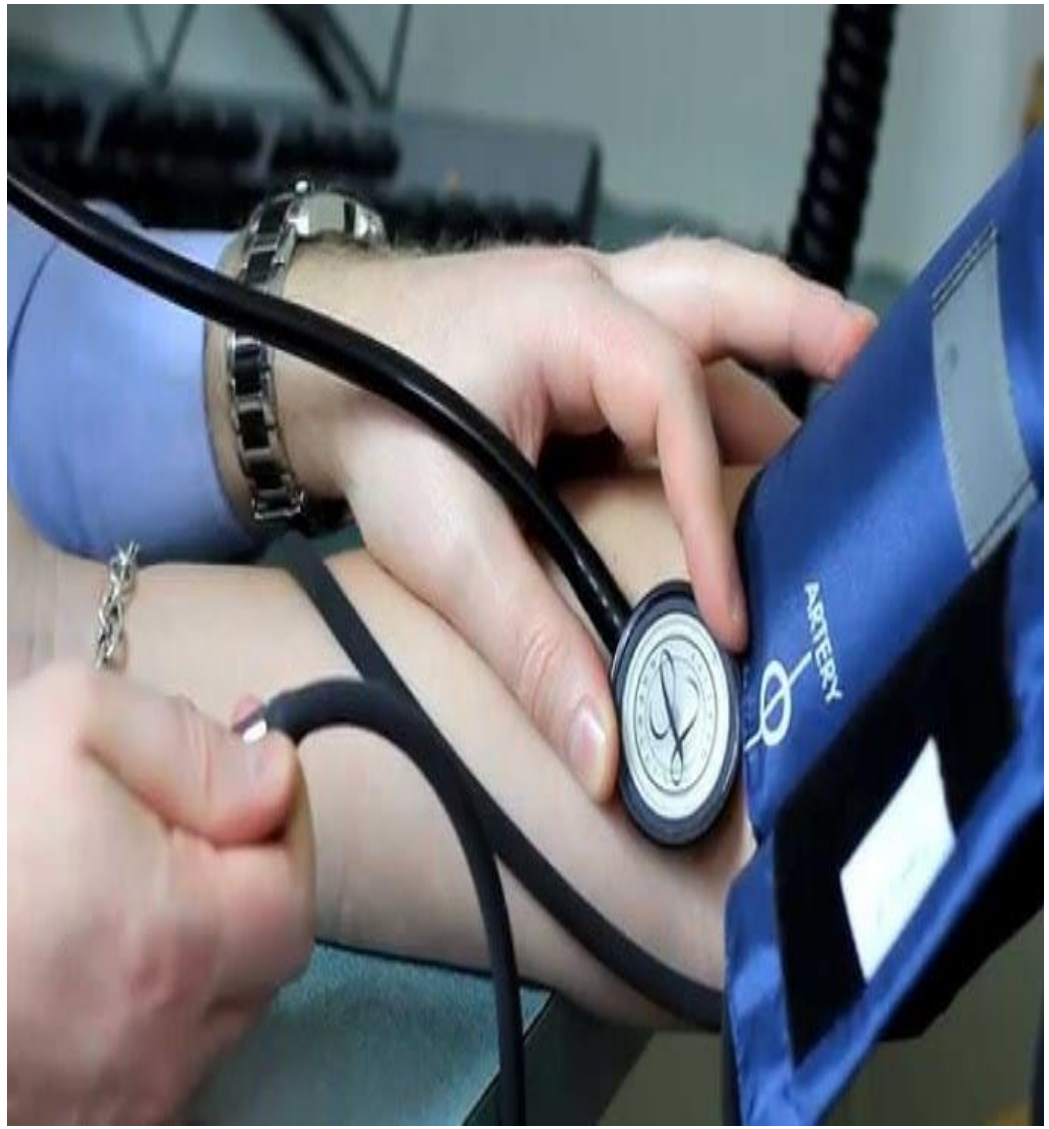
Al-Mustaqbal University
Department (Biomedical Engineering)
Class (4 Stage)
Subject (Medical Measurement lab1-)
Lecturer (Asst.lec.Hiba Diaa Alrubaie)
1st/term – Lect. (Blood Pressure)

Blood pressure (BP) is a fundamental indicator of cardiovascular health, essential for understanding the force exerted by circulating blood against the walls of the arteries. It’s a dynamic measurement that reflects the heart's pumping action, blood volume, blood vessel elasticity, and the resistance within the arteries. Accurate BP measurement is crucial for diagnosing and managing conditions like hypertension, hypotension, and related cardiovascular issues.

