SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)
Coimbatore -35.

19BMT202

Biomedical Sensors and Measurement

Unit – 4 Measurement of Non-Electrical Parameters

UNIT IV
Measurement of Non-Electrical Parameters

Measurement of B.P.

- **Two methods:** Direct & indirect

Sphygmomanometer:

Indirect method, "Estimate of pressure"

Has many types:

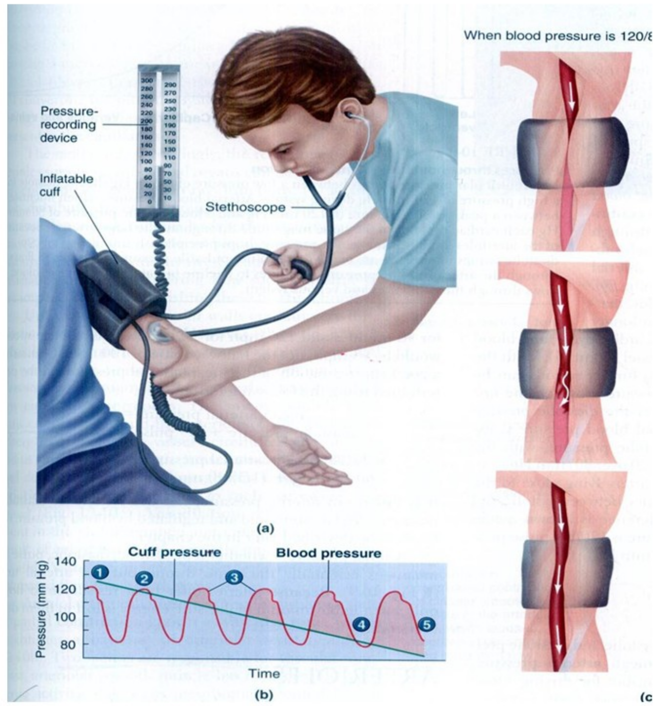
- Mercury sphygmomanometer
- Aneroid equipment
- Automatic equipment

Blood Pressure Cuff Size:

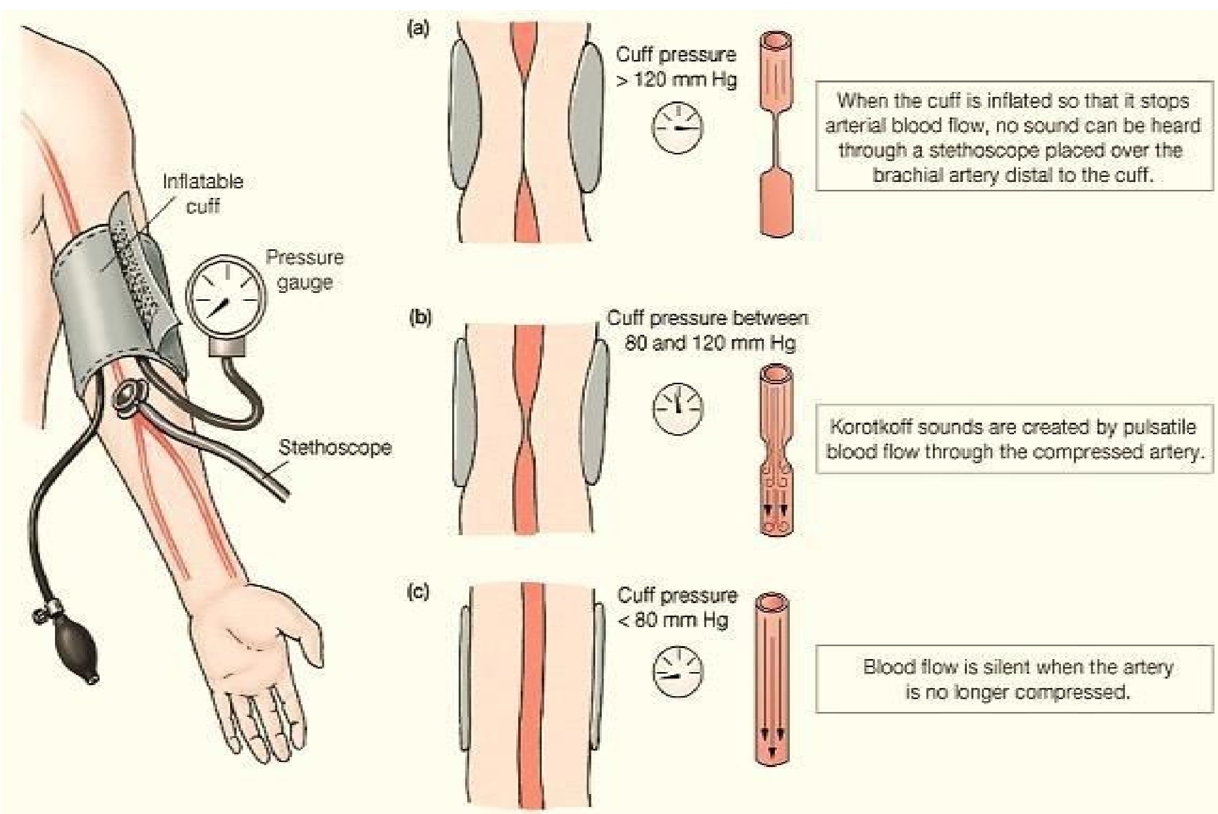
- Small - children & small adults
- Average
- Large - overweight & large adults

