

Chapter 2

Home (Self) Monitoring of Blood Pressure

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Introduction

Elevated blood pressure (BP) levels represent the most important modifiable risk factor for cardiovascular disease and for disease burden in developed countries [1]. Consistent evidence has shown that BP reduction with antihypertensive therapy reduces cardiovascular events, particularly in patients with moderate to severe hypertension [2]. An accurate assessment of BP levels and early identification and treatment of hypertension is thus essential for reducing the cardiovascular risk associated with this condition [3]. Since most evidence on the cardiovascular risk associated with elevated BP, as well as on the benefits of lowering BP levels, comes from studies using office BP (OBP) measures [4, 5], this technique is regarded as the reference standard for assessment of BP in clinical practice [3]. However, OBP is affected by important intrinsic limitations (i.e., inherent inaccuracy of the technique and the inability to track BP changes during subjects' usual activities and over a long period of time) and by extrinsic factors (i.e., observer's bias, digit preference, interference by the "white coat effect") that lead to over- or underestimation of subjects' BP values. In turn, this leads to misclassification of BP levels, i.e., masked hypertension, white coat hypertension, and false BP control or false resistant hypertension in treated subjects. In recognition of this, current guidelines for

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hypertension management advise combining OBP with information on out-of-office BP levels measured by means of ambulatory BP monitoring (ABPM) or home BP monitoring (HBPM) [3, 6–11], with the aim to better identify the presence of high BP levels and to define the need to start/modify antihypertensive treatment. Currently, 24-h ABPM is considered the gold standard for out-of-office BP monitoring, [10, 12]; however, because of its costs and need of trained clinic staff and specialized equipment, its use is in most cases (with the exception of NICE guidelines) recommended for selected groups of hypertensive patients [3, 4, 6, 13, 14]. Although HBPM cannot provide the extensive information on daily life BP behavior available with 24-h ambulatory recordings, it may represent an excellent complement to both OBP and ABPM in assessing BP levels for several reasons. In particular, the wide availability of automated and easy-to-use devices for home BP monitoring, which are acceptable for both patients and physicians, supports the extensive implementation of HBPM in clinical practice. Moreover, when performed on a regular basis, repeated BP measures obtained by patients at home (i.e., home BP monitoring of BP levels over 7 days before the clinical visit) offer the possibility to obtain accurate and frequent information on out-of-office BP not only during a single day, but also over several days, weeks, or months in a usual life setting, also allowing evaluation of dynamic BP changes over wider time windows, and to quantify the degree of BP variability (BPV) [8] (Table 2.1). All of these features not only allow a better identification of elevated BP levels, but also assessment of BP control in treated subjects, thus aiding in guiding therapeutic decisions. Besides, at variance from OBP, HBPM requires the active involvement of patients in managing their high BP conditions, which enhances patients' compliance and adherence to antihypertensive treatment, thus potentially increasing the rates of BP control. Because HBPM combines improved accuracy with the advantages of low cost and easy implementation, it is recommended whenever feasible for routine use in the clinical management of hypertension. The present chapter is aimed at reviewing the main features of HBPM, its prognostic significance, clinical advantages, and potential applications for the management of hypertension. In its last part, the chapter addresses the role of home-based blood pressure telemonitoring and information technologies for the management of hypertensive patients.

Methodological Aspects of HBPM

Measurement conditions and procedures: Although automated and semi-automated HBPM devices based on the oscillometric technique are widely used by hypertensive patients, their application is not always accompanied by the required knowledge or sufficient training to ensure a proper BP self-measurement at home. The resulting problems often include use of inaccurate devices and errors in measurement methodology and in interpretation of HBP values [15]. Care is thus required to guarantee that HBP measurements are kept under close supervision by physicians, in order to prevent an excessive frequency of self-BP readings due to anxiety as well as improper

Table 2.1 Comparison of features of three main methods for BP measurement

| Feature | OBP | ABPM | HBPM |
|----------------------------------|---------------------|---|---|
| No. of readings | Low | High | Medium |
| White coat effect | Yes | No | No |
| Operator dependency | Yes | No | No |
| Need of device validation | No ^a | Yes | Yes |
| Daytime BP | + | +++ | ++ |
| Night-time BP and dipping | – | +++ | –/+ ^b |
| Morning BP | ± | ++ | + |
| 24-h BP variability | – | ++ | ± |
| Long-term BP variability | – | ± | ++ |
| WCH and MH diagnosis | – | ++ | ++ |
| Placebo effect | ++ | – | – |
| Reproducibility | Low | High (24-h average values) | High (average of several values) |
| Prognostic value | + | +++ | ++ |
| Patient involvement | – | – | ++ |
| Patient training | – | ± | ++ |
| Physician involvement | +++ | ++ | + |
| Patients' acceptance | ++ | ± | ++ |
| Monitoring of treatment effects | Limited information | Extensive information on 24-h BP profile, cannot be repeated frequently | Appropriate for long-term monitoring, limited information on BP profile |
| Hypertension control improvement | + | ++ | +++ |
| Cost | Low | High | Low |
| Availability | High | Low | High |

Modified from Parati et al. [8], by permission
WCH white coat hypertension, MH masked hypertension, OBP Office Blood Pressure, ABPM ambulatory BP monitoring, HBPM home BP monitoring
^aYes if oscillometric device is used
^bNew HBPM devices may perform night-time BP measures

self-management of drug treatment by patients. Overall, conditions and procedures for proper HBP performance are similar to those recommended for OBP measurements [9]. Specifically, the patient should be relaxed in the sitting position, with the back supported, without crossing legs, in a quiet room and at least 5 min of rest should precede the measurement. The arm should be supported on a table and the cuff positioned at the heart level (when the arm-cuff is below or above the heart level, BP will be overestimated or underestimated, respectively). At the time of the first visit, when prescribing HBPM, BP measurements should be comparatively performed in both arms. If inter-arm BP difference exceeds 10 mmHg for SBP and/or 5 mmHg for DBP and persists after repeated measurements, the arm with the higher BP should be selected for future BP measurements both in the office and at home [9]. Attention should be given to selection of cuff size according to arm circumference, so that the bladder dimensions are adequate for accurate BP measurement.

Device selection: Monitors that measure BP at the upper arm (brachial artery) have been shown to be the most accurate and reliable in measuring peripheral BP levels. Although some automatic devices for BP measurement at the wrist or at the finger level have been developed, it should be mentioned that they are subject to important limitations mainly related to peripheral vasoconstriction, alterations in BP waveform going from central to more distal sites of recording, and the possibility of varying hydrostatic height difference between the peripheral cuff and the heart level, which may lead to significant inaccuracies in BP measurement. This is why use of wrist cuff devices is currently discouraged. Finally, it should be mentioned that despite the multitude of devices available on the market for HBPM, only some of them have fulfilled independent validation criteria for use in clinical practice (updated lists of validated BP-measuring devices are provided at dedicated websites such as www.dableducational.org, www.ipertensionearteriosa.net or www.bhsoc.org). In summary, on the background of the available evidence, current guidelines for HBPM recommend the use of validated, automated, electronic, oscillometric, upper arm-cuff devices, particularly those offering the possibility to store, transmit, or print measurements [9].

Frequency and timing of HBPM: When performed in a standardized fashion, BP measures collected by patients at home have been shown to be more accurate and reproducible than office and ambulatory BP levels [16–18]. To achieve the maximum benefits from HBPM, the optimal HBPM schedule to be used for clinical decision making should be able to offer a quantification of the prevailing level of HBP, aimed at yielding reproducible information on HBP values, with prognostic relevance. Since the reliability of HBPM increases with the number of BP readings available for analysis, a minimum of 12 measurements and up to 25 measurements are needed to achieve clinically relevant information on HBP levels. Recent secondary analysis of a large, randomized, clinical trial compared strategies for home- or clinic-based BP monitoring to determine the optimal methodology for obtaining clinically meaningful BP measurements [19]. In this trial, participants were asked to record BP values every other day at the same time. A minimum of three values over two weeks was required and only values spaced over 12 h were included. The study concluded that the best approach for correctly classifying BP control should be an

average of several BP measurements including both measurements from the clinic- and home-based settings [19–21]. However, the important variations in terms of frequency of self-BP measures, the frequency of reporting home-monitored values, clinicians' involvement, duration, and setting have been widely variable among studies, thus preventing authors from deriving consistent conclusions. Current guidelines recommend measuring BP levels at home over 7 days, with at least two morning and two evening measurements [9]. For clinical decision making, the average of all these values should be used with the exception of the first day, which should be discarded [9]. This 7-day schedule is recommended immediately before each visit to the physician's office, either at diagnosis or during follow-up. In recognition that long-term HBPM might allow a closer assessment of the stability of HBP control, improve patients' involvement and compliance with treatment, and maintain their BP measurement skills, it was suggested that 1–2 measurements per week might be useful also during the between-visit period [9]. Of note, programmable HBPM devices have been recently introduced that provide measures of night time BP levels comparable to those obtained by means of 24-h ABPM [22–24], thus widening the clinical applications of HBPM.

How Are Hypertension and BP Control Defined Based on HBPM?

Hypertension has a strong, continuous relationship with cardiovascular risk. Traditionally, OBP measurements have been used for cardiovascular risk stratification and for defining targets of therapy. The classification of BP categories (i.e., optimal BP <120/80; pre-hypertension 120–139/80–89; and hypertension $\geq 140/90$ mmHg) as well as definition of BP targets to be achieved by treatment, has been based on epidemiological studies using OBP measurements [3, 25]. These values cannot be directly extrapolated to HBPM, because meta-analyses of several studies on unselected populations or hypertensive patients [26, 27], comparing HBP and OBP distribution curves, have demonstrated HBP values to be lower than corresponding OBP values. Longitudinal studies in general populations [28–37] and in hypertensive subjects [38–40] as well as clinical trials on the use of HBPM have confirmed that the cut-off limit to define hypertension based on HBP should be lower than that used for OBP [41, 42]. Although the relationship between BP values self-measured at home and the incidence of CV morbidity and mortality should be further clarified by prospective studies, there is an agreement to diagnose hypertension when HBP is $\geq 135/85$ mmHg (corresponding to an OBP of $\geq 140/90$ mmHg). Prospective data are still needed, however, to formally recommend the proposed thresholds of <120/80 mmHg and <130/85 mmHg to define optimal and normal HBP, respectively. A couple of studies suggested that HBP thresholds for hypertension in high-risk patients might be lower than 135/85 mmHg [30, 39]. Although the target HBP to be achieved with treatment should logically be below the threshold used to diagnose hypertension (i.e., <135/85 mmHg), these target HBP levels

are still unknown, being currently explored by the ongoing HBPM studies [43]. Although attaining therapeutic goals may be difficult in some patients, it should be remembered that, even if BP is not fully controlled, each mmHg of reduction in HBP is important, as it contributes to the prevention of CV complications.

Prognostic Value of HBPM

As a general remark, it has to be acknowledged that the evidence available to support the prognostic value of HBPM is less than for ABPM, also because of the smaller number of outcome studies available so far [8, 9]. When averaged over a period of a few days, home BP measures have been shown to significantly predict the development of major nonfatal cardiovascular events (myocardial infarction, stroke) [28–35, 38, 44–52] as well as cardiovascular (fatal cardiovascular events) and all-cause mortality [28, 34, 35, 39, 47, 48, 53]. In most available studies, the prognostic value of HBPM has been found superior to that of OBP measurements with one exception, where a similar predictive value was observed for both techniques [38] (see Fig. 2.1 and Table 2.2).

