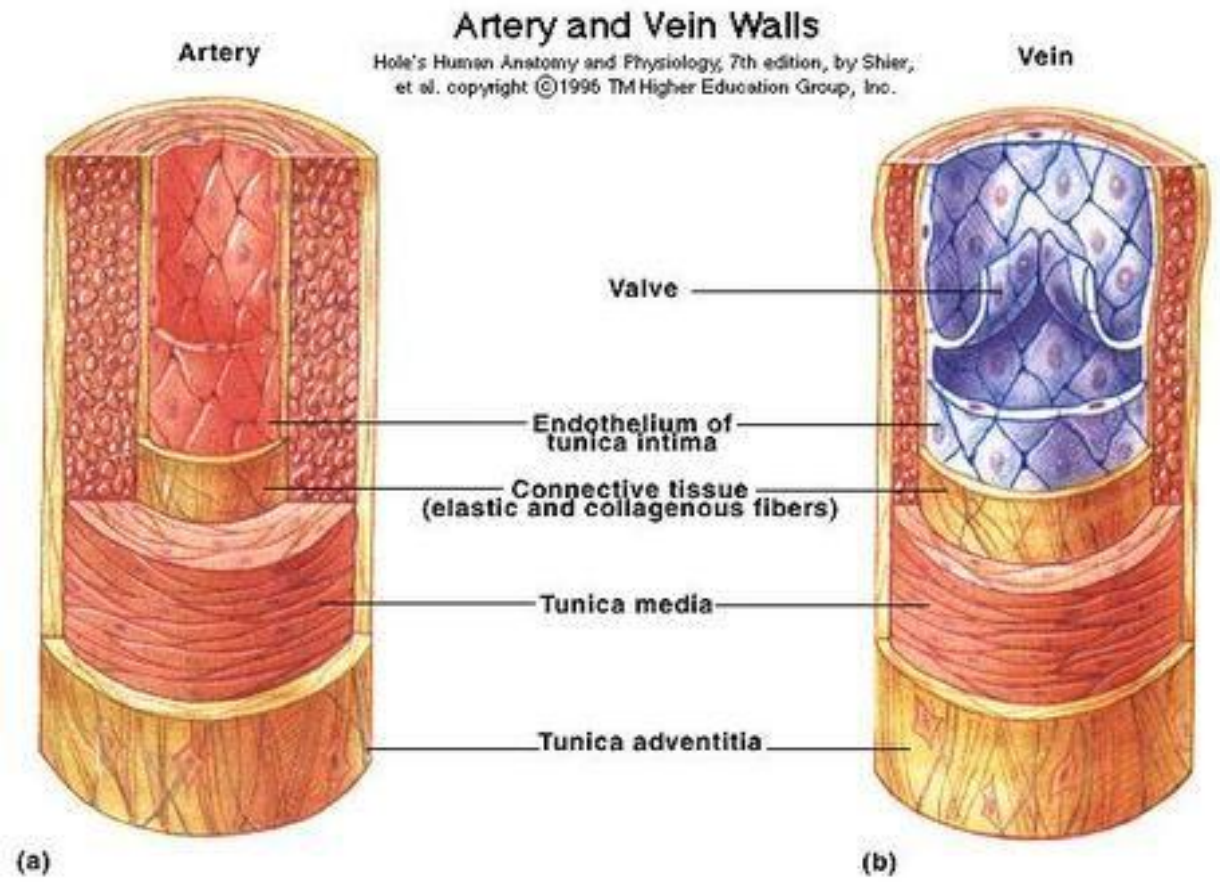
BLOOD PRESSURE MEASUREMENT

Blood vessels

Blood vessels – tubular structures, with particular named layers from innermost to outermost:

Tunica Intima
Tunica Media
Tunica Adventitia



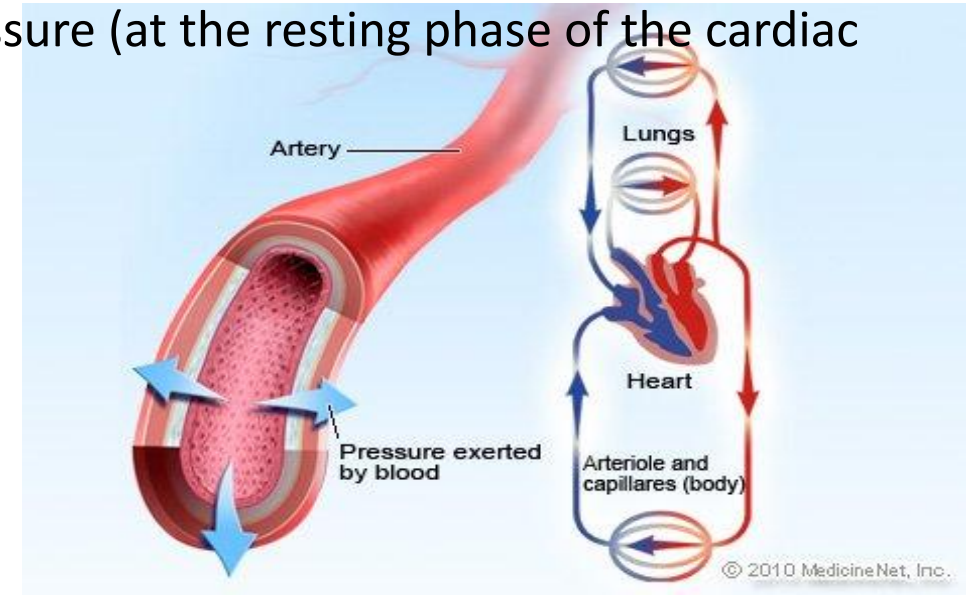
Blood Pressure
What drives blood along the blood vessels after it has left the heart?

Blood pressure is the pressure exerted by the blood on the walls of the blood vessels.

Blood pressure values are universally stated in millimeters of mercury (mmHg).

The systolic pressure is defined as the peak pressure in the arteries during the cardiac cycle;

The diastolic pressure is the lowest pressure (at the resting phase of the cardiac cycle).



Blood Pressure

Typical values for a resting, healthy adult are approximately 120 mmHg systolic and 80mm Hg diastolic (written as 120/80 mmHg), with individual variations.

These measures of blood pressure are not static, but undergo natural variations from one heartbeat to another, and throughout the day they also change in response to stress, nutritional factors, drugs, or disease.