Measurement of B.P.

the cuff is normally placed around an upper arm, at the same vertical height as the heart then Increase the pressure to 150 manual instrument, listening with a stethoscope to the brachial artery at the elbow, then slowly releases the pressure in the cuff. As the pressure in the cuffs falls, a "whooshing" or pounding sound is heard (Korotkoff sounds) when blood flow first starts again in the artery. The pressure at which this sound began is noted and recorded as the systolic blood pressure. The cuff pressure is further released until the sound can no longer be heard. This is recorded as the diastolic blood pressure.

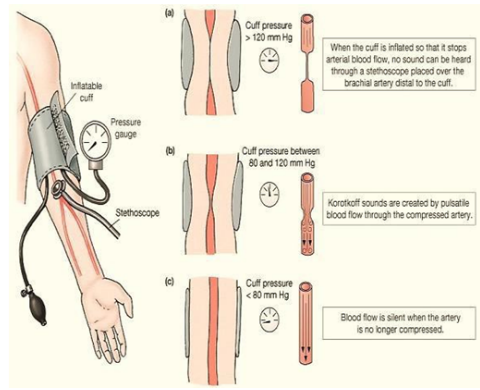


auscultatory method

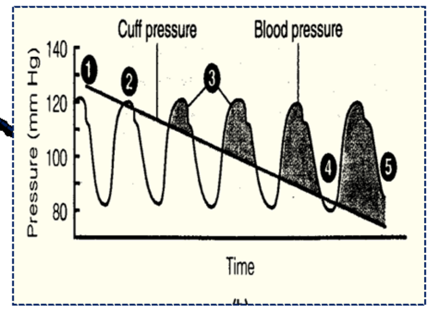


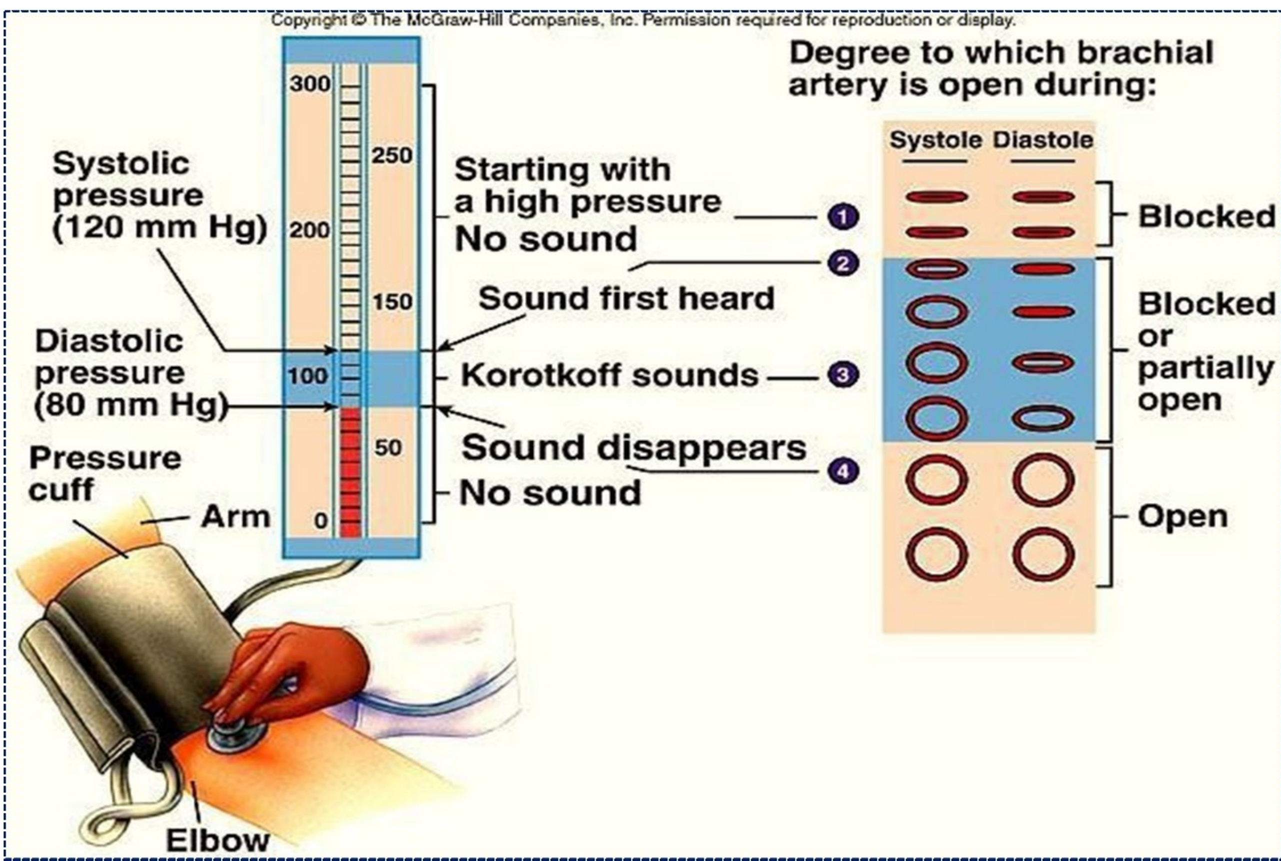
Measurement of B.P.

