Blood pressure estimation

Peshraw S. Hamadamin

Human Physiology Lab

First semester

Week 5

Date 5/11/2025

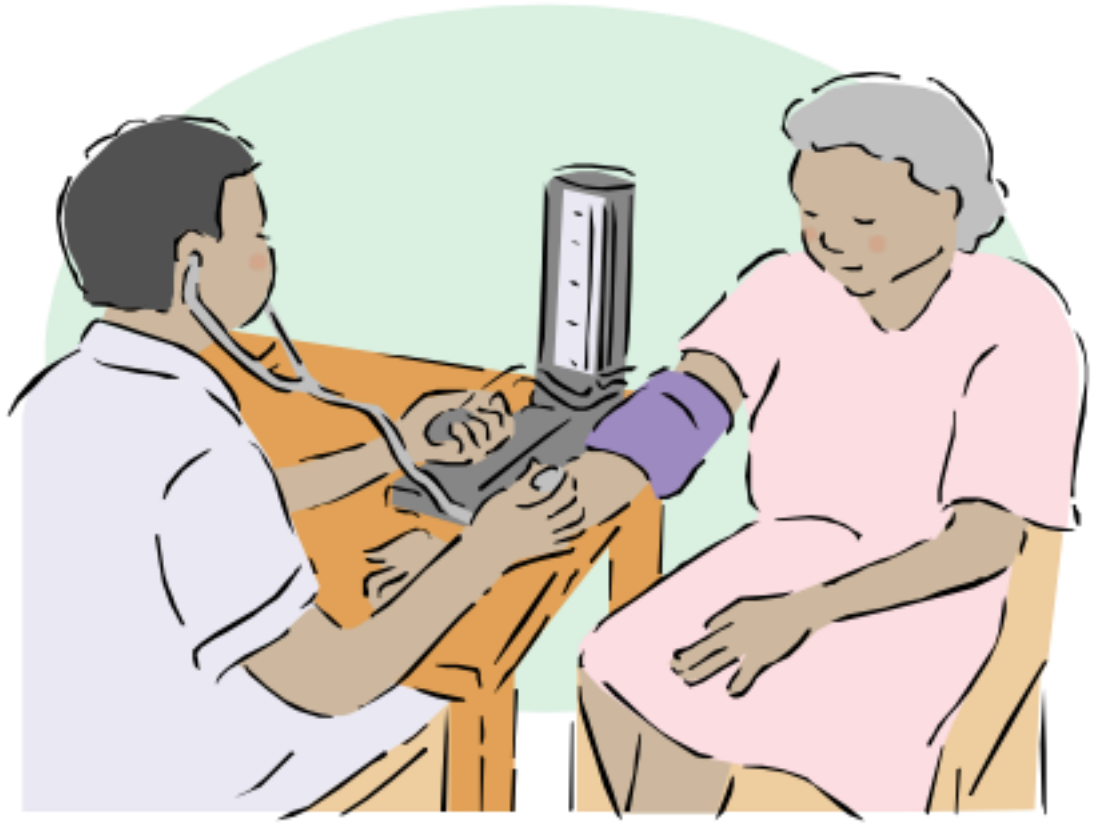
Outline

- Systolic and diastolic blood pressure
- Importance of blood pressure
- Instruments used for estimation blood pressure
- Procedure of blood pressure by using sphygmomanometer

Objectives

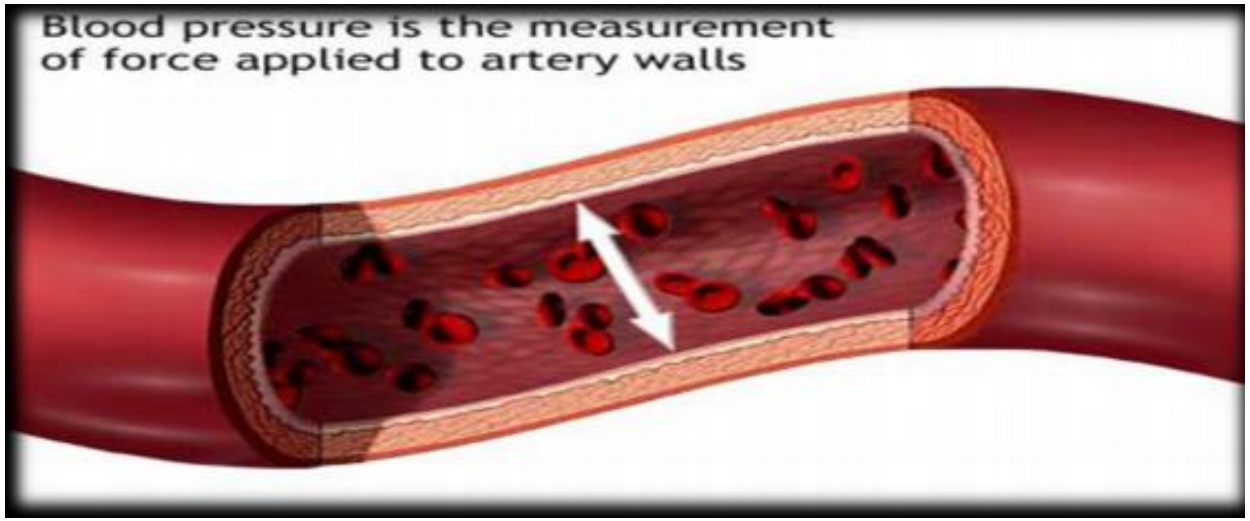
- Understanding the basics of blood pressure
- Understanding the systolic and diastolic blood pressure
- Understanding the importance of blood pressure
- Able to measure blood pressure by sphygmomanometer

