2021 European Society of Hypertension practice guidelines for office and out-of-office blood pressure measurement

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Abbreviations: ABPM, ambulatory blood pressure monitoring; BP, blood pressure; CVD, cardiovascular disease; HBPM, home blood pressure monitoring; MH; masked hypertension; OBP, office blood pressure; WCH, white-coat hypertension

SECTION 1: INTRODUCTION [1–4]

High blood pressure (BP) is the leading modifiable risk factor for morbidity and mortality worldwide. The basis for diagnosing and managing hypertension is the measurement of BP, which is routinely used to initiate or rule out costly investigations and long-term therapeutic interventions. Inadequate measurement methodology or use of inaccurate BP measuring devices can lead to overdiagnosis and unnecessary treatment, or underdiagnosis and exposure to preventable cardiovascular disease (CVD).

Office BP (OBP) is measured using different methods (auscultatory, automated, unattended with patient alone in the office), and out-of-office using ambulatory BP monitoring (ABPM), or home BP monitoring (HBPM), along with measurements in other settings (pharmacies, public spaces). With lower BP targets currently recommended by hypertension guidelines, the accuracy in BP measurement has become even more important to achieve optimal control and prevent adverse effects of over-treatment. Current guidelines recommend widespread use of ABPM and HBPM for detecting white-coat hypertension (WCH), masked hypertension (MH), resistant hypertension and other clinically important conditions. However, to date the classification of BP, as well as the threshold and target for treatment, are still based on conventional OBP measurements.

This European Society of Hypertension (ESH) statement aims to summarise essential recommendations for BP measurements for clinical practice in and out of the office. Members of the ESH Working Group on Blood Pressure Monitoring and Cardiovascular Variability prepared the first draft, which was reviewed by ESH Council members to formulate a draft statement. This document was then reviewed by external international experts, including general practitioners, and a final statement was developed.

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SECTION 2: ASPECTS COMMON TO ALL BP MEASUREMENT TECHNIQUES

2.1. Accuracy of BP measuring devices [5,6]

Background

- Reliable devices are essential for proper BP measurement. If inaccurate devices are used, measurements may be misleading. Automated electronic devices are now used almost exclusively for HBPM and ABPM and increasingly for OBP measurement.
- For the clinical validation of electronic BP monitors, several protocols developed by scientific organizations have been used in the past. In 2018, a Universal Standard was developed by the American Association for the Advancement of Medical Instrumentation, the ESH and the International Organization for Standardization (AAMI/ESH/ISO) for global use.
- Only BP measuring devices, which have been successfully validated by using an established protocol should be used (Table 1). Unfortunately, most of the devices available on the market have not been subjected to independent evaluation using an established protocol.
- An electronic BP monitor, which has been successfully validated in adults may not be accurate in other special populations, including children, pregnant women, individuals with very large arms (circumference >42 cm) and patients with arrhythmias (particularly atrial fibrillation). In these populations, separate validation is necessary.

Selecting reliable devices

- Updated lists of validated devices can be downloaded from several websites; those associated with scientific organisations are listed in Table 1.
- At the present time, of the over 4000 devices available on the market worldwide, fewer than 10% have passed established validation protocols.
- BP measuring devices with additional features (e.g. measurement of pulse wave velocity or central BP, atrial fibrillation detection, actigraphy), need to be validated for these functions, with evidence being provided to support their use in clinical practice.

2.2. Cuffs for BP measuring devices [3,4,7]

Cuff characteristics

- Electronic devices have their own cuffs, which are not interchangeable with those of other monitors even of the same brand.
- The selection of an appropriate cuff size is crucial for accurate BP measurement and depends on the arm circumference of each individual. A smaller than required cuff overestimates BP and a larger underestimates BP. A single cuff cannot fit the range of arm sizes of all adults.
- *Manual auscultatory devices*: use a cuff with inflatable bladder length which is 75–100% of the individual's middle upper-arm circumference and width 37–50% of the arm circumference.
- *Automated electronic devices*: select cuff size according to the device's instructions. Some devices have 'wide-range' cuffs, which fit the arm of most adults, but require proper validation.
- *People with large arms (mid-arm circumference >42 cm):* prefer a conic-shape cuff as rectangular cuff may overestimate BP. When BP cannot be measured using an upper-arm cuff device, a validated electronic wrist-cuff device may be used.

Procedure

- Place the centre of the bladder over the brachial artery pulsation in the antecubital fossa.
- The lower end of the cuff should be 2–3 cm above the antecubital fossa.
- The cuff should exert comparable tightness at the top and bottom edges. One finger should easily fit under the cuff at its top and bottom.

