Blood Pressure Reading, Indirect: Taking – Adult Patient

What is Taking an Indirect Blood Pressure Reading in an Adult?

› Blood pressure (BP) measurements reflect the pressure exerted by circulating blood upon the walls of blood vessels. BP results from two forces: the pressure created by the heart as it contracts to pump blood into the arteries and through the circulatory system and the force of the arteries as the vessel walls resist the pumping pressure of the heart. Indirect BP readings can be taken using either a manual sphygmomanometer (Figure 1) (e.g., manual mercury or aneroid [non-fluid based]) or an automated BP device (Figure 2). This Nursing Practice & Skill focuses on the skills needed to accurately perform indirect BP measurement in an adult using both the automated method and manual methods.
What: BP is measured in millimeters of mercury (mmHg) in the United States, and by the International System of Units (SI) in most countries outside the U.S. BP readings are comprised of two numbers, the systolic BP (SBP; i.e., the force of the heart contracting during systole) and the diastolic BP (DPB; i.e., the pressure of the heart as it relaxes between beats [diastole]), which is a function of blood volume and the size, elasticity, and resistance of the body’s blood vessels against the heart’s contractions

How: The inflatable cuff of the sphygmomanometer is placed around a limb to occlude an artery (typically the brachial artery of the upper arm) and is inflated to a pressure that prevents the flow of blood through the brachial artery. As the cuff is slowly deflated, a stethoscope placed over the brachial artery is used to auscultate the rhythmic tapping of Korotkoff sounds (i.e., the tapping sounds made by the blood flowing through the arteries during compression of the cuff of the sphygmomanometer). Both manual methods of taking indirect BP measurement require the clinician to know how to determine the appropriate size BP cuff to use and how to properly place the cuff on the patient’s brachial artery unless a different position is preferred. The manual method requires knowledge of the appropriate pressure to inflate the cuff before releasing the pressure to auscultate for Korotkoff sounds (For more information see, What You Need to Know Before Taking an Indirect Blood Pressure Reading in an Adult, below)

Where: BP is measured in all areas where patient care is rendered

Who: Depending on facility protocol, licensed and unlicensed clinicians with specialized training are permitted to perform manual indirect BP measurement. Although automated indirect BP measurement requires minimal training, it is important for the clinician to recognize the automated indirect measurement is not always accurate and the initial measurement should be compared to manual indirect measurement. A significant drawback to the use of automated BP machines is that readings can be inaccurate for patients with an irregular heart rhythm (Howlin et al., 2010)

What is the Desired Outcome of Taking an Indirect Blood Pressure Reading in an Adult?

› BP measurement is performed to
- establish a baseline BP for use as reference when interpreting future BP measurements
- Assess for hypertension, defined as SBP ≥ 140 mmHg, and/or diastolic BP ≥ 90 mmHg and monitor the effect of antihypertensive medication
- Assess for hypotension, which could be the result of various conditions (e.g., dehydration, hemorrhage, infection, neurogenic injury, and the effects of medications)
- assist in determining the appropriate level of physical activity. Measuring BP during exercise is useful in evaluating the stress placed on the heart during exertion and can be a valuable gauge in establishing an effective exercise program

Why is Taking an Indirect Blood Pressure Reading in an Adult Important?

› BP is one of the four cardinal vital signs of health (i.e., the measures of physiological status that assess the body’s basic functions [e.g., BP, body temperature, heart rate, respiratory rate]). Monitoring BP is an effective way of evaluating the stress on the cardiovascular system; which has a global impact on the body
• Untreated hypotension can cause dizziness, fainting, organ damage, and eventually death
• Signs and symptoms of a hypertensive crisis that can be life-threatening can include
  – severe chest pain
  – severe headache, especially if accompanied by confusion and blurred vision
  – nausea and vomiting
  – severe anxiety
  – shortness of breath
  – seizures
  – unresponsiveness

Compared to direct BP measurement, which requires a transducer-based arterial catheter and monitoring equipment), indirect BP measurement is portable, less complicated and costly, and requires relatively limited instruction

Facts and Figures

› In September 2015, the National Heart, Lung, and Blood Institute (NHLBI) announced significant conclusions from a landmark study (Systolic Blood Pressure Intervention Trial; SPRINT) that suggested intensive BP management significantly reduced rates of cardiovascular disease and lowered the risk of death among patients 50 years old with hypertension who are at increased risk for heart disease or those with kidney disease. The NHLBI suggested the SBP target of < 120 mmHg replace the existing target of < 140 mmHg (NHLBI et al., 2015)

