

How To Check Your Blood Pressure

Picking the Best Monitor for You

- Choose a proper size arm cuff . You should be able to slide one finger under the cuff and the lower edge should be one inch (2.5 cm) above your elbow. Larger/smaller cuffs may be ordered.
- Choose the type that best suits your needs:
 1. Automatic arm cuff: fits around the upper arm and automatically inflates. This type may not work for some people who have irregular heartbeats.
 2. Manual arm cuff: readings automatically display, but you must inflate the cuff by pumping a bulb.
 3. Wrist monitors: very convenient, but usually more expensive than other monitors, and slightly less consistent. Works well for people with big arms that may not fit well with arm cuffs.
 4. Fingertip monitors: not as reliable as other models and are not recommended.
- Ask your pharmacist to help you choose a reliable monitor. Some reputable brands include *Omron*, *Lifesource*, etc. Many generic store brand monitors are made by the same brand name companies.
- Other things to consider: Is the digital display large enough for you to read easily? Does the machine have the ability to store blood pressure values in its memory or will you need to keep these records?

Before Taking Your Blood Pressure

- Sit quietly for at least five minutes with your upper arm at heart level.
- Sit up straight with feet flat on the floor and your back supported. Do not cross your legs or your ankles.
- Wait at least half an hour after eating, smoking, or exercising to get the most accurate reading. You'll need to wait a couple of hours after ingesting caffeinated products.

Taking Blood Pressure

- Roll up the sleeve on your arm or remove any tight-sleeved clothing.
- For arm models, rest your arm on a table with your palm facing upwards. For wrist models keep your wrist level with your heart.
- Avoid talking while taking your blood pressure.
- May repeat after a few minutes. Record the average of three consecutive readings.
- It is important to check the blood pressure reading from your home machine with your healthcare provider at least once or twice a year, or more frequently if the machine is dropped or if the blood pressure readings change suddenly.

What Blood Pressure Numbers Mean

The readings from the blood pressure machine show how hard your heart is working to pump blood. The top number (systolic pressure) is the pressure while the heart pumps and the bottom number (diastolic pressure) is the pressure between heartbeats. People who have high blood pressure have a greater chance of developing heart disease, stroke, kidney disease, and blindness.

Blood pressure readings are generally lower with home monitors compared to readings from your healthcare provider's office. Your healthcare provider will decide whether to adjust your medications based on your home readings or office readings. Talk with your healthcare provider if you're concerned about your readings.

What You Can Do To Reduce Your Blood Pressure

There are several dietary and lifestyle changes you can make to decrease blood pressure. These include weight loss, decrease sodium intake, increase exercise, smoking cessation, drinking alcohol in moderation, and increase intake of fruits and vegetables. There are many other things you can do to help control your blood pressure, just ask your healthcare provider. If lifestyle changes alone do not lower your blood pressure, your healthcare provider may also have you take blood pressure lowering medication(s).

Blood Pressure Monitoring

—Information about **Validated Blood Pressure Monitors** is located in the “Home Blood Pressure” section of this document—

Background

An estimated one-quarter of Canadian adults and nearly one-third of U.S. adults have hypertension.^{1,2} Another one-quarter of U.S. adults have blood pressure in the ‘prehypertension’ range. Blood pressure is one of the most important clinical measurements since hypertension is a major risk factor for coronary heart disease, kidney failure, heart failure, stroke, and other conditions.³ The accuracy of blood pressure measurement can be affected by instrumentation, observer error, and patient error. This document reviews the proper way to measure blood pressure and provides a comparison between different blood pressure measurement methods. A patient handout on proper blood pressure measurement is also provided.

Monitoring Blood Pressure

The seventh report of the Joint National Committee on Prevention, Evaluation, and Treatment of High Blood Pressure (JNC-VII) classification for blood pressure in adults is as follows:³

Classification	SBP (mmHg)	DBP (mmHg)
Normal	<120	And <80
Prehypertension	120 to 139	Or 80 to 89
Stage 1 Hypertension	140 to 159	Or 90 to 99
Stage 2 Hypertension	≥160	Or ≥100

The Canadian Hypertension Education Program (CHEP) does not endorse the label of “prehypertension” (≥120/80 mmHg). Blood pressure in the range of 130 to 139 mmHg/85 to 89 mmHg is classified as high normal. A patient is considered hypertensive if the initial office blood pressure is ≥180/110 mmHg or blood

pressure ranges between 140 to 179/90 to 109 mmHg in patients with target organ damage, diabetes, or chronic kidney disease. A patient is also considered hypertensive if the blood pressure average over the first three office visits is SBP ≥160 mmHg or the DBP ≥100 mmHg, OR if the SBP averages ≥140 mmHg or the DBP averages ≥90 mmHg after five visits.²