2.3. White-coat hypertension and masked hypertension [1,2,8–10]

- When BP is evaluated using both office and out-of-office measurements (HBPM or ABPM), patients are classified into four categories (Fig. 1): normotension (OBP and out-of-office BP not elevated); sustained hypertension (elevated OBP and out-of-office BP); WCH (elevated OBP but not out-of-office BP); MH (elevated out-of-office but not OBP).

TABLE 1. Organisations with scientific association providing online lists of validated BP monitors

Organisation	Device lists *(language)*	Scientific association[a]	Website
STRIDE BP	International *(English, Chinese, Spanish)*	European Society of Hypertension – International Society of Hypertension – World Hypertension League	www.stridebp.org
BIHS	UK/Ireland *(English)*	British and Irish Hypertension Society	www.bihsoc.org/bp-monitors
VDL	USA *(English)*	American Medical Association	www.validatebp.org
Hypertension Canada	Canada *(English)*	Hypertension Canada	www.hypertension.ca/bpdevices
Deutsche Hochdruckliga	Germany *(German)*	German High Pressure League	www.hochdruckliga.de/betroffene/blutdruckmessgeraete-mit-pruefsiegel
JSH	Japan *(Japanese)*	Japanese Society of Hypertension	www.jpnsh.jp/com_ac_wg1.html

[a]Two websites are not associated with a scientific organisation (www.dableducational.org, www.medaval.ie).

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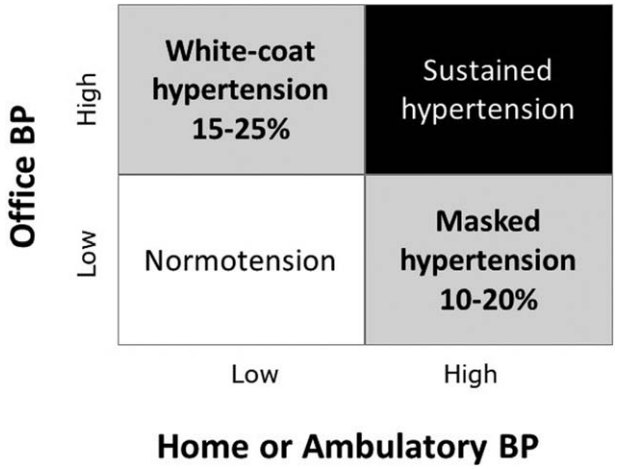


FIGURE 1 Classification of patients attending BP clinics according to their office and out-of-office BP measurements.

- WCH and MH are common in both untreated individuals and those with treated hypertension. Even with carefully taken OBP measurements, about 15–25% of individuals attending hypertension clinics have WCH and 10–20% MH.
- The diagnoses of WCH and MH require confirmation with a second set of out-of-office BP measurements, as their reproducibility is limited (Table 2).
- When OBP is close to the 140/90 mmHg threshold, the probability of misdiagnosis is increased. Thus, in individuals with OBP levels within the grade 1 hypertension range (140–159/90–99 mmHg), the probability of WCH is increased compared with those with higher OBP. Likewise, the probability of MH is increased in individuals with OBP within the high-normal BP range (130–139/85–89 mmHg) than those with lower levels. Thus, when OBP is 130–159/85–99 mmHg, out-of-office BP evaluation is strongly recommended.
- In some special cases, such as pregnant women, children and chronic kidney disease patients, out-of-office BP monitoring is particularly important for both diagnosis and follow-up. Special recommendations must be followed in these cases, which are not discussed in this statement.

2.4. BP variability [11,12]

The adverse cardiovascular consequences of hypertension, including events and mortality, largely depend on increased average BP values. Thus, decision-making in hypertension is based on average values of several BP readings obtained in and out of the office. However, BP is characterized by short-term (24 h ABPM), mid-term (day-to-day HBPM) and long-term (visit-to-visit OBP) fluctuations, which are the result of complex interactions between intrinsic cardiovascular regulatory mechanisms and extrinsic environmental and behavioural factors. Observational studies and non-randomized secondary analyses of randomised controlled trials suggest that adverse outcomes are also independently associated with increased BP variability, yet its additional predictive value is unclear. Thus, at present, BP variability remains a research topic without application in daily practice.

TABLE 2. Diagnosis and management of white-coat and masked hypertension phenomena (in untreated or treated individuals)

	White-coat hypertension[a]	Masked hypertension[a]
Diagnosis	Elevated OBP, but not 24 h ambulatory and/or home BP[b]	Elevated 24 h ambulatory and/or home BP, but not OBP[b]
Management	Lifestyle changes and annual follow-up. Consider drug treatment in patients with high or very-high CVD risk	Lifestyle changes and consider drug treatment

[a]These diagnoses require confirmation with repeat OBP and out-of-office BP measurements.
[b]'Elevated' based on OBP threshold ≥140/90 mmHg, 24 h ambulatory BP ≥130/80 mmHg, home BP ≥135/85 mmHg.

