



University of Diyala/ College of Medicine
Department of Physiology
Physiology Lab

Assessment of Vital Signs: **Body Temperature Measurement**

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Outlines



- Objectives



- Introduction about Vital Signs and Body Temperature



- Body Temperature: Background and Measurement



- Procedure of Body Temperature Measurement




- Some Medical Considerations

Objectives

At the end of this lab , students should :

- 1** Have a general idea about vital signs assessment.
- 2** Know how to measure body temperature in human beings.
- 3** Able to discuss the importance of body temperature in assessing the health status of the individuals.
- 4** Able to identify rationales for using different routes for assessing body temperature.

Assessment of Vital Signs

- **Assessment of vital signs** is one of the most important milestones of general examination. They are “vital” because they give a rapid and good general impression about the patient’s health status (*When these values are not zero, they indicate that a person is alive*).
- **The main vital signs are:**
 - ✓ **Body Temperature (Today’s Lab)**
 - ✓ Blood Pressure 
 - ✓ Pulse Rate
 - ✓ Rate of Breathing (Respiration Rate)
- Recently, many studies have designated the **pain as a fifth vital sign.**

Body Temperature

- ***Temperature*** is the degree of sensible heat or cold, expressed in terms of a specific scale (Celsius, Fahrenheit, and Kelvin).
- ***Body temperature*** is the balance between the heat production due to chemical activities by the body and heat lost by the body through radiation, conduction, convection, and vaporization (evaporation).
- It is considered as a marker of endocrine, metabolic, or muscle activity; the response of the body to heat or cold in the environment ; or the presence of infection or inflammation.
- Remember that : While heat production in the body is called ***thermogenesis*** , heat loss to the environment is called ***thermolysis***.

Types of Body Temperature

Core Temperature

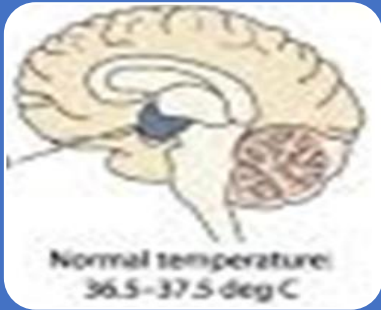
- Is the temperature of deep tissues of the body (e.g. cranium, thorax and abdominal cavity)
- It remains relatively constant (37°C) with range of 36.5-37.5°C.
- True core temperature can only be measured invasively , such as placing a temperature probe into the esophagus, pulmonary artery or urinary bladder.
- Non-invasive sites such as the rectum, oral cavity, axilla and external auditory canal are accessible and are believed to provide the best estimation of the core temperature.

Surface Temperature

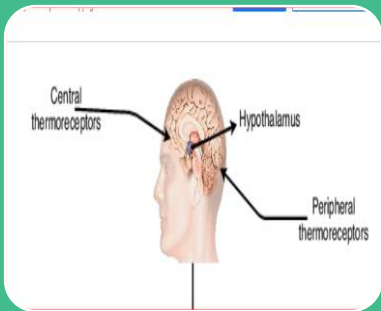
- Is the temperature of the skin & the subcutaneous tissue.
- It rises and falls in response to the environmental changes.

Body Temperature Regulation

Body temperature regulation is part of our “Homeostasis” process



Body temperature is regulated by **thermoregulatory center in the hypothalamus** that balances heat production and heat loss. The temperature regulating center is found in the Preoptic Area (the anterior portion of the hypothalamus).



The body keeps its core temperature constant at about 37°C by physiological adjustments controlled by the hypothalamus (Thermostat Center) where there are neurons sensitive to changes in skin and blood temperatures.



85% of body heat loss occurs through skin (radiation, conduction, sweating) and the remainder through the lungs and fecal and urinary excretions. Muscular work (including shivering) is a mechanism for raising body temperature.

Body Temperature Regulation

Why regulation of body temperature is required ?

1

The enzymes of the body work in optimal temperature.

2

Speed of chemical reaction varies with temperature.

3

Very low temperature leads to cardiac fibrillation and failure (Lower lethal core temperature is 26°C).