Hypertension is a major risk factor for coronary heart disease, kidney failure, heart failure, stroke, and other conditions.³ Therefore, it is important to have blood pressure checked on a regular basis and initiate lifestyle management and/or drug therapy if hypertension is detected. The blood pressure treatment goal is usually <140/90 mmHg for hypertension patients or <130/80 mmHg for patients with diabetes or chronic kidney disease.^{2,3}

Blood pressure measurement can be done with various devices in various settings (e.g., home monitoring devices, blood pressure measuring kiosks located in pharmacies, blood pressure measured in healthcare clinics, and ambulatory blood pressure monitoring). Studies have shown that blood pressure measurement can vary depending on the monitoring device, technique, and the setting in which the blood pressure is measured.^{1,3} Home blood pressure readings are consistently lower (by approximately 5 mmHg) than clinic pressures in most hypertensive patients.³ There are many factors that may affect clinic blood pressure readings, including the inherent variability of blood pressure, the tendency for blood pressure to increase in the presence of a healthcare provider (white coat effect), and inaccuracies in the methods used to measure blood pressure. Because of this variability, controversy exists as to which blood pressure reading clinicians should base hypertension treatment on.

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Proper Blood Pressure Measurement

There are many factors that may affect blood pressure readings. Room temperature, exercise, alcohol, caffeine, or nicotine consumption, arm position, muscle tension, bladder distension, talking, and background noise can all affect blood pressure reading.¹ It is important to control factors that may affect blood pressure reading prior to blood pressure measurement. At least three measurements should be made at least one minute apart and the average should be recorded.^{1,3}

The current guidelines recommend that the patient should be instructed to relax as much as possible with both feet on the ground, not crossed, arms supported and free of constrictive clothing at heart level for at least five minutes prior to blood pressure measurement.^{1,3} However, the optimal rest time before blood pressure measurement is still undefined. A recent study suggests a ten minute resting time may improve the precision and accuracy of blood pressure measurement to match the patient's true blood pressure.⁶ In that study, the authors found that systolic blood pressure may drop almost 11 mmHg after a 16 minute resting time.⁶ Whether resting for five minutes or ten minutes before blood pressure measurement, it is recommended the wait time to be consistent. Consider recording the wait time with blood pressure records to better interpret blood pressure readings.⁶

JNC-VII recommends that caffeine, exercise, and smoking should be avoided for at least 30 minutes prior to measurement.³ But some experts now question whether 30 minutes is long enough after caffeine consumption. A recent review states that caffeine has been found to elevate blood pressure acutely (by as much as 15 mmHg/13 mmHg), with blood pressure values increasing within 30 minutes and peak effect evident between one to two hours, persisting for four or more hours.⁴ Based on this finding, some experts suggest measuring blood pressure before ingestion of caffeinated products, waiting a couple of hours after caffeine ingestion, or interpret the result with prior coffee ingestion in consideration.⁴ It's been reported that ingestion of one to four and a half cups of coffee per day can increase blood pressure by 0.1 mmHg systolic and 1 mmHg diastolic. Ingestion of five or more cups of coffee a day can increase blood pressure by as much as 3.2 mmHg systolic and 1.4 mmHg

diastolic.⁴ Note that the effect of caffeine is different for each individual.

Cigarette smoking generally raises blood pressure acutely, but the level generally returns to baseline about 15 minutes after smoking.³ Chronic smokers are at a higher risk for developing "masked hypertension," where office blood pressure measurements (when not smoking) are generally lower than daytime home blood pressure measurements (when smoking).⁵ There is evidence that patients with untreated masked hypertension are at higher risk for cardiac morbidity.⁵ For this reason, home blood pressure monitoring or 24-hour ambulatory blood pressure measurement may be especially useful in chronic smokers.³

Posture also affects blood pressure. Blood pressure tends to increase from the lying to the sitting or standing position.⁷ However, in most people, as long as the arm is supported at heart level, posture is unlikely to lead to significant error in blood pressure measurement.⁷ The arm in which blood pressure is being measured should be supported and horizontal at the level of the heart. Blood pressure readings tend to be higher in an unsupported arm. Arm at a level lower than the heart may lead to overestimation of blood pressure, whereas arm at a level higher than the heart may lead to underestimation.^{1,3,7} The magnitude of error can be as high as 10 mmHg in systolic and diastolic blood pressure.^{1,7} Blood pressure is most commonly measured in a sitting or supine position. It is recommended that the patient be seated with back supported, both feet touching the ground and upper arm bared without constrictive clothing. An unsupported back and crossing the legs may increase the blood pressure.¹ If blood pressure is measured in a supine position, the arm should be supported with a pillow so it is not below heart level.¹

