The applicability of home blood pressure measurement in clinical practice: A review of literature

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Purpose: To review the literature on home blood pressure measurement (HBPM), to examine its validity and applicability for clinical practice and to provide recommendations regarding HBPM assessment.

Findings: HBPM can eliminate the white coat effect and offers the possibility to obtain multiple measurements under standardized conditions, which increases knowledge of overall blood pressure value. Although it is not entirely capable of replacing ambulatory blood pressure measurement (ABPM), HBPM correlates better with target organ damage and cardiovascular mortality than office blood pressure measurement (OBPM), it enables prediction of sustained hypertension in patients with borderline hypertension, and proves to be an appropriate tool for assessing drug efficacy. Additional advantages of HBPM are that it may increase drug compliance and patient's awareness of hypertension. Overall, OBPM yield higher blood pressure values than HBPM. Differences between OBPM and HBPM tend to increase with age and are generally higher in patients without antihypertensive treatment than in patients with antihypertensive treatment.

Recommendations: Measurements should be performed according to accepted guidelines and recordings should be performed with a memory equipped automatic validated device. From the data reviewed here, we recommend that HBPM be assessed monthly by taking two measurements in the morning within 1 hour after awakening and two in the evening for three consecutive days, the data from the first day should be dismissed. A subject should be labeled hypertensive if his/her HBPM value is equal to or greater than 137 mmHg systolic and/or 84 mmHg diastolic.

Keywords: blood pressure, hypertension, self-measurement, home measurement, ambulatory measurement, adherence

Introduction

Home blood pressure measurement (HBPM) is an ideal approach to assess someone's usual blood pressure (BP). For this purpose, there are presently several suitable devices available which have been rigorously tested. Their performance characteristics can easily be retrieved via the internet (http://www.dableducation.org), thus allowing deliberate decisions when one wants to purchase one of these. However, current guidelines with respect to HBPM differ among advising hypertension societies and there is no consensus yet about optimal strategies to be employed. Therefore, the clinician who wants to apply HBPM in practice will still be confronted with a number of uncertainties relating to eg, the reproducibility and accuracy of the technique, its ability to diagnose hypertension and the clinical implications of the obtained results. In a recent systematic review, we addressed in a rather concise way several of these items (Verberk et al 2005). The intention of the present review is to elaborate on these issues in somewhat greater detail. We have based our analyses on papers that

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were published in the period 1992–2005 and which were retrieved from PUBMED, EMBASE and the Cochrane database.

Reproducibility and accuracy of home blood pressure measurements

The issue of reproducibility was addressed by Celis et al (1997), who evaluated in older patients for how many days BP had to be measured in order to obtain steady levels of HBPM. They had 74 patients (= 60 years) measure their BP at home for 10 consecutive days. Sitting BP was measured once a day at noon. The average home blood pressure of the first three days was compared with the average of all ten days of measurement. No significant difference was found between these two averages, which led the investigators to conclude that three days of HBPM are sufficient to obtain a steady, reproducible level of sitting and standing BP.

Imai et al (1993) supported this conclusion in their study on HBPM among 363 households. While a total of 871 subjects were asked to perform HBPM once in the morning within 1h of waking, every day for four weeks, most subjects measured their HBP only about 21 times. Although this study was not designed to investigate reproducibility of HBPM, a preliminary analysis showed that the average home systolic BP (mean ± SD) in 458 subjects for the first three days of the 21-day period (123.2 ± 18.4 mmHg) was similar to that of the entire period (122.8 ± 17.5 mmHg). There was no significant difference among home diastolic BP throughout the 21 days of the study.

Theoretically, the time at which measurements are performed may contribute to the degree of reproducibility of HBPM. In this respect, results of the Ohasama-study (Imai et al 1999) showed that morning HBPM yielded significantly higher values than evening HBPM, albeit with lesser variability. In contrast, the Dübendorf-study (Weisser et al 1994) found lower BP levels with higher variability in the morning as compared to the evening. However, both studies differed with respect to population and methods. The Dübendorf-study excluded all patients who used antihypertensive medication, whereas 27% of the Ohasama population received antihypertensive treatment. Furthermore, evening HBPM in the Dübendorf-study was performed between 18.00 and 20.00 hour instead of before going to bed as in the Ohasama study.