› In December 2013, the Eighth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 8) published updated recommendations on the treatment of hypertension, which include the following key changes (James et al., 2013):
  • Less aggressive BP targets
  • Less aggressive thresholds for treatment-initiation for older adults and for individuals < 60 years of age with diabetes and kidney disease
  • Elimination of the recommendation to use thiazide-type diuretics only as the initial therapy in most patients. Instead, for non-Black hypertensive patients, the recommendation is to begin treatment with one of the following: thiazide-type diuretic, calcium channel blocker, angiotensin converting enzyme inhibitor, or angiotensin receptor blocker. For Black patients, the recommendation is to initiate treatment with either a thiazide-type diuretic or calcium channel blocker

› In the United States, BP definitions for individuals over age 18 are as follows (Chobanian et al., 2003; Note: These values are standard parameters for BP assessment and are measured in mmHg. The first number represents SBP. The second number, preceded by a forward slash, represents DBP):
  • **Hypotension**: 90/60 or less
  • **Normal**: More than 90/60 and less than 120/80
  • **Prehypertension**: More than 120/80 and less than 140/90
  • **Stage 1 hypertension**: More than 140/90 and less than 160/100
  – The Centers for Disease and Control and Prevention (CDC) includes a classification for uncontrolled BP: an average SBP 140 mmHg or an average DBP ≥ 90 mmHg (CDC, 2012)
  • **Stage 2 hypertension**: 160/100 and less than 180/102
  • **Hypertensive crisis**, also called hypertensive emergency, formerly called malignant hypertension: SBP 180 or DBP > 120 mmHg

An estimated 20% of adults worldwide have hypertension. In many countries, half of adults over 60 years of age are hypertensive (Madhur et al., 2014)

Ambulatory BP monitoring (ABPM; i.e., measurement of BP at regular intervals over a 24-hour period by a small device worn by the patient) is less likely to produce falsely elevated results due to “white coat” syndrome (i.e., hypertension caused by anxiety while in the physician’s office) and is more effective for assessing for hypertensive episodes because, rather than using a single BP recording, BP measurements are averaged over a 24-hour period. In addition, ABPM can uncover “masked” hypertension (i.e., normal BP readings in the clinician’s office and elevated out-of-office BP). ABPM is superior to home BP monitoring, because the latter involves periodic patient self-monitoring only and usually does not include nocturnal measurements (Perry, 2013)

• Although not as effective as ABPM, home BP monitoring does have advantages. Investigators in a cluster randomized controlled study of 450 patients with uncontrolled BP reported that, at 6 months, BP control was achieved in 57% of participants who underwent home BP monitoring in combination with pharmacist case management, compared to only 30% of participants who received the usual care. At 18 months, BP control was achieved in 71% and 57% of participants,
respectively. Improvements in BP control achieved through home BP monitoring and pharmacist case management persisted during 6 months of postintervention follow-up (Margolis et al., 2013)

- Authors who conducted a recent systematic review reported that patient self-monitoring of BP is associated with a 2.5mmHg reduction in SBP and a 1.8mmHg reduction in DBP (Glynn et al., 2010)

- Programs designed to educate patients with hypertension to self-monitor BP can improve BP control by teaching patients how to use home BP monitors properly, how to correctly position the BP cuff over the brachial artery, and the importance of not relying on a single reading but using an average of at least two BP measurements taken at least one minute apart (Fung et al., 2014)

- Researchers who conducted a recent study including 49 patients in the post-anesthesia care unit reported that clinicians often used the forearm to measure BP for patients with large upper-arm circumference, a practice that resulted in inaccurate BP readings. Note: The American Heart Association guidelines recommend the use of an appropriately-sized cuff positioned on the upper arm to use the brachial artery (Watson et al., 2011)

- A systematic review and meta-analysis noted that a difference of > 10 mmHg in DBP between both arms of a patient was associated with pre-existing cardiovascular disease and all-cause mortality (Clark et al., 2012)