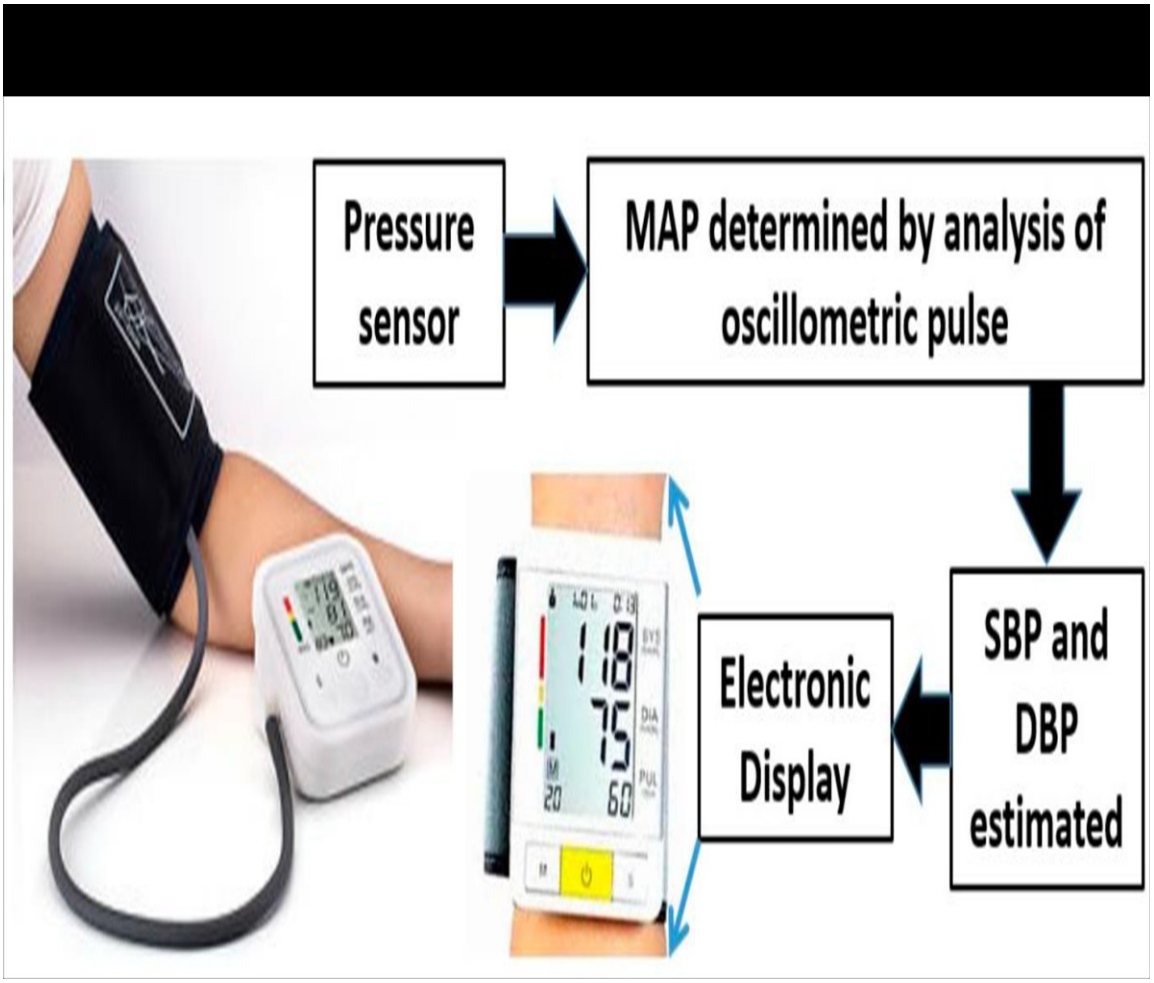
- BP is measured by listening for Korotkoff sounds produced by turbulent flow in arteries:
  - **Systolic pressure**
    = when 1st sound is heard
  - **Diastolic pressure**
    = when last sound is heard



- **Cuff pressure** > **systolic** blood pressure : No sound
- The first sound is heard at peak systolic pressure.
- Sounds are heard while **cuff pressure** < **blood pressure**.
- Sound disappears when **cuff pressure** < **diastolic pressure**.







Principle of oscillometric blood pressure management

Oscillometric measurement devices measure the amplitude of pressure changes in the occluding cuff as the cuff deflates from a pressure above the systolic pressure.

As the cuff pressure decreases, the pressure changes (pulsations) increase in amplitude. They reach a maximum, which approximates to the mean arterial pressure (MAP), and then diminish.

The result is a characteristic oscillometric amplitude profile, or “oscillation envelope”.