SECTION 3: OFFICE BP MEASUREMENT [1–4,13]

(Poster with key recommendations in Supplement), http://links.lww.com/HJH/B621

Background (Table 3)

- OBP remains the most used and often the only method used for hypertension detection and management. It is the most well studied method with the strongest evidence, on which the BP classification of hypertension and the recommended thresholds for treatment initiation and treatment targets are based.
- When used alone, OBP may be misleading in diagnosing hypertension in several untreated and treated individuals.
- Whenever possible, diagnostic and treatment decisions should be made with confirmatory out-of-office BP measurement (HBPM or ABPM). If this is not possible, repeated OBP measurements should be taken at additional visits.

OBP device requirements

- Use an automated electronic (oscillometric), upper-arm cuff device, which is validated according to an established protocol (Table 1). A device that takes triplicate readings automatically is preferred.
- If validated automated devices are not available, then use a manual electronic auscultatory device (hybrid)

TABLE 3. Advantages and limitations of OBP measurements

Advantages	Limitations
• Readily available in most healthcare settings. • Strong data linking OBP with CVD. Used in most observational and interventional outcome trials in hypertension	• Often poorly standardised leading to overestimation of BP. • Inadequate reproducibility, with single-visit OBP having low diagnostic precision in an individual. • Subject to WCH (reduced but still present with standardised measurements taken in repeated visits). • Will not detect MH.

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with LCD or LED mercury column-like display, or digital countdown (mercury sphygmomanometers are banned in most countries). Good quality shock-resistant aneroid devices might be used, but require calibration at least once per year. Deflate at 2-3 mmHg/s rate and use Korotkoff sound 1 for SBP and sound 5 for DBP in adults and children (use Korotkoff sound 4 if sounds are present at full deflation or at <40 mmHg point.
- Electronic devices for children and pregnant women must be validated specifically in these populations.
- Select cuff size to fit the individual's arm circumference according to the device's instructions (section 2.2).
- Ensure good working order with annual maintenance of device.

Box 1 OBP MEASUREMENT PROCEDURE (Fig. 2)

Conditions

- Quiet room with comfortable temperature.
- No smoking, caffeine, food or exercise for 30 min before measurement.
- Remain seated and relaxed for 3–5 min.
- No talking by patient or staff during or between measurements.

Posture

- Sitting with back supported by chair.
- Legs uncrossed, feet flat on floor.
- Bare arm resting on table; mid-arm at heart level.

Measurements

- Take 3 OBP readings (2 if they are normal) with 1 min interval between readings.
- Use the average of the last 2 readings.