Stergiou, Skeva et al (1998) have investigated both reproducibility and accuracy in the same group of patients. A total of 189 patients measured their BP during six working days, twice in the morning and twice in the evening. Reproducibility of HBPM was determined from the standard deviation (SD) of the measurements. Results showed that home BP on day 1 was higher than on each of days 2–6, with no difference among days 2–6. After comparing HBPM with ABPM, data indicated that a minimum program for a reliable estimation of HBP is to assess the average of the second and third workday, as this led to sufficient reduction in SD and a good correlation with ABPM data. Consequently, the results of the first day of HBPM should, in general, be discarded.

Most studies on self-registration of BP are based on measurements taken at home. However, it is possible that BP at home differs from BP at work due to job stress or other factors and that BP recorded at work might give a better indication of the overall BP value. This issue was addressed by Garcia-Vera and Sanz (Garcia-Vera and Sanz 1999) who studied BP measurements at work in addition to the number of measurements at home needed to estimate overall BP. Forty-three treated hypertensive patients self-recorded BP for 8-days three times a day (twice at home in the morning and evening and once at work at noon), thus collecting a total of 24 measurements. This procedure was repeated after one and 6-months. Results showed that it is enough to take two readings, one at work and the other at home, from 3 consecutive days to get reliable estimates of BP over 1-week and over 2-months. However, for reliable results over 6-months BP has to be measured for 2 consecutive days longer. Other findings of this study were that the reliability of self-measured BP taken at work was consistently, although not significantly higher than that obtained at home. Furthermore, diastolic BP needed fewer measurements for a proper estimation than systolic BP. Finally, the investigators emphasized that BP variability should not be underestimated and since BP variability increases with age that more self-BP readings should be obtained in older patients.

Finally, Brook (2000) performed an analysis among 12 published studies on HBPM in order to describe the effects of home monitoring schedules on the accuracy of BP registrations. Results showed that variations in monitoring schedules did not significantly affect the accuracy of home BP. In fact, the correlation between HBPM and ABPM did not improved with a greater number of home measurements. This implies that the accuracy of HBPM cannot only be explained by the large number of measurements, as is so frequently assumed. Rather, it suggests that HBPM is intrinsically different from OBPM and reflects overall BP better.

An important point that has not received much attention is whether some of the discrepancies between the various

studies regarding reproducibility and accuracy could not be explained simply by different devices being used. Unfortunately, there is not enough information about head-to-head comparisons of devices for self-measurement within the same individuals. Therefore, this possibility remains enigmatic.

When to diagnose hypertension on the basis of home measurements?

One of the first studies to determine reference values for HBPM was performed by de Gaudemaris et al (1994) They analyzed HBPM and OBPM data from 390 subjects, aged 20–59 years, who were not on antihypertensive treatment. Three HBPMs were performed in the morning and in the evening for 3 consecutive days, whereas OBPM was determined by 3 consecutive measurements at one visit. HBPM in the morning was lower than in the evening. Furthermore, within each session HBPM decreased after each measurement leading to the third HBPM being lower than the first. The same pattern was noted for the days of measurements; HBPM at the third day was lower than at the first day. Normal values for HBPM were determined by means of the so-called correspondence criterion with the upper limit for OBPM according to WHO criteria (140/90 and 160/95 mmHg) as reference. Using this approach, the upper limit for normotension by HBPM was proposed to be 127/83 mmHg. BP levels above 147/86 mmHg were considered to represent hypertension.

The Dübendorf study is a large population-based study that also set out to obtain normal values for HBPM (Weisser et al 1994). A total of 503 randomly selected individuals, who did not use antihypertensive drugs, were studied. All subjects performed HBPM during 14-days in the morning between 6 and 8 am and in the evening between 6 and 8 pm. OBPM was done before and after this two-week period. At the end, the means of both measurements were compared. Mean OBPM data (130.0 ± 16.5/82.1 ± 11.1 mmHg) were significantly higher than mean HBPM data (123.1 ± 14.6/77.6 ± 10.7 mmHg). When one takes an office pressure of 140 mmHg systolic and 90 mmHg diastolic as the upper limit of normal, these values reflected the 76.3% percentile (systolic) and 78.4 percentile (diastolic) of the distribution from the Dübendorf population. Corresponding HBPM values at these percentiles were 133 mmHg systolic and 86 mmHg diastolic, which were therefore set as the upper limits for normality. It would have been incorrect to use the difference between average HBPM and average OBPM as a correction factor since differences between HBPM and OBPM are greater in hypertensives than in normotensives (Battig et al 1989). Since the WHO/ISH had classified an OBPM of 120/80 mmHg as optimal and 130/85 mmHg as the limit between normal and high-normal BP (Guidelines Subcommittee 1999), the investigators from the Dübendorf study proposed to set the corresponding HBPM values at 115/75 and 125/80 respectively (Weisser et al 2000).