Blood Pressure

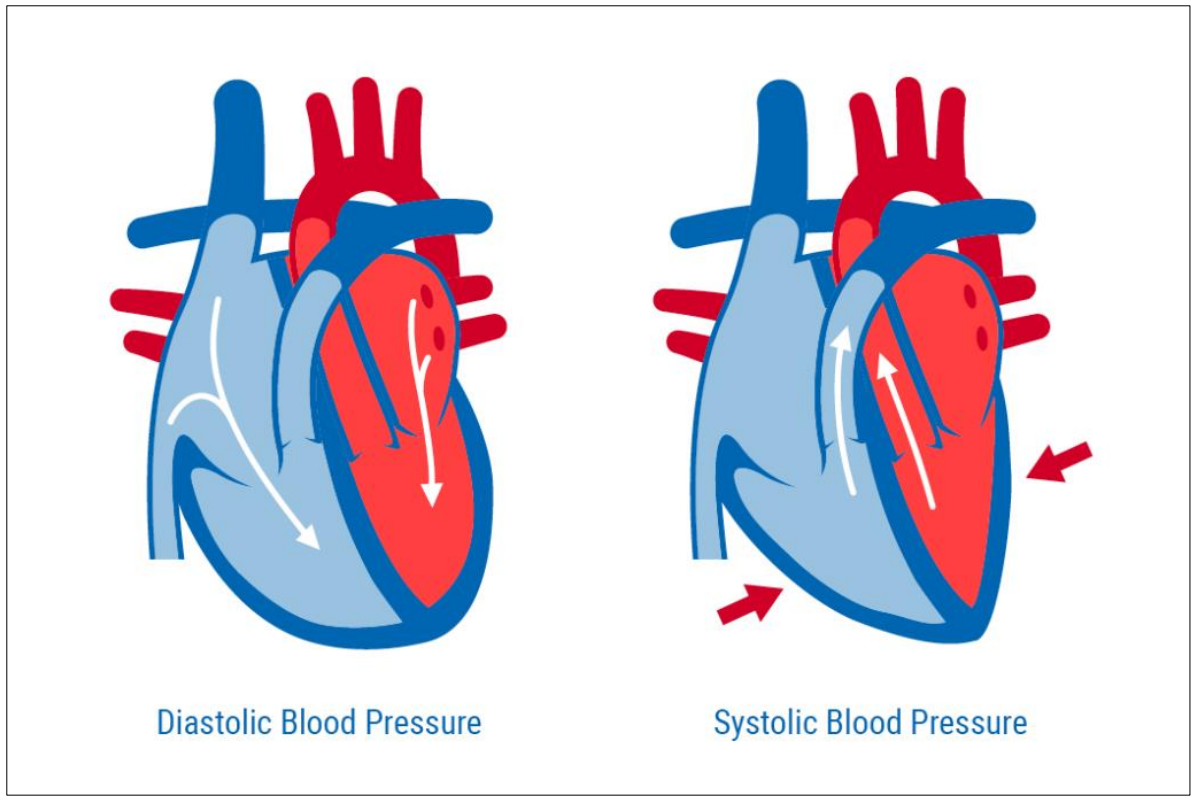


ARTERIAL BLOOD PRESSURE Definition

- Blood pressure is the force exerted by the blood against the walls of the arteries as it is pumped by the heart throughout the circulatory system. It is typically expressed as two values: **systolic** and **diastolic** pressure, measured in millimeters of mercury (mm Hg).