### What You Need to Know Before Taking an Indirect Blood Pressure Reading in an Adult

- Prior to measuring indirect BP, clinicians should be knowledgeable about the following:
  - Knowledge of cardiovascular physiology as it relates to BP and knowledge of the events/substances that can cause constriction or dilatation of blood vessels and affect the heart rate (e.g., medications, certain foods [e.g., tea, coffee, caffeinated soft drinks], physical activity, changes in posture, hot or cold weather, emotional stress)
  - Recognition that BP can be affected by age, weight, pregnancy, pain, dietary salt intake, overall level of fitness, genetic predisposition, disease processes (e.g., kidney disease, thyroid disease), use of alcohol or drugs, and cigarette smoking. BP varies slightly throughout the day
  - Knowledge of the events of BP measurement, which include auscultating for the first and last Korotkoff sounds during cuff inflation over an artery and observing the simultaneous pressure reading on the sphygmomanometer. When documenting BP, the SBP value is recorded first and the two values are separated by a forward slash (e.g., 120/80 mmHg)
    - The first of the Korotkoff sounds denotes the SBP measurement, and signals that the pressure in the cuff is low enough to allow blood to flow through the artery at the most forceful part of ventricular ejection
    - The last Korotkoff sound indicates the diastolic measurement, which is heard when the pressure in the cuff is low enough for the blood to flow freely through the artery. It is typical to observe small bumps of the needle on the pressure gauge after the Korotkoff sounds cease. **Do not mistake the small needle bumps on the sphygmomanometer as DBP**—remember, it is the Korotkoff sounds that indicate SBP and DBP, not the needle bumps on the sphygmomanometer
  - Patient considerations for measuring BP
    - Patient position: BP measurement should be taken in a seated or supine position. Feet should be flat on the floor—crossed legs can impede blood flow. The patient should remain quiet
    - Patient activity level: Wait at least 20 minutes and verify that the patient is relaxed before measuring BP in patients who have been engaged in activities that can temporarily increase BP (e.g., smoking, drinking coffee, walking briskly)
  - Equipment considerations for measuring BP
    - Cuff size selection: The cuff should be sized to accommodate the patient’s extremity. The cuff should be wide enough to encircle 80% of the upper arm and long enough to be fastened securely (Figure 4)—even if the cuff doesn’t pop off during inflation, an **inappropriately sized cuff will produce inaccurate readings**. Consider using a thigh cuff for an obese patient or a pediatric cuff for patients with low body fat. Recommended cuff size per age group/size is as follows (Figure 5):
      - Small adult (arm circumference < 23 cm/9 in) — 12 cm/4.7 in x 18 cm/7 in
      - Most adults (arm circumference < 33 cm/13 in) — 12 cm/4.7 in x 26 cm/10.2 in
      - Large-size adult (arm circumference < 50 cm/19.6 in) — 12 cm/4.7 in x 40 cm/15.7 in
Figure 4: The blood pressure cuff width should cover approximately 80% of the upper arm. Copyright© 2014, EBSCO Information Services.

Figure 5: Blood pressure cuffs are available in various sizes. Using an appropriately sized cuff is essential for an accurate reading. Copyright© 2014, EBSCO Information Services.

– Stethoscope—bell or diaphragm? When auscultating Korotkoff sounds, the bell of the stethoscope allows for better auscultation of the lower-pitched Korotkoff sounds heard with arterial flow. Some clinical resources recommend use of the bell for auscultation of low-pitched arterial sounds, while others make no specific recommendation. For example, the American Heart Association recommended use of the bell for auscultating Korotkoff sounds in their 2004 guidelines (Pickering et al., 2005), while the American Association of Critical-Care Nurses (AACN) offered no specific recommendation for bell or diaphragm in their 2010 Practice Alert for noninvasive BP measurement (American Association of Critical-Care Nurses, 2010).

- The stethoscope should be placed firmly against the skin to make a complete seal between the edge of the bell (or diaphragm) and the skin. Avoid pressing too firmly to avoid obliterating the lower-pitched Korotkoff sounds.

– BP measurement technique considerations

– Cuff positioning: Position the cuff around the upper arm so:
  - the lower border of the cuff is 2–3 cm/~1 inch above the antecubital fossa to best auscultate the brachial artery
  - the artery mark on the cuff is aligned with the brachial artery

– Arm support: Support the patient’s forearm at the level of the phlebostatic axis (i.e., the location of the right atrium, which is the fourth intercostal space at the mid-anterior-posterior diameter of the chest [midaxillary line]) (Figure 6). If the arm is not supported properly, the muscle contraction can result in inaccurately high DBP measurement.

- The BP reading can be inaccurately low if the arm is elevated above the heart level of the phlebostatic axis due to the effect of gravity and inaccurately high if the arm is below the heart level.
Estimate SBP prior to actual measurement to avoid damaging blood vessels, which can occur if the cuff is inflated more than 30 mmHg above the actual SBP. Prior to measuring BP, inflate the cuff so that it barely occludes the artery. Palpate the radial or brachial pulse to determine the estimated systolic blood pressure (ESBP). When performing BP measurement, inflate the cuff no more than 30 mmHg higher than the estimated value.