Studies have shown significant differences in blood pressure readings between arms.^{1,7} However, there is no clear pattern and the difference does not seem to depend on whether the patient is right- or left-handed.¹ It is recommended that blood pressure be checked in both arms at the first examination.¹ If blood pressure is consistently higher in one arm, the higher reading should be used to determine antihypertensive therapy.¹

It is important to use the correct cuff size to ensure the accuracy of readings. The blood

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pressure cuff should encircle at least 80% of the arm circumference.¹ If a cuff is too small, blood pressure tends to be overestimated and vice versa.¹ The magnitude of error can be as great as 30 mmHg.⁸

The recommended cuff sizes are:¹

Arm Circumference	Cuff Size	Cuff dimension
22 to 26 cm	Small Adult	12 x 22 cm
27 to 34 cm	Adult	16 x 30 cm
35 to 44 cm	Large Adult	16 x 36 cm
45 to 52 cm	Adult Thigh	16 x 42 cm

The midline of the cuff bladder (usually marked) should be placed over the arterial pulsation over the patient's bare upper arm. For clinic blood pressure measurement, the lower end of the cuff should be two to three centimeters above the antecubital fossa to allow room for stethoscope placement.¹ The cuff should be inflated rapidly to about 30 mmHg above the palpated systolic pressure.⁷ The deflation rate should be no greater than 2 mmHg to 3 mmHg per second. Deflation rate >2 mmHg per second can lead to significant underestimation of blood pressure.^{1,7}

Clinic Blood Pressure

Auscultatory clinic blood pressure measurement has been used by most for the diagnosis and treatment of hypertension. However, it's been shown that clinic blood pressure measurement may not be representative of the patient's true blood pressure, which is the average blood pressure over prolonged periods of time.¹ There is evidence that clinic blood pressure measurement may not correlate as well to target organ damage and cardiac morbidity compared to home blood pressure measurement.¹ The inaccuracy may be due to poor technique, defective device, inherent blood pressure variability, or white coat effect.¹

The gold standard device for clinic blood pressure measurement has been the mercury sphygmomanometer, but these are being removed from clinics due to environmental concerns.¹ Aneroid and hybrid sphygmomanometers are often used in place of mercury sphygmomanometers. Automated oscillometric blood pressure devices are increasingly being used

in clinic blood pressure measurement. The potential advantages of automated measurement in the office include elimination of observer error, minimizing the white coat effect, and increasing the number of readings.¹

Home Blood Pressure

Home blood pressure monitoring is a convenient and relatively inexpensive way to monitor blood pressure over long periods of time. Home blood pressure readings are useful to help monitor efficacy of antihypertensive therapy. In addition, studies have shown that home blood pressure may predict target organ damage and morbid events better than clinic blood pressure.³ Since home blood pressure readings are generally lower than clinic blood pressure readings, 135/85 mmHg (instead of 140/90 mmHg) is generally accepted as the upper limit of normal for home blood pressure.¹⁻³ A lower home blood pressure goal is recommended for diabetic patients, pregnant women, and patients with renal failure.³ It is helpful to get blood pressure readings from early morning and the evening.¹ Advise patients to take three consecutive readings at least one minute apart and record the average.¹

There are various home blood pressure monitors available on the market. Electronic blood pressure monitors are becoming more popular and take blood pressure from the upper arm, wrist, or finger. They are easy to use and correlate well with the auscultatory method.³ However, they may be more expensive than aneroid monitors (those with dial gauge and arm cuff with a stethoscope attached to the cuff). The standard location for blood pressure measurement is the upper arm. The wrist monitors are smaller than arm devices and can be used in obese people since wrist diameters are rarely affected by obesity. However, they may not be as accurate as arm monitors. The finger monitors have been found to be inaccurate and are not recommended.³

Recommend a home blood pressure monitor that has been approved or validated by the British Hypertension Society (BHS), the U.S. Association for the Advancement of Medical Instrumentation (AAMI), the American National Standards Institute (ANSI), the Canadian Hypertension Society (CHS), or the International Protocol (IP).^{9,10} Home monitor devices should be checked for accuracy every one to two years.^{1,2} Encourage patients to compare home blood pressure readings

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with readings from their primary care provider's office.