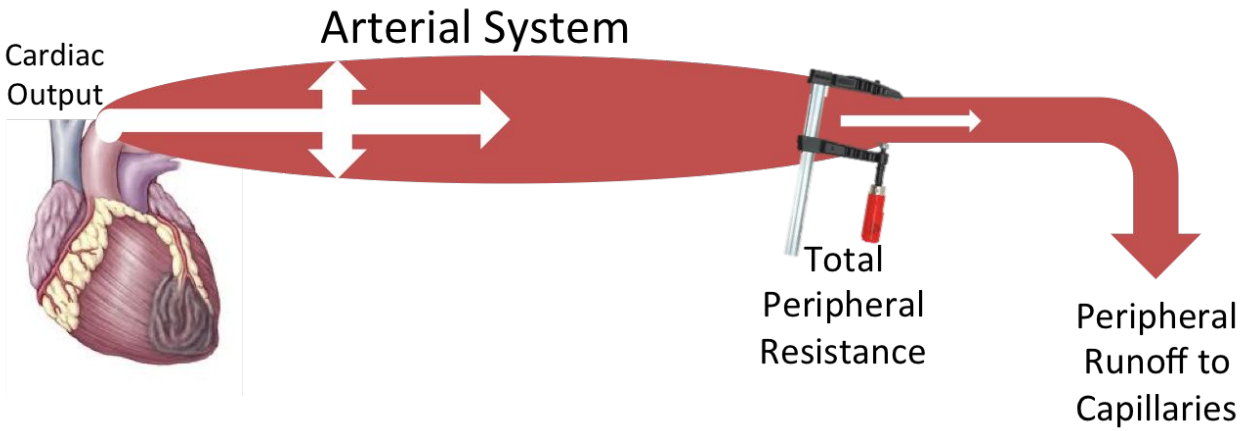
The peripheral resistance

Blood pressure= Cardiac output× peripheral resistance

As the blood flows from the arterial to the venous side of the circulation, it meets resistance because of the smaller caliber of the vessels and the viscous nature of the blood. This is called the peripheral resistance.

It is an important factor in generating and maintaining the arterial blood pressure.

Vasoconstriction of the small vessels increases the peripheral resistance, which in turn elevates the arterial blood pressure. Whilst vasodilatation decreases the resistance and lowers the pressure



Blood pressure
Preparation for measurement

Patient should abstain from eating, drinking, smoking and taking drugs that affect the blood pressure one hour before measurement.

Instruct your patients to avoid coffee, smoking or any other un prescribed drug on the day of the measurement

Because a full bladder affects the blood pressure it should have been emptied.

Painful procedures and exercise should not have occurred within one hour.

Patient should have been sitting quietly for about 5 minutes.

BP take in quiet room and comfortable temperature, must record room temperature and time of day.

Assess risk factors for blood pressure alterations:

- History of cardiovascular disease
- Renal disease
- Diabetes mellitus
- Circulatory shock (hypovolemic, septic, cardiogenic, or neurogenic)
- Acute or chronic pain
- Rapid intravenous (IV) infusion of fluids or blood products
- Increased intracranial pressure
- Postoperative status
- Toxemia of pregnancy

Assess for signs and symptoms of blood pressure alterations.

In patients at risk for high blood pressure (HBP), assess for headache (usually occipital), flushing of face, nosebleed, and fatigue in older adults.

Hypotension is associated with dizziness; mental confusion; restlessness; pale, dusky, or cyanotic skin and mucous membranes; cool, mottled skin over extremities.

Physical signs and symptoms indicate alterations in blood pressure.

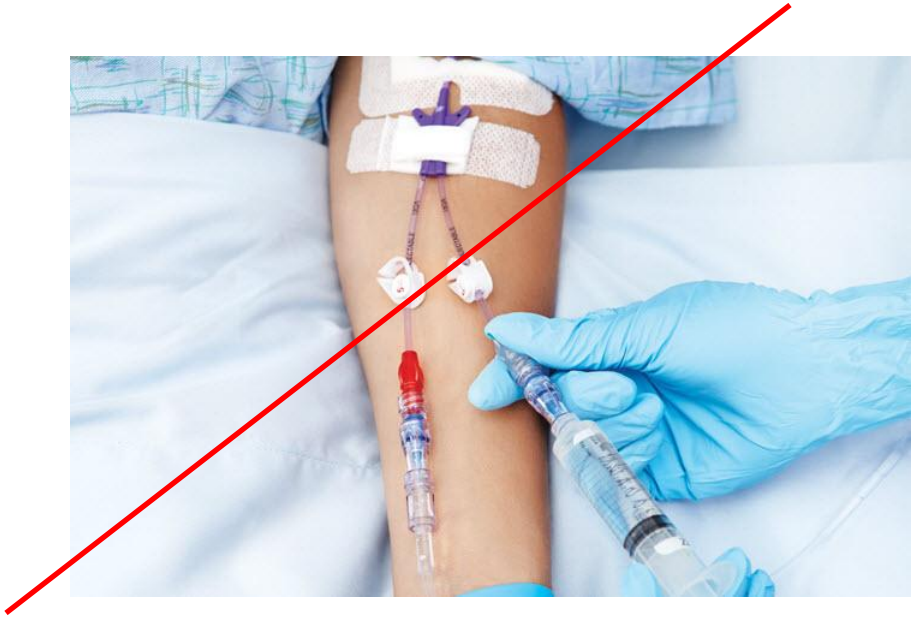
Hypertension is often asymptomatic until pressure is very high.