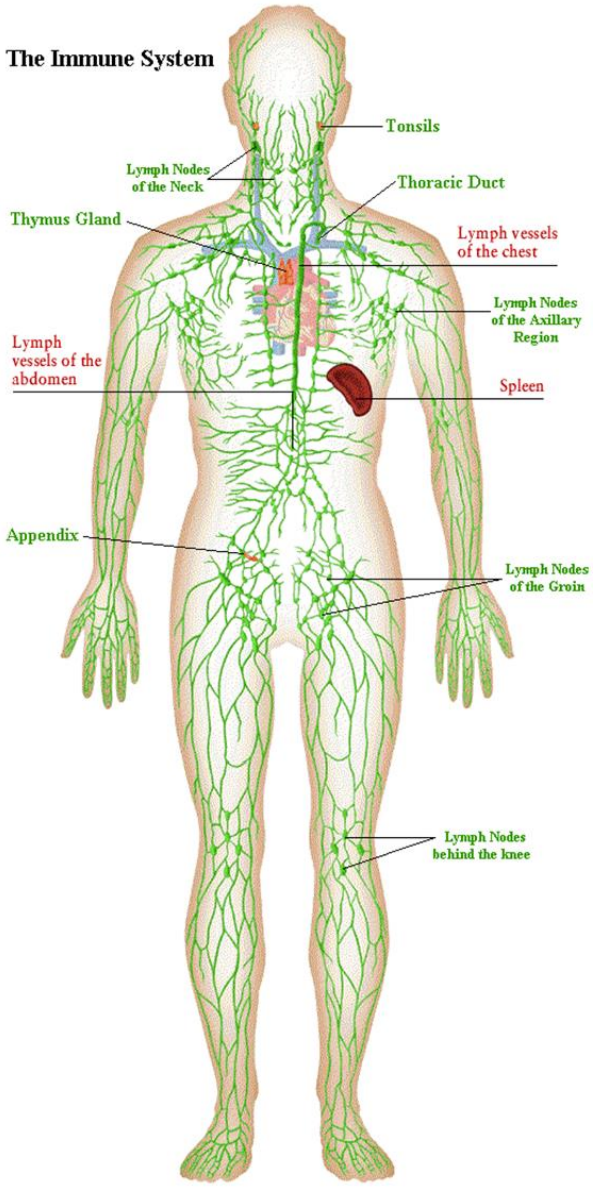


- **Systolic Pressure:** This is the higher of the two values and represents the pressure in the arteries when the heart contracts or beats. It is the maximum force of blood against the arterial walls.
- **Diastolic Pressure:** This is the lower of the two values and represents the pressure in the arteries when the heart is at rest between beats. It is the minimum force of blood against the arterial walls.



SIGNIFICANCE

1. To ensure the blood flow To various organs of the body . **Organ Function:** Adequate blood pressure ensures that vital organs such as the brain, kidneys, and liver receive the necessary blood supply for their proper function. Low blood pressure (hypotension) can lead to inadequate perfusion of these organs.
2. Plays an important role in exchange of nutrients and gases across the capillaries.
3. Required to make urine.
4. Required for the formation of the lymph.



Blood pressure facts

- Blood pressure is recorded as systolic over diastolic e.g. **120/60. mmHG**

Normal range

  - **Systolic Pressure:** Less than 120 mm Hg
  - **Diastolic Pressure:** Less than 80 mm Hg

- Blood pressure values are reported in millimeters of mercury (mmHg).
- The pressure of the circulating blood decreases as blood moves through arteries, arterioles, capillaries, and veins.
- Measures of arterial pressure are not static but undergo natural variations from one heartbeat to another and throughout the day.
- Blood pressure also changes in response to **stress**, **nutritional factors**, age, **drugs**, or **disease**.

Hypertension

Blood Pressure Category	Top Number (Systolic)		Bottom Number (Diastolic)
Normal	Less than 120	AND	Less than 80
Elevated	120 to 129	AND	Less than 80
High Blood Pressure Stage 1	130 to 139	OR	80 to 89
High Blood Pressure Stage 2	140 or higher	OR	90 or higher
Hypertensive Crisis	Higher than 190	AND/OR	Higher than 120

