Basic Operating Principles and Uses of Clinical Thermometer and Stethoscope

Learning Objectives :

1. Definitions of Temperature and Thermometer
2. Definition of clinical thermometer
3. Working Principle
4. Advantages and Disadvantages
5. Uses of Clinical Thermometer
6. Definition of Stethoscope
7. Working Principle
8. Types of Stethoscope
9. Uses of Stethoscope

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1. Definitions of Temperature and Thermometer:

1.1 Temperature: The temperature of a body is basically a measurement of the degree of hotness and the temperature is nothing but the average kinetic energy of all the molecules present in the body.

There are three main scales of temperature which are used to measure the temperature of a body, namely Celsius scale (°C), Fahrenheit scale (°F) and Kelvin scale (K).

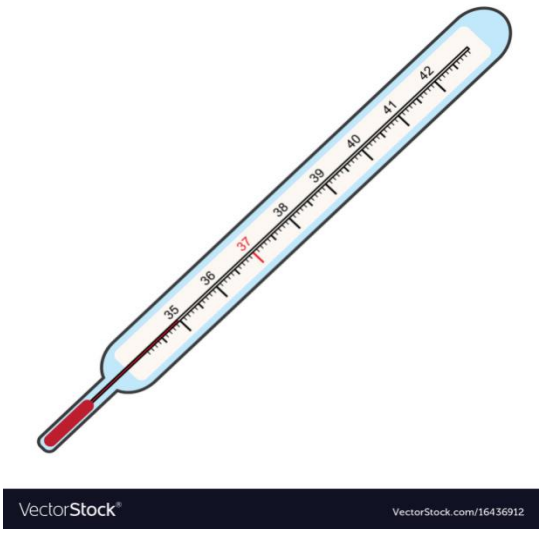
1.2 Thermometer: A thermometer is a device that measures the temperature of a body i.e degree of hotness. They are classified into two types 1. Clinical thermometers and 2. Laboratory thermometers [(1)].

2. Clinical Thermometer :

Clinical thermometer was invented by Thomas Clifford Allbutt in 1866. It is also known as a medical or doctor's thermometer and these are used only to measure the human body temperature. Clinical thermometers with a glass tube filled with mercury were predominant.

- Clinical thermometers are used for clinical purposes.
- It is developed for measuring the human body temperature.
- It has a long narrow glass tube with a bulb containing mercury at the end.
- The normal human body temperature is 37˚C which can vary between 35˚C and 42˚C. Hence, the clinical thermometers have range from 35˚C to 42˚C.
- The level of mercury thread in the capillary reads the temperature of the body in ˚C.
- Since mercury is a toxic, now a days, these thermometers have been replaced by digital thermometers.
- The Laboratory thermometers cannot used for clinical purposes as they have temperature scale ranging from -10 ^{0}C to 110 ^{0}C.

2.1 Design of the clinical thermometer:A clinical thermometer consists of a glass tube with the scale inscribed on it as shown in Figure 1. A glass bulb is provided at one end of the tube and it is filled with mercury. An extremely thin capillary tube runs through the middle of the glass tube. A small kink is provided near the neck the bulb.



Clinical Thermometer

https://tinyurl.com/y2sr4ezv

Digital Thermometer

https://tinyurl.com/58658nzk

3. Working Principle of Clinical Thermometer:

1. Thermometer must be kept clean and sterilized before using.
2. The thermometer is placed inside the mouth of the patient to measure the body temperature of the patient.
3. Due to the heat of the body,mercury in the glass bulb expands and it rises through the thin capillary thread. The new level of mercury thread indicates the temperature of the body.
4. Due to the presence of the kink, the level of the mercury does not fall even after removing the thermometer from the mouth.
5. To bring the mercury back in the bulb, the thermometer needs to be given few jerks or swing sharply a few times. This would allow the mercury to fall back to the glass bulb.

4. Advantages and Disadvantages:

1. In thermometers, mercury is the commonly used material and it is a very good conductor of heat. It expands very quickly when heated. It remains in liquid form over a wide range of temperatures and it is non-adhesive to glass.

2. Ifthe mercury leaks while measuring the temperature of a patient, it can cause serious problem as it is poisonous. To overcome this, the electronic digital thermometers and scanner thermometers are gradually replacing mercury thermometers.

5. Uses of Clinical Thermometers:

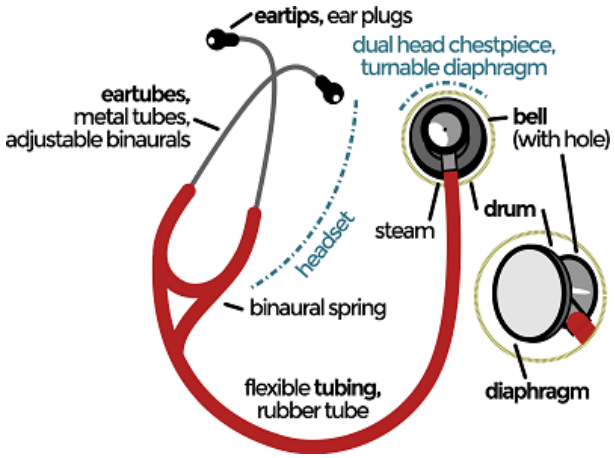
1. Clinical thermometer is used for the measurement of the temperature of a human body.
2. These are also used to measure the temperature of animals.
3. Women can use these clinical thermometers to predict fertile periods.
4. The thermometers are used in the field of medical science, meteorology, food technology, engineering applications etc.

