



Nursing Science

Vital Signs (Part Two)

Learning objectives

After completing this lecture, the students will be able to:

- Describe the mechanics of breathing and the mechanisms that control respirations.
- Identify the components of a respiratory assessment.
- Describe the respiratory rate and factors affecting respirations.
- Identify the blood pressure and determinants of blood pressure.
- Describe various factors affect the blood pressure and methods for assess measuring blood pressure
- Discuss measurement of blood oxygenation by using pulse oximetry and factors affecting oxygen saturation readings

3. Respirations



- **Respiration:** is the act of breathing (and gases exchange).
- **Inhalation or inspiration:** refers to the intake of air into the lungs.
- **Exhalation or expiration:** refers to breathing out, or the movement of gases from the lungs to the atmosphere.
- **Ventilation:** is also used to refer to the movement of air in and out of the lungs.

Breathing is of basically two types:

✓ Costal (thoracic) breathing:

- Involves the external intercostal muscles and other accessory muscles, such as the sternocleidomastoid muscles
- Observed by the movement of the chest upward and outward.

✓ Diaphragmatic (abdominal) breathing:

- Observed by the movement of the abdomen
- Involves the contraction and relaxation of the diaphragm.

Mechanics and Regulation of Breathing

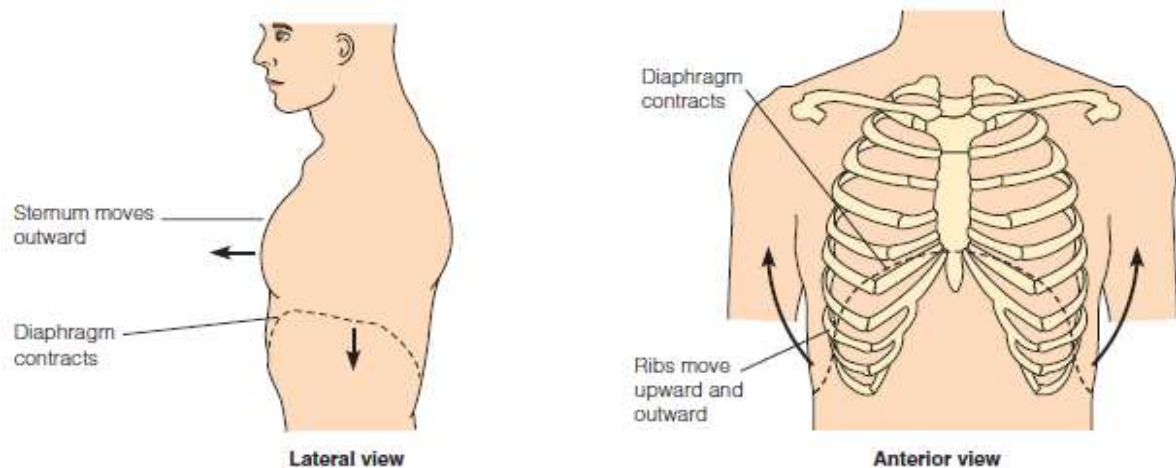


FIGURE 29.14 Respiratory inhalation: *Left*, Lateral view; *Right*, Anterior view.

Inhalation

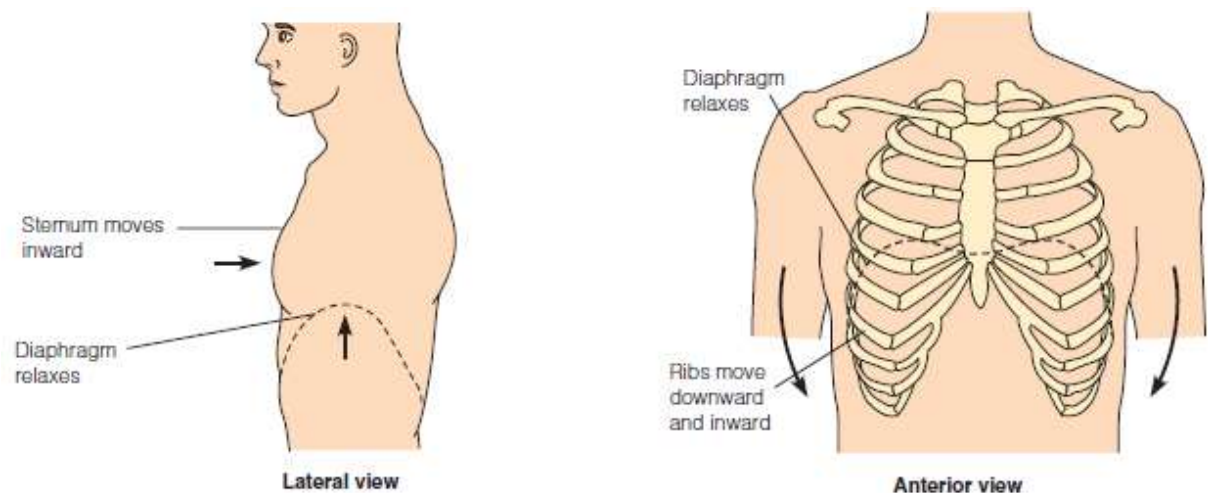


FIGURE 29.15 Respiratory exhalation: *Left*, Lateral view; *Right*, Anterior view.