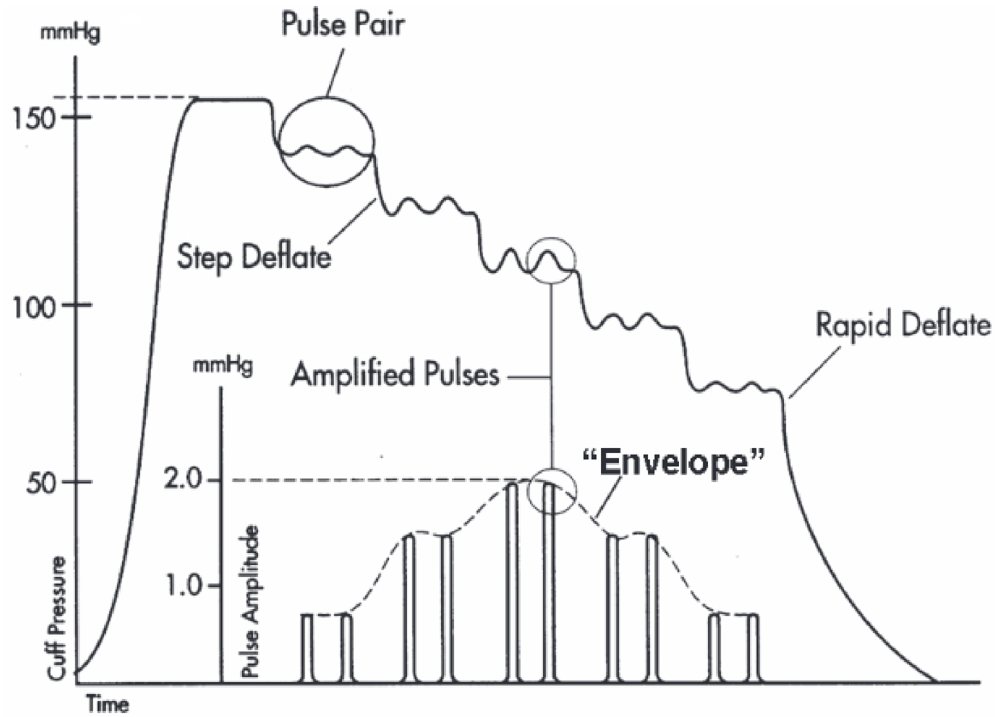


Figure 1: Oscillometric method

An algorithm analyzes the oscillation envelope and computes the systolic, mean, and diastolic pressures.

In an ideal case for an oscillometric NBP measurement, you inflate the cuff pressure to slightly above the patient's "expected" systolic blood pressure, then deflate the cuff in a reasonable number of discrete steps.

At each step, measure the oscillation amplitude of one pulse beat. An ideal, stable patient is one who is not moving during the entire measurement, has a heart rate of about 60 bpm and a normal blood pressure of about 120/80 mmHg.

For this patient, you could derive an accurate envelope curve with about 10 pressure deflation steps, using step sizes of about 8 mmHg.

With one pulse per step and pulses coming in every second, you would need about 10 seconds to assess the envelope in order to determine the patient's blood pressure. Allow another 20 seconds for cuff inflation, and you get a good systolic and diastolic blood pressure reading in about 30 seconds.

Number of pulsations per step versus inflation time

Unfortunately the typical pulsation signals from real patients, under real clinical conditions, are never as ideal as described above.