Some of the reputable brands of automatic blood pressure monitors include *Microlife*, *Lifescape*, *A&D*, *Omron*, etc. Each company manufactures multiple models of blood pressure monitors. The prices of automatic arm blood pressure monitors range from \$60 to \$120 U.S. depending on the model. For an up-to-date survey of **validated blood pressure monitors**, go to http://www.dableducational.org/sphygmomanometers/recommended_cat.html.

Blood pressure monitors endorsed by CHS include:

A&D or LifeSource monitors
Models: 705, 767, 767PAC, 767Plus, 774, 774AC, 779, 787, 787AC

Omron monitors
Models: HEM-705 PC, HEM-711, HEM-741CINT

Microlife or Thermor monitors (also sold as 'private label brands')
Model: BP 3BTO-A, BP 3AC1-1, BP 3AC1-1 PC, BP 3AC1-2, BP 3AG1, BP 3BTO-1, BP 3BTO-A (2), BP 3BTO-AP, RM 100, BP A100 Plus, BP A 100.

For the most up-to-date information about the CHS endorsed monitors, go to <http://www.hypertension.ca/chs/deviceendorsements/devices-endorsed-by-chs/>.

More information about hypertension management in Canada can be found at <http://www.hypertension.ca>.

Pharmacy Blood Pressure Kiosks

Blood pressure kiosks are available in most retail pharmacies. These blood pressure kiosks are generally not as accurate as mercury sphygmomanometers or validated home meters.¹¹ One major factor that may affect the accuracy of these blood pressure kiosks is inappropriate cuff size. Kiosks come with a standard size cuff and may underestimate blood pressure reading in obese people or overestimate in thin people. As with home blood pressure monitors, blood pressure readings from kiosks are generally lower than clinic blood pressure readings. The cuff size may be too small for more than half of the hypertensive population.¹¹ Due to the high chance

of inaccuracy, blood pressure readings from kiosks cannot replace other forms of blood pressure monitoring.^{12,13} It is recommended to calibrate blood pressure kiosks every six to 12 months to improve accuracy.¹⁴ Patients should be advised to have their blood pressure checked by a healthcare professional if they suspect they have high blood pressure based on kiosk reading.

Ambulatory Blood Pressure Measurement

Twenty-four hour ambulatory blood pressure monitoring may better predict a patient's true blood pressure than clinic blood pressure measurement.¹⁵ However, it is not commonly used due to the relatively high expense.¹⁵ Ambulatory blood pressure may be used to identify patients with nondipping blood pressure pattern (blood pressure does not decrease during sleep), white coat hypertension, or masked hypertension.^{1,3,5} Individuals with nondipping pattern appear to be at increased risk for blood pressure related complications compared with those with a normal dipping pattern. In addition, there is evidence suggesting that nighttime blood pressure may be the best predictor of risk.¹

During an ambulatory blood pressure measurement session, blood pressure is typically measured every 15 to 30 minutes over a 24-hour period (preferable on a workday). The blood pressure readings are stored in the monitor and can be converted into a report that provides mean values by hour and period (e.g., daytime, nighttime, and 24-hour values).

Studies have shown that the average level of ambulatory blood pressure predicts risk of morbid events better than clinic blood pressure.^{1,15} In addition, certain ambulatory blood pressure patterns may predict blood pressure-related complications.¹ Ambulatory blood pressure monitoring may be considered if:³

- White coat effect suspected in patients with hypertension and no target organ damage
- Drug resistance is apparent in clinic
- Hypotensive symptoms present with antihypertensive medications
- Patient experiences episodic hypertension
- Autonomic dysfunction is present

The upper limit of normal is set at 135/85 mmHg for ambulatory blood pressure monitoring since readings are generally lower than clinic blood pressure.¹ The Canadian

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Hypertension Education Program classifies ambulatory blood pressure measurements as hypertensive if awake SBP is ≥ 135 mmHg or the DBP is ≥ 85 mmHg, or if the mean 24 hour SBP is ≥ 130 mmHg or the DBP is ≥ 80 mmHg.²

Conclusion

Accurate blood pressure measurement is the key to determining appropriate therapy. Controversy exists as to whether drug therapy should be initiated or adjusted based on clinic blood pressure reading or home blood pressure reading. Since home blood pressure levels seem to better correlate to patient's risk for morbidity, home blood pressure monitoring is now strongly encouraged by experts. For accurate blood pressure readings, patients should be instructed on the proper way to measure blood pressure and they should use a blood pressure monitor that has been validated.

Users of this document are cautioned to use their own professional judgment and consult any other necessary or appropriate sources prior to making clinical judgments based on the content of this document. Our editors have researched the information with input from experts, government agencies, and national organizations. Information and Internet links in this article were current as of the date of publication.

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