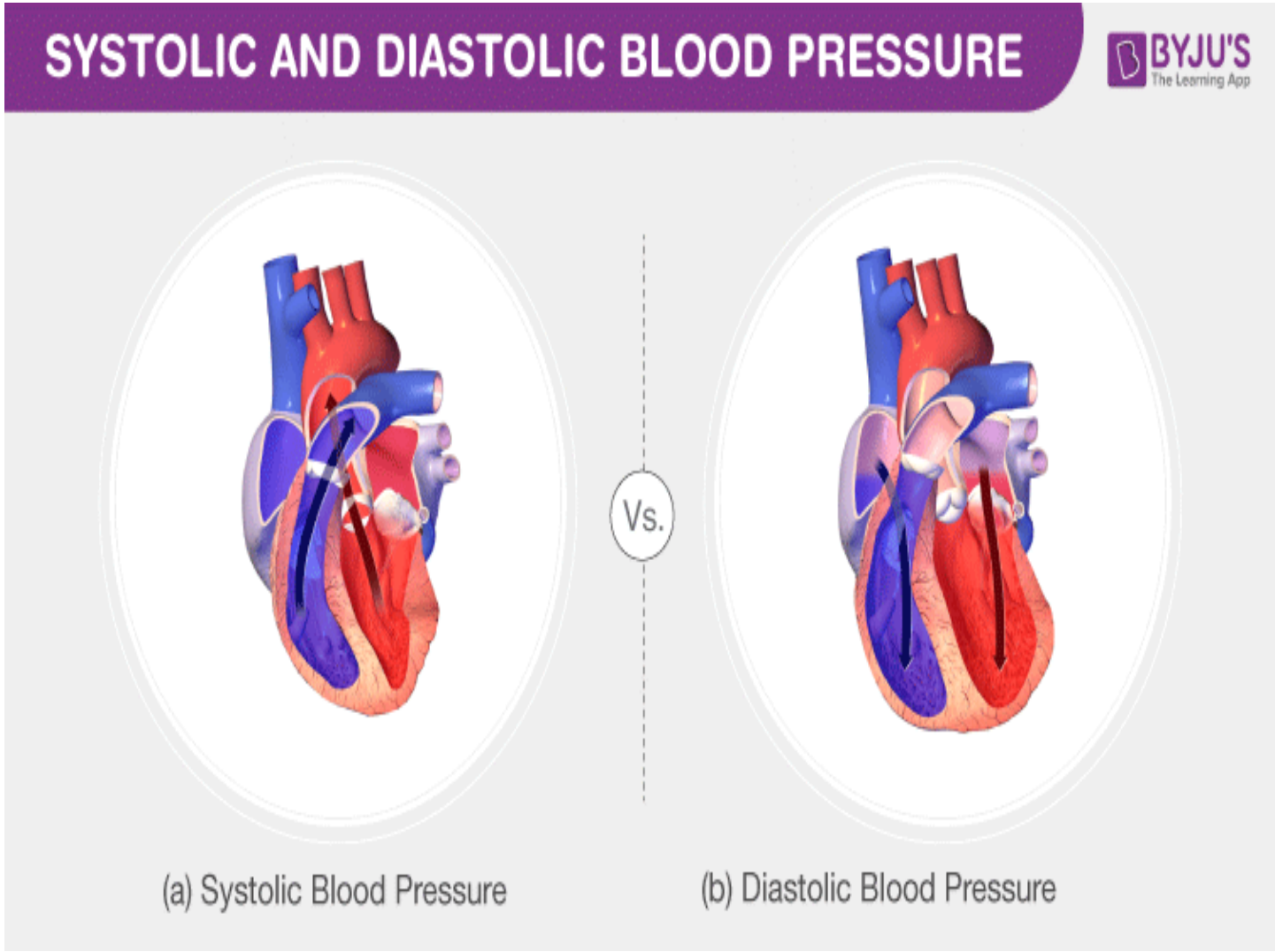
Blood pressure is measured in millimeters of mercury (mmHg), with a healthy adult's BP typically in the range:

•**Normal**: 120 mmHg systolic and 80 mmHg diastolic



Systolic Pressure (top number): Indicates the pressure in the arteries when the heart's ventricles contract and pump blood into the aorta. It represents the maximum arterial pressure during a heartbeat.

Diastolic Pressure (bottom number): Represents the pressure in the arteries when the heart relaxes between beats. This is the minimum arterial pressure, indicating the state of resistance within the arteries when the heart is at rest.