Category	Specific Factor / Mechanism	Physiological Effect	Result on Blood Pressure
Neural (Sympathetic Nervous System)	Overactivation of sympathetic nerves	↑ Heart rate, ↑ cardiac contractility, ↑ vasoconstriction	↑ Cardiac output and ↑ peripheral resistance
Renal (Kidney-related)	Sodium and water retention	↑ Blood volume and ↑ stroke volume	↑ Cardiac output → ↑ BP
	Overactive Renin–Angiotensin–Aldosterone System (RAAS)	Angiotensin II → vasoconstriction; Aldosterone → sodium and water retention	↑ Peripheral resistance and ↑ blood volume
	Impaired pressure-natriuresis (kidney unable to excrete sodium properly)	Sodium retention even at normal BP	Chronic volume expansion → ↑ BP
Cardiac Factors	Increased cardiac output (e.g., due to ↑ HR or stroke volume)	Heart pumps more blood per minute	↑ Systolic pressure
Vascular (Blood Vessel) Factors	**Arterial stiffness (loss of elasticity)**	Less compliance → higher resistance during systole	↑ Systolic BP, widened pulse pressure
	Atherosclerosis (cholesterol accumulation)	Narrowed lumen and hardened wall	↑ Peripheral resistance → ↑ BP
	Endothelial dysfunction	↓ Nitric oxide (vasodilator), ↑ endothelin (vasoconstrictor)	↑ Vascular tone → ↑ BP
	Vascular remodeling (wall thickening)	Reduced lumen size and elasticity	Chronic ↑ vascular resistance

Hormonal Factors	↑ Catecholamines (epinephrine, norepinephrine)	↑ HR, vasoconstriction	↑ BP
	↑ Cortisol (stress or Cushing's)	Enhances vasoconstriction and fluid retention	↑ BP
	↑ Insulin (insulin resistance)	Promotes sodium retention and sympathetic activity	↑ BP
Dietary Factors	High salt intake	Expands extracellular fluid volume	↑ BP
	Excess alcohol	Stimulates SNS and RAAS	↑ BP
Lifestyle / Environmental	Obesity	↑ SNS activity, ↑ RAAS, ↑ insulin resistance	↑ BP
	Sleep apnea	Intermittent hypoxia → ↑ SNS and RAAS	↑ BP
	Smoking	Endothelial damage, ↑ catecholamines	↑ BP
Genetic Factors	Sodium channel or RAAS gene variants	Altered salt handling or vascular tone	Predisposition to hypertension
Age-related Changes	Arterial stiffness and endothelial dysfunction	↓ Elasticity and vasodilation	↑ Systolic BP

Common Symptoms of Severe or Uncontrolled Hypertension

- Headache (especially morning, back of head), dizziness, confusion, blurred vision
- Chest pain (angina), palpitations, shortness of breath
- Blurred or double vision, vision loss (due to retinal damage)
- Swelling of ankles or feet, frequent urination (especially at night)
- Fatigue, nosebleeds (in severe cases), anxiety

If blood pressure rises rapidly above 180/120 mmHg, it can cause:

- **Severe headache**
- **Blurred vision**
- **Chest pain**
- **Shortness of breath**
- **Nausea or vomiting**
- **Seizures**
- **Loss of consciousness**

Hypotension

Hypotension means **abnormally low blood pressure** — when the pressure of blood in the arteries is **too low to deliver enough oxygen and nutrients** to organs and tissues.

- **Systolic BP < 90 mmHg**
- **and/or Diastolic BP < 60 mmHg**

Blood pressure = **Cardiac Output × Peripheral Resistance**

So, hypotension can result from:

- ↓ **Cardiac output** (less blood pumped)
- ↓ **Peripheral vascular resistance** (vessels too dilated)
- ↓ **Blood volume** (bleeding, dehydration)