C Assess for factors that influence blood pressure:	Allows you to anticipate factors that influence respirations, ensuring a more accurate interpretation.
• Age	Acceptable values for blood pressure vary throughout life (see Pediatric and Gerontologic Considerations).
• Gender	During and after menopause women often have higher blood pressures than men of same age.
• Daily (diurnal) variation	Blood pressure varies throughout day; pressure is highest during the day between 10:00 AM and 6:00 PM and lowest in early morning.
• Position	Blood pressure falls as person moves from lying to sitting or standing position; normally postural variations are minimal.
• Exercise	Increases in oxygen demand by the body for activity increase blood pressure.
• Weight	Obesity is an independent predictor of hypertension.
• Sympathetic stimulation	Pain, anxiety, or fear stimulates the sympathetic nervous system, causing blood pressure to rise.
• Medications	Antihypertensives, diuretics, beta-adrenergic blockers, vasodilators, calcium channel blockers, angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), and antidysrhythmics lower blood pressure; opioids and general anesthetics also cause a drop in blood pressure.
• Smoking	Smoking results in vasoconstriction, a narrowing of blood vessels. Blood pressure rises acutely and returns to baseline approximately 15 minutes after stopping smoking (NHBPEP, 2003).
• Ethnicity	Incidence of hypertension is higher in African Americans than in European Americans. African Americans tend to develop more severe hypertension at an earlier age and have twice the risk for the complications of hypertension (i.e., stroke and heart attack). Hypertension-related deaths are also higher among African Americans.

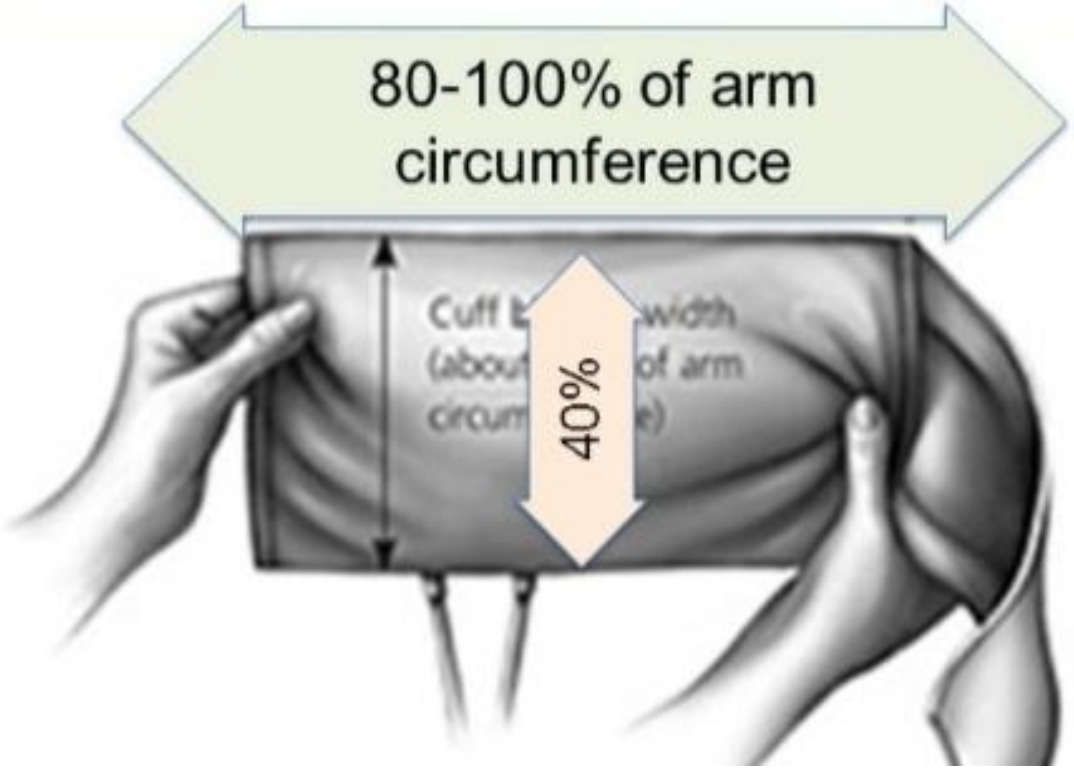
Determine best site for blood pressure assessment.
Avoid applying cuff to extremity when IV fluids are infusing,
an arteriovenous shunt or fistula is present, or breast or axillary surgery has been performed on that side.