4

Very high temperature leads to heat stroke (Upper lethal core temperature is 43.5°C)

Variations in Body Temperature

There are many physiological factors that may cause variations in body temperature:

Diurnal variation (circadian variation) of about 0.5°C : body temperature is lowest at about (6 a.m.) and highest in the evening.

Age: Infants and children have a wider range of body temperature than adults, and elderly have a lower body temperature than others.

Monthly cycle in women: during menstruation the average body temperature is at minimum, but during ovulation there is a rise in temperature.

Exercise: increases body temperature.

Emotional stress: increases body temperature.

Body Temperature

- The average normal body temperature is ***37°C with range of (36.6-37.2°C, or 97.8-99°F)***.

Hypothermia	< 35 °C
Subnormal	35-36.6°C
Normal	36.6-37.2°C (mouth)
Febrile	37.2-41.6° C
Hyperpyrexia	> 41.6° C

- Condition with body temperature more than 37.2°C (100°F) is called ***fever or pyrexia*** and that with a temperature of less than 35°C is called ***hypothermia***.
- ***Hyperpyrexia*** is an ***extreme*** elevation of body temperature .

Routes for Measuring Body Temperature

Body temperature can be measured from the **mouth (Oral)**, **axilla**, rectum, groin, and tympanic membrane.



Oral Route

- It is the most convenient route for measuring body temperature, used for conscious adult patients. Normally, it is 0.5°C lower than rectal temperature. It is affected by some factors as ingestion of hot/cold fluids and mouth breathing.



Axillary Route

- It is also convenient and used in practice usually for unconscious patients and for children. Normally, it is 0.5°C lower than oral body temperature and can be affected by environmental temperature changes.

Routes for Measuring Body Temperature

Body temperature can be measured from the **mouth, axilla, rectum, groin, and tympanic membrane.**

Rectal Route



- It is inconvenient route for measuring body temperature, but the most reliable route. The rectal temperature represents the temperature of the body core and is the least affected by environmental temperature . It is used in unconscious patients and in infants. Rectal temperature is normally 0.5°C higher than that of the oral route.

Groin Route



- It is convenient and usually used for children. It can be affected by environmental temperature and usually done by placing the bulb of the thermometer in the fold of the groin with the thigh held flexed on the abdomen. Groin temperature is 0.5°C lower than that of the oral route.

Routes for Measuring Body Temperature

Body temperature can be measured from the **mouth, axilla, rectum, groin, forehead, and ear.**

Forehead Route



- By skin. A special thermometer can quickly measure the temperature of the skin on the forehead. Range: 36.4-36.7°C.

Ear (Tympanic) Route



- Temperatures can be taken in the ear. A special thermometer can quickly measure the temperature of the ear drum, which reflects the body's core temperature (the temperature of the internal organs). Normal ranges: 36.8-37.3 °C) .

Body Temperature

➤ So, to summarize:

Rectal route (+ 0.5° C)
more than the oral route

>Mouth (Oral)>

Axillary and groin (- 0.5° C)
than the oral route

➤ FORMULA OF CONVERTING TEMPERATURE UNIT:

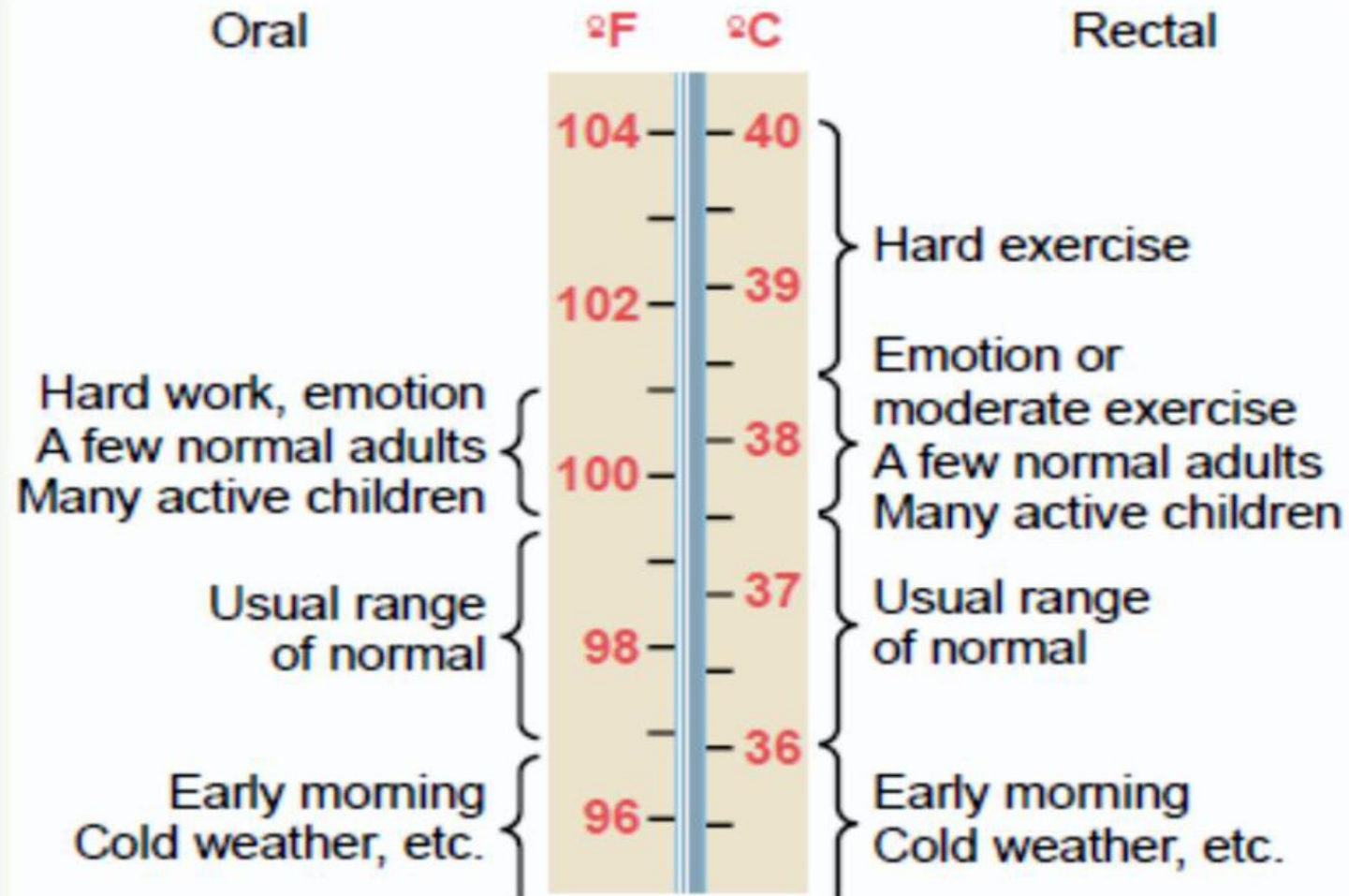
1. Changing Fahrenheit value to Celsius:

$$(F - 32) \times 5/9 = ^\circ C$$

2. Changing Celsius to Fahrenheit:

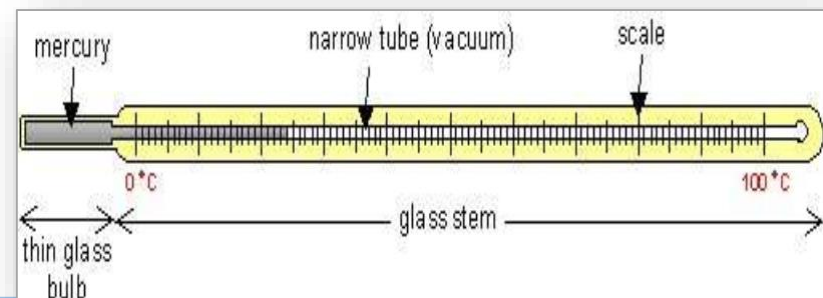
$$(C \times 9/5) + 32 = ^\circ F$$

Estimated Range of Body “Core” Temperature in Normal People



Thermometer

- **Thermometer:** is an instrument used to measure body temperature.
- **There are three main types of thermometer:**
 1. Mercury thermometer (the one we use in our lab)
 2. Digital (Electronic) thermometer
 3. Infrared (Tympanic) thermometer
- **Mercury thermometer**
 - ✓ Mercury glass thermometer is used for measuring oral, rectal, and axillary temperature.
 - ✓ It takes about 2-8 min for accurate result.
 - ✓ Placed below the tongue or in the axilla (arm pit) at least for 2 minutes. Mercury is **TOXIC** if it comes in contact with the skin, or mistakenly ingested.