Longitudinal and cross-sectional studies have reported that target organ involvement, including left ventricular mass index (LVMI), carotid intima-media thickness,

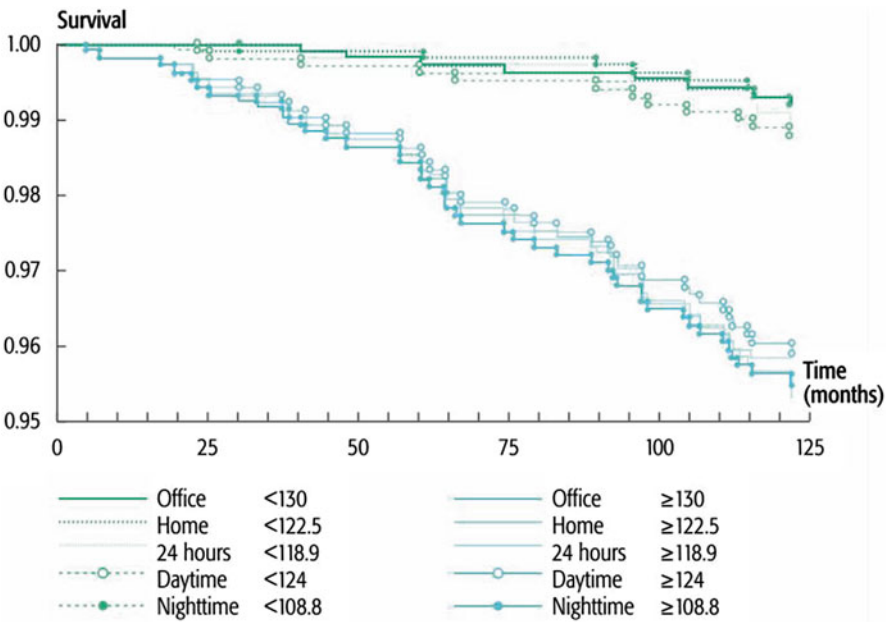


Fig. 2.1 Kaplan–Meier curves for survival free of CV disease in subjects with office, *home*, and ambulatory SBP values above and below median values. Modified from Segà et al. [35], by permission

Table 2.2 Home blood pressure measurements and outcomes

| Study | Population | Time of measurements | Average number of measurements | Outcome |
|--|---|--------------------------------|--------------------------------|---|
| Ohkubo et al. (1998) (Ohasama) [28], Hozawa et al. (2000) (Ohasama) [47] | General population aged ≥ 40 years | Morning | 21 | Cardiovascular, non-cardiovascular, and all-cause mortality |
| Ohkubo et al. 2004 (Ohasama) [29] | General population aged ≥ 40 years | Morning | 1–25 | Total stroke morbidity |
| Asayama et al. (2005) (Ohasama) [30] | General population aged ≥ 40 years | Morning | 25 | Total stroke morbidity |
| Ohkubo et al. 2004 (Ohasama) [31] | General population aged ≥ 40 years | Morning | 25 | Total, hemorrhagic, and ischemic stroke morbidity |
| Asayama et al. 2004 (Ohasama) [32] | General population aged ≥ 40 years | Morning and evening | 47 | Total stroke morbidity |
| Nishinaga et al. 2005 (Kahoku) [33] | Community dwelling elderly aged ≥ 65 years | Morning and evening | 20 | Cardiovascular, non-cardiovascular and all-cause mortality |
| Okumiya et al. 1999 (Kahoku) [48] | Community dwelling elderly aged ≥ 75 years | Morning and evening | 20 | Disability, cardiovascular and all-cause mortality, cardiovascular and stroke morbidity, Cardiovascular and all-cause mortality, total cardiovascular morbidity |
| Bobrie et al. 2004 (SHEAF study) [38] | Treated hypertensives aged ≥ 60 years | Morning and evening | 27 | Cardiovascular and all-cause mortality |
| Sega et al. (2005), Mancia et al. (2006) (PAMELA study) [34, 35] | General population aged 25–74 years | Morning and evening | 2 | Cardiovascular and all-cause mortality |
| Agarwal et al. 2006 (CKD Veterans) [39] | Veterans with CKD | Morning, afternoon and evening | Not available | Morbidity of end stage renal disease, all-cause mortality |
| Fagard, et al. 2005 (Flanders) [46] | General population aged ≥ 60 years | Morning | 3 | Major cardiovascular events (cardiovascular death, myocardial infarction and stroke) |
| Stergiou et al. 2007. (Didima) [53] | General population aged ≥ 18 years | Morning and evening | 12 | Total cardiovascular morbidity and mortality |
| Niiranen et al. 2014 [49] | Two cohorts of General population aged 34–64 years; and newly diagnosed and untreated hypertensive men and women aged 35–54 years | Morning and evening | 14 | composite of cardiovascular mortality, myocardial infarction, stroke, heart failure hospitalization, and coronary intervention |

Modified from Parati et al. [8], by permission

and microalbuminuria, is more strongly correlated with HBP measurements than with OBP measurements in patients with hypertension [51, 54–60] as well as in patients with chronic kidney disease (CKD) on hemodialysis (HD) [61], in elderly people, in women with pre-eclampsia, and in hypertensive patients with diabetes [8]. In the case of patients with CKD, HBP has been shown to be a better predictor of progression of CKD (as assessed with eGFR) [40, 62], including its progression to end stage renal disease (ESRD) [39] and of cardiovascular events and mortality [63] than OBP. In particular, in ESRD, HBPM may be more informative than pre- and post-dialysis OBP readings as it provides BP measurements that are more representative of the BP load over the interdialytic period. Indeed, several studies in ESRD have found HBP to be prognostically superior than OBP also in predicting subclinical organ damage (i.e., LVH) [61] and cardiovascular events (i.e., all-cause and CV mortality) [64, 65].

Role of HBPM in the Diagnosis and Management of Hypertension: Identification of Masked Hypertension and White-Coat Hypertension

As discussed above, HBPM and ABPM provide out-of-office BP measurements detecting BP changes in real life conditions and preventing the alarm reaction associated with OBP [66]. It is thus not surprising that BP levels measured in the clinic setting are in general higher than ambulatory BP measurements performed out of the clinic environment [67]. This is considered a major explanation for the frequently observed disagreements between OBP and out-of-office BP measurements when classifying hypertensive subjects [30]. Indeed, when considering the threshold values to define hypertension using OBP ($\geq 140/90$ mmHg) and HBP or 24h ABP ($\geq 130/80$ mmHg), a given individual may fall into one of four BP categories: sustained normotension (normal office BP and normal home or 24h ABP), sustained hypertension (high OBP and high home or 24h ABP), white coat hypertension (high office BP and normal home or 24h ABP), or masked hypertension (normal office BP and high home or 24h ABP) (Fig. 2.2).

Evidence on the ability of HBPM to identify WCH and MH [56, 68] was provided in a report of the Pressioni Arteriose Monitorate e Loro Associazioni (PAMELA) study in which the initial diagnosis of WCH (i.e., identified as office BP $>140/90$ mmHg and 24-h BP mean $<125/79$ mmHg or home BP $<132/82$ mmHg) was reassessed 10 years later. Overall, the study showed similar results in the ability of HBPM and ABPM for identifying WCH, sustained hypertension, true normotension, and masked hypertension, even if a substantial percentage of subjects changed from one category to another, including progression to sustained hypertension (Fig. 2.3).

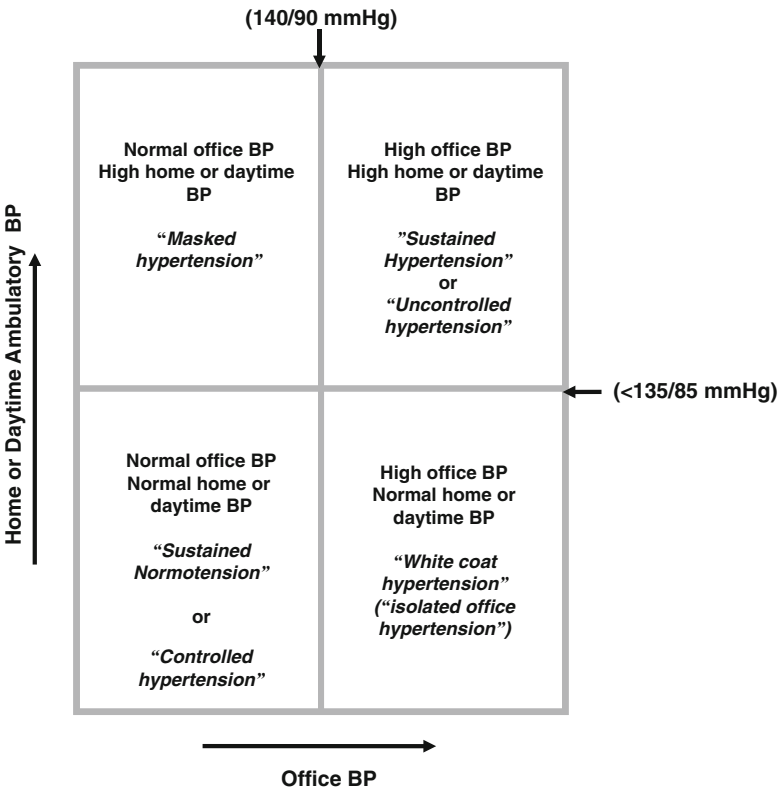


Fig. 2.2 Schematic relationship between office and home or daytime ambulatory BP. Classification of patients based on the comparison of office and home or daytime ambulatory blood pressure (BP). When focusing on ABP, current guidelines recommend to use 24h rather than daytime ABP, in order to include also night-time BP values Taken from Parati et al. [8], by permission

Role of HBPM in the Assessment of BP Control in Treated Hypertension

In the light of the available evidence supporting the prognostic and clinical advantages offered by HBPM, current international and national guidelines recommend the use of HBPM as part of the routine diagnostic and therapeutic approach to hypertension, particularly in treated patients [8, 69–74]. By providing accurate and frequent BP measures at regular time intervals over several days, weeks, or months, in a setting of typical daily living, HBPM is able to accurately track changes in BP levels induced by antihypertensive treatment and becomes a better indicator of BP control than OBP measurements alone [8]. HBPM may be an excellent tool to assess and improve the achievement of BP control, particularly in patients with apparent resistant hypertension in whom BP cannot be easily controlled even with several classes of antihypertensive medications. In support of this concept, several studies