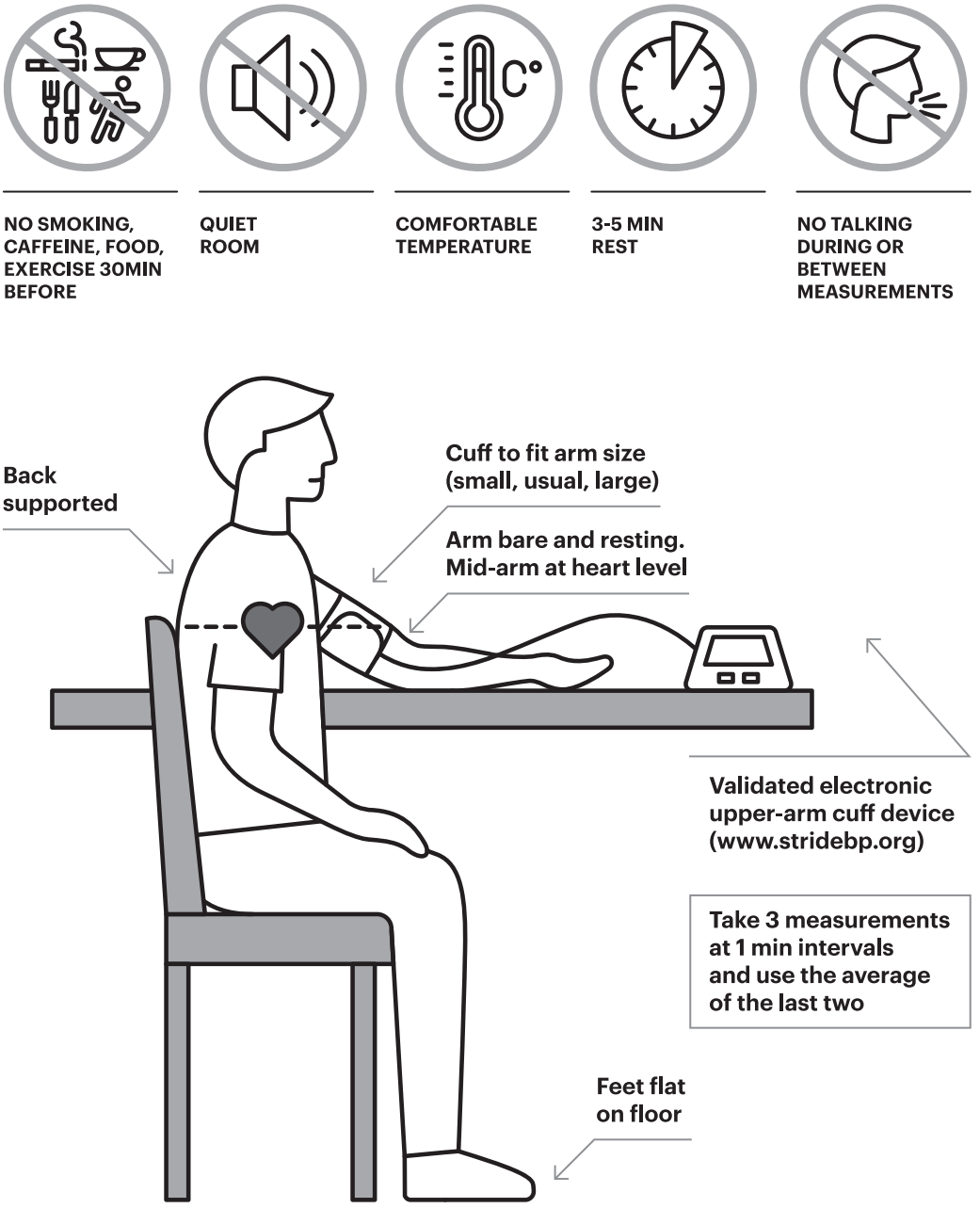


FIGURE 2 Poster of OBP measurement methodology.

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TABLE 4. Interpretation of average OBP (at least 2-3 visits with 2-3 measurements per visit)

	Normal-optimal BP (<130/85 mmHg)	High-normal BP (130–139/85–89 mmHg)	Hypertension Grade 1 (140–159/90–99 mmHg)	Hypertension Grade 2 and 3 (≥160/100 mmHg)
Diagnosis	Normotension highly probable	Consider MH	Consider WCH	Sustained hypertension highly probable
Action	Remeasure after 1 year (6 months in those with other risk factors)	Perform HBPM and/or ABPM. If not available confirm with repeated office visits		Confirm within a few days or weeks[a]. Ideally use HBPM or ABPM

[a]Treat immediately if OBP is very high (e.g. ≥180/110 mmHg) and there is evidence of target organ damage or CVD.

Diagnosis of hypertension based on OBP

- At least 2-3 office visits at 1–4-week intervals (depending on the BP level and CVD risk) are usually required for the evaluation of OBP.
- A diagnosis should not be made on a single office visit, unless OBP is very high (e.g. ≥180/110 mmHg) and there is evidence of target organ damage or CVD.
- In most cases, the diagnosis of hypertension should be confirmed by HBPM or ABPM. Particularly in untreated or treated individuals with OBP levels within the grade 1 hypertension range (140–159/90–99 mmHg), HBPM or ABPM is strongly recommended because of increased probability of WCH; likewise, in those with high-normal OBP levels (130–139/85–89 mmHg), as they have increased probability of MH (Table 4).
- If it is not possible to perform HBPM or ABPM, then confirm diagnosis by taking more OBP measurements in repeated visits.

Interarm BP difference

- At the initial visit, measure BP in both arms (some professional electronic devices can measure BP simultaneously).
- Interarm SBP difference >10 mmHg must be confirmed with repeated measurements. In this case, the arm with the higher BP should be used.
- Consistent interarm SBP difference >20 mmHg requires investigation for arterial disease.

Standing BP

- Further to sitting BP, standing BP should be measured in patients with treated hypertension, when there are symptoms suggesting postural hypotension, particularly in the elderly and in patients with neurodegenerative disease (e.g. Parkinson's, dementia) or diabetes.
- Measure standing BP after 1 min and again after 3 min standing.
- Orthostatic hypotension is present when there is a reduction in SBP of ≥20 mmHg within 3 min standing.

Unattended automated OBP measurement

- OBP measured automatically (3 or more readings) without any medical staff in the examination room (patient alone, i.e. 'unattended') provides a standardized OBP evaluation by ensuring quiet environment, automated device, multiple BP readings, no talking.
- Unattended automated OBP reduces but does not eliminate the WCH phenomenon, and the MH phenomenon is also present as with usual OBP measurements. Thus, again out-of-office BP evaluation (HBPM or ABPM) is often needed for accurate diagnosis.
- Unattended OBP measurements typically give lower values than usual OBP measurements, which appear to be similar to daytime ABPM. Thus, the threshold for diagnosing hypertension using unattended OBP is lower than with usual OBP measurements, yet not clearly defined and with insufficient outcome data.
- Unattended OBP measurement may not be feasible in several settings in clinical practice.