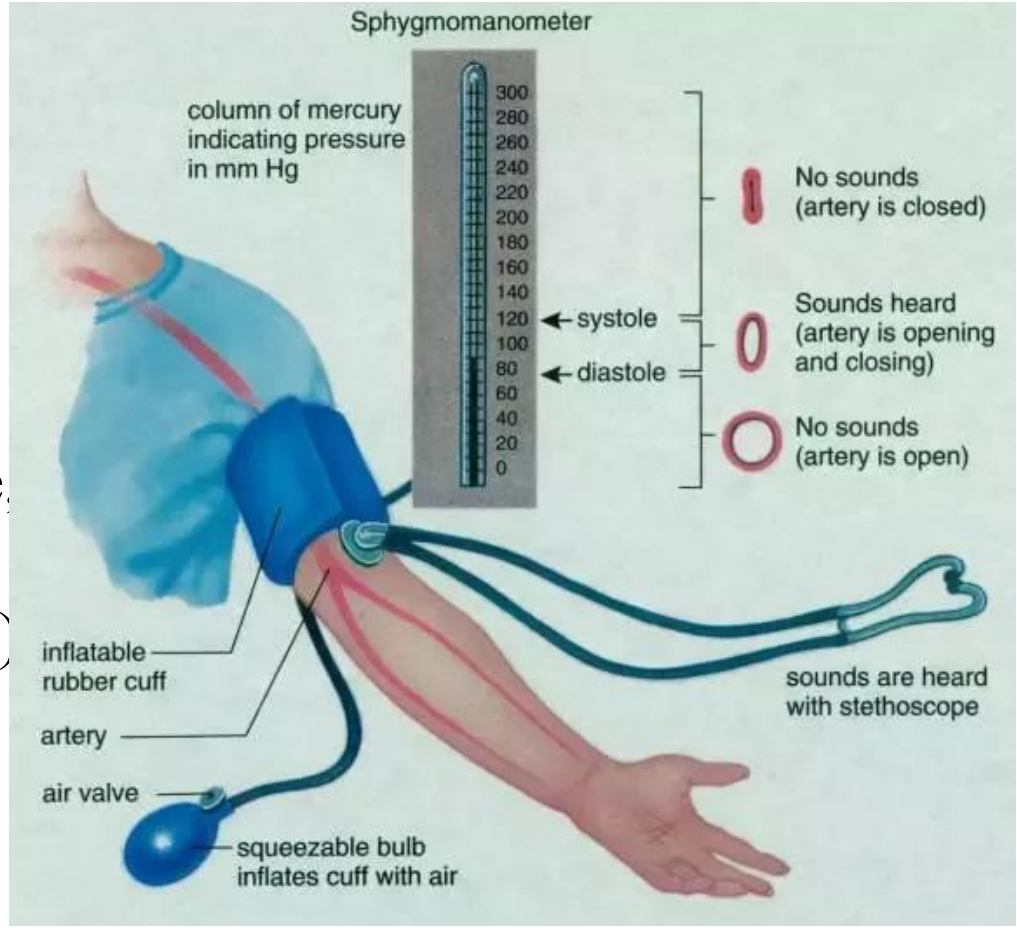
Hypotension is clinically significant when it causes symptoms or organ dysfunction, such as:

- Dizziness or fainting
- Blurred vision
- Weakness or fatigue
- Cold, clammy skin
- Confusion
- Rapid, shallow breathing
- Low urine output
- If severe or prolonged → may lead to **shock** and **organ failure**.

INDIRECT METHOD

Human Arterial blood pressure is measured by a ***sphygmomanometer***. This consists of:

1. A rubber bag surrounded by a cuff.
2. A manometer (usually a mechanical gauge, sometime electronic, or a mercury column)
3. An inflating bulb to elevate the pressure.
4. A deflating valve.