Hypertension

- Physical exertion increases pressure as the heart pumps harder and more rapidly in order to maintain adequate blood supply to muscles.
- When deposits build up in blood vessel walls (arteriosclerosis), the vessel walls become thicker and less elastic, and the interior diameter of the vessels is reduced. Arteriosclerosis can be caused by prolonged periods of hypertension or by excess amounts of cholesterol in the blood, or a combination of these factors, and others.
- The changes of elasticity seen in arteriosclerosis also have an effect on blood pressure waveforms, with a greater difference between systolic and diastolic values. This, combined with the reduced blood flow resulting from narrowed arteries, means that cardiac muscle perfusion is reduced significantly, Persistent hypertension can also cause strokes, aneurisms, and kidney failure.

Hypotension

- Low blood pressure, or hypotension, can also be caused by faulty autonomic nervous system responses, or by blood loss. Some individuals are able to function normally with lower than “normal” blood pressure, and actually may see some health benefits from this situation.
- Abnormally low blood pressure leads to reduced perfusion of all organs, but most significantly, the brain. Reduced cognitive function, dizziness, unconsciousness, and eventually death can result.

How Blood Pressure is Measured

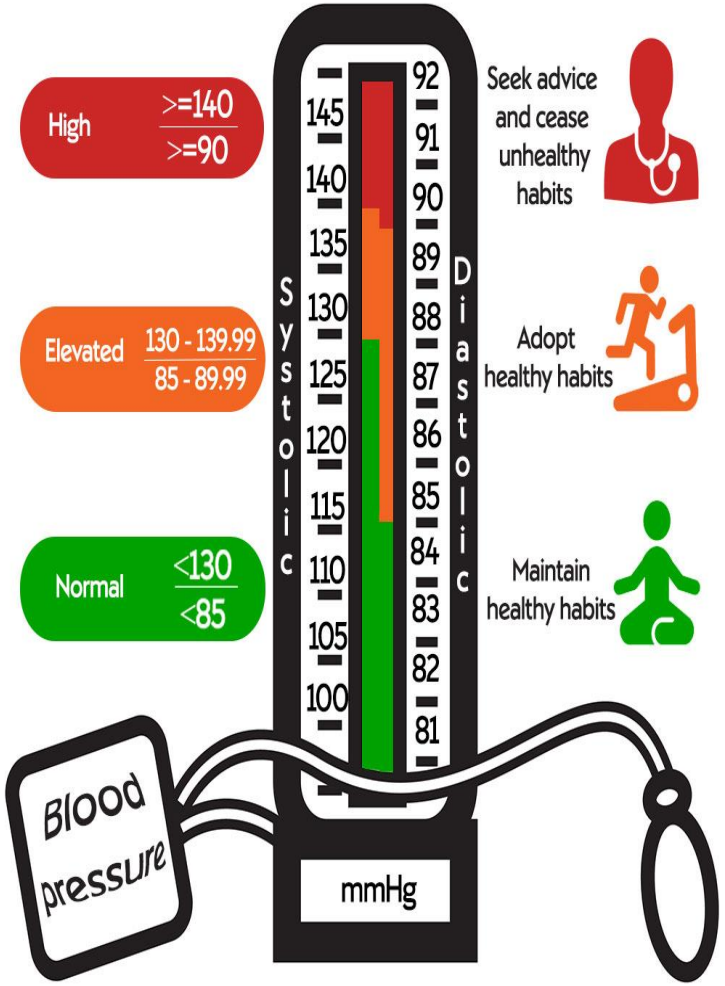
1. Manual Blood Pressure Measurement (Auscultatory Method)

•**Sphygmomanometer and Stethoscope**: This method involves placing an inflatable cuff around the upper arm at heart level and inflating it to stop blood flow in the brachial artery.

•**Procedure**:

- Inflate the cuff to a level above the expected systolic pressure.
- Gradually release air from the cuff while listening to blood flow sounds (Korotkoff sounds) with a stethoscope placed over the artery.
- The first sound indicates systolic pressure, while the point where sounds disappear corresponds to diastolic pressure.

•**Korotkoff Sounds**: These sounds, produced by blood flow changes in the arteries, help determine systolic and diastolic values.



2. Automated Blood Pressure Monitors (Oscillometric Method)

•**Digital Blood Pressure Monitors**: These devices are more convenient, widely used in clinical and home settings, and don’t require a stethoscope. They detect oscillations in arterial wall movements as the cuff deflates.