SECTION 4: 24 H AMBULATORY BP MONITORING (ABPM) [1–4,14]

(Poster with key recommendations in Supplement), http://links.lww.com/HJH/B621

Background (Tables 5-6)

- Provides multiple BP readings away from the office, in the usual environment of each individual.
- Provides BP readings during routine daytime activities and night-time sleep.
- Identifies WCH and MH.
- Provides an evaluation of the 24 h BP control with antihypertensive drug treatment.
- Recommended in several guidelines as the best method for diagnosing hypertension.

TABLE 5. Advantages and limitations of ABPM

Advantages	Limitations
• Objective results over 24 h. • Detects WCH and MH. • Confirms uncontrolled and resistant hypertension. • Assesses BP during usual daily activities. • Detects nocturnal hypertension and non-dippers. • Detects excessive BP lowering by drug treatment.	• Not widely available in primary care settings. • Rather expensive and time-consuming for healthcare provider. • May cause discomfort particularly during sleep. • Reluctance of some patients to use, especially when repeated. • Imperfect reproducibility for diagnosis within 24 h (superior to OBP). • Asleep BP often not calculated using the individuals' sleeping times.

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TABLE 6. Clinical indications for ABPM

Initial diagnosis	Treated hypertension	When to repeat[a]
• To diagnose hypertension. • To detect WCH and MH. • To identify nocturnal hypertension and non-dippers. • To assess BP changes due to autonomic failure.	• To identify WCH and MH. • To confirm the diagnosis of uncontrolled and resistant hypertension. • To ensure 24 h BP control (particularly in high-risk patients, pregnancy). • To confirm symptomatic hypotension due to excessive treatment. • To assess nocturnal hypertension and non-dipping. • Disagreement in diagnosis between OBP and HBPM.	To ensure adequate BP control, particularly in patients with increased CVD risk. Depends on availability, individual's risk and preferences. • *Uncontrolled hypertension*: might perform every 2–3 months until a normal 24 h profile. • *Controlled hypertension*: might perform annually.

[a]Repeat on like days (preferably routine workdays)

TABLE 7. ABPM implementation

Basic requirements	Fitting the monitor	Removing the monitor
• Perform ABPM preferably on a routine working day. • 10–15 min needed to initialise and fit the device.	• Frequency of measurement 20–30 min during day and night. • Cuff size according to the individual's arm circumference. • Fit cuff on bare non-dominant arm. Centre bladder over the brachial artery. • Take a test measurement. • Provide instructions to patient (Box 2).	• Remove the monitor after 24 h. • Determine day and night-time periods only according to patient's report. • Repeat ABPM if <20 valid awake or <7 asleep BP readings. • Interpretation of ABPM results in Box 3.

ABPM device requirements and use

- Electronic (oscillometric) upper-arm cuff device validated according to an established protocol (Table 1).
- Select cuff size to fit the individual's arm circumference according to the device's instructions (section 2.2).
- Devices for children or pregnant women must be validated specifically in these populations.
- Ensure good working order with annual maintenance of device.
- Recommendations on ABPM implementation in Table 7.

Box 2 ABPM INSTRUCTIONS TO PATIENT

- Explain the device function and procedure.
- Advise to follow usual daily activities.
- Advise to remain still with arm relaxed at each measurement.
- Advise not to drive. If this is necessary, to stop if possible or ignore measurement.
- Advise to avoid taking a shower or bath during ABPM.
- Provide a form to record sleeping times, drug intake, any symptoms or problems during the recording.
- Mark the brachial artery so that if the cuff becomes loose the patient can refit it.
- Explain how to switch off the monitor in case of malfunctioning.

Box 3 ABPM INTERPRETATION (Fig. 3)

ABPM thresholds of hypertension

24 h average:	≥130/80 mmHg	Primary criterion
Daytime (awake) average:	≥135/85 mmHg	Daytime hypertension[a]
Night-time (asleep) average:	≥120/70 mmHg	Night-time hypertension[b]

Asleep BP dip compared with awake BP (systolic and/or diastolic)

Asleep BP fall ≥10%:	Dipper[a,b]
Asleep BP fall <10%:	Non-dipper[a,b]

[a]Apply only if day/night BP is calculated using the individuals' sleeping times.
[b]The diagnosis must be confirmed with repeat ABPM.