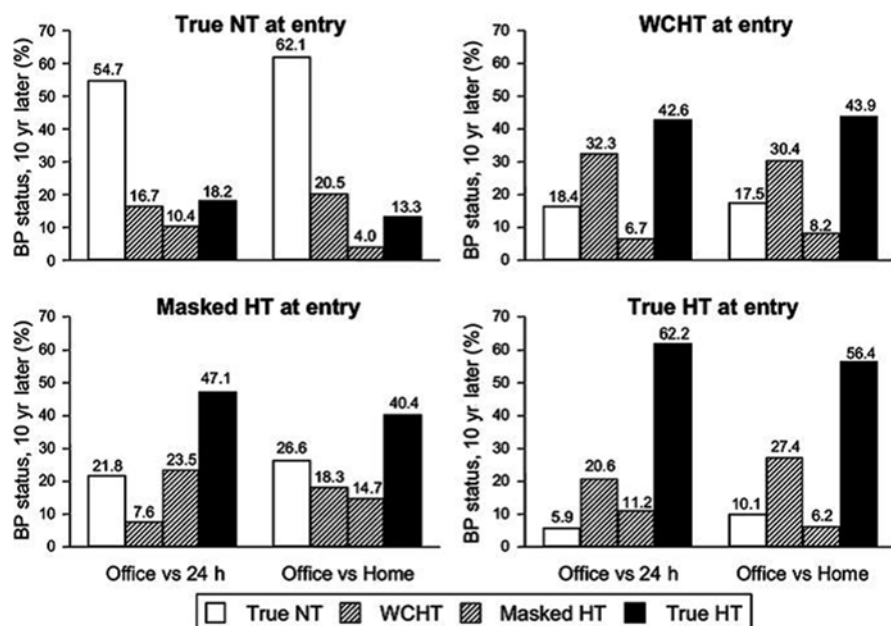


Fig. 2.3 Mean percentage changes in BP status among normotension (NT), white coat hypertension (WCHT), and masked hypertension (MHT) over the 10-year period of the study. Data referring to true hypertension (true HT) are shown for comparison. Taken from Mancia et al. [68], with permission

exploring the benefits of HBPM for the long-term management of patients on antihypertensive therapy have shown that when properly implemented, HBPM may significantly increase achievement of BP control when compared to conventional OBP [75, 76], while reducing the need of follow-up medical visits [77]. The benefits of HBPM in this regard may be derived from several factors. First, the use of HBPM improves adherence to prescribed treatment (see below). Secondly, in subjects who receive antihypertensive treatment, OBP measurements alone may be inaccurate in assessing true BP control. For instance, the alerting reaction to the medical visit may continue to be present in anyone treated for hypertension, regardless of the number of drugs being taken [78]. It is not uncommon to find patients with mild hypertension based on HBPM or ABPM who yet appear to have severe hypertension in the clinic, due to a white coat effect in this condition [79], or treated subjects who, despite achieving adequate out-of-office BP control with antihypertensive drugs, continue to present elevation in office BP levels because of a persistent emotional reaction to the medical visit. This phenomenon, which is equivalent to WCH in untreated patients, has been addressed as “white coat resistant hypertension” (WCRH) or false resistant hypertension in order to emphasize its occurrence in subjects receiving antihypertensive treatment [14].

Observational and interventional studies in treated hypertensives implementing OBP measures along with ambulatory or home BP monitoring have shown over-

whelmingly that up to one-third of treated hypertensives may be mistakenly classified as having resistant hypertension, when they actually have “false resistant hypertension” due to a persisting white coat effect [80]. A condition of greater clinical concern is masked resistant hypertension (MRH) or false BP control (i.e., BP appear to be controlled based on OBP, but is elevated when out-of-office BP levels are recorded)—this condition has been also reported to occur in about 30 % of treated subjects [81, 82].

The high prevalence of MRH and WCRH among treated hypertensive individuals further reinforces the clinical relevance of identifying these conditions. On the one hand, identification of WCRH would prevent undesirable modifications of antihypertensive treatment, i.e., an unnecessary increase in dose or number of antihypertensive drugs, and reduction of the chance of adverse effects associated with improperly prescribed multidrug therapy that often interferes with patients’ quality of life, leading in the end to poor compliance with treatment. At the same time, it would reduce the expenditures associated with unnecessary additional pharmacological treatment and/or unnecessary interventional device-based strategies (i.e., carotid baroreceptor activation [83] and renal denervation [84]) for the management of resistant hypertension. Indeed, given the elevated costs and the invasive nature of these approaches, as well as their potential adverse effects when improperly indicated, discarding WCRH based on out-of-office BP measures is currently considered among the eligibility criteria before proceeding with interventional treatment of resistant hypertension [85]. In contrast, identification of MRH would indicate the need to implement early modifications on antihypertensive treatment in order to prevent development/progression of subclinical organ damage and cardiovascular events associated with this condition.

Regarding the ability to identify masked hypertension and white coat hypertension, several studies have comparatively explored the performance of HBPM against the reference standard for out-of-office BPM represented by ABPM. Although MH was first studied with ABPM [86], it has been demonstrated that HBP can be as reliable as ABPM in identifying this phenomenon as well as the associated target-organ damage associated with MH [87]. Evidence has also been provided that HBPM is as reliable as ABPM in identifying WCH [87] and useful in identifying “truly” hypertensive patients likely to benefit from implementation of antihypertensive therapy from those with WCH in whom antihypertensive treatment is probably not needed [41]. In a recent study conducted in a group of subjects on stable treatment with ≥ 3 antihypertensive drugs using ABPM as reference method [88] in which resistant hypertension was defined as elevated OBP ($\geq 140/90$ mmHg) and true resistant hypertension as concomitant elevation in-office and out-of-office BP (SBP and/or DBP $\geq 135/85$ mmHg for HBP or awake ABP), there was agreement between ABP and HBP in diagnosing clinic or “white coat” resistant hypertension in 82 % of the cases (59 % with and 23 % without clinic resistant hypertension; kappa 0.59). Regarding the diagnosis of true resistant hypertension, there was agreement between ABP and HBP in 74 % of the cases (49 % with and 25 % without true resistant hypertension; kappa 0.46). The sensitivity, specificity, and positive and negative predictive values for HBP in detecting white coat resistant hypertension were 93 %, 93 %, 93 %, and 93 %, respectively.

63 %, 81 %, and 83 %, respectively. The respective values for HBP in detecting true resistant hypertension were 90 %, 55 %, 71 %, and 82 %, indicating that HBP may be a useful tool in the evaluation of false and true resistant hypertension [88].

Based on the above data, it may be concluded that a proper assessment of BP control and classification of treated hypertensive patients with the combined use of office, ambulatory, and ideally home BP measurements are essential for defining the need of performing additional diagnostic procedures (i.e., screening tests for secondary causes of resistant hypertension) and/or implementing more aggressive pharmacological or interventional strategies (Fig. 2.4) [89].

While emphasizing the above advantages of HBPM in assessing BP control by treatment, we have also to acknowledge that HBPM may not provide information on BP levels during night-time sleep, which have shown to be of major clinical relevance because of their demonstrated prognostic value [35, 44, 90–93]. However, in recent years validated, memory-equipped devices have been designed that can be programmed to provide nocturnal BP readings comparable to those obtained with 24-h ABPM [22–24].

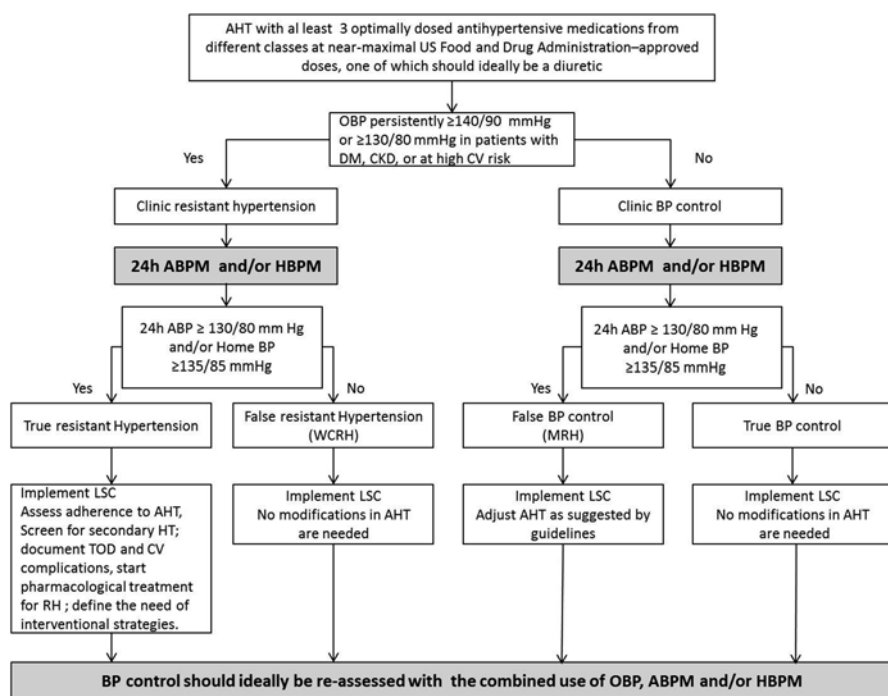


Fig. 2.4 Initial diagnostic approach to the patient with clinic resistant hypertension. *AHT* antihypertensive treatment, *HT* hypertension, *OBP* office blood pressure, *DM* diabetes mellitus, *CKD* chronic kidney disease, *CV* cardiovascular, *BP* blood pressure, *ABPM* ambulatory blood pressure monitoring, *HBPM* home blood pressure monitoring, *WCRH* “white coat” resistant hypertension, *MRH* “masked” resistant hypertension, *RH* resistant hypertension, *LSC* life style changes. Modified from Parati et al. [89], with permission

HBPM is admittedly less effective than ABPM in assessing the time distribution of BP control by treatment over 24 h. However, HBPM performed in the morning (before drug intake) and in the evening over different days may provide useful information about the efficacy of therapeutic coverage over 24 h and in the long term and may identify cases of morning hypertension attributable to insufficient duration of action of prescribed antihypertensive medications.

HBPM allows patients to perform repeated and regular BP measurements over extended periods of time and may be particularly advantageous in the case of treated hypertensive subjects with CKD, and particularly in those with ESRD. In hemodialysis (HD) patients, BP control poses unique challenges because of the marked reductions in intravascular volume immediately after HD and its progressive increases throughout the inter-dialytic period, which induce an extremely variable behavior of BP [94]. In this context, HBPM provides potential advantages such as the possibility of sampling BP at various times throughout the inter-dialytic period to aid in tracking daytime and day-to-day BP variations and providing BP measurements that are more representative of subject's actual BP burden.

HBPM: A Substitute or a Complement to ABPM and OBP Measures?

In view of the limitations characterizing OBP measurements, it becomes clear that an adequate assessment of BP control and a proper diagnosis of resistant hypertension cannot be based on just isolated OBP readings. Indeed, a recent position paper on ABPM of the European Society of Hypertension [14] recommends performing 24-h ABPM and/or HBPM for detecting the presence of WCH and identifying the presence of true hypertension and masked hypertension in all patients with uncomplicated, stage 1 and 2 hypertension before starting antihypertensive drug therapy. Based on the evidence from several studies supporting the clinical value of ABPM either for selecting patients for treatment or for assessing the effects of antihypertensive drug therapy, ABPM is currently considered the standard method for confirming the diagnosis of hypertension in clinical practice [12, 14] and for assessing BP control in treated hypertensive patients [3, 6, 14, 10]. However, ABPM is not always available everywhere and requires trained clinic staff and specialized equipment and software for its analysis [9].

When performed on a regular basis and following standardized protocols [9], repeated BP measures obtained by patients at home result in accurate and frequent out-of-office BP measurements not only during a single day, but also over several days, weeks, or months in the non-medical setting, hence providing more reliable measures not only on the degree, but also on the consistency of BP control over time [9].