Exhalation

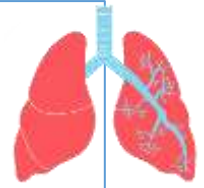
Respiration is controlled by:

- Respiratory centers in the medulla oblongata and the pons of the brain and
- Chemoreceptors located centrally in the medulla and peripherally in the carotid and aortic bodies. These centers and receptors respond to changes in the concentrations of oxygen (O_2), carbon dioxide (CO_2), and hydrogen (H^+) in the arterial blood.

Assessing Respirations

Note:

- Resting respirations should be assessed when the client is relaxed
- Each respiration includes one complete inhalation and exhalation.



1. Rate: Breaths per minute

- ✓ **Normally rate:** between 12 and 20 breaths per minute.
- ✓ **Eupnea:** Breathing that is normal in rate and depth
- ✓ **Bradypnea:** Abnormally slow respirations
- ✓ **Tachycardia:** Abnormally rapid respirations
- ✓ **Apnea:** is the absence of breathing.

2. Depth: Movement of the chest

- ✓ **Normal**
- ✓ **Tidal volume:** volume of air during normal inspiration and expiration, an adult takes in (about 500 ml) of air
- ✓ **Deep respirations:** a large volume of air is inhaled and exhaled, inflating most of the lungs
- ✓ **Shallow respirations:** a small volume of air inhaled and exhaled
- ✓ **Hyperventilation:** refers to very deep, rapid respiration
- ✓ **Hypoventilation:** refers to very shallow respirations.

☒ The sleeping client's respirations can fall to fewer than 10 shallow breaths per minute

3. Respiratory rhythm: refers to the regularity of the expirations and the inspirations (regular or irregular)

- Count regular respiratory rhythms for 30 seconds and multiply result by 2, and count irregular respiratory rhythms for a full minute.

4. Respiratory quality or character: refers to normal, effortless breathing. The Normal breathing sound is silent.

Dyspnea (labored): breath with substantial effort

Orthopnea: dyspnea occurs when lying flat position

5. **The effectiveness of respirations:** is measured in part by the uptake of oxygen from the air into the blood and the release of carbon dioxide from the blood into expired air.



Factors Affecting Respirations

- **Age:** As age increases, the respiratory rate gradually decreases.
- **Exercise:** Respirations increase in rate and depth with exercise.
- **Fever:** The respiratory rate will be faster in clients with an elevated temperature.
- **Medications:** Narcotics and other central nervous system depressants often slow the respiratory rate.
- **Stress, anxiety and pain**
- **High and Low Environmental Temperature**
- **Respiratory, cardiovascular disease and increased intracranial pressure**



4. Blood Pressure

Arterial blood pressure: is a measure of the pressure exerted by the blood as it flows through the arteries. Since the blood moves in waves, there are two blood pressure measures:

- **The systolic pressure:** is the pressure of the blood as a result of contraction of the ventricles, that is, the pressure of the height of the blood wave.
- **The diastolic pressure:** is the pressure when the ventricles are at rest.
- ✓ Blood pressure is measured in millimeters of mercury (mmHg).

Mean Arterial Pressure (MAP): represents the pressure actually delivered to the body's organs. Normal MAP is 70 to 110 mmHg.

$$\text{MAP} = (\text{systolic BP} + 2 \times \text{Diastolic BP}) / 3$$

Pulse pressure: The difference between the diastolic and systolic pressures systolic BP, normally is about 40 mmHg.

- ✓ **Anormal pulse pressure** is about 40 mmHg but can be as high as 100 mmHg during exercise.
- ✓ **Elevated pulse pressure** occurs in arteriosclerosis.
- ✓ **A low pulse pressure** (e.g., less than 25 mmHg) occurs in conditions such as severe heart failure.



Determinants of Blood Pressure

- **Pumping Action of the Heart:** At lower cardiac output the blood pressure decreases and When at higher cardiac output the blood pressure increases.
- **Peripheral Vascular Resistance:** the capacity or diameter of the arterioles and capillaries. Peripheral resistance can increase blood pressure, diastolic pressure especially is affected.
- **Blood Volume:** When the blood volume decreases (for example, as a result of a hemorrhage or dehydration), the BP decreases, when the volume increases (for example, as a result of a rapid intravenous infusion), the BP increases.
- **Blood Viscosity:** when the proportion of RBCs to blood plasma is high, BP increases when the blood is highly viscous.

Factors Affecting Blood Pressure

- **Age:** increase with age
- **Exercise:** Physical activity increases cardiac output and ↑BP. For reliable assessment of resting blood pressure, wait 20 to 30 minutes
- **Stress:** increasing the blood pressure reading; however, severe pain can decrease blood pressure.
- **Race**
- **Sex:** After puberty, females usually have lower BP than males of the same age. After menopause, women generally have higher BP than before.
- **Medications**
- **Obesity:** Both childhood and adult obesity predispose to hypertension.