Thermometer

➤ *Digital thermometer*

- ✓ Safer than mercury thermometer.
- ✓ Used to measure oral, axillary, and rectal temp.
- ✓ Takes about 30 sec. to 2 min for accurate reading.



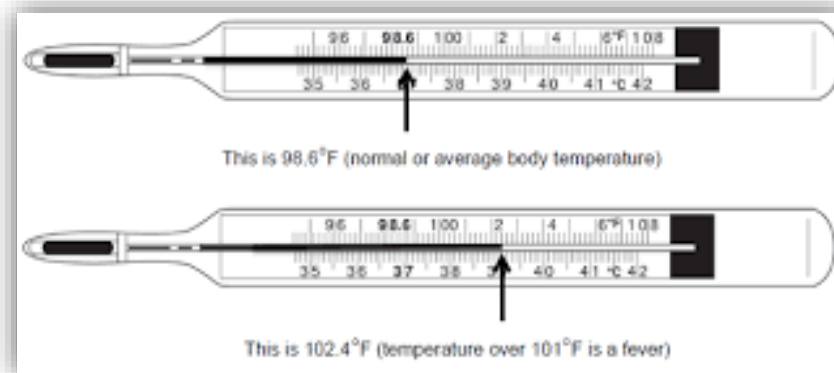
➤ *Infrared (Tympanic) thermometer*

- ✓ It is used to measure ear temperature/ tympanic temperature.
- ✓ It takes about 2-3 seconds for accurate reading.



Procedure of Oral Temperature Measurement

- ✓ Hold the thermometer from the end away from the bulb with your thumb and index finger.
- ✓ Lower the mercury level by shaking the thermometer to below 35°C.
- ✓ Wash the thermometer by antiseptic solution with cotton wool.
- ✓ Place the bulb of thermometer underneath the tongue and ask the patient to close his lips and breathe from his nose, for 2 min. then read the temperature at the level of mercury column.



- Repeat the procedure above for **axillary**, **groin** and **rectum** route for measuring temperature.

Fever

William Osler



Humanity has but three great enemies: fever, famine, and war; of these by far the greatest, by far the most terrible, is fever.