In view of the available evidence supporting the superior prognostic value of home vs. office BP levels, as well as the clinical advantages of HBPM, current hypertension guidelines recommend more extensive use of HBPM not only for the

initial diagnostic approach to hypertension (i.e., to identify “truly” hypertensive patients, likely to benefit from implementation of antihypertensive therapy [41]), but also for the long-term follow-up of treated hypertensive patients, even if they have controlled OBP, in order to better define the actual BP normalization rate achieved by various drug regimens [8, 9, 3, 25, 95]. Although HBPM shares many of the advantages of ABPM, including a cost-effective approach to the diagnosis of hypertension, it should not be considered as a substitute but rather as a complement to ABPM, since these methods are likely to pick up different types of BP behavior in a person’s activities of daily living.

Role of HBPM in Improving Adherence to Treatment and Reducing Therapeutic Inertia

Poor adherence to therapy has been recognized as one of the most important factors contributing to uncontrolled hypertension. By encouraging patients to become actively involved in their care, and by positively affecting their perceptions about the management of hypertension, HBPM offers the possibility to improve patient’s compliance and adherence to lifestyle changes and/or medical treatment [96]. Recent meta-analyses of randomized controlled trials have shown that compared to usual care based on OBP measurements, HBPM-guided antihypertensive treatment may significantly increase rates of achievement of BP control [75, 97] probably as a consequence of better compliance to treatment. In fact, HBPM is being increasingly implemented in clinical settings not only to guide antihypertensive therapy and to assess long-term BP control, but also as a means to improve patient’s compliance and adherence to antihypertensive treatment [98]. Another important advantage of HBPM in clinical practice is that it may help to overcome therapeutic inertia, since more information is provided to practitioners that allow more appropriate clinical decisions.

Assessment of Day-to-Day Blood Pressure Variability

HBPM may offer clinically relevant information when considering BPV over long periods of time. Although most studies on the prognostic relevance of BPV have focused on short-term BP changes assessed from 24-h ABPM, evidence from recent studies and clinical trials has suggested that an increased BPV in the mid-term (day-to-day) and in the long-term (i.e., between weekly, monthly, or yearly visits) relates to adverse implications for CV prognosis [99–103]. Although an extensive assessment of BPV for intermediate periods could theoretically be obtained by performing ABPM over consecutive days (i.e., during 48 h or more), this approach is neither well-accepted by patients nor available in all clinical settings. An alternative method for assessment of day-by-day BPV consists of its

calculation from BP measurements performed by patients at home over several days. Although HBPM cannot provide extensive information on nocturnal BP and BP profiles as ABPM does, a major advantage of this technique is that it provides information on the consistency of BP control over time earlier than when considering long-term visit-to-visit BPV, thus allowing early adjustment of antihypertensive treatment (and thus timely preventing development/progression of organ damage associated with inconsistent BP control). Besides, HBP monitors are widely available and are well-accepted by patients and are a more feasible approach for the evaluation of day-by-day BPV by applying different metrics: (1) Blood pressure standard deviation [104, 105], but with accounting for its dependence on mean BP levels, i.e., by calculating the coefficient of variation ($SD \times 100/BP$ mean) [104]; (2) morning maximum and minimum blood pressure (MMD); (3) "average real variability" (ARV), computed as the average of the absolute differences between consecutive BP measurements, focusing on the sequence of BP readings, thus reflecting reading-to-reading, within-subject variability in BP levels [106]; (4) variance independent of the mean (VIM), a method proposed to exclude the effect of mean BP from BPV by applying nonlinear regression analysis (i.e., plotting SD against mean) [99]. These indices of day-by-day BPV have been shown to be of prognostic value as indicated by a series of studies in which an increased day-by-day BPV independently of average home BP levels was predictive of development, establishment, and evolution of cardiac, vascular, and renal organ damage [107]. In a cross-sectional analysis of a population of never-treated participants with hypertension, an increased day-by-day BPV in home systolic BP (assessed as the maximum mean triplicate in home systolic BP over 14 consecutive days) was positively correlated with left ventricular mass index, increased carotid intima-media thickness, and urinary albumin/creatinine ratio over and above mean home SBP levels [107]. In a population of type 2 diabetes patients from Japan, increasing values of day-by-day variability (assessed as CV of morning and evening HBP measured over 14 consecutive days) were significantly higher in subjects presenting with macroalbuminuria (i.e., urinary albumin excretion ≥ 300 mg/g creatinine). Additionally, the CVs of morning systolic and diastolic BP and evening systolic BP were significantly correlated with urinary albumin excretion independently of other confounders [108]. A further report, also in type 2 diabetic patients, found higher values of SD of morning systolic HBP to be associated with increased arterial stiffness (i.e., higher pulse wave velocity) independent of other known risk factors [109]. Another study, conducted in a cohort of hypertensive patients, found home systolic BPV and max systolic BP to be associated with urinary albumin excretion [110]. In the frame of the Home Blood Pressure for Diabetic Nephropathy (HBP-DN) study, a prospective study in type 2 diabetic patients with microalbuminuria, higher values of SD of home systolic blood pressure (HSBP) were observed among subjects with the lowest values of estimated GFR (eGFR) [111]. Regarding the predictive value for cardiovascular events and mortality, the two main population studies exploring the prognostic value of mid-term BPV have found increasing values of day-by-day BPV to be associated with an increased risk

of fatal and nonfatal cardiovascular events [101–103]. In the Ohasama study from Japan, increasing values of variability in systolic HBP were associated with a higher risk of the composite end point of cardiac and stroke mortality, but only with a significant risk of stroke mortality, when the outcomes were independently considered [101]. In another report from the Ohasama study, increasing values of variability in systolic HBP were associated with a higher risk of cerebral infarction in ever smokers, but not in never smokers [102]. When the prognostic value of novel indices of BPV derived from self-measured HBP was evaluated in the population of the Ohasama study, increasing values of VIM and ARV, but not of morning maximum and minimum blood pressure (MMD) determined on a median of 26 readings, were associated with an increased risk of cardiovascular and total mortality. However, when adjustment was performed by accounting for average BP and common confounders, the incremental predictive value of VIM, MMD, and ARV over and beyond HBP level was only marginal (i.e., from <0.01 to 0.88 %) [102]. In the Finn-Home study in a cohort of adults from the general population [103], increasing variability in systolic and diastolic HBP measures performed over seven consecutive days was associated with a higher risk of cardiovascular events after 7.8 years of follow-up, which remained significant even after adjusting for age and average HBP levels, thus supporting the additive value of HBP variability in predicting CV prognosis [103]. Contrasting results were reported after 12-years of follow-up in a Belgium population in which no predictive value for HBP variability was observed for either cardiovascular mortality or morbidity after accounting for average BP levels [112]. In relation to the effects of antihypertensive treatment, despite the wide availability of monitors for HBP monitoring, only few interventional studies in hypertension have implemented routine assessment of HBPV in order to address whether reducing day-by-day BP variability with antihypertensive treatment in addition to reducing average home BP levels is associated with improvements in cardiovascular protection.

The results of interventional studies addressing the effects of antihypertensive treatment on HBP variability have been inconsistent. While some have found treatment with a beta-blocker to be related with lower HBP variability [109], other studies conducted in diabetic patients or in the general population have reported higher values of HBP variability in the arm receiving beta-blockers [109, 112]. A longitudinal study conducted in a population of hypertensive patients from Japan (with systolic HBP > 135 mmHg) explored whether reductions in HBP variability (determined on the basis of BP measures performed in the morning and the evening over seven consecutive days) were associated with changes in renal damage [assessed with urinary albumin excretion (UAE)] before and after 6 months of candesartan treatment. Although significant reductions were observed both in average BP levels and in HBP variability after 6 months of therapy, only treatment-induced reductions in average HBP but not in home BPV or in maximum home SBP were associated with reductions in UAE levels [110]. Another study reported lower values of systolic BPV in patients treated for <12 months with an angiotensin receptor blocker (ARB) but not with a calcium channel blocker (CCB) [113]. The only clinical study comparing the effects of different antihypertensive drug classes on BPV found a

CCB/ARB combination to be more effective in reducing systolic HBP variability, than a ARB/thiazide combination [114]. In the same study, significant reductions in pulse wave velocity (an index of arterial stiffness) induced by the ARB/CCB treatment (6 months) were independently correlated with changes in systolic HBP variability [114]. A recent non-randomized analysis of a population of diabetic subjects receiving different drug classes found lower values of morning HBP variability in subjects receiving calcium antagonists than in those receiving angiotensin converting enzyme (ACE) inhibitors or ARBs [115].

Telemonitoring of Home BP Monitoring

The wide availability and low cost of automated BP measuring devices and the emphasis put by healthcare systems on delivering patient-centered care have stimulated development of home-based telemonitoring. Such a system requires active involvement of patients who self-monitor their BP levels as well as pulse rate and send these values to a healthcare provider. However, in daily clinical practice, these data are usually reported in handwritten logbooks and oftentimes are inaccurate and/or illegible. This makes interpretation of HBPM values a difficult task, either when exploring BP behavior over the recording period and/or when estimating the BP changes in response to antihypertensive treatment. These issues may discourage physicians from using HBPM data for clinical decision-making. In recent years, the rapid development of e-health-related technologies has made it possible to develop home-based telemonitoring systems that allow transfer of data obtained by patients at home to a remote server (through a stationary or mobile phone or internet connection) where HBPM values are stored and analyzed [116, 117]. Automatically generated reports of these data are easier to interpret by the physician or the health personnel and thus more useful to make therapeutic decisions, which may be communicated to the patient without the need for additional clinic visits. Several HBPT systems are available, some of which also allow sending reminders to patients indicating the time of BP measurement and/or of medication intake. Patients can alter their health behaviors or have adjustments made in their medication regimen between visits, avoiding the need to wait months between visits for adjustments. Home-based monitoring may also alert the provider about new changes in a patient's health that may be associated with uncontrolled hypertension. In addition to traditional face-to-face clinic visits, patient-centered care involves providing care outside the clinic as well, which has been linked to improved patient satisfaction and to innovative ways of providing healthcare [118]. Moreover, telephone contacts offer a medium to enable patients to be reached regardless of geographic location and have been shown effective in changing multiple patient behaviors [119, 120]. Considering the decreased transportation burden and time savings, home-based telemonitoring may be more convenient for patients [121] and may encourage the development of a sense of control and support for chronic disease self-management [122].

Improving Achievement of BP Control Rates with Home BP Telemonitoring

Recent reports of interventional studies and meta-analyses of clinical trials have provided evidence that addition of remote telemonitoring of home BP values is effective in improving compliance to treatment, blood pressure control, and related medical and economic outcomes in hypertensive patients [117, 123–126], especially in those with treatment-resistant hypertension due to poor compliance with multiple drug prescriptions [127] (Fig. 2.5).

Preliminary reports also suggest a possible utility of HBPT for self-titration of antihypertensive medication by patients [128]. However, despite these results, heterogeneity of published studies in terms of HBPM protocols (i.e., devices, frequency of measures, method for reporting BP levels) and study populations suggests that well-designed, large-scale, randomized, controlled studies are still required to demonstrate the clinical usefulness of this technique [117, 126].

