MEASURING AND RECORDING TEMPERATURE, PULSE AND RESPIRATIONS

INTRODUCTION

Reading and recording a patient’s temperature, pulse, and respirations is one of the most important things you will do in your career as a Certified Nursing Assistant (CNA). Why is it so important? For two simple reasons:

- These measurements are quick, simple, and very reliable indicators of a person’s basic state of health.
- Abnormal changes in these measurements are one of the quickest, simplest, and most reliable indicators that someone is ill.

It is easy to see then why the body temperature, pulse, and respirations are collectively called the *vital signs*. These measurements are very sensitive tools that can tell us if a patient has an infection, if a patient is having an adverse reaction to a drug, if a patient needs oxygen - the temperature, pulse and respirations provide a “window” through which we can assess someone’s medical condition.

OBJECTIVES

When the student has completed this module, he/she will be able to:

1. Identify one reason why measuring temperature, pulse, and respirations is important.
2. Identify normal oral temperature in the Fahrenheit and Celsius scales.
3. Identify which two of these five methods are the most accurate.
4. Identify a definition of the pulse rate.
5. Identify the normal respiratory rate and rhythm for an adult.

WHAT IS BODY TEMPERATURE AND HOW IS IT PRODUCED AND CONTROLLED?

Body temperature is basically a measurement of how warm or cold we are. It represents a balance between two things: *the amount of heat we produce and the heat we lose*.

We produce body heat by the process of metabolism and by normal physical activity (and sometimes because of illness). In all of these processes, heat is a byproduct. Body heat is also affected by the environment - this is not heat that we produce, but it certainly affects body temperature.

We lose body heat by one of the following mechanisms:

- Radiation: A basic law of science is that heat will move to an area that is cold - it will radiate. This law also applies to human physiology, so our body heat will
Radiate to the environment if the surrounding temperature is lower than body temperature. Heat naturally moves away from our bodies to the surrounding area in much the same way that a radiator spreads heat into a room. If the environment is warm and humid, mechanisms that try and lower body temperature by radiation are initiated. If the environment is cold, the body will try decrease radiation and heat loss by such mechanisms as shivering and decreasing the blood flow to the surface of the skin.

- **Conduction**: Heat moves from a hot object—our bodies—to a cold object when the two are in contact; the heat is *conducted* to the cold object. If you sit on a block of ice, you will lose body heat. Conduction is then the transfer of heat from one object that is in contact with another.

- **Convection**: There is always a layer of air surrounding body that is slightly warmed by the radiation of body heat. However, if a cold wind (or a strong breeze of almost any temperature, actually) is blowing directly on you that layer of warm air is removed. When that happens, radiation of body heat is increased and body heat will be lost. The warm air is moved away and your body heat then is lost to the cold air.

- **Evaporation**: Water on the skin is evaporated by body heat and as this happens, body heat is lost.

**Learning Break**: Small amounts of body heat are lost by defecation, breathing and urination, but the four mechanisms discussed above the primary ways in which body heat is lost. Most body heat is lost through radiation, but all of these can be working at any one time.

So, body heat represents a balance between the heat we produce and the heat we lose. The environment can affect body temperature, and body temperature can also be increased or decreased by the presence of a disease, an injury, an infection, the time of day or hormone levels, or by our level of physical activity.

But regardless of why body heat is decreased or increased, human physiology always strives to balance and control loss and heat production to maintain the body temperature within a certain range. Body heat is controlled by an area of the brain called the hypothalamus. The hypothalamus is similar to a thermostat. The hypothalamus has a “set point” and if the body temperature goes too far above or too far below that set point, the hypothalamus can initiate physiological processes that will bring the body temperature back to within the normal range. These processes are: (continued -→)
Increased body temperature
↓
Increased sweating
↓
Blood vessels dilate
↓
Metabolic rate is decreased
↓
Muscular activity is decreased

Decreased body temperature
↓
Decreased sweating
↓
Blood vessels constrict
↓
Metabolic rate is increased
↓
Muscular activity is increased.

If the body temperature is too high, sweating increases loss of body heat by evaporation, the blood vessels dilate and allow body heat to radiate, and metabolic rate and muscle activity are decreased so that less body heat is produced. All of the processes can be reversed if more body heat is needed.

