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# GETTING THE NUMBERS RIGHT: ACCURATE MEASUREMENT OF BLOOD PRESSURE

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# Disclosures

- None relevant to presentation
- Advisory Board participation:
  - Akcea, Amgen, Sanofi Regeneron



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# Objectives

- Improve accurate assessment of blood pressure in the office setting
- Review the role of out-of-office blood pressure monitoring as a supplement to office measurements
- Provide guidance for patients on procedures for home blood pressure monitoring



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# Blood pressure measurement

## Recommendation for Accurate Measurement of BP in the Office

COR	LOE	RECOMMENDATION
I	C-EO	1. For diagnosis and management of high BP, proper methods are recommended for accurate measurement and documentation of BP (Table 8).

- Palpatory
- Auscultatory
- Oscillometric



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# Blood pressure measurement: Palpatory

- Advantages
  - Can be performed in noisy environment
  - Does not require much equipment
- Disadvantages
  - Only systolic BP can be measured
  - Inaccuracy in infants and hypotensive patients



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# Blood pressure measurement: Auscultatory

- Advantages
  - Simple
  - Does not require much equipment
- Disadvantages
  - Cannot be used in noisy environment
  - Observer variability
  - Mechanical errors (mercury leak, air leak, cuff obstruction)
  - Inaccuracy in infants and hypotensive patients
  - Variability in correlation with intra-arterial pressure



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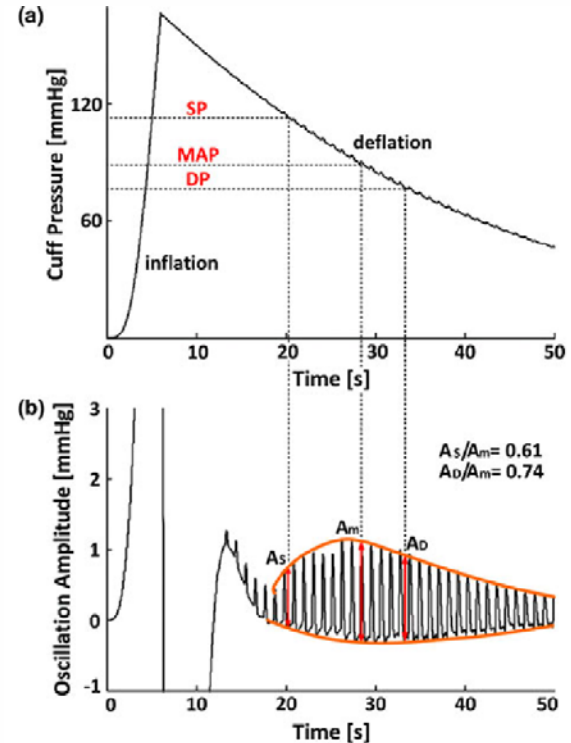
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# Blood pressure measurement: Oscillometric

- Sensor detects oscillations in pulsatile blood volume during cuff inflation and deflation
- BP indirectly calculated from maximum amplitude algorithms
- Use devices with validated measurement protocol



# Blood pressure measurement: Oscillometric



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Homepage > BP monitors > For Home Use



Validated BP Monitors for Home Use

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<https://bihsoc.org/bp-monitors/for-home-use/>



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# Blood pressure measurement: Oscillometric

- Advantages
  - Automatically inflate multiple times allowing patients to be alone and undisturbed during measurement
  - Simplicity and ease of use
  - Validated devices
  - MAP can be measured even in hypotension
  - Growing body of evidence supporting use
- Disadvantages
  - Fixed algorithms can lead to variance



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# Measuring Blood Pressure: Avoiding the Pitfalls

- Accurate measurement is essential
  - Categorize level of BP
  - Ascertain BP-related CVD risk
  - Guide management of high BP



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# Measuring Blood Pressure: Avoiding the Pitfalls



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# Checklist for Accurate Measurement of BP

## Step 1: Properly prepare the patient

Relax, in chair with feet on floor and uncrossed, back supported, >5 minutes

Avoid caffeine, exercise, smoking >30 minutes

Empty bladder

No conversation during rest or measurement

Remove clothing over arm



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# Checklist for Accurate Measurement of BP

## Step 2: Use proper technique

- Validated, calibrated device
- Arm supported
- Correct cuff size (encircles 80% of arm)
- Cuff on upper arm at level of right atrium (not wrist)
- Either stethoscope diaphragm or bell may be used (if auscultatory)

**TABLE 9**

**Selection Criteria for BP Cuff Size for Measurement of BP in Adults**

Arm Circumference	Usual Cuff Size
22-26 cm	Small adult
27-34 cm	Adult
35-44 cm	Large adult
45-52 cm	Adult thigh

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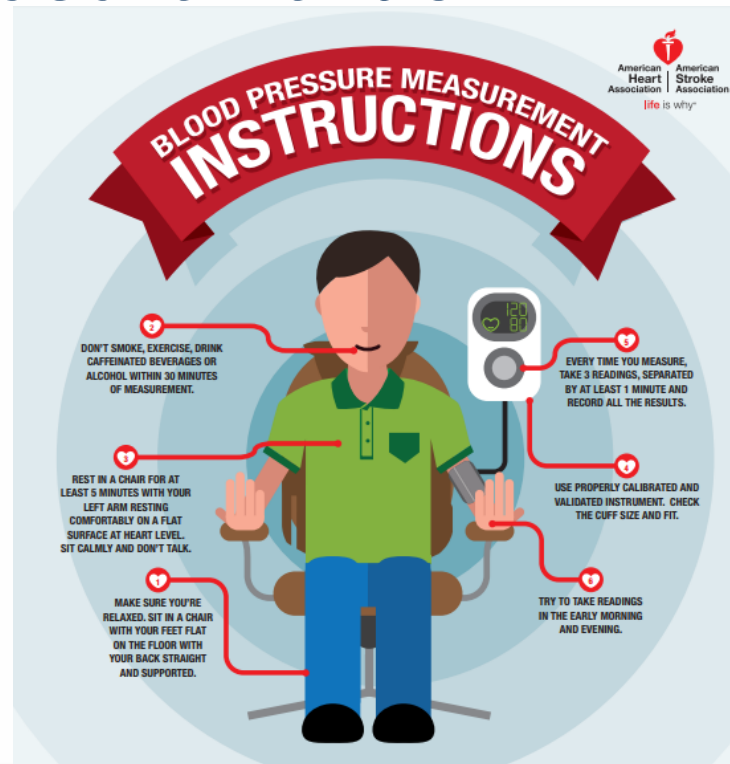
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# Checklist for Accurate Measurement of BP