The Role of Nurse and Pharmacist in Home Blood Pressure Telemonitoring Systems

Patient-centered hypertension management requires a team-oriented approach often involving multidisciplinary roles (nurses, pharmacists, physicians) with the patient at the core [129]. In recent trials, nurses with varying levels of training [120, 130–133],

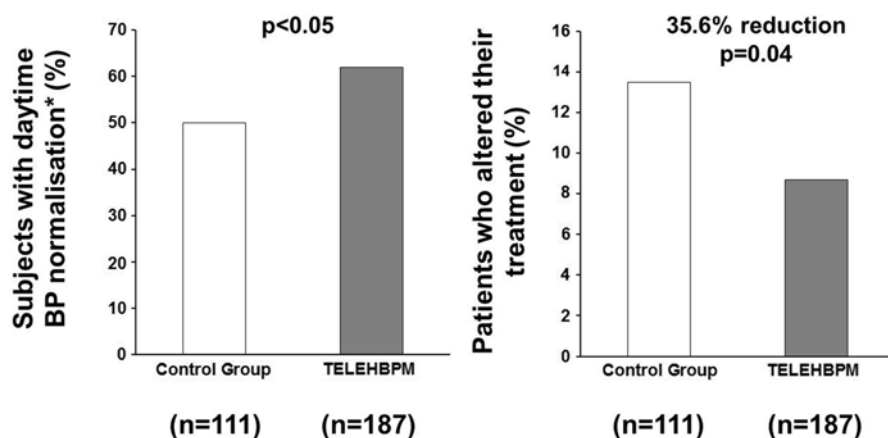


Fig. 2.5 Percentage of patients with daytime ambulatory BP normalization (systolic BP <130 mmHg and diastolic BP <80 mmHg). In this study, hypertensive patients were randomized to be conventionally managed based on office BP measurement (white bars, $n = 111$) or to be managed based on teletransmission of home BP values (gray bars: $n = 187$). Modified from Parati et al. [123], by permission

and clinical pharmacists [134–138], have been involved in this approach to patients' care. In particular, nurse-delivered interventions have been shown to contribute to improved patient outcomes [120, 132]. These nursing professionals are trained to address lifestyle and behavioral actions such as diet and exercise patterns, strategies for weight reduction, and smoking cessation, among others. Nurses at all practice levels are able to educate patients on proper home-based BP monitoring techniques, procedures for telemonitoring, and interpretation about appropriate BP thresholds. In addition, nurse practitioners (NP) are advanced practice-registered nurses with additional training enabling them to prescribe or manage pharmacotherapy. Their services involve ordering, conducting, and interpreting diagnostic and laboratory tests; prescribing pharmacologic agents and non-pharmacologic therapy; and teaching and counseling. Like the NP, clinical pharmacists with additional training and scopes of practice are able to prescribe and manage pharmacotherapy. Clinical pharmacists are an excellent source of counseling regarding safe, appropriate, and cost-effective medications use [139, 140]. Pharmacists may initiate, discontinue, or adjust pharmacotherapy based on clinical indications [135, 141, 139, 140].

Clinical pharmacist-administered behavioral and medication management interventions have been shown to improve BP control and the management of other chronic conditions leading to reductions in cardiovascular risk [141]. To date though, most of the evidence supporting the effects of pharmacist-driven interventions on BP levels has been provided in a traditional community-based setting rather than through telemonitoring [142, 143]. Of note, while the NP or clinical pharmacist may appear to be ideal interventionists with their pharmacotherapy privileges, cost-effectiveness is a major factor as LPNs and RNs may require significantly less monetary resources.

Cost-effectiveness of Home BP Telemonitoring-Based Programs

Although some financial aspects may limit the implementation of HBPT (i.e., costs of purchasing and maintaining the system, the need of trained personnel, requirement of telephonic/Internet connections), they may be partly counterbalanced by the reduction in the costs of patients' management compared with usual care. It is suggested that home-based monitoring may encourage more appropriate resource utilization by curtailing the need for unnecessary clinic visits (e.g., visits solely for a BP check), while simultaneously initiating needed visits when a patient's BP is out of target range. Several studies have demonstrated that home-based BP monitoring, especially when coupled with behavioral interventions, may be cost-additive or cost-neutral to the healthcare system in the short-term [144–146]. Of note, combining telemonitoring of BP levels plus behavioral modification and/or self-modification of treatment with the support of pharmacies could represent an excellent strategy not only to improve achievement of BP control, but also to further reduce healthcare costs and expenses. It has been generally felt that the initial expense will result in

long-term savings through cardiovascular disease reduction. The few studies conducted exploring this issue have shown that home-based BP telemonitoring may not only improve achievement of BP control, but also reduce the adverse cardiovascular outcomes associated with elevated BP levels. However, additional research is still needed to better understand the cost-effectiveness and long-term effects of home-based BP monitoring in clinical outcomes.

Conclusions

HBPM is a simple, inexpensive methodology that offers significant clinical advantages over routine OBP measurements. Consistent evidence has indicated that home BP is a strong and modifiable risk factor with superior prognostic value over conventional OBP measurements in predicting initiation, establishment and progression of subclinical organ damage, and the development of fatal and non-fatal CV events and all-cause and CV mortality in hypertension. A number of randomized controlled trials (RCTs) have also provided evidence of the benefits and cost-effectiveness of programs based on implementation of home-based BP telemonitoring. During the diagnostic assessment of hypertension, it reduces misclassification of BP levels by identifying WCH and MH, and in treated hypertensive subjects telemonitoring allows a better assessment of the BP response to antihypertensive treatment and may help improving therapeutic decisions. At variance from OBP, HBPM requires the active involvement of patients in managing their high BP conditions, which enhances patients' compliance and adherence to antihypertensive treatment. Besides, provided that the practitioner has more information available to make clinical decisions, HBPM also helps to reduce therapeutic inertia. In turn, all of this may potentially increase rates of BP control. Finally, unlike ABPM, HBPM does not allow the assessment of BP during sleep or at work, nor the quantification of short-term BP variability, although it may allow to assess day-by-day BP variability, thus offering a means to quantify long-term BP variations which, as recently suggested, may have prognostic significance. Based on these clinical advantages over OBP measurements (in particular its improved accuracy, low cost and easy implementation), the use of HBPM has been strongly supported by current guidelines for hypertension management as a complement to office BP measures and ambulatory BP monitoring and as part of the routine diagnostic and therapeutic approach to hypertension management [3, 8, 11, 12, 25, 147].

Despite the several advantages and potential applications offered by HBPM, in particular in subjects with resistant hypertension, evidence from intervention randomized trials on hypertension management is still needed in order to address several important issues in this field, such as the definition of HBP targets to achieve with BP lowering strategies or the optimal strategy for a meaningful application of HBPM in clinical practice.

References

1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380(9859):2224–60. Epub 2012/12/19.
2. Wright Jr JT, Bakris G, Greene T, Agodoa LY, Appel LJ, Charleston J, et al. Effect of blood pressure lowering and antihypertensive drug class on progression of hypertensive kidney disease: results from the AASK trial. *JAMA*. 2002;288(19):2421–31. Epub 2002/11/21.
3. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Bohm M, et al. 2013 ESH/ESC guidelines for the management of arterial hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *Eur Heart J*. 2013;34(28):2159–219. Epub 2013/06/19.
4. O'Brien E, Asmar R, Beilin L, Imai Y, Mallion JM, Mancia G, et al. European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement. *J Hypertens*. 2003;21(5):821–48. Epub 2003/04/26.
5. MacMahon S, Peto R, Cutler J, Collins R, Sorlie P, Neaton J, et al. Blood pressure, stroke, and coronary heart disease. Part 1, Prolonged differences in blood pressure: prospective observational studies corrected for the regression dilution bias. *Lancet*. 1990;335(8692):765–74. Epub 1990/03/31.
6. Parati G, Stergiou G, O'Brien E, Asmar R, Beilin L, Bilo G, et al. European Society of Hypertension practice guidelines for ambulatory blood pressure monitoring. *J Hypertens*. 2014;32(7):1359–66. Epub 2014/06/03.
7. Armstrong C. JNC8 Guidelines for the Management of Hypertension in Adults. *Am Fam Physician*. 2014;90(7):503–4. Epub 2014/11/05.
8. Parati G, Stergiou GS, Asmar R, Bilo G, de Leeuw P, Imai Y, et al. European Society of Hypertension guidelines for blood pressure monitoring at home: a summary report of the Second International Consensus Conference on Home Blood Pressure Monitoring. *J Hypertens*. 2008;26(8):1505–26. Epub 2008/07/16.
9. Parati G, Stergiou GS, Asmar R, Bilo G, de Leeuw P, Imai Y, et al. European Society of Hypertension practice guidelines for home blood pressure monitoring. *J Hum Hypertens*. 2010;24(12):779–85. Epub 2010/06/04.
10. Ritchie LD, Campbell NC, Murchie P. New NICE guidelines for hypertension. *BMJ*. 2011;343:d5644. Epub 2011/09/09.
11. Houle SK, Padwal R, Tsuyuki RT. The 2012-2013 Canadian Hypertension Education Program (CHEP) guidelines for pharmacists: an update. *Can Pharm J*. 2013;146(3):146–50. Epub 2013/06/26.
12. Pickering TG, Miller NH, Ogedegbe G, Krakoff LR, Artinian NT, Goff D. Call to action on use and reimbursement for home blood pressure monitoring: a joint scientific statement from the American Heart Association, American Society Of Hypertension, and Preventive Cardiovascular Nurses Association. *Hypertension*. 2008;52(1):10–29. Epub 2008/05/24.
13. Chertow GM, Levin NW, Beck GJ, Depner TA, Eggers PW, Gassman JJ, et al. In-center hemodialysis six times per week versus three times per week. *N Engl J Med*. 2010;363(24):2287–300. Epub 2010/11/26.
14. O'Brien E, Parati G, Stergiou G, Asmar R, Beilin L, Bilo G, et al. European Society of Hypertension position paper on ambulatory blood pressure monitoring. *J Hypertens*. 2013;31(9):1731–68. Epub 2013/09/14.
15. Stryker T, Wilson M, Wilson TW. Accuracy of home blood pressure readings: monitors and operators. *Blood Press Monit*. 2004;9(3):143–7. Epub 2004/06/17.
16. Stergiou GS, Efstathiou SP, Argyraki CK, Gantzaru AP, Roussias LG, Mountokalakis TD. Clinic, home and ambulatory pulse pressure: comparison and reproducibility. *J Hypertens*. 2002;20(10):1987–93. Epub 2002/10/03.