The Didima study which is comparable to the Dübendorf study analyzed 562 untreated subjects of an average population (Stergiou et al 2000). OBPM was taken on two visits (triplicate measurements) and HBPM was performed on 3 workdays (duplicate morning and evening measurements). HBPM thresholds for hypertension were determined according to three different approaches: (1) as 139.7/83.0 mmHg, using the percentile criterion (95th percentile of the HBPM distribution among 476 normotensive subjects), (2) as 139.7/85.8 mmHg, using the correspondence criterion (the percentiles of the HBPM distribution that correspond to OBPM values = 140/90 mmHg) and (3) as 137.4/82.7 mmHg using the regression equation between HBPM and OBPM data (calculation of that HBPM value which corresponds to an OBPM of 140/90 using the regression equation between HBPM and OBPM). These results led the investigators to suggest that an average HBPM below 137/82 mmHg might be regarded as normal, and one above 140/86 mmHg as probably abnormal. Pressures between these limits would then have to be considered as borderline. This study eliminated the results of the first day measurements for both OBPM and HBPM and this resulted in better correlations between the two types of measurements.

The Pamela study analyzed data from a random sample of 1438 subjects who received no antihypertensive drug treatment (Mancia et al 2001). HBPM, assessed once in the evening on the day of the medical visit and once the following morning, was compared to OBPM, which was assessed on one medical visit for three consecutive times. OBPM yielded markedly higher blood pressure values than HBPM. Results led the investigators to propose normal values of 132/83 mmHg on the basis of the 95th percentile method (Mancia et al 2001) and to 130/81 mmHg on the basis of the regression equation method (Mancia et al 1995).

Because so many studies have compared OBPM with HBPM, Thijs et al (1998) performed a meta-analysis in an attempt to determine an operational threshold for HBPM. Seventeen studies were analyzed containing a total of 5422 subjects. Comparison between these studies was complicated by differences in type of subjects (age, normotensive-hypertensive and untreated-treated), differences in devices (oscillometric-auscultatory) and differences in measurement procedures. With weighting for the number of

subjects included in the various studies the average HBPM data were 115/71 mmHg in normotensive subjects and 119/74 mmHg in untreated persons who were not selected on the basis of their BP. Different approaches to establish normality resulted in four different reference values namely: 137/89 mmHg and 135/86 mmHg when the mean plus two standard deviations or the 95th percentile were taken as cut-off points, 125/79 mmHg when the regression between OBPM and HBPM was determined and 129/84 mmHg when the HBPM value was calculated which corresponded with an OBPM of 140/90 mmHg. The same investigators have also set up an international database in which a large amount of HBPM values were collected obtained from several studies on HBPM (Thijs et al 1999). Reference values for HBPM from this database were determined according to the 95th percentiles of 2401 normotensive subjects, which led to the following values: 136/85 mmHg for morning HBPM, 139/86 for evening readings and 137/85 for all readings.

Probably, the best method to determine optimal or normal HBPM values is the one which is based on long-term follow-up in conjunction with the registration of hypertension-related complications. This method has been applied by Tsuji et al (1997) in the Ohasama study. Survival data from 1913 subjects (normotensives and hypertensives) aged above 40-years who were followed for a mean duration of 5.0-years were available for their analysis. During a 4-week period HBPM was measured every morning, within 1h after awakening, in the sitting position after more than 2 minutes of rest. The investigators found a linear association between home systolic pressure and mortality. The correlation between home diastolic pressure and mortality was non-linear and best approximated by a second order equation (U-shaped curve). With a Cox proportional hazards regression model adjusted for age, gender and the use of antihypertensive medication the investigators examined the association between baseline BP values and overall mortality. Based on the results of this analysis, a HBPM value of 137/84 mmHg or above was proposed to denote hypertension. Normotension was defined as a HBPM level below 137 mmHg systolic and between 66 and 83 mmHg diastolic. This study, however, has several limitations. First of all, the effects of known risk factors for cardiovascular diseases such as smoking or cholesterol were ignored in the analysis. Second, HBPM were obtained only at baseline, and changes in HBPM since then were not taken into account. Finally, the mortality from cerebrovascular disease in this community was significantly higher than in the overall Japanese population. Another point of discussion is the arbitrary endpoint that was used. In the analysis the HBPM level with the lowest mortality risk was treated as the reference category, which in this case was 75 mmHg for home diastolic pressure. It was argued that a 10% increase in mortality in comparison to the reference category should be considered as a serious and substantial risk. This arbitrarily set target value finally let to the proposed normal values. However, it remains a critical point of discussion whether a 10% increase in mortality is an acceptable target or not.