In addition, avoid applying cuff to extremity that has been traumatized or diseased or requires a cast or bulky bandage.

Use lower extremities when brachial arteries are inaccessible.

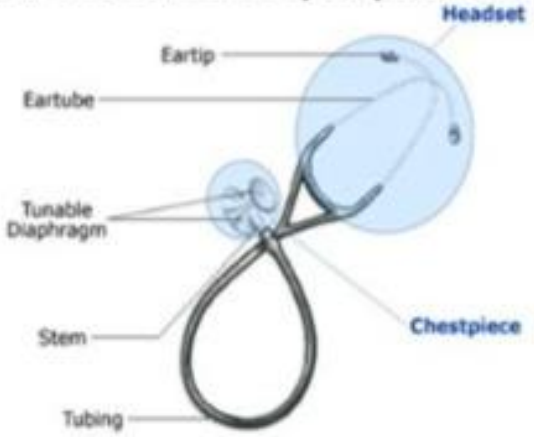


For adults: The bladder of the cuff **length** must encircle at least 80% of the upper arm circumference (100% in children). The **width** of the bladder must encircle at least 40% of the arm circumference.



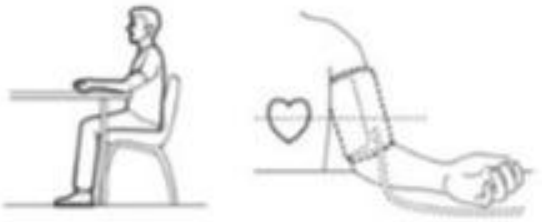
Additional checks

- The lower edge of the cuff should be at least 1" (2-1/2 cm) above the bend in the elbow (antecubital fossa).
- Palpate brachial artery (you may need to straighten arm to feel the brachial pulse). Place the middle of the bladder over the brachial artery.
- Wrap the cuff smoothly and snugly around the arm. Test for proper cuff application by placing both thumbs under the applied cuff and tug gently; the cuff should not move.
- Are the ear pieces of your stethoscope pointed the right way?



Positioning

- Seated with feet on the floor and back well supported (no crossed legs!).
- An effort should be made to help the client relax.
- No smoking or caffeine for 30 minutes prior to the procedure.
- Sleeveless BP cuff applications are preferred.
- The arm should be slightly flexed, the palm of the hand up, with the entire forearm supported on a smooth, flat surface. The brachial artery must be at heart level.



What is wrong in these pictures?

BOX 5-6 Common Mistakes in Blood Pressure Assessment

Error	Effect
Bladder or cuff too wide	False low reading
Bladder or cuff too narrow or too short	False-high reading
Cuff wrapped too loosely or unevenly	False-high reading
Deflating cuff too slowly	False-high diastolic reading
Deflating cuff too quickly	False-low systolic and false-high diastolic reading
Arm below heart level	False-high reading
Arm above heart level	False-low reading
Arm not supported	False-high reading
Stethoscope that fits poorly or impairment of examiner's hearing, causing sounds to be muffled	False-low systolic and false-high diastolic reading
Stethoscope applied too firmly against antecubital fossa	False-low diastolic reading
Inflating too slowly	False-high diastolic reading
Repeating assessments too quickly	False-high systolic reading
Inaccurate inflation level	False-low systolic reading
Multiple examiners using different Korotkoff sounds for diastolic readings	False-high systolic and false-low diastolic reading