17. Stergiou GS, Baibas NM, Gantzarou AP, Skeva II, Kalkana CB, Roussias LG, et al. Reproducibility of home, ambulatory, and clinic blood pressure: implications for the design of trials for the assessment of antihypertensive drug efficacy. *Am J Hypertens*. 2002;15(2 Pt 1):101–4. Epub 2002/02/28.
18. Warren RE, Marshall T, Padfield PL, Chrubasik S. Variability of office, 24-hour ambulatory, and self-monitored blood pressure measurements. *Br J Gen Pract*. 2010;60(578):675–80. Epub 2010/09/21.
19. Powers BJ, Olsen MK, Smith VA, Woolson RF, Bosworth HB, Oddone EZ. Measuring blood pressure for decision making and quality reporting: where and how many measures? *Ann Intern Med*. 2011;154(12):781–8, W-289–90. Epub 2011/06/22.
20. McManus RJ, Mant J, Bray EP, Holder R, Jones MI, Greenfield S, et al. Telemonitoring and self-management in the control of hypertension (TASMINH2): a randomised controlled trial. *Lancet*. 2010;376(9736):163–72. Epub 2010/07/14.
21. Kaambwa B, Bryan S, Jowett S, Mant J, Bray EP, Hobbs FD, et al. Telemonitoring and self-management in the control of hypertension (TASMINH2): a cost-effectiveness analysis. *Eur J Prev Cardiol*. 2014;21(12):1517–30. Epub 2013/08/31.
22. Ishikawa J, Shimizu M, Sugiyama Edison E, Yano Y, Hoshida S, Eguchi K, et al. Assessment of the reductions in night-time blood pressure and dipping induced by antihypertensive medication using a home blood pressure monitor. *J Hypertens*. 2014;32(1):82–9. Epub 2013/12/12.
23. Ushio H, Ishigami T, Araki N, Minegishi S, Tamura K, Okano Y, et al. Utility and feasibility of a new programmable home blood pressure monitoring device for the assessment of night-time blood pressure. *Clin Exp Nephrol*. 2009;13(5):480–5. Epub 2009/05/19.
24. Stergiou GS, Triantafyllidou E, Cholidou K, Kollias A, Destounis A, Nasothimiou EG, et al. Asleep home blood pressure monitoring in obstructive sleep apnea: a pilot study. *Blood Press Monit*. 2013;18(1):21–6. Epub 2012/12/25.
25. Lackland DT. Hypertension: Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure guidelines. *Curr Opin Neurol*. 2013;26(1):8–12. Epub 2012/12/18.
26. Thijs L, Staessen JA, Celis H, de Gaudemaris R, Imai Y, Julius S, et al. Reference values for self-recorded blood pressure: a meta-analysis of summary data. *Arch Intern Med*. 1998;158(5):481–8. Epub 1998/03/21.
27. Thijs L, Staessen JA, Celis H, Fagard R, De Cort P, de Gaudemaris R, et al. The international database of self-recorded blood pressures in normotensive and untreated hypertensive subjects. *Blood Press Monit*. 1999;4(2):77–86. Epub 1999/08/18.
28. Ohkubo T, Imai Y, Tsuji I, Nagai K, Kato J, Kikuchi N, et al. Home blood pressure measurement has a stronger predictive power for mortality than does screening blood pressure measurement: a population-based observation in Ohasama. *Jpn J Hypertens*. 1998;16(7):971–5. Epub 1998/10/30.
29. Ohkubo T, Asayama K, Kikuya M, Metoki H, Hoshi H, Hashimoto J, et al. How many times should blood pressure be measured at home for better prediction of stroke risk? Ten-year follow-up results from the Ohasama study. *J Hypertens*. 2004;22(6):1099–104. Epub 2004/05/29.
30. Asayama K, Ohkubo T, Kikuya M, Metoki H, Obara T, Hoshi H, et al. Use of 2003 European Society of Hypertension-European Society of Cardiology guidelines for predicting stroke using self-measured blood pressure at home: the Ohasama study. *Eur Heart J*. 2005;26(19):2026–31. Epub 2005/05/27.
31. Ohkubo T, Asayama K, Kikuya M, Metoki H, Obara T, Saito S, et al. Prediction of ischaemic and haemorrhagic stroke by self-measured blood pressure at home: the Ohasama study. *Blood Press Monit*. 2004;9(6):315–20. Epub 2004/11/27.
32. Asayama K, Ohkubo T, Kikuya M, Metoki H, Hoshi H, Hashimoto J, et al. Prediction of stroke by self-measurement of blood pressure at home versus casual screening blood pressure measurement in relation to the Joint National Committee 7 classification: the Ohasama study. *Stroke*. 2004;35(10):2356–61. Epub 2004/08/28.

33. Nishinaga M, Takata J, Okumiya K, Matsubayashi K, Ozawa T, Doi Y. High morning home blood pressure is associated with a loss of functional independence in the community-dwelling elderly aged 75 years or older. *Hypertens Res.* 2005;28(8):657–63. Epub 2006/01/06.
34. Mancia G, Facchetti R, Bombelli M, Grassi G, Sega R. Long-term risk of mortality associated with selective and combined elevation in office, home, and ambulatory blood pressure. *Hypertension.* 2006;47(5):846–53. Epub 2006/03/29.
35. Sega R, Facchetti R, Bombelli M, Cesana G, Corrao G, Grassi G, et al. Prognostic value of ambulatory and home blood pressures compared with office blood pressure in the general population: follow-up results from the Pressioni Arteriose Monitorate e Loro Associazioni (PAMELA) study. *Circulation.* 2005;111(14):1777–83. Epub 2005/04/06.
36. Asayama K, Ohkubo T, Kikuya M, Obara T, Metoki H, Inoue R, et al. Prediction of stroke by home "morning" versus "evening" blood pressure values: the Ohasama study. *Hypertension.* 2006;48(4):737–43. Epub 2006/09/06.
37. Tsuji I, Imai Y, Nagai K, Ohkubo T, Watanabe N, Minami N, et al. Proposal of reference values for home blood pressure measurement: prognostic criteria based on a prospective observation of the general population in Ohasama, Japan. *Am J Hypertens.* 1997;10(4 Pt 1):409–18. Epub 1997/04/01.
38. Bobrie G, Chatellier G, Genes N, Clerson P, Vaur L, Vaisse B, et al. Cardiovascular prognosis of "masked hypertension" detected by blood pressure self-measurement in elderly treated hypertensive patients. *JAMA.* 2004;291(11):1342–9. Epub 2004/03/18.
39. Agarwal R, Andersen MJ. Prognostic importance of clinic and home blood pressure recordings in patients with chronic kidney disease. *Kidney Int.* 2006;69(2):406–11. Epub 2006/01/13.
40. Rave K, Bender R, Heise T, Sawicki PT. Value of blood pressure self-monitoring as a predictor of progression of diabetic nephropathy. *J Hypertens.* 1999;17(5):597–601. Epub 1999/07/14.
41. Staessen JA, Den Hond E, Celis H, Fagard R, Keary L, Vandenhoven G, et al. Antihypertensive treatment based on blood pressure measurement at home or in the physician's office: a randomized controlled trial. *JAMA.* 2004;291(8):955–64. Epub 2004/02/26.
42. Verberk WJ, Kroon AA, Lenders JW, Kessels AG, van Montfrans GA, Smit AJ, et al. Self-measurement of blood pressure at home reduces the need for antihypertensive drugs: a randomized, controlled trial. *Hypertension.* 2007;50(6):1019–25. Epub 2007/10/17.
43. Saito S, Asayama K, Ohkubo T, Kikuya M, Metoki H, Obara T, et al. The second progress report on the Hypertension Objective treatment based on Measurement by Electrical Devices of Blood Pressure (HOMED-BP) study. *Blood Press Monit.* 2004;9(5):243–7. Epub 2004/10/09.
44. Fagard RH, Celis H. Prognostic significance of various characteristics of out-of-the-office blood pressure. *J Hypertens.* 2004;22(9):1663–6. Epub 2004/08/18.
45. Mancia G, Zanchetti A, Agabiti-Rosei E, Benemio G, De Cesaris R, Fogari R, et al. Ambulatory blood pressure is superior to clinic blood pressure in predicting treatment-induced regression of left ventricular hypertrophy. SAMPLE Study Group. Study on Ambulatory Monitoring of Blood Pressure and Lisinopril Evaluation. *Circulation.* 1997;95(6):1464–70. Epub 1997/03/18.
46. Fagard RH, Van Den Broeke C, De Cort P. Prognostic significance of blood pressure measured in the office, at home and during ambulatory monitoring in older patients in general practice. *J Hum Hypertens.* 2005;19(10):801–7. Epub 2005/06/17.
47. Hozawa A, Ohkubo T, Nagai K, Kikuya M, Matsubara M, Tsuji I, et al. Prognosis of isolated systolic and isolated diastolic hypertension as assessed by self-measurement of blood pressure at home: the Ohasama study. *Arch Intern Med.* 2000;160(21):3301–6. Epub 2000/11/23.
48. Okumiya K, Matsubayashi K, Wada T, Fujisawa M, Osaki Y, Doi Y, et al. A U-shaped association between home systolic blood pressure and four-year mortality in community-dwelling older men. *J Am Geriatr Soc.* 1999;47(12):1415–21. Epub 1999/12/11.
49. Niiranen TJ, Maki J, Puukka P, Karanko H, Jula AM. Office, home, and ambulatory blood pressures as predictors of cardiovascular risk. *Hypertension.* 2014;64(2):281–6. Epub 2014/05/21.

50. Ward AM, Takahashi O, Stevens R, Heneghan C. Home measurement of blood pressure and cardiovascular disease: systematic review and meta-analysis of prospective studies. *J Hypertens*. 2012;30(3):449–56. Epub 2012/01/14.
51. Fuchs SC, Mello RG, Fuchs FC. Home blood pressure monitoring is better predictor of cardiovascular disease and target organ damage than office blood pressure: a systematic review and meta-analysis. *Curr Cardiol Rep*. 2013;15(11):413. Epub 2013/09/24.
52. Niiranen TJ, Hanninen MR, Johansson J, Reunanen A, Jula AM. Home-measured blood pressure is a stronger predictor of cardiovascular risk than office blood pressure: the Finn-Home study. *Hypertension*. 2010;55(6):1346–51. Epub 2010/04/14.
53. Stergiou GS, Baibas NM, Kalogeropoulos PG. Cardiovascular risk prediction based on home blood pressure measurement: the Didima study. *J Hypertens*. 2007;25(8):1590–6. Epub 2007/07/11.
54. Stergiou GS, Argyraki KK, Moysakis I, Mastorantonakis SE, Achimastos AD, Karamanos VG, et al. Home blood pressure is as reliable as ambulatory blood pressure in predicting target-organ damage in hypertension. *Am J Hypertens*. 2007;20(6):616–21. Epub 2007/05/29.
55. Tachibana R, Tabara Y, Kondo I, Miki T, Kohara K. Home blood pressure is a better predictor of carotid atherosclerosis than office blood pressure in community-dwelling subjects. *Hypertens Res*. 2004;27(9):633–9. Epub 2005/03/08.
56. Hara A, Ohkubo T, Kikuya M, Shintani Y, Obara T, Metoki H, et al. Detection of carotid atherosclerosis in individuals with masked hypertension and white-coat hypertension by self-measured blood pressure at home: the Ohasama study. *J Hypertens*. 2007;25(2):321–7. Epub 2007/01/11.
57. Niiranen T, Jula A, Kantola I, Moilanen L, Kahonen M, Kesaniemi YA, et al. Home-measured blood pressure is more strongly associated with atherosclerosis than clinic blood pressure: the Finn-HOME Study. *J Hypertens*. 2007;25(6):1225–31. Epub 2007/06/15.
58. Tsunoda S, Kawano Y, Horio T, Okuda N, Takishita S. Relationship between home blood pressure and longitudinal changes in target organ damage in treated hypertensive patients. *Hypertens Res*. 2002;25(2):167–73. Epub 2002/06/06.
59. Tomiyama M, Horio T, Yoshii M, Takiuchi S, Kamide K, Nakamura S, et al. Masked hypertension and target organ damage in treated hypertensive patients. *Am J Hypertens*. 2006;19(9):880–6. Epub 2006/09/01.
60. Gaborieau V, Delarche N, Gosse P. Ambulatory blood pressure monitoring versus self-measurement of blood pressure at home: correlation with target organ damage. *J Hypertens*. 2008;26(10):1919–27. Epub 2008/09/23.
61. Agarwal R, Brim NJ, Mahenthiran J, Andersen MJ, Saha C. Out-of-hemodialysis-unit blood pressure is a superior determinant of left ventricular hypertrophy. *Hypertension*. 2006;47(1):62–8. Epub 2005/12/14.
62. Suzuki H, Nakamoto H, Okada H, Sugahara S, Kanno Y. Self-measured systolic blood pressure in the morning is a strong indicator of decline of renal function in hypertensive patients with non-diabetic chronic renal insufficiency. *Clin Exp Hypertens*. 2002;24(4):249–60. Epub 2002/06/19.
63. Agarwal R, Andersen MJ. Blood pressure recordings within and outside the clinic and cardiovascular events in chronic kidney disease. *Am J Nephrol*. 2006;26(5):503–10. Epub 2006/11/25.
64. Alborzi P, Patel N, Agarwal R. Home blood pressures are of greater prognostic value than hemodialysis unit recordings. *Clin J Am Soc Nephrol*. 2007;2(6):1228–34. Epub 2007/10/19.
65. Agarwal R. Blood pressure and mortality among hemodialysis patients. *Hypertension*. 2010;55(3):762–8. Epub 2010/01/20.
66. Parati G, Mancia G. White coat effect: semantics, assessment and pathophysiological implications. *J Hypertens*. 2003;21(3):481–6. Epub 2003/03/18.
67. Little P, Barnett J, Barnsley L, Marjoram J, Fitzgerald-Barron A, Mant D. Comparison of agreement between different measures of blood pressure in primary care and daytime ambulatory blood pressure. *BMJ*. 2002;325(7358):254. Epub 2002/08/03.

