



## Appendix B: Recommended Methods and Techniques for Measuring Blood Pressure

### Recommended Methods for Measuring Blood Pressure

At appropriate visits, ask permission to check BP on all adults (trauma-informed practice). Inform patients that they may be sensitive to the tightening of the cuff on their arm.

In the office setting, the use of automated office blood pressure (BP) electronic device, which averages multiple readings, is recommended as an alternative to taking a manual office BP. The advantages of automated office BP measurements include: 1) BP measurements are comparable to ambulatory BP monitoring; 2) readings are consistent from visit-to-visit; 3) reduces white-coat and masked hypertension (HTN); and 3) correlates well with cardiovascular (CV) outcomes (e.g., acute myocardial infarction, cerebrovascular events). However, manual office BP may be appropriate in cases such as for patients with arrhythmias.

**Table 1. Comparison of measurement equivalence numbers**

<i>Method</i>	<i>Automated Office BP</i>	<i>Ambulatory BP Monitoring (mean 24-hour)</i>	<i>Ambulatory BP Monitoring (mean awake)</i>	<i>Home BP Monitoring</i>	<i>Manual Office BP</i>
Measurements (mm Hg)	135/85	130/80	135/85	135/85	140/90

**Abbreviations:** BP = blood pressure; mm Hg = millimetre of mercury.

When confirming a HTN diagnosis, consider a 24-hour ambulatory or home BP monitoring for appropriate patients (e.g., suspected white-coat HTN, unusual fluctuating office-based BP readings).<sup>7,11</sup> Even though ambulatory BP monitoring is considered the most accurate for BP measurements, there are some known limitations including: 1) cost (patient-pay ~ \$50); 2) accessibility issues (both in actual devices and trained professionals to interpret results); and 3) patient may not be able to tolerate ambulatory BP monitoring device. Home BP measurements are comparable to ambulatory BP measurement and may be used if ambulatory BP monitoring is not tolerated or available. Ambulatory and home BP monitoring may also have a role in the management of HTN, including determining the efficacy of antihypertensive drugs or assessing resistant HTN.

Both the method used and the presence of any errors (refer to Table 2 below) may lead to a misdiagnosis and/or inappropriate treatment decision. When comparing common manual office BP practices versus proper standardized technique measurements, the mean manual office BP was at least 10/5 mm Hg higher. As well, manual office BP was consistently higher than the recognized 5 mm Hg difference when compared to mean ambulatory BP monitoring (awake).

**Table 2. Common errors in when measuring blood pressure**

<i>Type of Error</i>	<i>% Affect</i>	<i>Notes</i>
Natural variation	≥ 14%	<ul style="list-style-type: none"> <li>After 2 office visits, a patient with a true systolic BP of 130 mm Hg will have a 14% chance of an average above 140 mm Hg. After 10 visits, the risk of this average (and potential misdiagnosis) increases to 64%. In healthy adults &lt; 35 years, the probability of misclassification exceeds that of accurate diagnosis.</li> </ul>
Incorrect measurement technique	> 60%	<ul style="list-style-type: none"> <li>63% of physicians and nurses were found to be out of range in BP measurement (false increases or reductions); none followed the American Heart Association's technique recommendations.</li> <li>When comparing common MOBP practices to proper technique, the mean MOBP was at least 10/5 mm Hg higher than the proper technique.</li> </ul>
White-coat HTN	20%	<ul style="list-style-type: none"> <li>More common in elderly patients and is generally associated with a relatively benign prognosis.</li> <li>Physicians consistently obtain higher readings than nurses.</li> </ul>
Office-based measurement	~ 100%	<ul style="list-style-type: none"> <li>An AOBP measurement, which averages multiple readings, is superior to MOBP in the office setting.</li> </ul>
CVD risk not assessed	~ 100%	<ul style="list-style-type: none"> <li>Patients with CVD or are high-risk for CVD are approached the same as low-risk patients.</li> </ul>

**Abbreviations:** ABPM = ambulatory blood pressure monitoring; AOBP = automated office blood pressure; BP = blood pressure; CVD = cardiovascular disease; HTN = hypertension; MOBP = manual office blood pressure; mm Hg = millimetre of mercury.

## Techniques for Measuring Blood Pressure

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### ► Office Blood Pressure Measurement

#### *Equipment Requirements*

- Ensure appropriate equipment is being used (e.g., accurate sphygmomanometer, calibrated and validated electronic devices, cuff with an appropriate bladder size).

#### *Patient Requirements*

- Patient has rested comfortably for 5 minutes in a seated position, legs uncrossed and a supported bare arm.
- For elderly and diabetic patients, BP may be measured in a supine position.

#### *Arm Selection*

- Select which arm to be used by measuring both arms with the BP cuff at heart level. Use the arm with the higher BP for future measurement and interpretation.

#### *Taking Measurements*

- For AOBP: Set the device to take measurements at 1- or 2-minute intervals. Discard the 1st reading and average the latter readings.
- For auscultation:
  - Take 3 measurements, with at least one-minute elapse between readings. Discard the 1st reading and average the latter 2 readings.
  - Increase the pressure rapidly to 30 mm Hg above the level at which the radial pulse is extinguished.
  - Place the bell or diaphragm of the stethoscope gently and steadily over the brachial artery.
  - Open the control valve so that the rate of deflation of the cuff is approximately 2 mm Hg per heartbeat. A cuff deflation rate of 2 mm Hg per beat is necessary for accurate systolic and diastolic estimation.
  - Read the systolic level - the first appearance of a clear tapping sound (phase I Korotkoff) – and the diastolic level (the point at which the sounds disappear (phase V Korotkoff)). If Korotkoff sounds persist as the level approaches 0 mm Hg, then the point of muffling of the sound is used (phase IV) to indicate the diastolic pressure. Leaving the cuff partially inflated for too long will fill the venous system and make the sounds difficult to hear.
- For those with an arrhythmia: additional readings with auscultation may be required to estimate the average systolic and diastolic pressure.