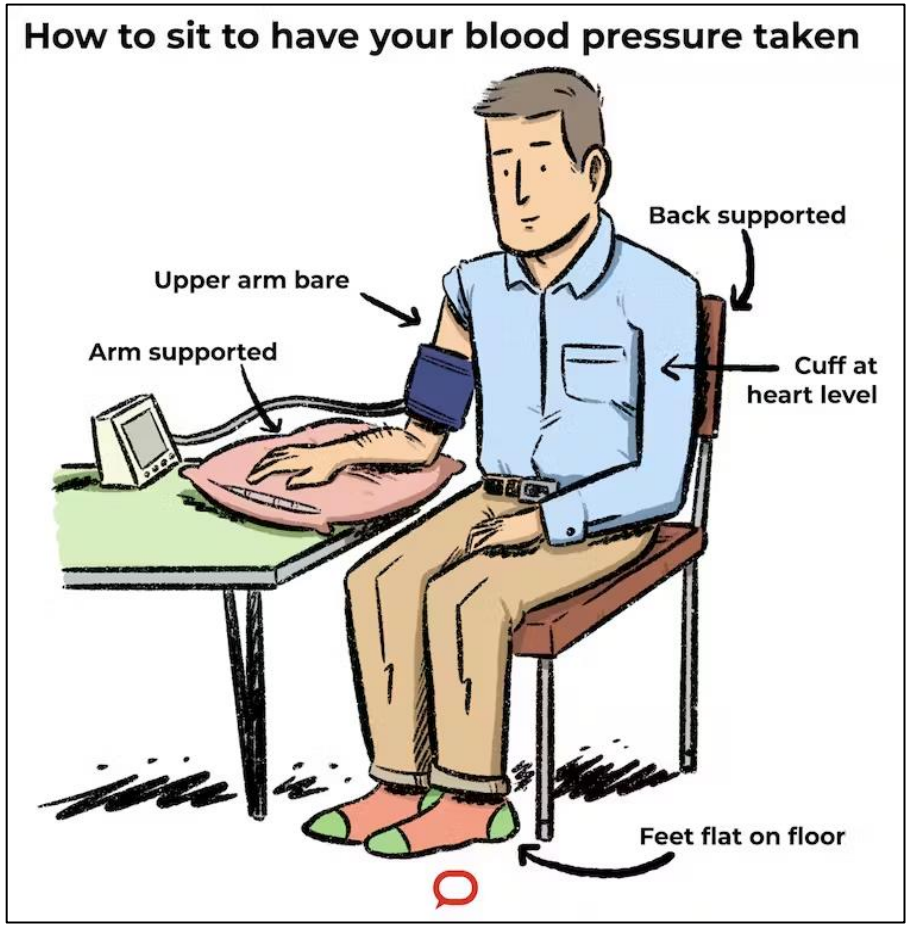



WelchAllyn
Speidel + Keller
pressostabil
OMRON
SYS
DIA
START


NET

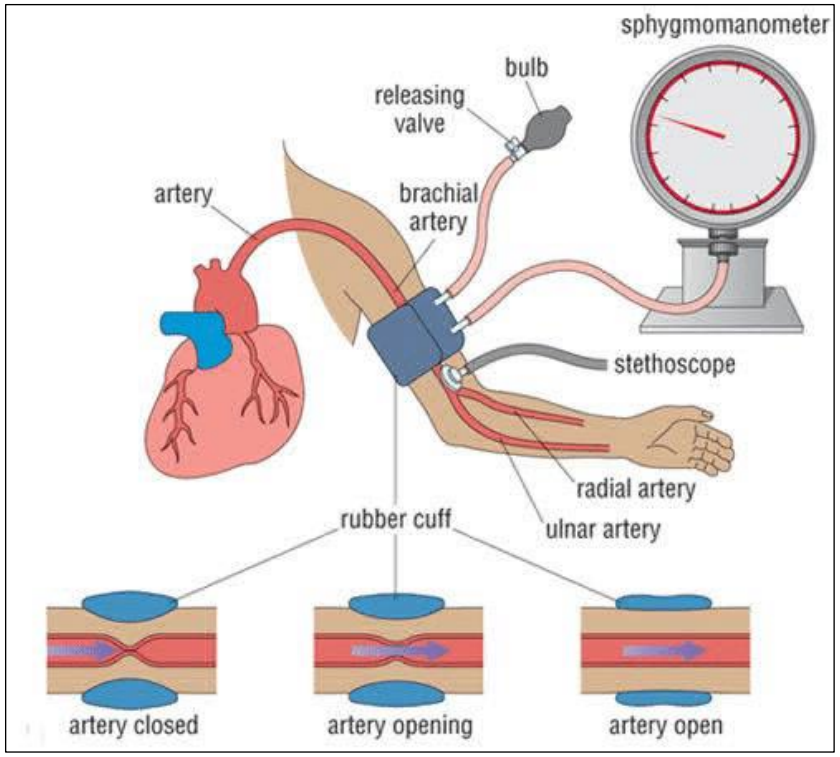
Measuring blood measurement tips

- HCP need adequate training and should have their performance reviewed periodically
- Devices for measuring BP must be properly validated, maintained and regularly recalibrated according to manufacturers instruction.
- Ensure an appropriate cuff size for the patient's arm is used
- Standardize the environment; **relaxed temperate** setting with the person quiet and **seated with arm outstretched** and **supported**
- Palpate the radial or brachial pulse before measuring BP