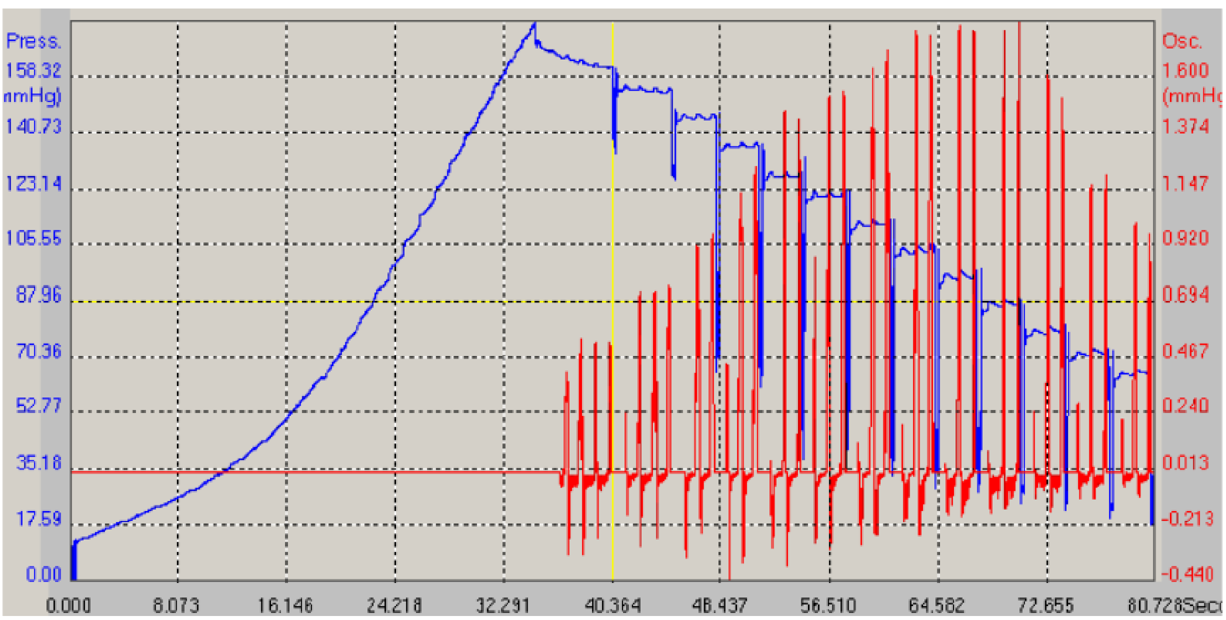


Figure 2: Cuff pressure and pulsation amplitudes

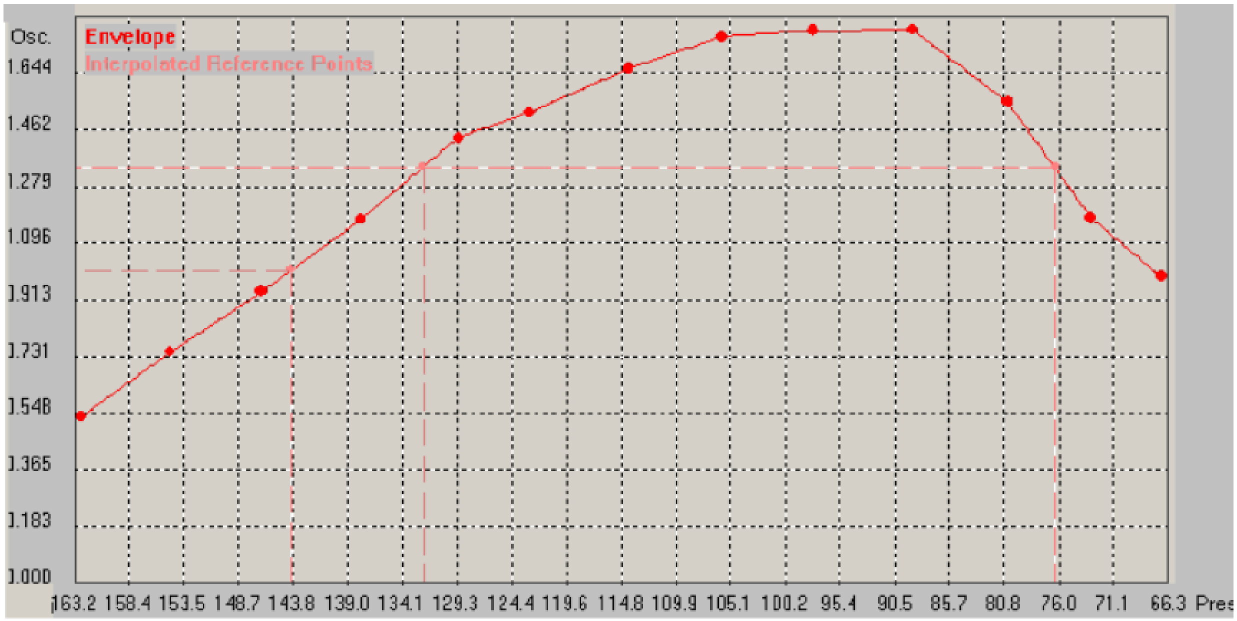


Figure 3: Ideal amplitude profile “envelope”

Figure 2 and Figure 3 show raw amplitudes and the resulting envelope taken from a real, straight forward, and easy-to-read oscillometric measurement with no obvious artifact.

This gives very reliable systolic, diastolic, and mean blood pressure results. This example still comes close to the ideal picture.

However, instead of one pulsation, at least two pulsations were measured for each deflation step, meaning that the measurement time has already more than doubled. A meaningful envelope curve is the basis for a reliable NBP measurement

Key differences between oscillometric and auscultatory methods

With the **auscultatory method,** the clinician assesses the systolic and diastolic pressures by using a stethoscope. It is important to understand that in the auscultatory method, the systolic and diastolic points are well defined by the sudden appearance and disappearance of sounds.

In the **oscillometric method**, they are more vaguely and empirically determined points on a continuously varying amplitude profile. This profile never goes fully to zero and can easily be distorted by artifact and physiological differences between patients. Usually, it is possible to find a maximum point on the envelope curve that approximately represents the mean arterial pressure displayed by the monitor. However, with a distorted or small oscillation envelope, it can become quite challenging to determine systolic and diastolic levels. In such cases, the algorithm as implemented provides only a mean pressure reading.