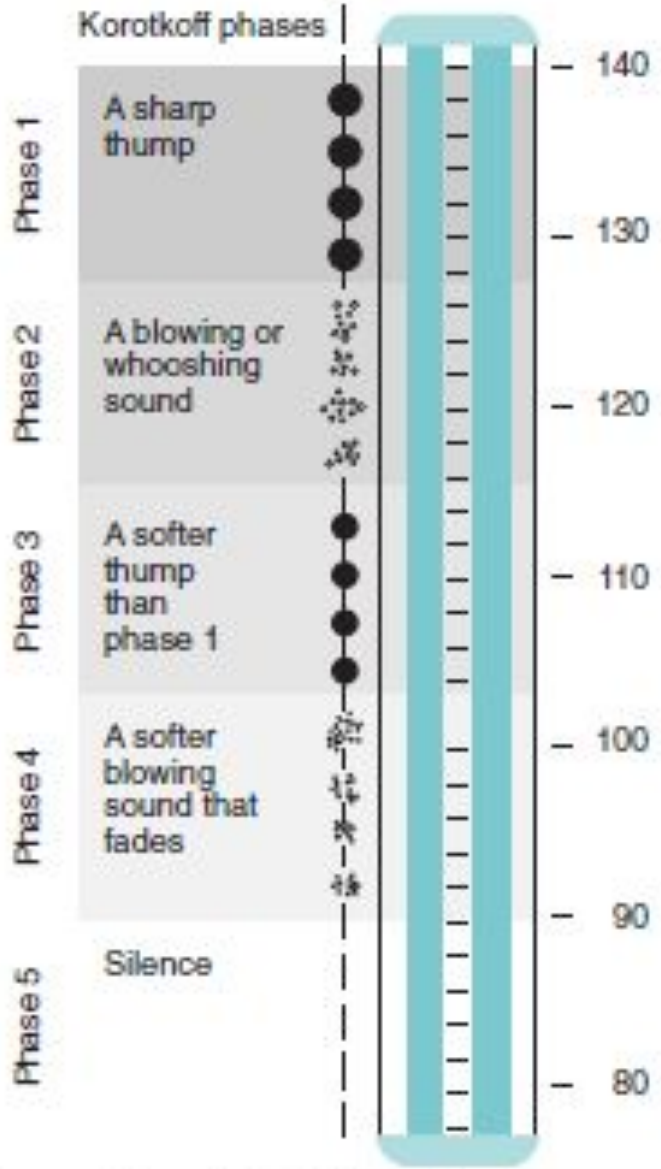


FIG 5-9 The sounds auscultated during blood pressure measurement can be differentiated into five Korotkoff phases. In this example the blood pressure is 140/90 mm Hg.

Korotkoff sounds

Phase 1: TAPPING, The first appearance of clear, tapping sounds that gradually become louder.

Phase 2: SWISHING, The sounds change to a murmur and have a swishing sound.

Phase 3: KNOCKING, The sounds have a loud, knocking quality, but are not quite as clear as those in Phase 1.

Phase 4: MUFFLING, The sounds suddenly are muffled and again have a faint, swishing quality.

Phase 5: NO SOUND, All sounds disappear (often referred to as the **onset of silence**).

What is this person checking for?

Here the clinical staff person is checking the **“Maximum Inflation Level” or MIL.**

Many will not have heard of this recommended step.

But the clinical person feels for the radial pulse and then inflates the cuff while continuously feeling for the radial pulse.