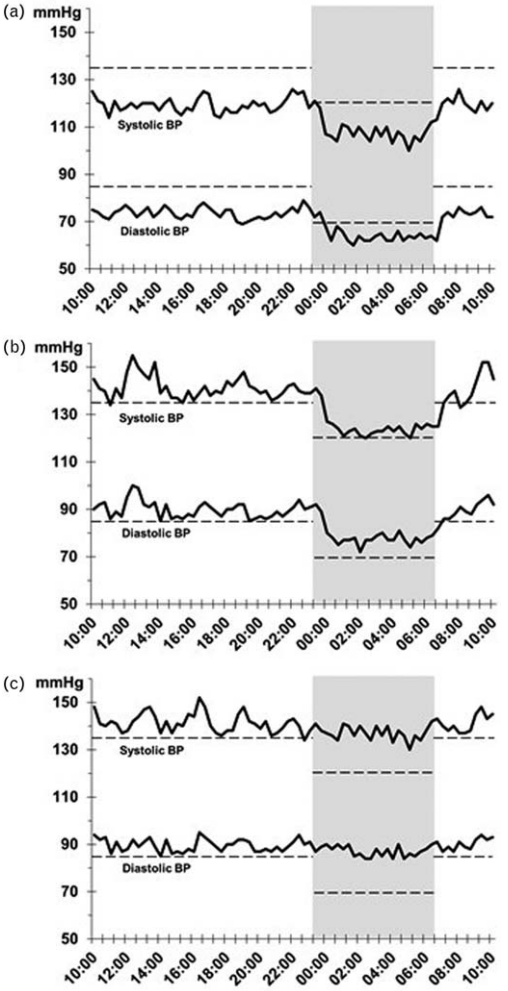


FIGURE 3 24 h ABPM recordings: (a) normal; (b) hypertensive dipper; (c) hypertensive non-dipper.

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SECTION 5: HOME BP MONITORING (HBPM) [1–4,15,16]

(Poster with key recommendations in Supplement), http://links.lww.com/HJH/B621.

Background (Tables 8-9)

- Widely used in many countries.
- Provides multiple BP readings away from the office, in the usual environment of each individual.
- Identifies WCH and MH.
- Recommended as the best method for long-term follow-up of treated hypertension.

TABLE 8. Advantages and limitations of HBPM

Advantages	Limitations
• Widely available at relatively low cost. • Preferred method for long-term monitoring of treated hypertensive patients. • Acceptable to patients for long-term use. • Detects WCH and MH. • Confirms uncontrolled and resistant hypertension. • Detects excessive BP lowering from drug treatment. • Improves adherence with treatment and thereby hypertension control rates. • Can be used with telemonitoring and connection to electronic patient files. • Can reduce healthcare costs.	• Requires medical supervision. • Inaccurate devices and inappropriate cuff size often used. • Monitoring may be too frequent, in the presence of symptoms, and under inappropriate position. • May induce anxiety to some patients. • Risk of unsupervised treatment changes by patients. • Possible selective reporting of BP readings by patients (usually omitting higher BP values). • Doctors may estimate instead of calculating average home BP. • No information on BP at work or during sleep (novel HBPM devices under testing measure BP during sleep).

TABLE 9. Clinical indications for HBPM

Initial diagnosis	Treated hypertension
• To confirm diagnosis of hypertension. • To detect WCH and MH.	• Use in all treated hypertensive patients, unless incapable or unwilling to perform in good quality, or anxious with self-monitoring. • To identify WCH and MH. • For titration of BP-lowering medication. • For monitoring long-term BP control. • To ensure strict BP control where mandatory (high-risk patients, pregnancy). • To improve patients' long-term compliance with treatment.

HBPM device requirements and use

- Electronic (oscillometric) upper-arm cuff device validated according to an established protocol (Table 1).
- Prefer devices with automated storage and averaging of multiple readings, or with mobile phone, PC or internet link connectivity enabling data transfer.
- Wrist devices are generally not recommended because of their inferior accuracy compared with upper-arm devices and issues with incorrect use. Validated wrist devices might be used in people with very large arms when upper-arm cuff measurement is not possible or reliable.
- Auscultatory devices are generally not recommended for HBPM. Also, finger-cuff devices, wristband wearables and other cuffless devices should not be used for HBPM.
- Devices for children or pregnant women must be validated specifically in these populations.
- Select cuff size to fit the individual's arm circumference according to the device's instructions (section 2.2).
- Recommendations on HBPM implementation and patient training in Boxes 4-7.

Box 4 HBPM PROCEDURE (Fig. 2)

Conditions

- Quiet room with comfortable temperature.
- No smoking, caffeine, food or exercise for 30 min before measurement.
- Remain seated and relaxed for 3–5 min.
- No talking during or between measurements.

Posture

- Sitting with back supported by chair.
- Legs uncrossed, feet flat on floor.
- Bare arm resting on table; mid-arm at heart level

Cuff

- Select cuff size that fits the arm circumference according to the device's instructions.
- Wrap the cuff around bare arm according to the device's instructions (usually left arm).