Figure 6: Location of the phlebostatic axis. Copyright © 2014, EBSCO Information Services.

- Contraindications for measuring BP include use of a limb
  - being used for I.V. fluid infusion
  - with an arteriovenous (AV) shunt or fistula
  - on the same side of the body as mastectomy or axillary surgery
  - with evidence of disease or trauma

- Be aware of the technique for measuring orthostatic BP measurements (i.e., BP measurements taken after lying supine for five minutes and at one and three minute intervals after standing to detect postural changes) (CDC, n.d.). Often orthostatic BP is measured several times to establish an average baseline (for more information, see Nursing Practice & Skill ... Vital Signs, Postural: Measuring).

Preliminary steps that should be performed before taking an indirect BP reading include the following:

- Review the facility/unit-specific protocol for the designated times for indirect measurement of BP
- Review the treating clinician’s order for measurement of BP if different from the scheduled times or methods (e.g., orthostatic measurements). Recognize that typically no order exists for BP measurement because as a standard of care, BP measurement is taken on a scheduled basis or when the patient’s condition has changed
- Review patient’s medical history/medical record for previous readings and to become knowledgeable about the baseline reading and to determine if he/she has an irregular heart rhythm, which requires use of the manual technique
- Review the manufacturer’s instructions for all equipment to be used and verify
- the equipment is in good working order
- Review the patient’s medical history/medical record for current medications, and any allergies (e.g., to latex, medications, or other substances); use alternative materials, as appropriate

Gather the following equipment and supplies necessary for measuring BP indirectly:

- Nonsterile gloves and additional personal protective equipment (PPE; e.g., gown, mask, eye protection) can be necessary depending on the patient’s condition and if exposure to body fluids is anticipated
- Facility-approved antiseptic wipes to disinfect equipment, including stethoscope and BP cuff, before and after patient contact. Many facilities provide each patient with a disposable BP cuff that can be thrown away after the patient is discharged
- For manual BP measurement: sphygmomanometer with appropriately-sized cuff, and stethoscope
- For automated BP measurement: automated BP machine with appropriately-sized cuff
- Written information to reinforce verbal instruction, if available

How to Take an Indirect Blood Pressure Reading in an Adult

- Perform hand hygiene; don PPE
- Identify the patient using at least two unique identifiers, according to facility protocol
Establish privacy by closing the door to the patient’s room, and/or drawing the curtain surrounding the patient’s bed.

Introduce yourself to the patient and family member(s) and explain your clinical role.

- Assess the patient and family for knowledge deficits and anxiety regarding BP measurement.
  - Determine if the patient/family requires special considerations regarding communication (e.g., due to illiteracy, language barriers, or deafness); make arrangements to meet these needs if they are present.
  - Use a professional certified medical interpreter when a communication barrier exists.

- Explain the procedure for BP measurement and its purpose; answer any questions and provide emotional support as needed.
  - Advise the patient that he/she might feel minor discomfort during cuff inflation. If using an automated cuff, explain that it can inflate more tightly than manual ones. Reassure the patient that any discomfort caused by cuff inflation will be brief.

- Adhere to facility infection control standards and employ correct aseptic technique throughout the procedure.

- Assist the patient into a seated or supine position with the involved arm supported and positioned at the phlebostatic axis.

- Assess the selected arm to confirm there are no contraindications for BP measurement.

- Verify that the equipment, including stethoscope, has been disinfected between patients.

- (Note: The following directions assume use of the brachial artery—adjust the instructions below if a different artery is selected.) Confirm the selected cuff is the appropriate size for the patient by wrapping the cuff snugly around the patient’s upper arm, approximately 2–3 cm/~1 inch above the antecubital fossa. The artery marking on the cuff should be aligned with the patient’s brachial artery.

- Perform a manual BP measurement as follows:
  - Estimate the systolic pressure by palpating the brachial or radial pulse while inflating the cuff to the pressure where the pulse is obliterated, noting this measurement as the ESBP.
  - Deflate the cuff and wait 30–60 seconds for any venous congestion caused by the cuff to dissipate before measuring BP.
  - Inflate the cuff to approximately 30 mmHg higher than the ESBP. The cuff should be inflated quickly to avoid measurement distortion.
  - Place the bell or diaphragm of the stethoscope over the brachial artery.
  - Slowly release the cuff pressure while auscultating for Korotkoff sounds and observing the gauge on the sphygmomanometer. At the first Korotkoff sound, note the pressure reading on the gauge (the needle on the gauge should bump upward slightly, then continue to fall)—this pressure measurement represents the SBP.
  - Continue to listen for when the Korotkoff sounds cease and note the pressure gauge measurement. Record this reading as the DBP.
  - Recall that the SBP and DBP are identified by sounds, not by the intermittent needle bumps observed on the pressure gauge.