68. Mancia G, Bombelli M, Facchetti R, Madotto F, Quarti-Trevano F, Polo Friz H, et al. Long-term risk of sustained hypertension in white-coat or masked hypertension. *Hypertension*. 2009;54(2):226–32. Epub 2009/07/01.
69. Mancia G, De Backer G, Dominiczak A, Cifkova R, Fagard R, Germano G, et al. 2007 Guidelines for the Management of Arterial Hypertension: The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *J Hypertens*. 2007;25(6):1105–87. Epub 2007/06/15.
70. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*. 2003;42(6):1206–52. Epub 2003/12/06.
71. Williams B, Poulter NR, Brown MJ, Davis M, McInnes GT, Potter JF, et al. Guidelines for management of hypertension: report of the fourth working party of the British Hypertension Society, 2004-BHS IV. *J Hum Hypertens*. 2004;18(3):139–85. Epub 2004/02/20.
72. Whitworth JA, World Health Organization ISOHWG. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. *J Hypertens*. 2003;21(11):1983–92. Epub 2003/11/05.
73. Imai Y, Otsuka K, Kawano Y, Shimada K, Hayashi H, Tochikubo O, et al. Japanese society of hypertension (JSH) guidelines for self-monitoring of blood pressure at home. *Hypertens Res*. 2003;26(10):771–82. Epub 2003/11/19.
74. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Recommendations for blood pressure measurement in humans and experimental animals: Part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Hypertension*. 2005;45(1):142–61. Epub 2004/12/22.
75. Cappuccio FP, Kerry SM, Forbes L, Donald A. Blood pressure control by home monitoring: meta-analysis of randomised trials. *BMJ*. 2004;329(7458):145. Epub 2004/06/15.
76. Rogers MA, Small D, Buchan DA, Butch CA, Stewart CM, Krenzer BE, et al. Home monitoring service improves mean arterial pressure in patients with essential hypertension. A randomized, controlled trial. *Ann Intern Med*. 2001;134(11):1024–32. Epub 2001/06/05.
77. McManus RJ, Mant J, Roalfe A, Oakes RA, Bryan S, Pattison HM, et al. Targets and self monitoring in hypertension: randomised controlled trial and cost effectiveness analysis. *BMJ*. 2005;331(7515):493. Epub 2005/08/24.
78. Myers MG. Pseudoresistant hypertension attributed to white-coat effect. *Hypertension*. 2012;59(3):532–3. Epub 2012/01/19.
79. Parati G, Ulian L, Santucci C, Omboni S, Mancia G. Difference between clinic and daytime blood pressure is not a measure of the white coat effect. *Hypertension*. 1998;31(5):1185–9. Epub 1998/05/12.
80. de la Sierra A, Segura J, Banegas JR, Gorostidi M, de la Cruz JJ, Armario P, et al. Clinical features of 8295 patients with resistant hypertension classified on the basis of ambulatory blood pressure monitoring. *Hypertension*. 2011;57(5):898–902. Epub 2011/03/30.
81. Oikawa T, Obara T, Ohkubo T, Kikuya M, Asayama K, Metoki H, et al. Characteristics of resistant hypertension determined by self-measured blood pressure at home and office blood pressure measurements: the J-HOME study. *J Hypertens*. 2006;24(9):1737–43. Epub 2006/08/18.
82. de la Sierra A, Banegas JR, Oliveras A, Gorostidi M, Segura J, de la Cruz JJ, et al. Clinical differences between resistant hypertensives and patients treated and controlled with three or less drugs. *J Hypertens*. 2012;30(6):1211–6. Epub 2012/04/25.
83. Papademetriou V, Doumas M, Faselis C, Tsioufis C, Douma S, Gkaliagkousi E, et al. Carotid baroreceptor stimulation for the treatment of resistant hypertension. *Int J Hypertens*. 2011;2011:964394. Epub 2011/08/09.
84. Doumas M, Faselis C, Papademetriou V. Renal sympathetic denervation in hypertension. *Curr Opin Nephrol Hypertens*. 2011;20(6):647–53. Epub 2011/09/03.
85. Schmieder RE, Redon J, Grassi G, Kjeldsen SE, Mancia G, Narkiewicz K, et al. ESH position paper: renal denervation - an interventional therapy of resistant hypertension. *J Hypertens*. 2012;30(5):837–41. Epub 2012/04/04.

86. Pickering TG, Davidson K, Gerin W, Schwartz JE. Masked hypertension. *Hypertension*. 2002;40(6):795–6. Epub 2002/12/07.
87. Stergiou GS, Salgami EV, Tzamouranis DG, Roussias LG. Masked hypertension assessed by ambulatory blood pressure versus home blood pressure monitoring: is it the same phenomenon? *Am J Hypertens*. 2005;18(6):772–8. Epub 2005/06/01.
88. Nasothimiou EG, Tzamouranis D, Roussias LG, Stergiou GS. Home versus ambulatory blood pressure monitoring in the diagnosis of clinic resistant and true resistant hypertension. *J Hum Hypertens*. 2012;26(12):696–700. Epub 2011/11/11.
89. Parati G, Ochoa JE, Bilo G. False versus true resistant hypertension. In: Mancia G, editor. *Resistant hypertension: epidemiology, pathophysiology, diagnosis and treatment*. Milan: Springer; 2013. p. 59–75.
90. Staessen JA, Thijs L, Fagard R, O'Brien ET, Clement D, de Leeuw PW, et al. Predicting cardiovascular risk using conventional vs ambulatory blood pressure in older patients with systolic hypertension. Systolic Hypertension in Europe Trial Investigators. *JAMA*. 1999;282(6):539–46. Epub 1999/08/18.
91. Kikuya M, Ohkubo T, Asayama K, Metoki H, Obara T, Saito S, et al. Ambulatory blood pressure and 10-year risk of cardiovascular and noncardiovascular mortality: the Ohasama study. *Hypertension*. 2005;45(2):240–5. Epub 2004/12/15.
92. Fagard RH, Celis H, Thijs L, Staessen JA, Clement DL, De Buyzere ML, et al. Daytime and nighttime blood pressure as predictors of death and cause-specific cardiovascular events in hypertension. *Hypertension*. 2008;51(1):55–61. Epub 2007/11/28.
93. Boggia J, Li Y, Thijs L, Hansen TW, Kikuya M, Bjorklund-Bodegard K, et al. Prognostic accuracy of day versus night ambulatory blood pressure: a cohort study. *Lancet*. 2007;370(9594):1219–29. Epub 2007/10/09.
94. Lacson Jr E, Lazarus JM. The association between blood pressure and mortality in ESRD-not different from the general population? *Semin Dial*. 2007;20(6):510–7. Epub 2007/11/10.
95. Mallion JM, Clerson P, Bobrie G, Genes N, Vaisse B, Chatellier G. Predictive factors for masked hypertension within a population of controlled hypertensives. *J Hypertens*. 2006;24(12):2365–70. Epub 2006/11/04.
96. Edmonds D, Foerster E, Groth H, Greminger P, Siegenthaler W, Vetter W. Does self-measurement of blood pressure improve patient compliance in hypertension? *J Hypertens Suppl*. 1985;3(1):S31–4. Epub 1985/04/01.
97. Agarwal R, Bills JE, Hecht TJ, Light RP. Role of home blood pressure monitoring in overcoming therapeutic inertia and improving hypertension control: a systematic review and meta-analysis. *Hypertension*. 2011;57(1):29–38. Epub 2010/12/01.
98. Logan AG, Dunai A, McIsaac WJ, Irvine MJ, Tisler A. Attitudes of primary care physicians and their patients about home blood pressure monitoring in Ontario. *J Hypertens*. 2008;26(3):446–52. Epub 2008/02/28.
99. Rothwell PM, Howard SC, Dolan E, O'Brien E, Dobson JE, Dahlof B, et al. Prognostic significance of visit-to-visit variability, maximum systolic blood pressure, and episodic hypertension. *Lancet*. 2010;375(9718):895–905. Epub 2010/03/17.
100. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet*. 2005;365(9455):217–23. Epub 2005/01/18.
101. Kikuya M, Ohkubo T, Metoki H, Asayama K, Hara A, Obara T, et al. Day-by-day variability of blood pressure and heart rate at home as a novel predictor of prognosis: the Ohasama study. *Hypertension*. 2008;52(6):1045–50. Epub 2008/11/05.
102. Hashimoto T, Kikuya M, Ohkubo T, Satoh M, Metoki H, Inoue R, et al. Home blood pressure level, blood pressure variability, smoking, and stroke risk in Japanese men: the Ohasama study. *Am J Hypertens*. 2012;25(8):883–91. Epub 2012/06/08.
103. Johansson JK, Niiranen TJ, Puukka PJ, Jula AM. Prognostic value of the variability in home-measured blood pressure and heart rate: the Finn-Home Study. *Hypertension*. 2012;59(2):212–8. Epub 2012/01/05.
104. di Rienzo M, Grassi G, Pedotti A, Mancia G. Continuous vs intermittent blood pressure measurements in estimating 24-hour average blood pressure. *Hypertension*. 1983;5(2):264–9. Epub 1983/03/01.

