

Blood Pressure Measurement Advisory

Discipline:	Integrated
ICD-10 Codes:	N/A
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The Challenge

Hypertension is a prevalent condition that affects approximately 45% of the adult US population and is the most commonly diagnosed condition at outpatient office visits. Hypertension is a major contributing risk factor for heart failure, myocardial infarction, stroke, and chronic kidney disease. The United States Preventive Services Task Force (USPSTF) recommendations include screening for hypertension in adults 18 years or older with in-office blood pressure measurement, and obtaining blood pressure measurements outside of the clinical setting for diagnostic confirmation before starting treatment.¹ Routine screening of blood pressure should be performed on all persons after age 18.²

Diagnosis and treatment of hypertension depends on accurate and reproducible measurement of auscultatory blood pressure. The lowering of target blood pressure in patients with diabetes and kidney disease has made this even more imperative. And yet, blood pressure reading is one of the most inaccurately performed measurements in clinical medicine.³

“True” blood pressure is defined as the average level over a prolonged period of time. Random blood pressure readings make no allowance for variations in daily life situations, nor do they identify the “white coat” hypertension or masked hypertension that can occur when a patient is in the office. This is the reason why diagnosis of hypertension requires two or more elevated readings taken on two or more office visits. But faulty methods of measurement can lead to erroneous high or low results that can result in incorrect diagnoses and treatment. Additionally, home blood pressure measurements can be used, but it is important to ensure that a patient knows how to use the device, and be aware that the results on home units are often different than in the office.

The American Heart Association (AHA) published a new set of guidelines for the measurement of blood pressure in November 2017.⁴ A study performed on medical students in 2017 based on these guidelines indicated that only 1 out of 159 medical students correctly performed all 11 elements in a blood pressure check challenge with simulated patients, and that the average steps performed correctly was 4.1. More than half of the students correctly placed the cuff over a bare arm, used the correct cuff size, supported the arm, asked patients not to talk during the

measurement, and had patients uncross their legs. But far fewer than half failed to ensure that the patient's feet were flat on the ground, asked patients not to use their cell phone or read, checked BP in both arms noting the arm with the higher reading, or correctly stating which arm should be used for future readings. Few had the patients rest in a seated position for five minutes before taking the blood pressure.⁵

Failure to correctly take blood pressure can have serious implications. This measurement is an important indicator of cardiovascular health and can result in errors in treatment. When blood pressure is erroneously elevated, patients may be placed on antihypertensive medications they do not need, and when too low, appropriate treatment may not be instigated. Falsely elevated blood pressure readings can also create unneeded stress and anxiety for patients.

Classification of Hypertension (AHA; December 2021)³

Classification	Systolic (mmHg)	Diastolic (mmHg)
Normal	less than 120	less than 80
Prehypertension	120-129 and	80-89
Stage 1 hypertension	130-139 or	80-89
Stage 2 hypertension	at least 140 or	at least 90
Hypertensive Crisis	Over 180 and/or	Over 120

The classification is based on two or more seated blood pressure measurements, performed correctly with well-maintained equipment in two or more office visits. Interpretation of blood pressure in children must take into account the child's age, sex and height. Hypertension in children is defined as systolic and/or diastolic pressure at or above the 95th percentile, using tables to determine normal and elevated levels.

Blood Pressure Definitions

BP Measurement	Definition
Systolic (SBP)	First Korotkoff sound
Diastolic (DBP)	Last Korotkoff sound
Pulse pressure	SBP minus DPB
Mean arterial pressure	DBP plus 1/3 pulse pressure
Mid-BP	Sum of SBP and DBP divided by 2

AHA Guidelines for in-Office Blood Pressure Measurements

Recommendation	Comments
Patient should be seated comfortably, with feet on the floor and back supported with legs uncrossed for > 5 minutes. The arm should be free of clothing. Ask if the patient is chilly.	Diastolic pressure is higher in the seated position; systolic is higher when supine. An unsupported back may increase diastolic pressure; crossed legs may increase systolic pressure up to 10 mm; unsupported back can increase 6-10 mm.

	Reading over clothing can increase systolic from 10-50 mm. A cold room can elevate readings.
Ensure that the patient has emptied his/her bladder before measurement.	A full bladder can increase readings by 10-15 mm.
The patient should avoid exercise, eating, caffeine and tobacco for at least 30 minutes prior to reading.	All can elevate the blood pressure, especially systolic.
Neither the patient nor the person taking the blood pressure should talk during the procedure.	Talking can produce deviations in measurement of 10-15 mm.
Patient's arm should be supported at heart level.	If the upper arm is below the level of the right atrium, readings will be too high; if above the heart, readings will be too low. If the arm is unsupported and held up by the patient, readings will be too high.
Position the middle of the cuff on the patient's upper arm at the level of the right atrium (midpoint of the sternum).	
Cuff bladder should encircle 80% or more of the upper arm circumference, and note what size cuff is used.	An undersized or oversized cuff increases errors in measurement of 10-40 mm.
While reading, the pressure should be deflated at 2-3 mm per second.	Deflation rates greater than 3 mm/sec can cause systolic pressures to appear lower, and diastolic pressures to appear higher.
The first and last audible sounds should be recorded as systolic and diastolic to the nearest 2 mm. If additional sounds are heard they must be noted.	May use palpated estimate of radial pulse obliteration to estimate before pumping up the cuff, and then inflate to 20-30 mm above that reading to perform the measurement.
Separate repeated measurements by 1-2 minutes, using an average of 2 or more repeated readings obtained on 2 or more separate occasions to obtain true BP.	
Record the results and inform the patients of them, preferably verbally and in writing.	