## Step 3: Take proper measurements

- At first visit record BP in both arms. Use arm with higher reading in subsequent readings.
- Separate repeated measurement by 1-2 minutes
- For auscultatory readings, deflate cuff pressure 2 mmHg/second while listening for Korotkoff sounds
- For home measurements, standardize timing relative to medication dosing



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# Checklist for Accurate Measurement of BP

## Steps 4, 5, 6: Average, document, provide

- Use average based on  $\geq 2$  readings obtained on  $\geq 2$  occasions to estimate patient's BP
- Note time of most recent BP medication prior to reading
- Provide readings to patient verbally and in writing



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# Out-of-Office and Self-Monitoring of BP

- Office BP ideally used to screen for HTN
- Out-of-office BP for confirmation of diagnosis and management
- Particularly important
  - Increased recognition of inconsistencies between office and home BP
  - Greater reductions in BP being recommended for control
  - Increased attention to role of home self-monitoring

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# Out-of-Office and Self-Monitoring of BP

**TABLE 10** Procedures for Use of HBPM (S4.2-8–S4.2-10)

Patient training should occur under medical supervision, including:

- Information about hypertension
- Selection of equipment
- Acknowledgment that individual BP readings may vary substantially
- Interpretation of results

Devices:

- Verify use of automated validated devices. Use of auscultatory devices (mercury, aneroid, or other) is not generally useful for HBPM because patients rarely master the technique required for measurement of BP with auscultatory devices.
- Monitors with provision for storage of readings in memory are preferred.
- Verify use of appropriate cuff size to fit the arm (Table 9).
- Verify that left/right inter-arm differences are insignificant. If differences are significant, instruct patient to measure BPs in the arm with higher readings.

Instructions on HBPM procedures:

- **Remain still:**
  - Avoid smoking, caffeinated beverages, or exercise within 30 min before BP measurements.
  - Ensure  $\geq 5$  min of quiet rest before BP measurements.
- **Sit correctly:**
  - Sit with back straight and supported (on a straight-backed dining chair, for example, rather than a sofa).
  - Sit with feet flat on the floor and legs uncrossed.
  - Keep arm supported on a flat surface (such as a table), with the upper arm at heart level.
- Bottom of the cuff should be placed directly above the antecubital fossa (bend of the elbow).
- **Take multiple readings:**
  - Take at least 2 readings 1 min apart in morning before taking medications and in evening before supper. Optimally, measure and record BP daily. Ideally, obtain weekly BP readings beginning 2 weeks after a change in the treatment regimen and during the week before a clinic visit.
- **Record all readings accurately:**
  - Monitors with built-in memory should be brought to all clinic appointments.
  - BP should be based on an average of readings on  $\geq 2$  occasions for clinical decision making.

The information above may be reinforced with videos available [online](#).

- Provide patient with training on home BP monitoring
- Record diary or preferably use device with memory
- Bring diary or device to each visit
- Take readings before morning medications and in evening before supper
- Obtain weekly readings beginning 2 weeks after treatment and during the week before clinic visit
- Avoid excess focus

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# Ambulatory BP Monitoring (ABPM)

- Major RCTs based on clinic BP readings
- ABPM often used to supplement
  - Obtain readings every 15-30 minutes during the day and 15-60 minutes at night
- Can provide
  - Estimates of mean BP over monitoring period
  - Determine daytime-to-nighttime BP ratio to identify extent of “nocturnal dipping”
  - Identify early morning surge pattern
  - Estimate BP variability
  - Allow for recognition of symptomatic hypotension
- In US, reimbursement approved for suspected white coat hypertension.



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# Out-of-Office and Self-Monitoring of BP

COR	LOE	RECOMMENDATION
I	A <sup>SR</sup>	1. Out-of-office BP measurements are recommended to confirm the diagnosis of hypertension (Table 11) and for titration of BP-lowering medication, in conjunction with telehealth counseling or clinical interventions (S4.2-1–S4.2-4).

SR indicates systematic review.

**TABLE 11** Corresponding Values of SBP/DBP for Clinic, HBPM, Daytime, Nighttime, and 24-Hour ABPM Measurements

Clinic	HBPM	Daytime ABPM	Nighttime ABPM	24-Hour ABPM
120/80	120/80	120/80	100/65	115/75
130/80	130/80	130/80	110/65	125/75
140/90	135/85	135/85	120/70	130/80
160/100	145/90	145/90	140/85	145/90

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# Take Home Messages

- Accurate assessment of blood pressure in the office setting is challenging and is best suited for screening for hypertension.
- Out-of-office blood pressure monitoring is used for confirmation of diagnosis and management of hypertension.
- Provide guidance for patients on procedures for home blood pressure monitoring and selection of validated automatic devices.



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# Thank you!



SIPRESS

*"I'm going to take your blood pressure, so try to relax  
and not think about what a high reading might mean  
for your chances of living a long, healthy life."*



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