The point at which the pulse disappears approximates the systolic BP. Then allow the cuff to deflate, wait seconds and re-inflated to a point that is mmHg above the estimated systolic blood pressure and take the BP accordingly.

This allows the clinician to know “how high to go” which may make the procedure more comfortable for patients.

Maximum Inflation Level (MIL)

This technique can help you know how high to inflate the BP cuff!

Determining the Maximum Inflation Level (MIL)

- Apply the pressure cuff.
- Locate the radial pulse.
- Palpate the radial pulse while steadily inflating cuff & watching the mercury column or aneroid gauge.
- Note the point on the mercury column or aneroid gauge at which the radial pulse disappears.
- The point at which the radial pulse disappeared is approximately the same as the client's systolic BP.
- Rapidly deflate the cuff.

Taking the blood pressure

- After determining the MIL, wait 15 to 20 seconds before measuring BP with stethoscope.
- Before inflating the cuff, squeeze the bladder to release all air and thus ensure that the pressure level is at zero.
- After the 15 to 30 second wait, palpate the brachial pulse and place the stethoscope head directly over the brachial pulse make sure head of stethoscope is NOT touching the cuff or tubing.

- With stethoscope in place, close valve and by rapidly & steadily squeezing the bulb, inflate the cuff 20-30 mmHg above the point where the pulse disappeared in the **MIL steps.**

- Open the valve and begin deflation of the cuff.

- Maintain a constant deflation rate of 2-3 mmHg per second.

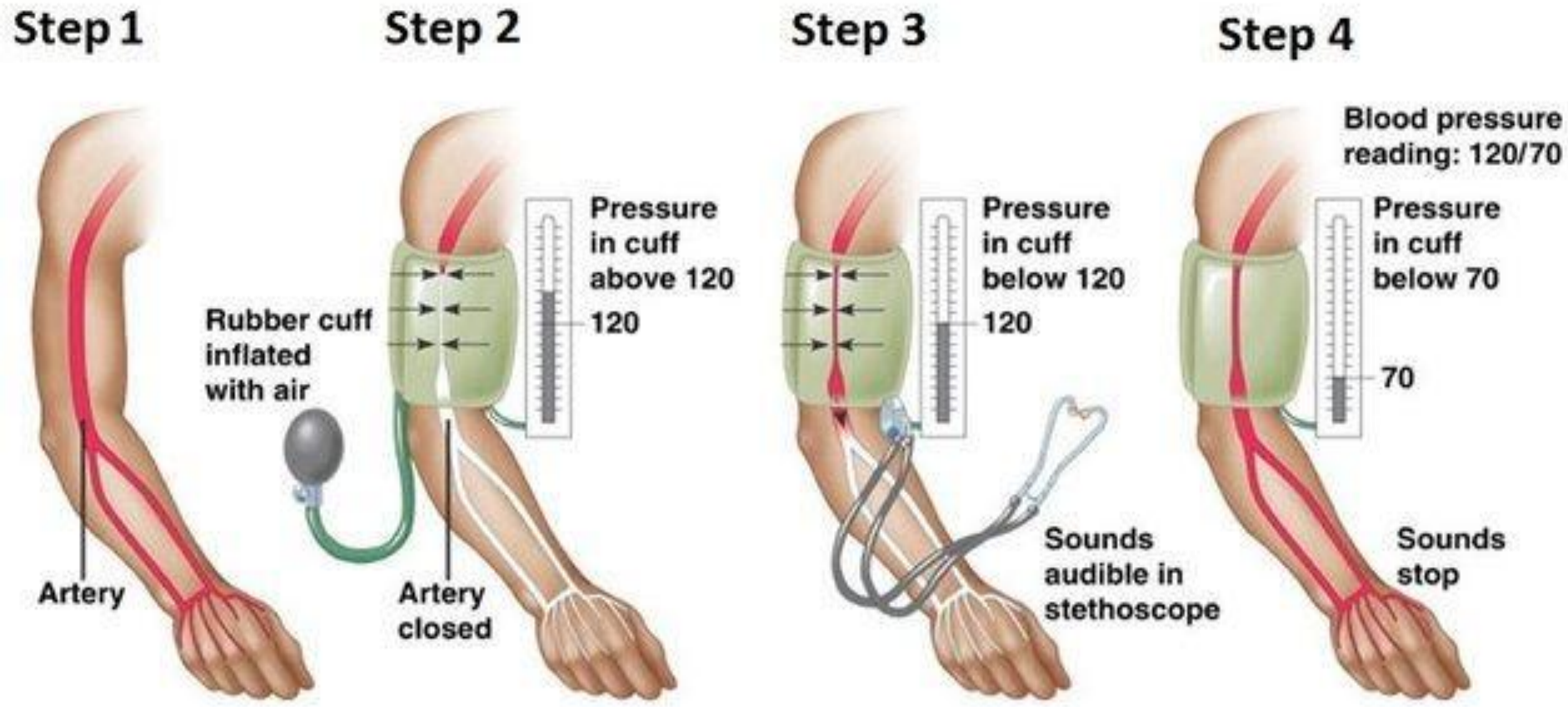
- Continue to listen to about 10 mm below where the last sound was heard.