AZ QUOTES

AZ QUOTES

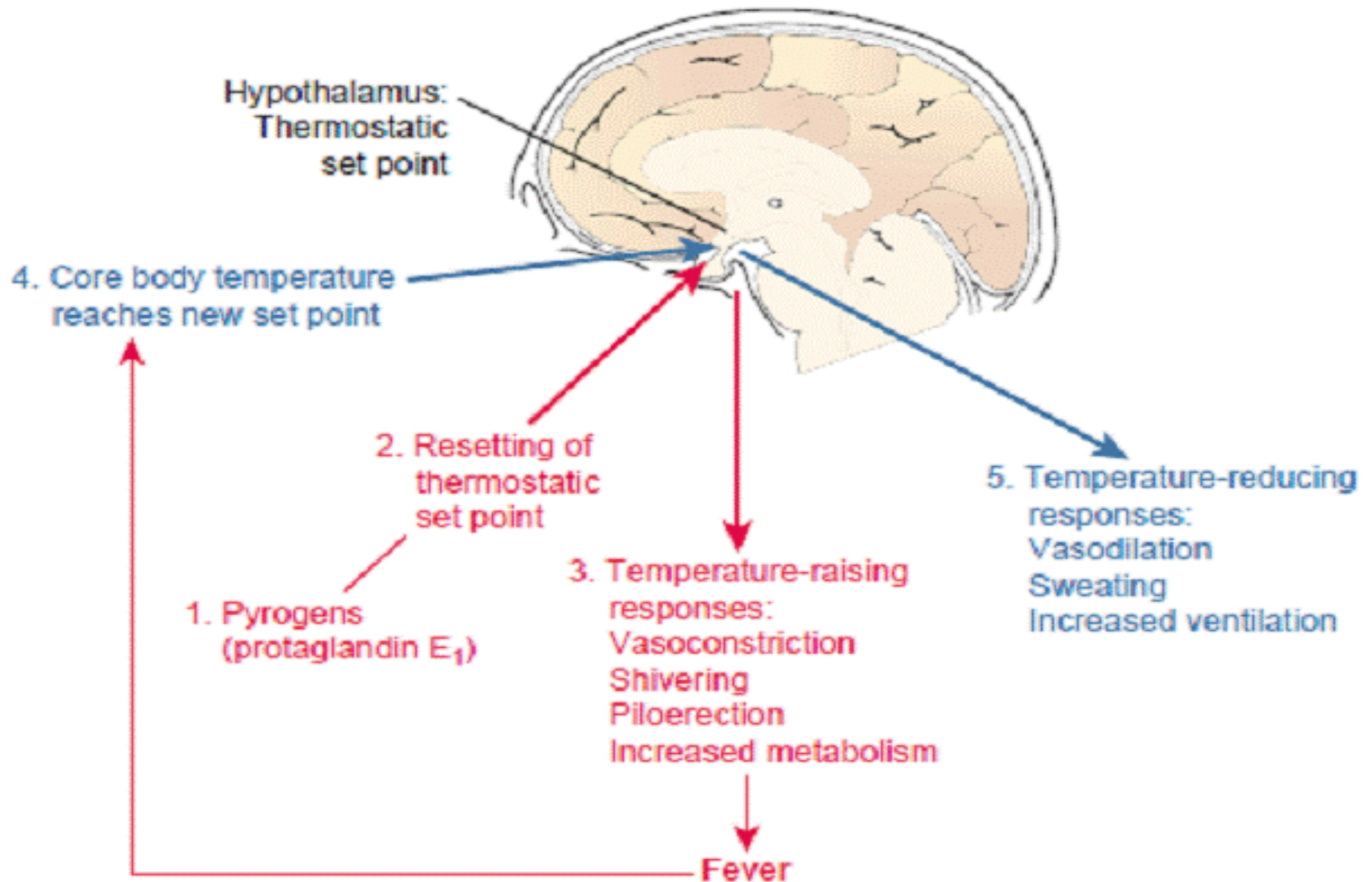
Fever

- ***Fever*** is an elevation of body temperature that exceeds the normal daily variation and occurs in conjunction with an increase in the hypothalamic set point (e.g., from 37°C to 39°C). [an A.M. temperature of >37.2°C (>98.9°F) or A P.M. temperature of >37.7°C (>99.9°F)]

The person who is having fever is indicated as ***febrile***.

- **Fever can be categorized in different ways**
 - a. *Low grade fever* : above 37.1°C but below 38.2°C .
 - b. *High grade fever* : above 38.2°C.
 - c. *Hyperpyrexia* : higher than 41.6°C.

Mechanisms of Fever



Etiology of Fever

Causes of fever can be classified as followings :

Infections

- **A. Bacterial** : typhoid fever , T.B. , pneumonia , brucellosis , meningitis , pyelonephritisetc
- **B. Viral** : hepatitis A & B , measles , rubella , COVID-19etc
- **C. Parasitic** : malaria , toxoplasmosis etc and **D. Fungal**.

Malignancies

- Leukemia , lymphoma , hepatoma , neuroblastoma etc .