Clinical significance of home measurements

In a recent meta-analysis, Cappuccio et al (2004) showed that office blood pressure was lower by an average of 4.2 mmHg systolic and 2.4 mmHg diastolic in subjects with hypertension who had home blood pressure monitoring than in those who had standard blood pressure monitoring in the healthcare system (Cappuccio et al 2004). The authors also concluded that subjects were more likely to achieve target BP values when performing HBPM than when performing OBPM. This study, therefore, underscores the clinical importance of HBPM. As indicated below, HBPM can be useful in a number of circumstances.

White coat effect and white coat hypertension

White coat hypertension (WCH) refers to the phenomenon that clinic blood pressure is elevated while out-of-office blood pressure is normal. The white coat effect (WCE), on the other hand, refers to an increase of blood pressure occurring at the time of a clinic visit and dissipating soon thereafter (Pickering, Gerin et al 2002). Commonly, the WCE is not considered to be a risk factor for stroke and other cardiovascular events. However, results from the Ohasama-study showed that WCH is not completely innocent as subjects with this condition had an approximately 2-fold higher risk of eventually developing hypertension as compared to sustained normotensives (Ugajin et al 2005). This finding was confirmed by the results of the PAMELA study, which showed a progressive increase in both cardiovascular and all-cause mortality risk from subjects in whom office, home, and ambulatory BP were all normal to those in whom one of the three BPs were elevated, regardless of which BP was considered (Mancia et al 2006).The WCE is also frequently seen and many studies have addressed its determinants. The WCE is more prevalent in women than in men (Tsai 2003), occurs more frequently in normotensives than in hypertensives (Zakopoulos et al 2002), it increases with age (Mansoor et al 1996) and is more related to untreated than to

treated hypertension (Stergiou et al 2004). Since HBPM can detect the WCE (Stergiou, Zourbaki et al 1998), it seems to be of particular help when dealing with patients with white coat hypertension.

Masked hypertension

Another condition in which HBPM may be useful is masked hypertension, which is characterized by a normal office pressure but an elevated pressure outside the office (Pickering, Davidson et al 2002). This abnormality is not readily detected as individuals will usually be classified as being normotensive or, in the case of treated hypertension, as being well-controlled. The prevalence of masked hypertension varies among series but there is little doubt that it is associated with increased cardiovascular morbidity and mortality (Ohkubo et al 1998; Bobrie et al 2001, 2004; Bjorklund et al 2003; Ohkubo et al 2005).

HBPM and target organ damage

Tsunoda and coworkers have performed a cross-sectional study with a five year follow-up period and which showed that HBPM data correlate better with target organ damage (TOD), in particular left ventricular mass index (LVMI), than OBPM data (Tsunoda et al 2002). This finding was confirmed by Mule et al (2002) who demonstrated that HBPM data, especially those obtained on the second day, correlated significantly, and more strongly with LVMI, albumin excretion rate and global TOD, including cardiac, renal and retinal abnormalities than OBPM data. Since these early observations, the results of several other prognostic studies have been published which are all consistent with the previous ones.

Despite these findings, it would be wrong to conclude that HBPM is always superior to OBPM since Jula et al (1999) found that if OBPM data were obtained by a non-physician these values correlated as well with TOD (LVMI and albuminuria) as HBPM and ABPM did. In addition, Cuspidi et al (2002) showed that hypertensive patients who were well controlled on the basis of HBPM or ABPM but who had incomplete OBPM control, have more pronounced cardiac alterations than patients in whom both HBPM and OBPM values were controlled well. Nevertheless, we can safely conclude that HBPM is a valuable predictor of TOD and a useful diagnostic modality in clinical practice.