WHAT IS A NORMAL BODY TEMPERATURE?

Human physiology has adapted so that we maintain body temperature within a relatively narrow range. If we are too hot or too cold our bodies cannot function properly, and if body temperature rises or falls above or below certain limits, there can be serious effects to our health.

Traditionally, normal body temperature has been defined as an oral temperature of 98.6°F. The F stands for Fahrenheit. Fahrenheit is simply the name of one of the systems of measurement that can be used to record body temperature. However, “normal” body temperature differs from person to person as much as 1°. Also, everyone’s body temperature goes up and down through the day: it is the lowest during the middle of the night during sleep and it is the highest during the day when we are active. Body temperature also fluctuates for women when they are ovulating or menstruating.

No can say with absolute certainty what a normal body temperature is. However, we will define it here as the following:

- The normal oral temperature is 98.2°F ± 1.2°F
- A normal oral temperature would then be anywhere from 97°F to 99.4°F
- A normal rectal temperature is defined as 99.6°F ±1°F
- A normal rectal temperature would then be 98.6°F to 100.6°F
- You may be working in a clinical setting where the body temperature is measured and recorded using the *Celsius system*. The Celsius is abbreviated as C.
- In the Celsius system, a normal body temperature is defined as an oral temperature of 36.8°C ± 0.7°
- A normal rectal temperature would be 37.5°C ± 0.7°
- Normal temperatures in the Celsius system would then be 36.1°C-37.5°C, orally, and 36.8°C-38.2°C

It is important to know what normal body temperature is, but it is also important to remember that what is normal varies from person to person, and to also place body temperature in context. If someone typically has a body temperature of 97°F but now that person has a temperature of 99.4°F and that person is coughing and feels nauseous and tired, the temperature is in the normal range but the rise of almost 2.5 degrees is certainly significant.

Children normally have a body temperature that is higher than that of adults, and the elderly have a lower body temperature than children and younger adults. Strenuous exercise can raise body temperature up to 40°C/104°F.

### Pediatric Temperature Chart

- Age 0-2 years: 97.9-100.4°F, or 36.6-38°C, rectal
- Age 3-10 years: 97.9-100.4°F, 04 36.6-38°C, rectal
- Age 11 and older: 98.6-100.4°F, or 37-38°C, rectal

### HOW IS BODY TEMPERATURE MEASURED?

Body temperature is checked to a) detect the presence of a fever or to check for the presence of an illness, b) as part of the normal health screening process and, c) determine the effectiveness of medications given to reduce a fever.

When we measure body temperature, what we are trying to do is determine the patient’s *core temperature*. This is the temperature of the body at its core, the temperature that the body and its vital organs are truly experiencing. To obtain an accurate measurement of core body temperature a direct, invasive measuring method must be used. However, unless the patient is very ill, invasive methods of measuring body temperature are not needed nor are they practical. In any situation in which a CNA would be measuring and recording body temperature, an indirect measuring technique would be used. The term indirect does not mean that these methods are inaccurate or inferior. It simply means they are a reflection of core temperature, and they are perfectly appropriate for the majority of clinical settings.

The body temperature can be measured a) orally, b) rectally, c) by placing the thermometer in the armpit, d) by placing the thermometer in the ear canal (the *otic* method), or e) by placing a thermometer against the forehead. The proper method to use will depend on several things:
• The patient’s age: Very young children and very elderly people may have difficulty keeping an oral thermometer in the mouth for the required time.
• The patient’s medical condition: There are many instances in which a patient’s medical condition would determine how you would measure his/her temperature. Example: Someone who is unconscious or disoriented would not be a candidate for an oral temperature measurement. Example: Someone who cannot breathe through the nose would not be a candidate for an oral temperature.
• Need for accuracy: Although all of the methods (e.g., oral, rectal, etc.) of measuring body temperature are accurate if they are done properly, some will more closely reflect the core temperature than others. The rectal route is the preferred method for checking body temperature because it provides the closest approximation of core temperature, and it is the method that is the least likely to be done incorrectly. If the rectal method cannot be used, the otic method would be the second choice for measuring a reflection of the patient’s core temperature.
• The clinical setting: Where you work can determine which method of measuring body temperature is the most appropriate to use. Example: If you are working in a busy adult clinic and there is limited time and limited options for maintaining privacy and protecting the patient’s modesty, measuring body temperatures rectally would obviously be impractical. Example: If you are working in a busy pediatric clinic, privacy and modesty concerns might not be as important and using the rectal method would be acceptable. It would also be preferable in many cases as infants and young children often cannot cooperate with the procedure of taking the temperature orally. The rectal method would be faster and more efficient.