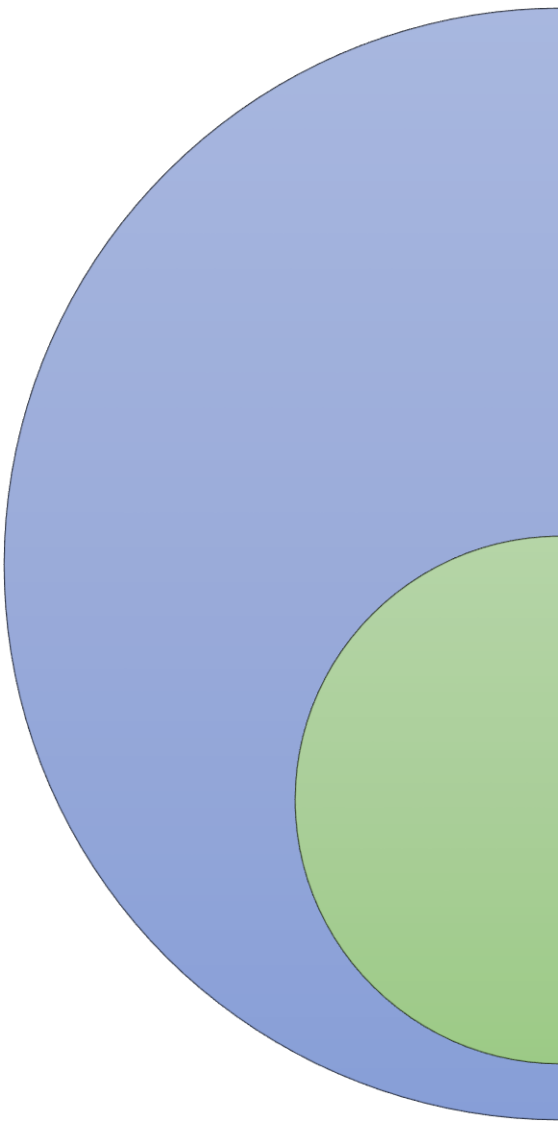
Autoimmune

- SLE , rheumatoid arthritis , rheumatic fever , vasculitis etc

Others

- Drug-induced fever , factitious fever .

Hyperpyrexia

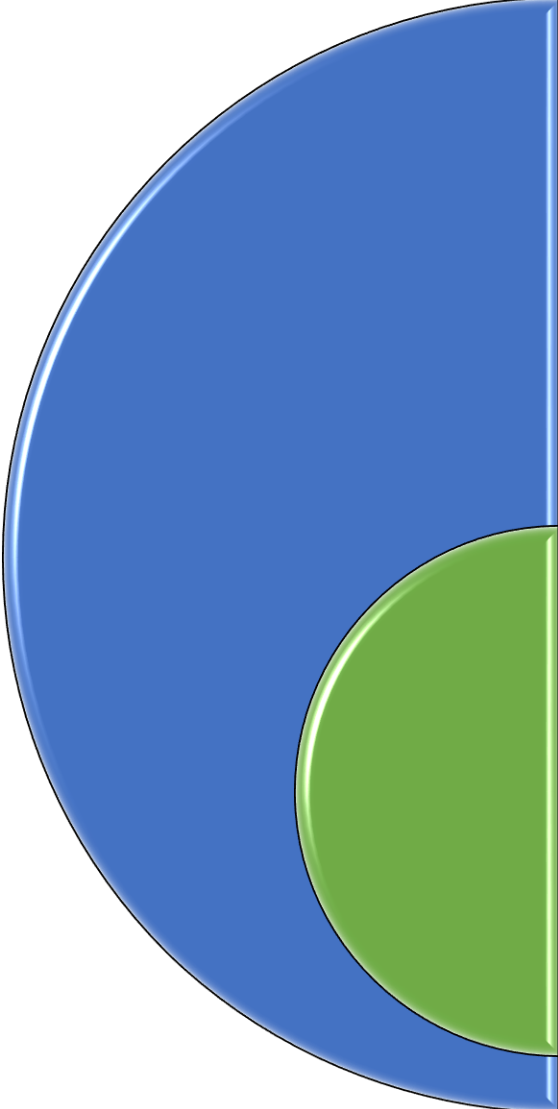


Hyperpyrexia is a fever with an **extreme** elevation of body temperature greater than or equal to 41.6°C . Such a high temperature is considered a **medical emergency** as it may indicate a serious underlying condition or lead to significant side effects.

Causes :

1. Severe infection
2. CNS hemorrhage particularly pontine hemorrhage (most common cause) .
3. Lobar pneumonia
4. Thyroid crisis

Hyperthermia



Hyperthermia is an example of high temperature that is not a fever. It is characterized by unchanged (normothermic) setting of the thermoregulatory center in conjunction with an uncontrolled increase in body temperature that exceeds the body's ability to lose heat .