- **Diurnal variations:** Pressure is usually lowest early in the morning when the metabolic rate is lowest, then rises throughout the day and peaks in the late afternoon or early evening.
- **Medical conditions:** Any condition affecting the cardiac output, blood volume, blood viscosity, and/or compliance of the arteries has a direct effect on the blood pressure.
- **Temperature**
- **Sodium intake:** A high sodium intake can increase the release of natriuretic hormone, which indirectly contributes to hypertension.

Assessing Blood Pressure

▪ Methods for assessing BP

1. Direct (invasive monitoring)

- Measurement involves the insertion of a catheter into the brachial, radial, or femoral artery.
- Arterial pressure is represented as wavelike forms displayed on an oscilloscope. With correct placement, this pressure reading is highly accurate.

2. Indirect Methods (noninvasive)

- **Auscultatory Method:** is most commonly used in hospitals, clinics, and homes.
- **Palpatory Methods:** is sometimes used when Korotkoff's sounds cannot be heard and electronic equipment to amplify the sounds is not available, or to prevent misdirection from the presence of an auscultatory gap.

▪ Sites for BP Assessment:

- ✓ **Upper arm;** most common site (Brachial Artery)
- ✓ **Thigh** (Popliteal Artery) indicated when blood pressure cannot be measured on either arm (e.g., because of burns or other trauma).

- ✓ **Lower arm** (Radial artery); possible site for infants or clients who have very large upper arms.

Blood pressure is not measured on a particular limb (arm or leg) in the following situations:

- ❖ The shoulder, arm, or hand (or the hip, knee, or ankle) is injured or diseased.
- ❖ A cast or bulky bandage is on any part of the limb.
- ❖ Axilla or inguinal lymph nodes have been removed on the side of the limb (such as after radical mastectomy).
- ❖ Intravenous infusion is being given in that limb.
- ❖ The patient has an arteriovenous fistula (e.g., for renal dialysis) in that limb.

TABLE 29.5 Classification of Blood Pressure

Category	Systolic (mm Hg)	Diastolic (mm Hg)
Optimal	<120	and/or <80
Normal	<130	and/or <85
High Normal	130–139	and/or 85–89
Stage 1 HTN	140–159	and/or 90–99
Stage 2 HTN	>160	and/or ≥100

Source: Adapted from Canadian Hypertension Education Program. (2016). *The 2016 Canadian Hypertension Education Program Recommendations*. Ottawa, ON: Author. Retrieved from <http://www.hypertension.ca/>.

Alteration in Blood Pressure

1. Hypertension

- A blood pressure that is persistently above normal $\geq 140/90$ mmHg
- Usually asymptomatic
- Factors associated with primary hypertension include
 - ☒ Thickening of the arterial walls
 - ☒ Reduces the size of the arterial lumen, and loss of elasticity



- ☒ lifestyle factors, such as cigarette smoking, obesity, heavy alcohol consumption, caffeine consumption, lack of physical exercise, high blood cholesterol levels, and continued exposure to stress.

2. Hypotension

- BP that is below normal, that is, a systolic reading consistently between 85-110 mm Hg in an adult.
- Orthostatic Hypotension is BP that falls when the patient sits or stands as evidenced by a decrease in systolic or diastolic BP of 10 mm Hg or a rise in pulse of 20 beats/min without any change in BP.



5. Oxygen Saturation

- A **pulse oximeter** is a noninvasive device that estimates a client's (**SaO₂**) by means of a sensor attached to the client's finger, toe, nose, earlobe, or forehead (or around the hand or foot of a neonate).
- The pulse oximeter can detect hypoxemia (low oxygen saturation) before clinical signs and symptoms, such as a dusky color to skin and nail beds develop.
- Oxygen saturation assessed using the invasive approach is documented as SaO₂ (arterial oxygen saturation); oxygen saturation assessed by pulse oximetry is documented as SpO₂ (peripheral oxygen saturation or tissue oxygenation)

BOX 29.3 OXIMETRY: UNDERSTANDING THE NUMBERS

SpO ₂ , %	Oxygenation
95–100	Normal
91–94	Mild hypoxia
86–90	Moderate hypoxia
<85	Severe hypoxia

Note: Oximetry measurements should always be interpreted in conjunction with other patient factors, including signs and symptoms of hypoxia.

Source: Adapted from Valdez-Lowe, C., Ghareeb, S. A., & Antinian, N. T. (2009). Pulse oximetry in adults. *American Journal of Nursing*, 109(6), 52.



Factors Affecting Oxygen Saturation Readings

- **Hemoglobin:** If the hemoglobin is fully saturated with oxygen, the SpO₂ will appear normal, even if the total hemoglobin level is low.
- **Circulation:** The oximeter will not provide an accurate reading if the area under the sensor has impaired circulation or poor perfusion
- **Activity:** Shivering, tremors, wiggling, seizures or excessive movement of the sensor site can interfere with accurate readings
- **Carbon monoxide poisoning:** Pulse oximeters cannot discriminate between hemoglobin saturated with carbon monoxide (CO) versus oxygen.
- **Bright lights:** Bright lights may cause falsely low oximeter readings
- **Nail polish**

References

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