HBPM and cardiovascular mortality

Another way to determine the clinical significance of HBPM is to study the relation between HBPM and cardiovascular mortality by means of a prognostic cohort study as has been done by Ohkubo et al (1998) in the Ohasama-study. After a mean follow-up period of 6.6-years the investigators found that HBPM correlated better with cardiovascular mortality than OBPM. This finding was confirmed by Bobrie et al (2004) who concluded that HBPM has better prognostic accuracy than OBPM with respect to cardiovascular mortality and cardiovascular events in elderly patients who are being treated for their hypertension by general practitioners. Fagard et al (2005) studied the prognostic significance of out-of-office BP among 391 elderly patients in general practice. They found that the prognostic value of home BP with regard to major cardiovascular events was better than that of office BP and was at least similar to that of daytime ambulatory BP. Finally, the PAMELA study provided evidence for the prognostic significance of HBPM (Mancia et al 2006).

A question which still needs some attention is which blood pressure value as obtained with HBPM correlates best with outcome. According to the Ohasama study this may be already the very first measurement. Despite some discrepancies in the results with regard to morning and evening HBPM, it would appear that also the early morning surge has prognostic potential, independently from the 24 h ambulatory blood pressure profile (Kario et al 2003). For that reason, HBPM in the morning is probably more valuable as compared to evening HBPM in terms of cardiovascular prognosis and should, therefore, never be omitted.

HBPM as a guide to treatment of hypertensive patients

Ambulatory blood pressure monitoring (ABPM) is an appropriate tool for the determination of the pharmacodynamic properties of antihypertensive drugs, such as onset and duration of action as well as modification of the diurnal blood pressure profile. The capability of ABPM to determine such properties seems to be related mainly to the fact that many measurements can be obtained under standardized conditions and that observer bias can be excluded. Since these characteristics can also be ascribed to HBPM, this technique may be a potential substitute for ABPM in monitoring the effects of antihypertensive drugs in individual patients as well as in groups of patients.

How to determine drug efficacy

Since excessive BP variability may be a risk factor for TOD, it is important for an antihypertensive drug not only to decrease overall BP but also to decrease BP variability and to create a smooth BP. The smoothness of antihypertensive

drugs can be expressed by means of the trough-to-peak ratio (TPR). This is defined as the ratio between an antihypertensive agent's effect at the end of the interval between doses (trough), and its effect at the time of its presumed maximum effect a few hours after dosing (peak). ABPM can perform about 80 measurements per day and may, therefore, determine the TPR rather precisely. Since it is impossible to obtain so many measurements with HBPM, the morning-to-evening ratio (MER) has been introduced as a replacement for TPR (Menard et al 1994). For MER one assumes that if medication is taken with a 24 h-interval, the trough is reached just before the new medication is taken after 24 h in the morning (M), while 12 h earlier in the evening (E), the full effect of the drug can be expected (the peak).

Several studies have already analyzed drug treatment using HBPM. In most cases, BP differences before and after treatment proved to be greater for OBPM than for HBPM. These differences might be ascribed to the expectation of the physician who assumes a decline in BP after drug administration (Vaur et al 1998; Leeman et al 2000). Since a placebo effect is not readily apparent with home measurements, HBPM seems to be a reliable tool for drug efficacy assessment, a finding which more studies confirmed (Zannad et al 1996; Fernandez-Gonzalez et al 2000; Stergiou et al 2002). Nevertheless, HBPM has some limitations in comparison to ABPM. The latter can measure BP on predetermined times without any manipulation by the patient, record BP during daily routine, determine nocturnal BP and ascertain whether a drug is effective during the early morning surge. It is, indeed, important to analyze the effect of antihypertensive drugs on the early morning rise since this is associated with an increased frequency of cardiovascular events. However, since HBPM is less expensive and less inconvenient for the patient it still serves as a reliable substitute for ABPM when assessing drug effects. Besides, there is already an HBPM device available which is able to measure BP during sleep at predetermined times (Chonan et al 2001). This HBPM device allows measurement of nocturnal BP during more nights at different sleep qualities.

Institution of antihypertensive treatment according to HBPM

In the THOP trial, Staessen et al investigated whether antihypertensive treatment can be instituted on the basis of HBPM values (Staessen et al 2004). This randomized clinical trial with a duration of 1-year compared OBPM with HBPM for their potential to serve as a guide to initiate and titrate antihypertensive drug treatment. A total of 400 patients were randomized to groups in which antihypertensive treatment was based either on HBPM or OBPM. Triplicate morning and evening measurements were performed for a 7-day period prior to the visit at the physicians' office where OBPM was performed. Antihypertensive drug treatment was titrated in a stepwise fashion based on either the mean diastolic pressure of the 42 HBPMs or the average of the 3 consecutive OBPMs. Adjustment of antihypertensive treatment based on HBPM led to less intensive drug treatment and lower costs but also to less BP control, with no difference in general well-being or left ventricular mass. Furthermore, HBPM allowed identification of patients with white coat hypertension (WCH). These findings support a strategy to implement HBPM as a complementary tool to conventional OBPM. The fact that HBPM-based treatment led to less BP control as compared to OBPM can be explained by the high threshold (diastolic pressure $>$89 mmHg) on which treatment decisions were based. This underscores the need for other prospective outcome studies to establish which values of HBPM should be considered normal.