- Perform automated BP measurement as follows—*a manual BP readings should be performed if the patient has an irregular heart rhythm*:
  - Power on the machine and wait for the indication the machine is ready to measure BP.
  - Press the appropriate panel/button to begin cuff inflation and wait for the cuff to be inflated, then fully deflated.
  - Note: Most automated BP measurement devices are programed to inflate the cuff to standard parameters. If your patient’s SBP is higher than the established parameters, the machine will first attempt to measure BP using the standard parameters, then reset itself to adjust upward until an accurate BP can be measured.
  - Evaluate if the reading appears within the expected values based on previous baseline measurements and patient’s condition. If the reading appears to be inaccurate, remeasure the BP—best practice is to use the manual method when rechecking BP.
  - Record the SBP/DBP numerical measurement shown on the display monitor.

- Advise the patient of the BP reading.

- Clean and disinfect equipment, including stethoscope, per facility protocol.

- Discard PPE and perform hand hygiene.

- Update the patient’s plan of care, if appropriate, and document indirect BP measurement in the patient’s medical record, including the following information:
  - Date and time of BP measurement.
  - BP measurement and type of device used.
  - Site used to obtain BP.
  - Patient’s position during the procedure.
• Any unexpected patient events or outcomes, the nursing interventions performed, patient’s response to interventions, and whether the treating clinician was notified
• Patient/family member education, including topics presented, response to education provided/discussed, plan for follow-up education, and details regarding any barriers to communication and/or techniques that promoted successful communication

Other Tests, Treatments, or Procedures That Can Be Necessary Before or After Taking the Blood Pressure Reading in an Adult
› Alert the treating clinician of unexpected readings
› Diagnostic testing (e.g., EKG, echocardiogram, renal ultrasound, CT scan) can be ordered to evaluate for disorders causing abnormal BP, as well as end-organ damage
› If the abnormal BP is determined to be related to an existing treatment regimen, the treating clinician will adjust the plan (e.g., lower or increase dosage or decrease in prescribed medication)
› Counseling with nutrition services can be ordered if hypertension is related to unhealthy weight

What to Expect After Taking a Blood Pressure Reading in an Adult
› The patient’s BP will be measured accurately without complications and with minimal discomfort

Red Flags
› A hypertensive crisis or hypertensive emergency can require immediate treatment with intravenous antihypertensive medications (e.g., nicardipine, nitroprusside, fenoldopam, nitroglycerin, enalaprilat, hydralazine, labetalol, esmolol, and phentolamine)
› Hypertensive crises require immediate treatment to avoid neurologic end-organ damage (e.g., hypertensive encephalopathy, cerebral vascular accident/cerebral infarction, subarachnoid hemorrhage, intracranial hemorrhage), cardiovascular end-organ damage (e.g., myocardial ischemia/infarction, acute pulmonary edema, aortic dissection, left ventricular dysfunction), or damage to other organ systems (e.g., eclampsia during pregnancy, retinopathy, acute renal failure/insufficiency)
› Hypertensive crises are distinguished from hypertensive urgencies, in which target organ damage is not probable, but there exists elevated risk for stroke, heart attack, and other life-threatening events
› Life-threatening hypotension can indicate shock or cardiovascular collapse

What Do I Need to Tell the Patient/Patient’s Family?
› Communicate the indication for BP measurement and the results of the measurement to the patient
› If hypertension is diagnosed, the patient should be educated about making improvements in diet and lifestyle, such as smoking cessation and weight loss
› If home monitoring of BP is part of the treatment plan, the patient, family, and any caregivers, should be instructed how to perform BP measurement and the importance of communicating with the treating clinician any unexpected values, especially SBP > 180mmHg or DBP > 120 mmHg
› Provide contact information (name of contact, telephone number or pager with 24-hour access) in the event emergency care is needed
› Signs and symptoms of a hypertensive crisis (review the signs, symptoms, and complications of hypo- and hypertension listed in Why is Taking an Indirect Blood Pressure Readings in Adults Important?)

References