**Methods of Measuring Body Temperature**

• Oral temperature: Wait at least 20 to 30 minutes after the patient has eaten or had something to drink or smoked a cigarette: if you don’t, the temperature may be not be accurate. Place the thermometer in the patient’s mouth under the tongue and instruct the patient to close his/her mouth tightly. Oral temperatures are lower than core temperatures, and they are usually lower than rectal temperatures.
• Rectal temperature: A rectal temperature is the closest reflection of core temperature. Make sure that you can protect the patient’s privacy and modesty. Apply a lubricating jelly to the tip of the thermometer and gently insert the tip 0.5 to 1 inch into the rectum. Do not use force! If there is a large amount of stool in the rectum, the temperature may not be accurate.
• Otic temperature: Otic is a term that means of, or pertaining to the ear. An otic temperature measures the heat of the eardrum and the ear canal, and it is considered to be an accurate reflection of core temperature. An otic temperature is usually lower than a rectal temperature. To take an otic temperature, insert the tip of the thermometer gently into the ear canal. Do not use force.
• Axillary temperature: The medical term for the armpit is axilla, and the axilla can be used to measure body temperature. An axillary temperature is usually lower than an oral temperature and always lower than a rectal temperature. To take an
axillary temperature, place the tip of the thermometer in the center of the patient’s armpit, then have the patient hold his/her arm tightly against the side of the body.

- **Temperature strips**: Temperature strips are quick and accurate. They can be used in the axilla or on the forehead. To use a temperature strip, first make sure the skin is clean and dry and then place the strip for the specified amount of time.

- **Temperature sensors**: Temperature sensors measure the heat of the blood flowing through the temporal artery in the forehead. This is a quick and accurate way of measuring body temperature.

Electronic thermometers are used almost exclusively today; when the temperature has been recorded these units will have a signal that will indicate that the procedure is complete.

Remember, a rectal or otic temperature measurement is preferred for accuracy if the patient is ill. A rectal or otic temperature measurement may also be done if the oral/axillary/forehead temperature is elevated. Rectal and otic temperatures are usually 0.5° to 1° F higher than an oral temperature. An axillary temperature is usually 0.5° to 1° F lower than an oral temperature.

Inaccurate body temperature measurement may be due to the patient recently eating, drinking or smoking, recent vigorous physical activity, not keeping the mouth closed around the thermometer, not leaving the thermometer in place for the proper length of time, or not putting the thermometer in the proper area.

Using one of the “less accurate” methods for measuring body temperature would be appropriate for routine screening and assessment. But if the oral temperature is elevated or the patient may be ill or is obviously sick then it is best to take the temperature rectally, if possible.

Make sure that you record the patient’s body temperature as soon as possible after you have performed this procedure: it is all too easy to forget the reading during a busy day. When you record the temperature always document what method you used.

**HIGH BODY TEMPERATURES, LOW BODY TEMPERATURES**

**High Body Temperature: Fever**

An elevated body temperature is called a fever. However, to be considered a fever the body temperature must be elevated a certain number of degrees. This figure is somewhat arbitrary, but most sources agree that a fever should be defined as follows:

Fever is a body temperature that is 100°F or higher (if the temperature is taken orally) or 101°F (if the temperature is taken rectally. In the Celsius scale, a fever would be an oral temperature higher than 37.7°C or a rectal temperature higher than 38.3°C.

Fever is always an indication that the patient has an illness and in most cases a fever is caused by an infection. Fever can also be the result of a side effect of some drugs, and a fever can be caused by medical conditions that do not involve an infection. People with a
fever often have a rapid pulse, they are frequently diaphoretic, and they typically feel uncomfortable.