Adherence to treatment

HBPM may have a positive effect on adherence to treatment as it can increase patient's awareness of hypertension. Vetter et al (2000) compared two groups of 622 patients with mild to moderate hypertension to test this hypothesis. All patients received losartan (50 mg) as monotherapy. Patients were randomized to a group receiving a device (OMRON) to measure their pressure at home or to a group where this device was not provided. In the group of patients who measured their BP at home there was a slight improvement in BP control as compared to the patients who did not measure their own BP at home.

Ashida et al (2000) investigated the relationship between HBPM and compliance with treatment among 1452 patients. Patients were asked whether they had a BP monitoring device at home or not and how many measurements they performed if they possessed one. From these questions it could be concluded that patient's compliance improved with increasing HBPM assessments. Additionally, patients who measured their BP at home showed more awareness about their hypertension as compared to patients who did not. However, this study may be biased because patients who buy and use a BP monitoring device are likely to be different from those who do not.

Marquez-Contreras et al (2006) investigated the relationship between HBPM and adherence to treatment among 250 patients with newly diagnosed or uncontrolled

hypertension. Patients were randomized into two groups: one which received standard health care intervention and another in which patients received an automatic device for performing BP measurements at home. Results at the end of the trial showed that patients who performed home measurements had a significantly better adherence and a greater reduction of diastolic BP.

Limitations

Besides the many advantages, HBPM also carries some limitations. As is the case with OBPM, several factors can disturb HBPM, such as body and arm position, but also dinner, alcohol, exercise and smoking. Another source of variation of HBPM in both clinical trials and clinical practice is that the measurements often are not well performed. For example, the SMART study lost 35% of their data due to bad HBPM performance (Zannad et al 1996). This substantial loss of recordings was largely related to insufficient preparation. For all these reasons, patients should receive extensive instructions from a well-trained technician to ensure that measurements are meticulously performed. Since many healthcare practitioners do not use the recommended BP measurement technique, attention should also be paid to their training. In addition, calibration of the devices used should be performed regularly.

Reporting bias

The accuracy of HBPM devices has greatly improved so that a validated HBPM device can hardly be considered a cause for bad HBPM performance. Reporting bias, however, can still be a cause of misinterpretation as was highlighted by Johnson et al (1999), who performed a trial in which HBPM values, as collected by the patient, had to be reported to the physician. Subjects were unaware that their monitor electronically stored the BP data. Results of this study showed that most HBPM results were correctly reported, but that erroneous reporting occurred significantly more often in cases of uncontrolled than in well-controlled BP. Therefore, to prevent misinterpretation of HBPM one should preferably use printer or memory-equipped HBPM devices.

Conclusion

Home blood pressure measurements can already be applied in clinical practice if recordings will be taken with an automatic validated device. Relatively few studies have attempted to determine normal values for HBPM but such values should preferably be established on the basis of prognostic studies. Although further research is necessary with respect to HBPM and its correlation to cardiovascular and cerebrovascular disease, there are already enough arguments for implementing HBPM into daily clinical practice. Indeed, HBPM can eliminate WCE and offers the possibility to obtain multiple measurements under standardized conditions, which may lead to reliable BP values with little variability. The technique may be particularly useful in situations where more detailed knowledge of a patient's daytime BP is required or desired such as in borderline hypertension, diabetes mellitus, pregnancy and when assessing drug efficacy. An additional advantage of HBPM is that it may increase compliance with treatment and patient's awareness of hypertension.

However, since HBPM is also subject to reporting bias and incorrect performance OBPM should not yet be abandoned. Due to an increasing workload for physicians in western countries it seems to be only a matter of time before people measure their BP at home and transmit it through the Internet to the hospital, instead of visiting the doctor at the clinic. The feasibility of this modern approach of hypertension management is currently under investigation.

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