Causes:

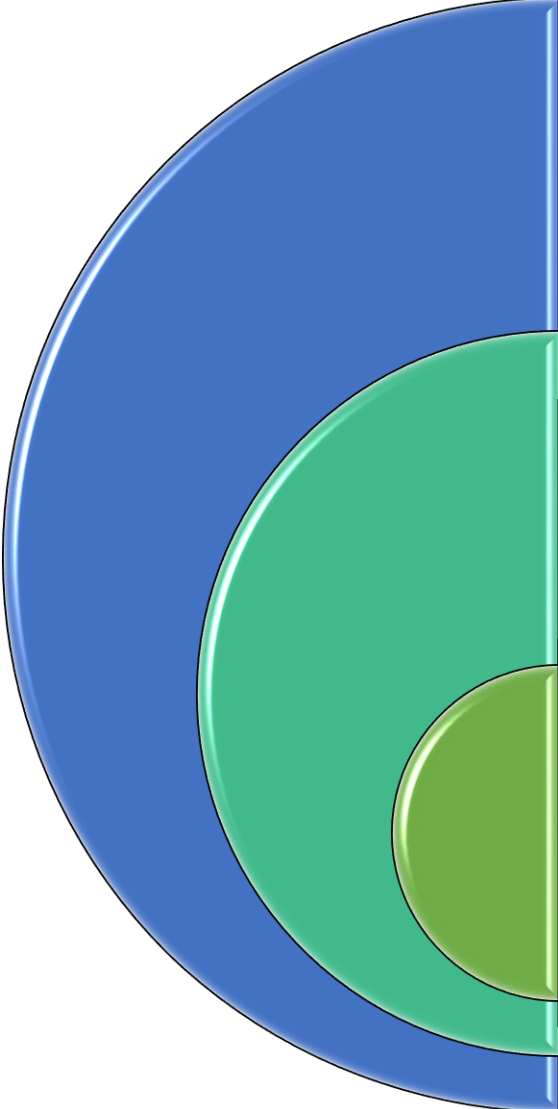
1. Heatstroke, : exercise in high than normal heat and/or humidity.
2. Central nervous system stimulants such as amphetamines , cocaine , anticholinergic ... etc
3. Malignant hyperthermia .

Heat Stroke

Since it is a serious condition, let's talk a little bit about heat stroke:

- Serious Condition, high environmental temperature
- Overheating of body, impaired sweating
- Hyperpyrexia (41°C or 106°F)
- **Symptoms:**
 - ✓ Headache
 - ✓ Restlessness
 - ✓ Mental confusion /Delirium
 - ✓ Convulsions,
 - ✓ CV collapse &
 - ✓ COMA.
- Death results if untreated
- Temperature to be brought down to 102°F with *ice packs*.

Hypothermia



Hypothermia occurs when the body's core temp falls below 35°C. The very young are susceptible because they have poor thermoregulation and a high body surface area to weight ratio, but the elderly are at highest risk.

Hypothermia classified into: Mild hypothermia (35-32°C), Moderate hypothermia (32-28°C), and Severe hypothermia below 28°C.

Causes:

- a. Severe sepsis
- b. Cold injury
- c. Hypothyroidism

Frostbite

Have you heard about frostbite?

- When the body is exposed to extremely low temperatures, surface areas can freeze; the freezing is called *frostbite*.
- It mostly occurs in the lobes of ears and in the digits of hands and feet.



Take Home Assignment

Assignment #1

- When do you need to assess vital signs?

Assignment #2

- Why People should maintain a normal body temperature of about 37°C ?

Assignment #3

- What are the Advantages and disadvantages of fever ?

Assignment #4

- Readings of body temperature measured rectally for febrile child at 6 a.m & at evening are& respectively .

Temperature With Consequences

- ▶ 40-44°C -- Heat stroke with multiple organ failure and brain lesions
- ▶ 38-40°C -- Hyperthermia (as a result of fever or exercise)
- ▶ 36-38°C -- Normal range
- ▶ 34-36°C -- Mild hypothermia
- ▶ 30-34°C -- Impairment of temperature regulation
- ▶ 27-29°C -- Cardiac fibrillation