A high fever can be very uncomfortable for the patient, and it is frightening to lay people. However, fever is a natural response by the body to infection and illness, and although a fever is unpleasant to have there a lot of evidence that a fever may be more helpful than it is harmful. A fever may actually help the body fight off infection and lowering an elevated temperature will interfere with this natural defense. Also, although a high fever can be alarming, there is only so high a fever can go. Many people, even health care professionals, become upset and concerned when body temperature begins to rise over a certain point. But if a fever is caused by an infection the body temperature cannot go to levels that are actually dangerous: there are protective mechanisms that prevent his from happening.

However, whether or not fever is helpful or harmful, and whether or not it should be lowered are complicated issues, and a fever should never be ignored. A fever is always an indication that something is wrong, and a fever always needs to be evaluated in the context of the patient. A fever of 104° in a two-year-old child who has a simple viral illness such as the flu is not the same as a fever of 104° in an 87-year-old patient who has pneumonia and has a medical history of heart and lung disease. For the child the fever is not terribly concerning, for the adult it is bit in both cases the fever is a warning sign.

Notify an RN or your supervisor immediately if the patient’s body temperature is abnormally high or if there has been a significant change from the patient’s normal baseline.

Learning Break: An extremely high body temperature is called hyperthermia. The terms fever and hyperthermia are sometimes used interchangeably, but they are not the same. Hyperthermia is defined as a body temperature that is 40.5°C/104.9°F or higher. At times, a patient who is hyperthermic can have a body temperature of over 106°, but a fever caused by an infection cannot become that high. Most cases of hyperthermia are caused by heat stroke or they are adverse effect from a drug, and the body temperature of a patient who is hyperthermic can become so high that permanent neurological damage is possible.

Fever may be a natural defense mechanism, but as mentioned earlier, it is an indication of an ongoing pathological process: in simpler terms, a fever is telling you that the patient is sick. A fever also adds stress to the body. It increases heart rate, it raises metabolic demands of the body, and it can cause dehydration. In addition, many of our normal physiological activities do not function well if the body temperature is too high.

You have probably noticed that the definition of fever and the definition of normal body temperature overlap. There is no universal agreement about what body temperatures are considered to be the “normal” range and what temperature is considered to be a fever. And remember, body temperature differs for everyone. It differs depending on age, gender, and it fluctuates throughout the day. Consider the numbers in this module to be approximations, guidelines. The facility you work in will have protocols about what is and what is not considered to be a fever, and those protocols will be very similar to has been discussed here.
Low Body Temperature: Hypothermia

A low body temperature is called hypothermia. Hypothermia is defined as a temperature that is less than the lower limit of normal, specifically less than 97°F orally, less than 98.6°F rectally. In the Celsius scale, these would be 36.1°C orally and 37°C.

In most cases hypothermia is caused by prolonged exposure to the cold. There are also certain drugs and medical conditions that can cause hypothermia. These would include alcohol, barbiturates, narcotics such as heroin, or a stroke.

Hypothermia affects the body in much the same way as hyperthermia: the normal physiological activities do not function well if body temperature is too cold.

How are Fever and Hypothermia Treated?

The focus of this module is measuring and recording temperature, pulse, and respirations, but a short discussion of therapies used to treat fever and hypothermia is included.

Fever is treated by using medications, external, and internal cooling techniques. Acetaminophen and ibuprofen reduce a fever by “re-setting” the hypothalamus, a.k.a., the “thermostat.” External cooling techniques work by conduction, convection, evaporation, and radiation. These techniques include cold water immersion, cooling blankets, ice packing, and fans, and if you imagine these being used for someone who has a fever you can easily see how each one works (e.g., cooling blankets and ice pack work by radiation). The internal methods of cooling are much more complicated and sophisticated. They are used for patients who have extremely high body temperatures, and they will not be discussed here.

Hypothermia is treated by using internal and external and internal warming techniques. External warming techniques are immersion in warm water or use of a warming blanket. The internal warming methods are all invasive techniques and will not be discussed.