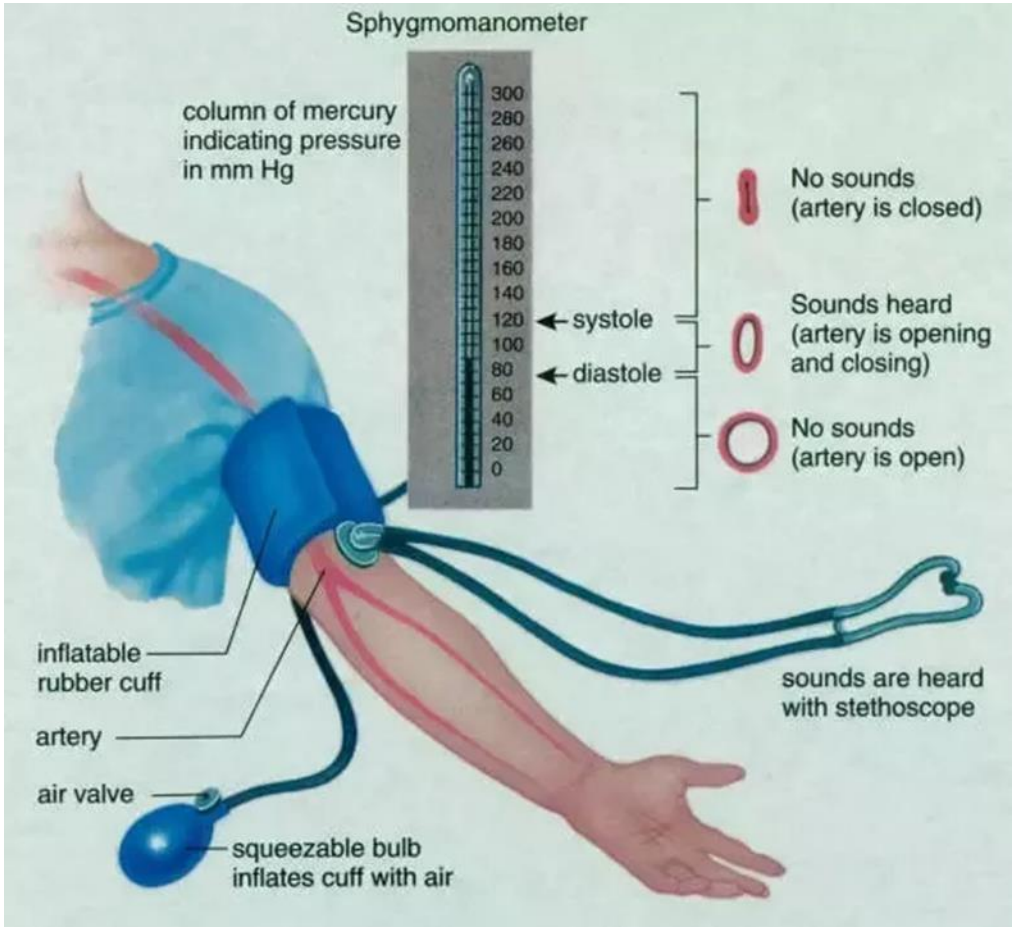


Procedure

1. The sphygmomanometer is placed on a bench where the subject cannot see the mercury column.
2. Blood pressure is recorded after the subject has rested quietly for 5 minutes, and this measure should precede all other measures.
3. The subject is seated with the arm resting on the bench, the elbow approximately at the level of the heart.
4. Wrap the deflated cuff around the upper arm, just above the elbow crease, with the arrow on the cuff pointing directly at the **brachial** artery. Ensure the cuff is snug but not overly tight.
5. The stethoscope is placed over the **brachial artery** in the cubital fossa. The pressure is released at a rate of approximately 2 mm per second.