•**Procedure**:

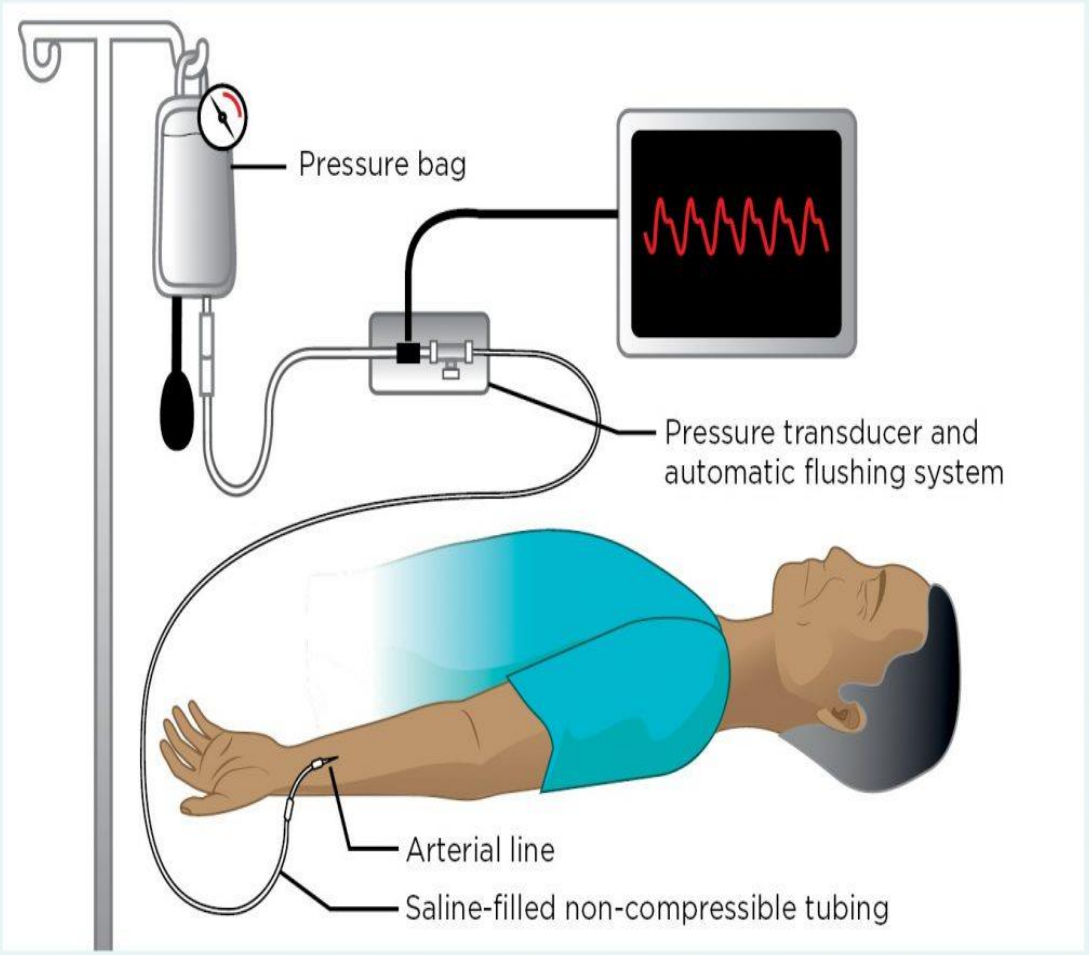
- Place the cuff on the upper arm or wrist (depending on the device).
- The device automatically inflates and deflates the cuff, capturing blood pressure readings digitally.

•**Advantages**: These monitors are easy to use, minimize human error, and often provide an average of several readings.

3. Invasive Blood Pressure Monitors

- Fluid-filled transducer
- Microtip pressure catheter
- The most accurate and timely method of measuring blood pressure is to insert a fine, saline-filled cannula (tube) into the blood vessel or structure of interest. The cannula is connected to a pressure transducer.

Fig 2. **Arterial line connection**



Factors Affecting Blood Pressure Readings

- Several physiological and external factors can impact BP readings:
- **Time of Day**: BP tends to be lower in the morning and higher in the afternoon and evening.
- **Body Position**: BP can vary if measured lying down, sitting, or standing.
- **Physical Activity**: Exercise can temporarily increase BP, though regular exercise tends to lower resting BP.
- **Diet**: High sodium intake raises BP, while potassium and magnesium have a lowering effect.
- **Emotions and Stress**: Stress and anxiety can raise BP due to increased sympathetic nervous system activity.
- **Cuff Size and Placement**: A cuff that is too small or improperly placed can produce inaccurate readings.