6.Stethoscope:

6.1 Definition:Stethoscope is a device normally used by medical practitioners to listen to the sound of heart beat of human body or an animal and blood pressure (BP) in veins and arteries.

The word *stethoscope* is derived from the two Greek words, *stethos* (chest) and *scopos* (examination) and it is used to listen the sounds from heart and chest. It is also used to hear bowel sounds and blood flow noises in arteries and veins [(2)].

A typical stethoscope consists of a round shaped resonator or chest piece and a long tube. The tubes are connected to the ears while the resonator is placed on the chest to transmit the sound. These devices are used to monitor acoustic sound variation and also to check the scientific vacuum chambers.



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6.2 A typical stethoscope consists of:

- A round shaped resonator or chest piece. The round shaped resonator is made up of a bell and diaphragm.
- Tubing
- Binaural
- And a pair of head-set

Round Shape Resonator: This part of the stethoscope touches the chest of the patient to capture chest's sound. The round shape resonator consists of a diaphragm and a bell.

The Diaphragm*:* This is the lower part of the chest piece. It is a flat metallic disc surrounded by chill rings which enable it to pick a very high pitch sound.

Bell: The smaller part of the resonator is called bell. It is made up of hollow piece of metal which helps at picking up low frequency sounds.

Tubing: This is a long tube made of polyvinyl chloride and latex rubber. It is flexible and durable and it helps to reach the patient with ease.

Head Set: This part of the stethoscope is responsible for transmission of the sound from the round shaped resonator to the listener's ears. A metal is always inserted into the stethoscope tubing to convey the sound. The ear tip of the headset is always surrounded by a rubber which serves as a support to the headset.

Binaural: These are metallic piece that are inserted into the stethoscope tube, which directly plays the role of transmitting the sound from the chest piece into the listener's ears.

7. Working Principle of A Typical Stethoscope :

Whenever a medical practitioners place a stethoscope diaphragm on a chest of a patient, a vibration will occur at the flat surface of the stethoscope. As a result, the sound waves which is generated from the patient's body. The vibration picked by the diaphragm is being protected externally in order to prevent loss of sound and channelled through the tube in a specific direction. Inside the tube, multiple reflections occur and this continues in succession until it reaches the ear tips at the other ends of the device[(3)].

For example, the heartbeats are of high pitch which travel at a very high frequencies and cause a lot of pressure variations at a given period of time. The sound waves thus produced set the diaphragm into vibrations and the same sound wave travels through the stethoscope tube and to the listener'sear.

The working principle of the bell is different from that of the diaphragm. It has a smaller surface area to detect and to pick up a lower pitched sounds. It picks up the vibration of the body in contact caused by that movement rather than the vibration of the arteries directly which then vibrate the bell.

8. Types of Stethoscope :

Because of technological advancement in other to improve its efficiency and effectiveness the stethoscopes are classified into two types, 1) Acoustic and 2) Electronic.

Acoustic Stethoscope: This type of stethoscope is most commonly used and it works based on transmission of sound waves from the resonator to the listener's ear through hollow tubes. The resonator consists of two parts, diaphragm and a bell. The diaphragm transmits high frequency sound while the bell is used to transmit lower frequency sound. The acoustic stethoscope has poor amplification.

Electronic Stethoscope: Electronic stethoscope work in the same way as the acoustic stethoscope. It is provided with amplifiers and speakers to amplify the low frequency sound.

Acoustic Stethoscope

https://rb.gy/m2frmp

Electronic Stethoscope

https://rb.gy/y4aqjh

8. Uses of Stethoscope :

The following are some of the most crucial uses of a Stethoscope,

1. To detect the size of the Liver.
2. To calculate blood pressure.
3. To determine the lung sounds.
4. To detect heart sounds.
5. Tomeasure Bowel sounds.
6. To check the congestive heart failure.
7. To detect bruits.
8. As a deaf aid.
9. To keep a day to day track of body sounds.
10. To check the recovery rate from surgery.

10. References :

(1) https://www.vedantu.com/physics/clinical-laboratory-thermometer

(2) South Australian Medical Heritage Society Inc, Website for the Virtual Museum Retrieved from http://samhs.org.au/Virtual%20Museum/Medicine/stethoscopes/stethoscopes.html

(3)https://steemit.com/stemng/@emmatech/the-science-and-working-principle-of-stethoscope