Box 5 PATIENT TRAINING

- Use a reliable device (lists in Table 1).
- Conditions and posture for measurement.
- Measurement schedule before office visit.
- Measurement schedule between visits.
- Interpretation of measurements. Inform patients about usual BP variability.
- Action if BP is too high or too low.

Box 6 HBPM SCHEDULE (Fig. 4)

For diagnosis and before each office visit

- Measurements for 7 days (at least 3 days).
- Morning and evening measurements.
- Before drug intake if treated and before meals.
- Two measurements on each occasion with 1 min between them.

Long-term follow-up of treated hypertension

- Make duplicate measurements once or twice per week (most frequent), or per month (minimum requirement).

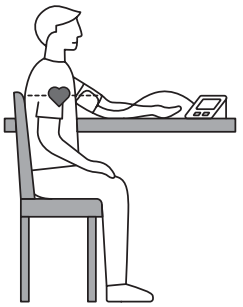
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Home Blood Pressure Monitoring

Name: _____

Date of birth: ____ /____ /_____ Device: _____

			Time	Systolic-Diastolic	(Pulse rate)
DAY 1 ___ /___ / 202_	Morning	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
	Evening	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
DAY 2 ___ /___ / 202_	Morning	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
	Evening	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
DAY 3 ___ /___ / 202_	Morning	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
	Evening	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
DAY 4 ___ /___ / 202_	Morning	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
	Evening	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
DAY 5 ___ /___ / 202_	Morning	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
	Evening	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)



Validated electronic arm-cuff device

Before each office visit:
→ 7-day monitoring (at least 3)
→ Morning and evening, before drug intake
→ After 5 min sitting rest
→ 2 measurements with 1 min interval

Long-term follow-up:
Duplicate measurement once or twice per week or month

			Time	Systolic-Diastolic	(Pulse rate)
DAY 6 ___ /___ / 202_	Morning	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
	Evening	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
DAY 7 ___ /___ / 202_	Morning	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)
	Evening	1st	__:__	_____ - _____	(_____)
		2nd		_____ - _____	(_____)

WRITE HERE THE AVERAGE OF ALL READINGS EXCEPT OF DAY 1: _____ - _____ (_____)

FIGURE 4 Form for reporting 7-day HBPM.

Box 7 HBPM INTERPRETATION

- Prefer automated report and averaging of readings stored in device memory (or mobile). Otherwise, review readings reported in a logbook (Fig. 4).
- Assess HBPM of 7 days (at least 3 days with at least 12 readings).
- Discard the first day and calculate the average of all the other readings. Individual readings have little diagnostic accuracy.
- Average home BP ≥135/85 mmHg indicates hypertension.

Box 8 CLINICAL IMPLEMENTATION OF BP MEASUREMENT IN PHARMACIES

Device	Validated electronic upper-arm cuff device (Table 1). Prefer a device that takes triplicate readings automatically. Ensure good working order and annual maintenance. Cuff size to fit the individual's arm circumference according to the device's instructions (section 2.2).
Conditions	As for OBP (Box 1, Fig. 2). Quiet area with comfortable temperature and no talking during or between measurements.
Interpretation	Average of 2-3 readings ≥135/85 mmHg suggests uncontrolled hypertension. Diagnosis and treatment decisions should not be based solely on such measurements.

SECTION 6: BP MEASUREMENT IN PHARMACIES [17]

Background (Table 10)

- Widely used in several countries.
- Its validity and applicability for management have not been adequately investigated.

TABLE 10. Advantages and limitations of BP measurement in pharmacies

Advantages	Limitations
• Easily accessible and convenient for patients as no appointment is generally required. • Useful for screening untreated individuals and for following treated hypertensive patients. • Could save both general practitioner time and healthcare costs. • May not induce a pronounced white-coat effect. • Possible alternative to ABPM or HBPM if they are not feasible.	• Possible use of non-validated devices, inappropriate cuff size and conditions (posture, rest, talking, etc.). • Weak evidence on BP threshold for diagnosis and interpretation. • Possible impact of inadequate measurement and interpretation on increased referrals to general practitioners.

- 24 h ABPM may be performed in pharmacies.

SECTION 7: BP MEASUREMENT IN PUBLIC SPACES (KIOSKS) [4]

Background (Table 11)

- Kiosks are stations in public spaces where BP is measured with an automatic device triggered by the user.
- Very little studied, but useful for screening in the general population.

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TABLE 11. Advantages and limitations of BP measurement in public spaces

Advantages	Limitations
• Useful for screening in the general population. • Accessible to the public and convenient to patients as no appointment is required. • Could save both general practitioner time and healthcare costs.	• Possible use of non-validated devices, inappropriate cuff size and conditions (posture, rest, talking, etc.). • Single standard size or wide-range cuff generally available, which may not fit too small or large arms. • Unknown hypertension thresholds. • Frequent lack of follow-up by medical professionals.