BODY TEMPERATURE: SUMMARY

- Measuring the body temperature is a reliable and easy way to determine someone’s basic state of health.
- Measuring the body temperature is a reliable and easy way to determine if someone is ill.
- Body temperature represents the balance between heat production and heat loss.
- Body heat can be lost by conduction, convection, evaporation, or radiation.
- Body temperature can be measured in various ways: the rectal or otic are the most accurate and are higher than the axillary, forehead, or oral methods.
- The normal oral temperature is 98.2°F ± 1.2° or 36.8°C ± 0.7°. The normal rectal temperature is 99.6°F ± 0.7° or 37.5°C ± 0.7°.
- Fever is defined as an oral temperature 100°F or higher or a rectal temperature 101°F or higher. In the Celsius scale, a fever would be an oral temperature 37.7° or higher or a rectal temperature 38.3° or higher.
- The specific numbers for normal body temperature and fever are not absolute.
- If a patient has a fever, report this immediately to an RN or your supervisor.
READING AND RECORDING THE PULSE.

What Is The Pulse?

The heart, the blood, and the blood vessels make up the circulatory system. The heart pushes the blood through the blood vessels to vital organs and tissues. The blood carries the oxygen that the organs and tissues need to function; it removes waste products that are a byproduct of metabolism, and carries them to the lungs for elimination.

The heart acts like a pump and each heartbeat has two phases, a resting phase (diastole) and a pumping phase (systole). During diastole, the chambers of the heart fill with oxygenated blood that is received from the lungs. During systole, the walls of these chambers contract and send out a “wave” of blood to the lungs, brain, kidneys, muscles, etc. Taken together, systole and diastole make up the heartbeat. The heart beats constantly and rhythmically, and the pulse - the waves of blood the heart sends out with each beat - is a measurement of the number of heartbeats per minute.

In certain areas of the body, the blood vessels are close to the surface of the skin and this wave of blood that represents a heartbeat can be felt. The pulse can also be measured by listening to heart with a stethoscope. Measuring the pulse rate is like measuring the body temperature; it is a quick, reliable, and easy way to determine someone’s basic state of health or to determine if he/she is sick. The heart rate speeds up or slows down in response to stress, injury, infection, activity level, changes in the environment, drugs, etc. The following examples help illustrate this point.

Example #1: If someone is bleeding - perhaps they have very a large internal blood vessel that has ruptured - there is less blood available in the circulation. Less blood means that there is a diminished capacity of the circulatory system to deliver oxygen and without oxygen the body cannot function. To compensate for this loss of blood and oxygen carrying capacity, the heart speeds up and the pulse rate increases.

Example #2: An asthma attack narrows the bronchial passages in the lungs and decreases the amount of oxygen that can be transferred from the lungs to the blood. In response, the heart will speed up in order to deliver a greater amount of blood per minute to the body because each volume of blood is not carrying the normal load of oxygen.

Example #3: Patients who take the cardiac medication digoxin will often have heart rates that are slow and below the normal limit. Digoxin affects the “pacemaker” cells of the heart and in someone who is taking digoxin the heart will not beat as fast as it normally would.
What Is A Normal Pulse Rate?

As with the other vital signs there is a range of heartbeats that is considered to be normal.

- Babies up to the age of 1: 100-160 beats per minute.
- Children of the ages 1 to 10: 60 to 120 beats per minute
- Children of the ages 11-17: 60 to 100 beats per minute.
- Adults: 60 to 100 beats per minute.
- Athletes: 40-60 beats per minute.

These values are considered to be normal for the given ages, but as with all of the vital signs the normal pulse varies from person to person. But just as important as the rate, however, is the rhythm. A normal heartbeat will be regular like the ticking of a clock. The amount of time between each beats will be the same and if it is not, this is considered abnormal.

A pulse rate that is below the lower limit of normal is called bradycardia. A pulse rate that is above the upper limit of normal is called tachycardia. An irregular pulse occurs when the interval between each heartbeat is different. In most circumstances, bradycardia, tachycardia, and an irregular pulse are considered to be abnormal.

How to Measure and Record the Pulse

Measuring and recording the pulse is simple. It can be done in many places in the body. For example, if it was necessary the pulse could be checked on the forehead, on the arm opposite the elbow (The area where blood samples are often taken from), the feet, both sides of the wrist, or in certain locations on the legs.