Cuff Sizes

<i>Recommendations: Adult (by arm circumference)</i>	
22-26 cm	12x22 cm (small adult)
27-34 cm	16x30 cm (adult)
35-44 cm	16x36 (large adult)
45-52 cm	16x42 cm (adult thigh)

<i>Recommendations: Children by age</i>	
Newborns and premature infants	4x8 cm
Infants	6x12 cm
Other children	9x18 cm

Other potential effects on blood pressure: Stress or anxiety can markedly increase measurements. Ask the patient about their stress level before performing, or while waiting to do a second reading.

Obstacles: Physicians are often not the person who routinely takes blood pressure in the office setting. Medical assistants and nurses may be the first line, but physicians may want to repeat measurements in their office based on symptoms and previous results. Should the various persons taking blood pressures make different errors in measurement, results may be very, making diagnosis and management problematic.

Time is sometimes the main obstacle, such as in allowing patients to relax for 5 minutes, or taking the time to remove clothing, or taking readings on both arms. Most practices do not routinely take readings in both arms, but there are times when this is important, including when the first reading appears to be elevated. It also makes sense when there is known cardiovascular or renal disease, physical weakness on one side, lightheadedness, or fainting. Documenting information takes time, as does ensuring that patients have an empty bladder, are comfortable and settled correctly, and that they are relaxed.

Here's How You Can Help: Providing as stress-free an environment as possible when taking vitals can assist patients in being relaxed while having their blood pressure taken. Allowing them to relax after getting to the office is very important, even when time is an issue. Being familiar with the AHA recommendations will allow a physician and their staff to maintain consistency in taking vitals. Educational sessions to keep staff consistent can be effective. Important things to remember:

- Wait 5 minutes before taking blood pressure, allowing patients to relax
- Have the patient sit with back support, feet on the floor and arm supported at heart level. Do not talk or let the patient talk or do anything else during the reading.
- Do not take blood pressure over clothing. Try not to create a tourniquet effect with the sleeve of the patient rolled up tightly.
- Use the correct size cuff.
- Inflate the cuff to 180 to begin with; go higher, if necessary, on a second try. Alternatively, use estimate of radial pulse elimination and pump the cuff to 20-30 mm above that number to begin measurement.
- Deflate the blood pressure device slowly and smoothly 2-3 mm per second.
- Listen for the first and second sounds, keeping in mind that sometimes there are more sounds, and continuing to listen after the last sound, especially if it seems to indicate a high diastolic pressure and there may be another sound.

- If blood pressure is elevated, repeat the testing, but wait 1-2 minutes before repeating on the same arm and average the two readings.
- In older patients, checking for postural hypotension by obtaining seated and standing readings is a good idea, and especially important if patients exhibit tachycardia.
- If a patient's arm is too large for the largest cuff size, place a smaller cuff over the forearm and auscultate the radial artery.
- On a first visit with a patient, taking measurements in both arms and use the arm with the highest pressure for subsequent measurements. Taking pressures in both arms can help to identify coarctation of the aorta and upper extremity arterial obstruction.
- For children, the right arm is always preferable, as right arm measurements are used to develop normal range tables.

The use of automated blood pressure reading devices is common, and the units generally provide a surface for supporting the raised arm being tested. Waiting to repeat measurements if the pressure is elevated is important. Sometimes, it is best to try the other arm when measurements need to be repeated, unless there is time to wait 5 minutes before repeating the measurement.

Patients may present with masked or white coat hypertension. Masked hypertension is where the readings are elevated at home, and normal in the office. White coat hypertension is where the readings are normal at home but elevated in the office. Generally, white coat hypertension will present with readings from 130-160, and diastolic readings of 80-100. With masked hypertension patients may be on medications and within control when monitored in the office, but pressures are higher when at home. In this case as well, monitoring with home and ambulatory readings should be done. A person with white coat hypertension may also be elevated when home, but less so. Either way, this should be tracked.

Masked hypertension is associated with elevated risk of CVD twice the normotensive population, while pure "white coat" hypertension may not be. Periodic monitoring is generally a good idea to determine if the high levels become sustained.

Ensuring that the same techniques are routinely followed by everyone in the office will provide more reliable information and support for diagnosis and management of patients, as well as reducing the stress of an incorrect reading of high blood pressure for the patient.

Clinical Advisory Feedback

CHP desires to keep our clinical pathways and advisories customarily updated. If you wish to provide additional input, please use the e-mail address listed below and identify which clinical pathway or advisory you are referencing. Thank you for taking the time to give us your comments.

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¹Screening for Hypertension in Adults: US Preventive Services Task Force Reaffirmation Recommendation Statement. US Preventive Services Task Force, Krist AH, Davidson KW, Mangione CM, Cabana M, Caughey AB, Davis EM, Donahue KE, Doubeni CA, Kubik M, Li L, Ogedegbe G, Pbert L, Silverstein M, Stevermer J, Tseng CW, Wong JB. JAMA. 2021 Apr 27;325(16):1650-1656. doi: 10.1001/jama.2021.498

²Screening for High Blood Pressure in Children and Adolescents: US Preventive Services Task Force Recommendation Statement. US Preventive Services Task Force, Krist AH, Davidson KW, Mangione CM, Barry MJ, Cabana M, Caughey AB, Donahue K, Doubeni CA, Epling JW Jr, Kubik M, Ogedegbe G, Pbert L, Silverstein M, Simon MA, Tseng CW, Wong JB. JAMA. 2020 Nov 10;324(18):1878-1883. doi: 10.1001/jama.2020.20122

³ New AHA Recommendations for Blood Pressure Measurement; Am Fam Physician 2005 Oct1;72(7): 1391-1298

⁴ 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/PCNA Guideline for Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults; November 2017

⁵ Medical Students Fall Short on Blood Pressure Check Challenge; 8.31.17; jamanetwork.com