Box 9 CLINICAL IMPLEMENTATION OF BP MEASUREMENT IN PUBLIC SPACES

Device	Validated electronic upper-arm cuff device (Table 1). Preferably the device should have a wide-range cuff to fit arm size of most adults and should take 2-3 readings automatically. It should display instructions to user for posture and procedure.
Conditions	As for OBP (Box 1, Fig. 2), plus follow specific device's instructions. Quiet area with comfortable temperature and no talking during or between measurements.
Interpretation	Threshold for hypertension unknown and probably variable according to conditions. Use only for screening. Diagnosis or treatment decisions should not be based on such measurements.

SECTION 8: CUFFLESS WEARABLE BP MONITORS [18]

A large number of cuffless wearable (wrist-band) devices are available on the market claiming that they accurately measure BP. These devices have a sensor, which evaluates the pulsation of arterioles and estimate BP based on pulse wave velocity, or other technologies. Cuffless wearable devices have great potential as they can obtain multiple or even continuous BP measurements for days or weeks without the disturbance of cuff-induced limb compression. The assessment of the accuracy of cuffless devices requires the use of a validation protocol, which is specific for these devices and includes procedures additional to those used for conventional cuff-devices. At present, the accuracy and usefulness of cuffless devices are uncertain. Therefore, they should not be used for diagnostic or treatment decisions.

SECTION 9: MOBILE TECHNOLOGIES–APPS [19]

Recently, impressive expansion of mobile devices has led to the development of mobile health (mHealth) technologies, identified by the WHO as a potential promoter of better health conditions even in low-income countries, through strategies based on mobile apps. However, despite good results in clinical studies, BP telemonitoring based on services by professional providers is not regularly implemented in daily practice, mainly because of high installation and maintenance costs. Digital health is a promising approach and has the potential to significantly improve management of patients with hypertension. However, there is high heterogeneity of proposed interventions, and more adequately powered randomized controlled trials are needed to clarify feasibility, efficacy and cost-effectiveness of these new strategies, before they can be recommended for clinical practice.

SECTION 10: COMBINED USE OF BP MEASUREMENT METHODS (Table 12) [1–4]

OBP

- OBP is the most used and often the only method available for hypertension management, on which the BP classification and thresholds for treatment initiation and targets are based.
- Out-of-office BP evaluation (ABPM or HBPM) is necessary for the accurate evaluation of many untreated and treated individuals. If this is not possible, repeated OBP measurements should be taken in additional visits.

ABPM–HBPM

- Both methods are appropriate for hypertension diagnosis, treatment titration and long-term follow-up. ABPM may be more suitable for the initial evaluation and HBPM for long-term follow-up.
- ABPM is better studied and gives results for awake and asleep BP in an unbiased way within 24 h. However, it is relatively expensive, not widely available, inadequately reimbursed in many countries, and not acceptable for repeated use by some patients.
- HBPM is widely available at relatively low cost in most countries, it is well accepted by most patients for long-term use and improves treatment adherence. However, often it is not standardised, non-validated devices are often used, and appropriate patient education and counselling are necessary.
- In general, any two of the three methods (office, home, ambulatory), which agree are necessary for reliable diagnosis. In most patients, BP should be evaluated in the office and with ABPM or HBPM. When office and out-of-office measurements agree on the hypertension classification (Fig. 1), a diagnosis can be safely made. When they disagree (WCH, MH) then confirmation with repeated office and out-of-office BP measurements is necessary and decisions should be based on ABPM or HBPM. Ideally, both ABPM and HBPM should be used, as they occasionally provide different and complementary information.

BP measurement in pharmacies and public spaces

- There is inadequate evidence regarding diagnostic thresholds or clinical utility for hypertension diagnosis and management. Therefore, they are useful for screening and not for decision-making.

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TABLE 12. Clinical utility of office and out-of-office BP measurement methods

Clinical use	Office	Home	24 h ambulatory	Pharmacy	Public space
Screening	+++	+	–	++	+
Initial diagnosis	+	++	+++	–	–
Treatment titration	+	++	++	–	–
Follow-up	++	+++	+	+	–
Main indication	Screening of untreated individuals. Follow-up of treated patients	Long-term follow-up of treated patients (preferred method)	Initial diagnosis (preferred method)	Screening of untreated individuals. Follow-up of treated patients	Opportunistic screening
Hypertension (mmHg)	≥140/90	≥135/85	≥130/80	≥135/85 (?)	?

Conflicts of interest

G.S., P.P., G.P. and E.O.B. conducted validation studies for various manufacturers of blood pressure measurement technologies and advised manufacturers on device and software development. A.J., E.L., A.P., G.M. and R.K. have no conflicts of interest in relation to the topic of this article.

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