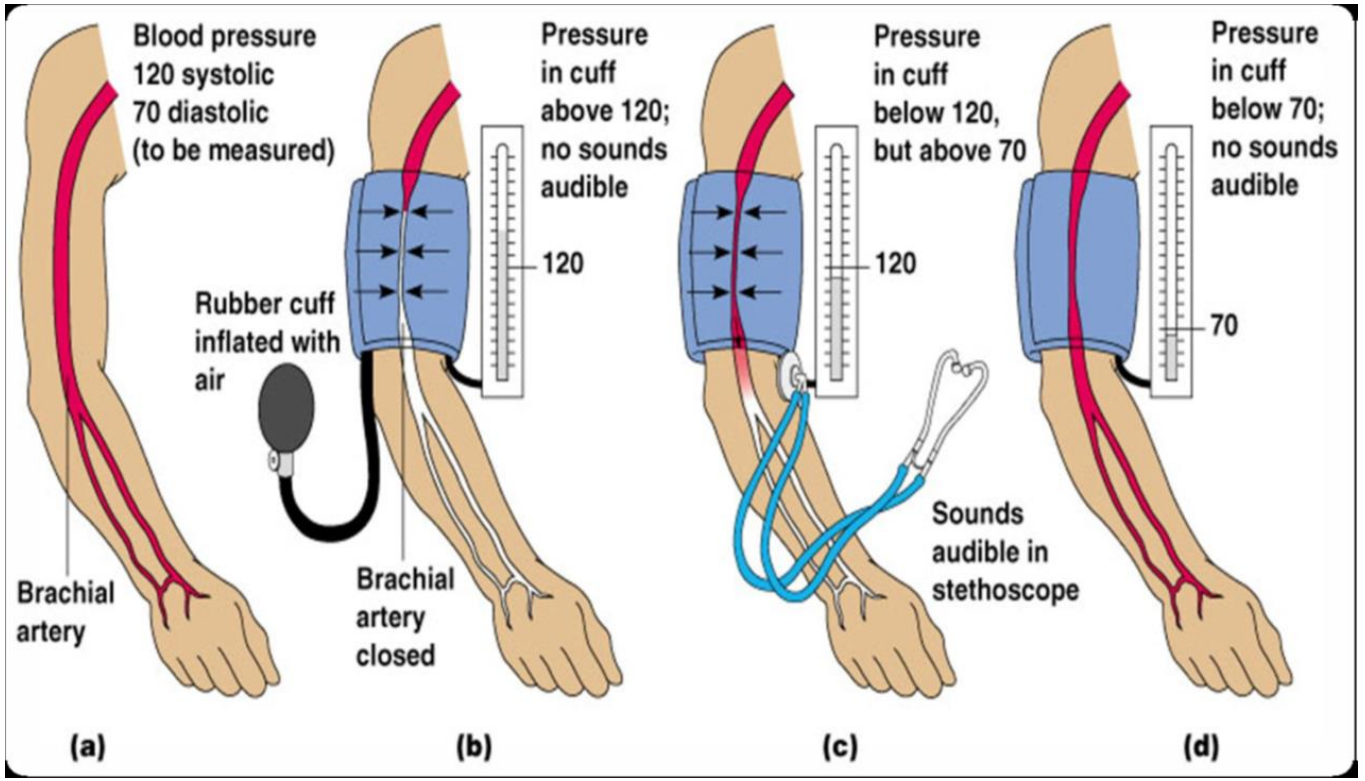


6. Locate the **radial artery** on the wrist (by palpation) to estimate the approximate systolic pressure.
7. Inflate the cuff by squeezing the bulb while looking at the pressure gauge. Inflate the cuff until the pressure is well above the expected systolic pressure (usually around 160-180 mm Hg).
8. Gradually release the pressure by opening the valve or releasing the bulb's pressure. This should be done at a rate of about 2-3 mm Hg per second.



Listen for Sounds (Korotkoff Sounds):

9. Begin listening for the Korotkoff sounds. The first sound you hear is the systolic pressure, which is the pressure in the artery when the heart is contracting and pushing blood into the arteries.
10. Continue listening for the sounds as the pressure decreases; the point at which the sounds disappear is the diastolic pressure. This is the pressure in the artery when the heart is at rest between beats.

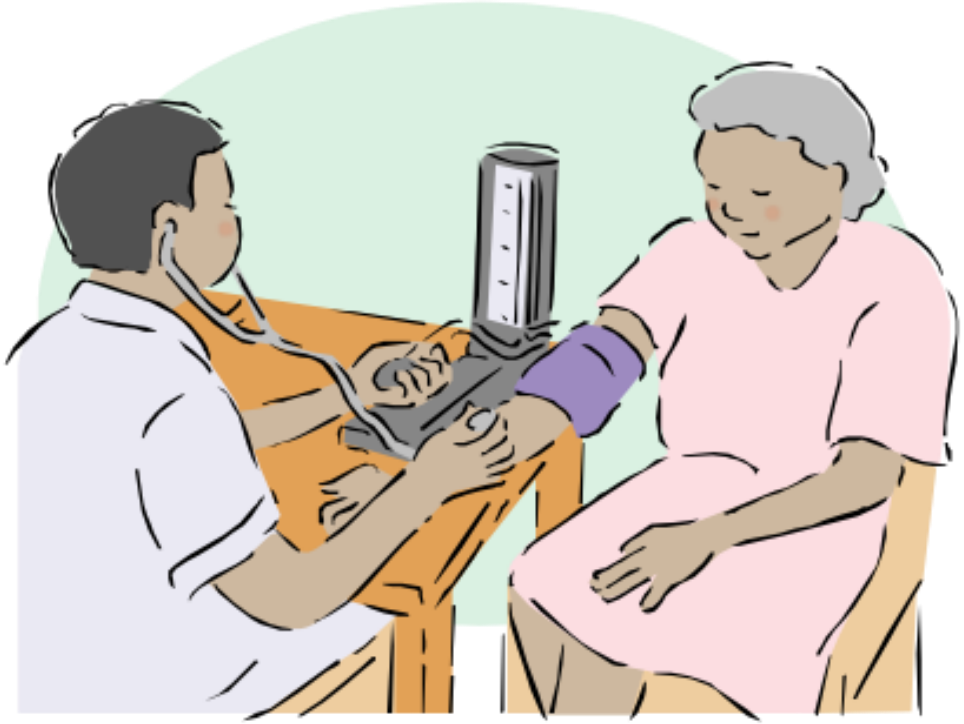


11.Record the Blood Pressure:

A. **Note the systolic pressure when you first hear the Korotkoff sounds.**

B. **Note the diastolic pressure when the sounds completely disappear.**

12. Gradually deflate the cuff fully and remove it from the arm.



References

- Ghai, C. L., M.D. (2012). A Textbook of Practical Physiology. Jaypee Brothers Medical Pub.
- Hall, J. E., & Hall, M. E. (2020). Guyton and Hall Textbook of Medical Physiology. Elsevier.
- Saladin, K. (2020). Anatomy & Physiology: The Unity of Form and Function. McGraw-Hill Education.