105. Mancia G, Di Rienzo M, Parati G. Ambulatory blood pressure monitoring use in hypertension research and clinical practice. *Hypertension*. 1993;21(4):510–24. Epub 1993/04/01.
106. Mena L, Pintos S, Queipo NV, Aizpurua JA, Maestre G, Sulbaran T. A reliable index for the prognostic significance of blood pressure variability. *J Hypertens*. 2005;23(3):505–11. Epub 2005/02/18.
107. Matsui Y, Ishikawa J, Eguchi K, Shibasaki S, Shimada K, Kario K. Maximum value of home blood pressure: a novel indicator of target organ damage in hypertension. *Hypertension*. 2011;57(6):1087–93. Epub 2011/05/04.
108. Ushigome E, Fukui M, Hamaguchi M, Senmaru T, Sakabe K, Tanaka M, et al. The coefficient variation of home blood pressure is a novel factor associated with macroalbuminuria in type 2 diabetes mellitus. *Hypertens Res*. 2011;34(12):1271–5. Epub 2011/08/05.
109. Fukui M, Ushigome E, Tanaka M, Hamaguchi M, Tanaka T, Atsuta H, et al. Home blood pressure variability on one occasion is a novel factor associated with arterial stiffness in patients with type 2 diabetes. *Hypertens Res*. 2013;36(3):219–25. Epub 2012/10/26.
110. Hoshida S, Yano Y, Shimizu M, Eguchi K, Ishikawa J, Kario K. Is home blood pressure variability itself an interventional target beyond lowering mean home blood pressure during antihypertensive treatment? *Hypertens Res*. 2012;35(8):862–6. Epub 2012/04/06.
111. Nishimura M, Kato Y, Tanaka T, Todo R, Tone A, Yamada K, et al. Significance of estimating the glomerular filtration rate for the management of hypertension in type 2 diabetes with microalbuminuria. *Hypertens Res*. 2013;36(8):705–10. Epub 2013/04/05.
112. Schutte R, Thijs L, Liu YP, Asayama K, Jin Y, Odili A, et al. Within-subject blood pressure level—not variability—predicts fatal and nonfatal outcomes in a general population. *Hypertension*. 2012;60(5):1138–47. Epub 2012/10/17.
113. Ishikura K, Obara T, Kato T, Kikuya M, Shibamiya T, Shinki T, et al. Associations between day-by-day variability in blood pressure measured at home and antihypertensive drugs: the J-HOME-Morning study. *Clin Exp Hypertens*. 2012;34(4):297–304. Epub 2012/05/09.
114. Matsui Y, O'Rourke MF, Hoshida S, Ishikawa J, Shimada K, Kario K. Combined effect of angiotensin II receptor blocker and either a calcium channel blocker or diuretic on day-by-day variability of home blood pressure: the Japan Combined Treatment With Olmesartan and a Calcium-Channel Blocker Versus Olmesartan and Diuretics Randomized Efficacy Study. *Hypertension*. 2012;59(6):1132–8. Epub 2012/05/02.
115. Ushigome E, Fukui M, Hamaguchi M, Tanaka T, Atsuta H, Ohnishi M, et al. Beneficial effect of calcium channel blockers on home blood pressure variability in the morning in patients with type 2 diabetes. *J Diabetes Investig*. 2013;4(4):399–404. Epub 2014/05/21.
116. Pickering TG, Gerin W, Holland JK. Home blood pressure teletransmission for better diagnosis and treatment. *Curr Hypertens Rep*. 1999;1(6):489–94. Epub 2000/09/12.
117. Parati G, Omboni S. Role of home blood pressure telemonitoring in hypertension management: an update. *Blood Press Monit*. 2010;15(6):285–95. Epub 2010/11/19.
118. Rosenthal TC. The medical home: growing evidence to support a new approach to primary care. *J Am Board Fam Med*. 2008;21(5):427–40. Epub 2008/09/06.
119. Friedman RH, Kazis LE, Jette A, Smith MB, Stollerman J, Torgerson J, et al. A telecommunications system for monitoring and counseling patients with hypertension. Impact on medication adherence and blood pressure control. *Am J Hypertens*. 1996;9(4 Pt 1):285–92. Epub 1996/04/01.
120. Bosworth HB, Olsen MK, Gentry P, Orr M, Dudley T, McCant F, et al. Nurse administered telephone intervention for blood pressure control: a patient-tailored multifactorial intervention. *Patient Educ Couns*. 2005;57(1):5–14. Epub 2005/03/31.
121. Friedman RH. Automated telephone conversations to assess health behavior and deliver behavioral interventions. *J Med Syst*. 1998;22(2):95–102. Epub 1998/05/08.
122. Cottrell E, McMillan K, Chambers R. A cross-sectional survey and service evaluation of simple telehealth in primary care: what do patients think? *BMJ Open*. 2012;2(6), e001392. Epub 2012/11/30.
123. Parati G, Omboni S, Albini F, Piantoni L, Giuliano A, Revera M, et al. Home blood pressure telemonitoring improves hypertension control in general practice. The TeleBPCare study. *J Hypertens*. 2009;27(1):198–203. Epub 2009/01/17.

124. Parati G, Omboni S, Compare A, Grossi E, Callus E, Venco A, et al. Blood pressure control and treatment adherence in hypertensive patients with metabolic syndrome: protocol of a randomized controlled study based on home blood pressure telemonitoring vs. conventional management and assessment of psychological determinants of adherence (TELEBPMET Study). *Trials*. 2013;14:22. Epub 2013/01/25.
125. Omboni S, Gazzola T, Carabelli G, Parati G. Clinical usefulness and cost effectiveness of home blood pressure telemonitoring: meta-analysis of randomized controlled studies. *J Hypertens*. 2013;31(3):455–67. discussion 67–8. Epub 2013/01/10.
126. Omboni S, Guarda A. Impact of home blood pressure telemonitoring and blood pressure control: a meta-analysis of randomized controlled studies. *Am J Hypertens*. 2011;24(9):989–98. Epub 2011/06/10.
127. Ogedegbe G, Schoenthaler A. A systematic review of the effects of home blood pressure monitoring on medication adherence. *J Clin Hypertens (Greenwich)*. 2006;8(3):174–80. Epub 2006/03/09.
128. Bobrie G, Postel-Vinay N, Delonca J, Corvol P, Investigators S. Self-measurement and self-titration in hypertension: a pilot telemedicine study. *Am J Hypertens*. 2007;20(12):1314–20. Epub 2007/12/01.
129. Carter BL, Bosworth HB, Green BB. The hypertension team: the role of the pharmacist, nurse, and teamwork in hypertension therapy. *J Clin Hypertens (Greenwich)*. 2012;14(1):51–65. Epub 2012/01/13.
130. Chiu CW, Wong FK. Effects of 8 weeks sustained follow-up after a nurse consultation on hypertension: a randomised trial. *Int J Nurs Stud*. 2010;47(11):1374–82. Epub 2010/04/24.
131. Hebert PL, Sisk JE, Tuzzio L, Casabianca JM, Pogue VA, Wang JJ, et al. Nurse-led disease management for hypertension control in a diverse urban community: a randomized trial. *J Gen Intern Med*. 2012;27(6):630–9. Epub 2011/12/07.
132. Kim MT, Han HR, Hedlin H, Kim J, Song HJ, Kim KB, et al. Teletransmitted monitoring of blood pressure and bilingual nurse counseling-sustained improvements in blood pressure control during 12 months in hypertensive Korean Americans. *J Clin Hypertens (Greenwich)*. 2011;13(8):605–12. Epub 2011/08/03.
133. Bosworth HB, Powers BJ, Olsen MK, McCant F, Grubber J, Smith V, et al. Home blood pressure management and improved blood pressure control: results from a randomized controlled trial. *Arch Intern Med*. 2011;171(13):1173–80. Epub 2011/07/13.
134. Magid DJ, Ho PM, Olson KL, Brand DW, Welch LK, Snow KE, et al. A multimodal blood pressure control intervention in 3 healthcare systems. *Am J Manag Care*. 2011;17(4):e96–103. Epub 2011/07/21.
135. Melnyk SD, Zullig LL, McCant F, Danus S, Oddone E, Bastian L, et al. Telemedicine cardiovascular risk reduction in veterans. *Am Heart J*. 2013;165(4):501–8. Epub 2013/03/30.
136. Zullig LL, Melnyk SD, Goldstein K, Shaw RJ, Bosworth HB. The role of home blood pressure telemonitoring in managing hypertensive populations. *Curr Hypertens Rep*. 2013;15(4):346–55. Epub 2013/04/30.
137. Zullig LL, Melnyk SD, Stechuchak KM, McCant F, Danus S, Oddone E, et al. The Cardiovascular Intervention Improvement Telemedicine Study (CITIES): rationale for a tailored behavioral and educational pharmacist-administered intervention for achieving cardiovascular disease risk reduction. *Telemed J E Health*. 2014;20(2):135–43. Epub 2013/12/07.
138. Omboni S, Sala E. The pharmacist and the management of arterial hypertension: the role of blood pressure monitoring and telemonitoring. *Expert Rev Cardiovasc Ther*. 2015;13(2):209–21. Epub 2015/01/13.
139. Harris IM, Baker E, Berry TM, Halloran MA, Lindauer K, Ragucci KR, et al. Developing a business-practice model for pharmacy services in ambulatory settings. *Pharmacotherapy*. 2008;28(2):285. Epub 2008/01/30.
140. Burke JM, Miller WA, Spencer AP, Crank CW, Adkins L, Bertch KE, et al. Clinical pharmacist competencies. *Pharmacotherapy*. 2008;28(6):806–15. Epub 2008/05/28.
141. Santschi V, Chiolerio A, Burnand B, Colosimo AL, Paradis G. Impact of pharmacist care in the management of cardiovascular disease risk factors: a systematic review and meta-analysis of randomized trials. *Arch Intern Med*. 2011;171(16):1441–53. Epub 2011/09/14.

142. Carter BL, Bergus GR, Dawson JD, Farris KB, Doucette WR, Chrischilles EA, et al. A cluster randomized trial to evaluate physician/pharmacist collaboration to improve blood pressure control. *J Clin Hypertens (Greenwich)*. 2008;10(4):260–71. Epub 2008/04/11.
143. McLean DL, McAlister FA, Johnson JA, King KM, Makowsky MJ, Jones CA, et al. A randomized trial of the effect of community pharmacist and nurse care on improving blood pressure management in patients with diabetes mellitus: study of cardiovascular risk intervention by pharmacists-hypertension (SCRIP-HTN). *Arch Intern Med*. 2008;168(21):2355–61. Epub 2008/11/26.
144. Wang V, Smith VA, Bosworth HB, Oddone EZ, Olsen MK, McCant F, et al. Economic evaluation of telephone self-management interventions for blood pressure control. *Am Heart J*. 2012;163(6):980–6. Epub 2012/06/20.
145. Reed SD, Li Y, Oddone EZ, Neary AM, Orr MM, Grubber JM, et al. Economic evaluation of home blood pressure monitoring with or without telephonic behavioral self-management in patients with hypertension. *Am J Hypertens*. 2010;23(2):142–8. Epub 2009/11/21.
146. Lovibond K, Jowett S, Barton P, Caulfield M, Heneghan C, Hobbs FD, et al. Cost-effectiveness of options for the diagnosis of high blood pressure in primary care: a modelling study. *Lancet*. 2011;378(9798):1219–30. Epub 2011/08/27.
147. Parati G, Bilo G. Home blood pressure measurements will or will not replace 24-hour ambulatory blood pressure measurement. *Hypertension*. 2009. Epub 2009/09/10.

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