Systolic BP: the point at which the first of two or more continuous sounds are heard.

Diastolic BP: recorded at the disappearance of sound (also called the onset of silence), not at the last sound.
Subtract 2mmHg from the last sound you hear. (e.g. if the last sound is at 80mmHg, the diastolic BP is 78mmHg!)
Read to the nearest even number. If the reading falls between two numbers, read the number above.

For example, if the last sound is heard at “90”, then the diastolic blood pressure is recorded as "88”.

Measurement of blood pressure



Unexpected Outcomes	Related Interventions
1 Patient's blood pressure is above acceptable range.	• Repeat measurement in other extremity and compare findings. • Verify correct selection and placement of blood pressure cuff. • Have another nurse repeat measurement in 1 to 2 minutes. • Observe for related symptoms that are not apparent unless blood pressure is extremely high, including headache, facial flushing, nosebleed, and fatigue in older patient. • Report blood pressure to nurse in charge or health care provider to initiate appropriate evaluation and treatment. • Administer antihypertensive medications as ordered.
2 Patient's blood pressure is not sufficient for adequate perfusion and oxygenation of tissues.	• Compare blood pressure value to baseline. • Position patient in supine position to enhance circulation and restrict activity that decreases blood pressure further. • Repeat measurement with sphygmomanometer. Electronic blood pressure devices are less accurate in low-flow conditions. • Assess for signs and symptoms associated with hypotension, including tachycardia; weak, thready pulse; weakness; dizziness; confusion; and cool, pale, dusky, or cyanotic skin. • Assess for factors that contribute to a low blood pressure, including hemorrhage, dilation of blood vessels resulting from hyperthermia, anesthesia, or medication side effects. • Report blood pressure to nurse in charge or health care provider to initiate appropriate evaluation and treatment. • Increase rate of IV infusion or administer vasoconstriction drugs if ordered.
3 Unable to obtain blood pressure reading.	• Determine that no immediate crisis is present by obtaining pulse and respiratory rate. • Assess for signs and symptoms of decreased cardiac output; if present, notify nurse in charge or health care provider immediately. • Use alternative sites or procedures to obtain blood pressure; use Doppler ultrasonic instrument (see Chapter 6); palpate systolic blood pressure.
4 Patient experiences orthostatic hypotension.	• Maintain patient safety. • Return patient to safe position in bed or chair.

TABLE 5-2 Classification of Blood Pressure for Adults Ages 18 Years and Older*

Category	Systolic (mm Hg)		Diastolic (mm Hg)
Normal	<120	and	<80
Prehypertension	120-139	or	80-89
Stage 1	140-159	or	90-99
Stage 2	≥160	or	≥100