#### *Results*

- Record BP to the closest 2 mm Hg (for manual office BP) or 1 mm Hg (for automated office BP); which arm was used; position of patient (i.e., supine, sitting or standing); and heart rate.
- A mean 24-hour ambulatory BP monitoring 130/80 equates to an automated office BP 135/85 and a manual office BP of 140/90 mm Hg.

### ► Ambulatory Blood Pressure Monitoring Measurement

#### *Equipment Requirements*

- Ensure ambulatory BP monitoring device has been validated independently using established protocols. A list of validated devices is provided at Hypertension Canada's website on [Blood Pressure Measurement Devices](#) under the 'Hypertension & You' heading ([www.hypertension.ca](http://www.hypertension.ca))

#### *Patient Requirements*

- Ensure the patient is able to tolerate ambulatory BP monitoring (e.g., keeping cuff in correct position and dry) and is willing to keep a diary of events (e.g., when medication(s) were taken, bedtime).

#### *Taking Measurements*

- Have the device take 2 measurements per hour during the patient's daytime (i.e., awake) hours. Record the average BP from at least 14 measurements.

### Results

- A mean 24-hour ambulatory BP monitoring 130/80 equates to a mean awake ambulatory BP monitoring of 135/85 and a manual office BP of 140/90 mm Hg.
- Any changes in nocturnal BP should be taken into account with any decisions to prescribe or withhold drug therapy. This is because a decrease in nocturnal BP of less than 10% is associated with increased risk of CV events.

### Resources

- Ambulatory BP monitoring Educational Resource Video for healthcare professionals from the [British and Irish Hypertension Society \(BIHS\)](#) YouTube channel, under 'Blood Pressure Measurement'.

## ► Home Blood Pressure Monitoring Measurement

### Equipment Requirements

- Ensure home BP monitoring device has been validated independently and is calibrated. Follow the instruction manual that comes with the device and reach out to a health care professional to confirm accuracy of BP measurements. A list of validated devices is listed on Hypertension Canada's website ([www.hypertension.ca](http://www.hypertension.ca)) and have the endorsement logo on their package.



### Patient Requirements

- Ensure patient is well suited (e.g., does not have arrhythmia or experiences undue anxiety) and is capable of implementing proper technique (e.g., using proper cuff size being relaxed, seated position, reasonable amount of time after heavy physical activity, drinking coffee or smoking).



### Taking Measurements

- Have the patient take 2 consecutive (at 1 minute intervals) measurements once in the morning and once in the evening for 4–7 days. Discard 1st day of measurements, and average the remaining measurements.

### Results

- A home BP monitoring 135/85 equates to a mean awake ambulatory BP monitoring 135/85 and a manual office BP 140/90 mm Hg.

**Table 1. Ranking of preferred methods for measuring blood pressure by accuracy and accesibility<sup>2,7,15-17</sup>**

<b>1. Automated Office BP</b>	
<b>135/85 (automated office BP) = 135/85 (ambulatory BP monitoring: mean awake)</b>	
Advantages	1) Measurements are comparable to ambulatory BP monitoring (the gold standard); 2) readings are consistent from visit-to-visit and between care providers; 3) reduces white-coat and masked HTN; and 4) correlates well with CV outcomes (e.g., acute MI and cerebrovascular events); 5) Can be performed by trained non-medical staff such as medical office assistants, saving healthcare provider and patient visit time.
Limitations	1) May be challenging to find quiet/alone place and appropriate positioning of the patient; 2) Staff may have time and space constraints to perform AOBP.
<b>2. Ambulatory BP Monitoring</b>	
<b>130/80 (ambulatory BP monitoring: mean 24-hour) = 135/85 (ambulatory BP monitoring: mean awake) = 140/90 (manual office BP)</b>	
Advantages	Ambulatory BP monitoring is considered the preferred method for accurate BP measurements.
Limitations	1) May cost (patient-pay ~ \$50); 2) accessibility issues (both in actual devices and trained professionals to interpret results); and 3) patient may not be able to tolerate ambulatory BP monitoring.
Technical Notes	Offer ambulatory BP monitoring to patients with elevated BP and who can tolerate keeping the cuff position correctly and dry for 24 hours. Use 24 hr standard (average) and not awake when there is uncertainty regarding patient sleep times.
<b>3. Home BP Monitoring</b>	
<b>135/85 (home BP monitoring) = 135/85 (ambulatory BP monitoring: mean awake) = 140/90 (manual office BP)</b>	
Advantages	1) Measurements are comparable to ambulatory BP monitoring (the gold standard); 2) correlates well with target organ damage and CV mortality.
Limitations	Offer home BP monitoring if ambulatory BP monitoring is not tolerated. Ensure device is appropriate (e.g., cuff size) and validated (i.e., includes the endorsement logo and/or listed on <a href="http://www.hypertension.ca">www.hypertension.ca</a> ). A Standard protocol should be used.
	 
<b>4. Manual Office BP</b>	
Advantages	1) Considered a more accurate reading for patients with arrhythmias; and 2) accessibility.
Limitations	1) Known issues with the accuracy of manual office BP (e.g., white-coat effect, improper technique, faulty equipment, digit preference, & threshold avoidance) that may result in approximately 10/5 mm Hg higher readings; and 2) relatively poor predictor of CV risk related to BP status.

**Abbreviations:** BP = blood pressure; CV = cardiovascular; HTN = hypertension; mm Hg = millimetre of mercury; MI = myocardial infarction.