sunil Sathe is a member of Cardiologist Society of India.

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