But the two simplest and most commonly used sites for checking the pulse are: a) the chest, directly over the heart, using a stethoscope, and b) on the side of the wrist using the radial artery, palpating with the fingers. Either method is acceptable

- Radial artery: The radial artery is located on the wrist (on the side opposite the back of the hand) just below the base of the thumb. You can find it by taking two fingers and placing them in this area: you should easily feel a rhythmic pulse. Count the pulse for at least 30 seconds and then multiply times by two; the result will be the pulse rate. Do not use your thumb to count the pulse. Many people have a strong pulse in their thumbs and this can interfere with accurately feeling someone’s pulse.
- The chest: The heart is located on the left side of the chest, approximately midway between the waist and the shoulder. Place your stethoscope in that area and listen for the heartbeat. Count for 30 second and then multiply times two; the result will be the pulse rate.

Learning Break: When you are listening to someone’s heart rate with a stethoscope, you will hear two sounds with each beat: these are commonly described as “lub-dub.” These
are the sounds of the heart valves opening and closing with each single heart beat and together they represent one heart beat.

Make a note of the heart rate and the rhythm (regular or irregular) and record it in the proper place in the patient’s chart. If the heart rate is abnormally slow or fast or irregular, notify an RN or the supervisor immediately. You should also notify an RN or your supervisor if the patient’s heart rate is unusually slow or fast for that patient.

Tachycardia, Bradycardia, and an Irregular Pulse: What Do they Mean?

Tachycardia, bradycardia, and an irregular pulse are abnormal: they indicate that something is wrong. However, unlike a high temperature which in most cases indicates the presence of an infection, abnormal pulse readings can be caused by many things. For example, tachycardia, bradycardia, and an irregular pulse can all be adverse reactions to a drug and depending on the situation they can all be adverse reactions to the same drug. So, although measurement of the pulse is important, it is less specific than the measurement of body temperature as an indicator of why the patient is ill.

PULSE RATE: SUMMARY

- The pulse is a measurement of the number of heartbeats in one minute.
- The pulse can be increased or slowed down by illness, injury, infection, drugs, the environment, or activity level.
- The normal pulse for an adult should be regular and between 60 and 100 beats per minute.
- A pulse rate that is abnormally slow is called bradycardia.
- A pulse rate that is abnormally fast is called tachycardia.
- The two most accurate places to measure the pulse are the radial artery and the chest.
- Notify the R.N. or your supervisor if the patient’s heart rate bradycardic, tachycardic or is unusually slow or fast for that patient.

MEASURING AND RECORDING THE RESPIRATIONS

Respirations Explained

Respiration is the medical term for breathing. The respiratory system delivers oxygen to the blood when we inhale and helps eliminate by-products of metabolism (specifically, carbon dioxide) when we exhale. Depending on the need for oxygen or the need to eliminate carbon dioxide, the respiratory rate - the number of breaths in a minute - can increase or decrease. The respiratory rate can be influenced by the environment, stress, drugs, illness, activity level, or injury.

Example: A myocardial infarction (heart attack) is caused by blockage of the arteries in the heart. The heart is deprived of oxygen and to compensate, the respiratory rate increases.
Example: When someone exercises, the muscles have a greater need for oxygen because they are working harder. In response, the respiratory rate is increased.

How To Measure And Record Respirations

- Look at the patient’s chest, count the number of breaths the patient takes for 30 seconds and then multiply times two: that will be the respiratory rate.
- The normal respiratory rate for an adult is 12 to 20 a minute. For infants and children, the respiratory rate is higher: normal for newborns and infants would be 30 to 40 breaths a minute, for children normal would be 25 to 30 breaths a minute.
- A respiratory rate that is below the normal limits is called bradypnea.
- A respiratory rate that is above the normal limits is called tachypnea.
- The respiratory rate should be regular.
- Notify the R.N. or your supervisor if the patient’s respiratory rate is below or above the normal limits or is unusually slow or fast for that patient.

RESPIRATIONS: SUMMARY

- The respiratory rate is a measurement of the number of breaths in one minute.
- The normal respiratory rate for an adult is 12 to 20 breaths a minute.
- The respiratory rate for newborns, infants, and children is higher than the respiratory rate of adults.
- The respiratory rate should be regular.
- A respiratory rate that is below the normal limits is called bradypnea.
- A respiratory rate that is above the normal limits is called tachypnea.