

Module 3 - Aerosol and Humidity Therapy

This module will allow the learner to gain knowledge with various aerosol and humidity therapy equipment, indications, hazards and applications.

Rationale

Why is it important for you to learn this material?

A large percentage of your patients will require humidity therapy, aerosol therapy, or a combination of the two. The effort to minimize insensible water loss through the use of patient-appropriate humidity devices is important, as medical gases are anhydrous. This may have an effect on secretion tenacity to total blood volume and must be managed in such a way as to best serve your patient. A common means of delivering a variety of pulmonary medications is through the use of aerosol-generating devices. With the introduction of any medication comes the requirement for a full understanding of the goal of therapy, method of action, drug compatibility, and possible side effects. An understanding of how a range of delivery systems for both aerosol and humidity therapy function is fundamental to ensuring that your patient is receiving the best and most appropriate treatment you can provide.

Learning Outcome

When you complete this module you will be able to

Differentiate between the physical properties of aerosol and humidity therapy and discuss the devices used for the delivery of both. You will be able to discuss pharmacological effects, classification of pulmonary medications, method of action, and be able to reflect on dosage calculations and compatibility of agents.

Learning Objectives

Here is what you will be able to do when you complete each objective.

1. Differentiate between the terms humidity and aerosol and define terms that describe physical properties of humidity and aerosol.
2. Discuss the various delivery systems for humidity therapy.
3. Discuss humidity therapy in terms of clinical indication, contraindication, complications, and hazards.
4. Discuss aerosol therapy in terms of clinical indication, contraindication, complications, and hazards.
5. Explain how penetration, deposition, and clearance of an aerosol can be influenced.
6. Explain a variety of pharmacological terms.
7. Describe the receptor site theory, sympathetic stimulation, and cholinergic/anticholinergic effects on the cardiopulmonary system.
8. Differentiate between sympathomimetic, parasympatholytic, and xanthine bronchodilators.
9. Describe the physiological effects of corticosteroids.
10. Discuss drug preparation and compare systemic versus inhalation/instillation delivery of drugs.

Objective 1

When you complete this objective you will be able to...

Differentiate between the terms humidity and aerosol and define terms that describe physical properties of humidity and aerosol:

- Humidity
- Condensation
- Aerosol
- dew point
- vapour, vapour pressure
- humidifier
- atomizer
- capillary action
- nebulizer
- absolute humidity
- relative humidity
- clearance, deposition, retention
- evaporation
- stability

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Chapter 4 in Cairo, J.M., Mosby's Respiratory Care Equipment, 7th Edition. Definitions may also be found in Chapter 1 of Cairo.

Answer the following questions:

1. Differentiate between an aerosol and humidity in molecular and particle size terms.
2. Briefly describe the following physical properties with relation to humidity and aerosols:
 - humidity –
 - condensation –
 - aerosol –
 - dew point –
 - vapour –
 - vapour pressure –
 - humidifier –
 - atomizer –
 - capillary action –
 - nebulizer –

- absolute humidity –
 - relative humidity –
 - clearance –
 - deposition –
 - retention –
 - evaporation –
 - stability –
3. Differentiate between “cold” and “heated” humidification.
 4. Determine the relative humidity given the following conditions:
(Note: Capacity at 21°C equals 18 mg/L):
 - Absolute humidity of 31 mg/L at a temperature of 37°C
 - Absolute humidity of 6 mg/L at a temperature of 21°C
 5. A known sample of gas is said to have a relative humidity of 50%. Would the relative humidity change if the gas was heated in a closed system? Why or why not?

Objective 2

When you complete this objective you will be able to...

Discuss the various delivery systems for humidity therapy including:

- face tents
- t-pieces
- masks
- tracheostomy masks
- tent/croupette/hoods
- incubator

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Chapter 3 in Cairo, J.M., Mosby's Respiratory Care Equipment, 7th Edition.

1. Describe the function, use, and limitations of the following devices:
 - face tents –
 - t-pieces –
 - masks –
 - tracheostomy masks –
 - tent –
 - croupette –
 - hoods –
 - incubator –

Objective 3

When you complete this objective you will be able to...

- Discuss humidity therapy in terms of clinical indication, contraindication, complications, and hazards.

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Chapter 4 in Cairo, J.M., Mosby's Respiratory Care Equipment, 7th Edition.

Answer the following questions:

2. An adult patient is admitted to your unit and s/he requires oxygen therapy via nasal cannula at 6l pm in order to maintain adequate saturation measured by pulse oximetry. Describe the method of applying humidity if it is required.
3. Describe the indications for humidity therapy in neonatal, pediatric, and adult populations.
4. When would humidity therapy be contraindicated? Does this vary according to the age of your patient?
5. What complications and hazards must you and your patient be aware of with respect to humidity therapy?
6. Why is the transmission of micro-organisms more of a concern with aerosol therapy than with humidity therapy?

Objective 4

When you complete this objective you will be able to...

- Discuss aerosol therapy in terms of clinical indication, contraindication, complications, and hazards.

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Chapter 4 in Cairo, J.M., Mosby's Respiratory Care Equipment, 7th Edition.

Answer the following questions:

1. An adult patient is admitted to your unit and s/he requires an aerosol to be administered to deliver a respiratory medication. Describe the method of applying this medication treatment. How can you be sure that this treatment is required?
2. Describe the indications for aerosol therapy in neonatal, pediatric, and adult populations.
3. Differentiate between aerosol therapy and aerosol medication delivery.
Aerosol:
Medication aerosol:
4. When would aerosol therapy be contraindicated? Does this vary according to the age of your patient?
5. What complications and hazards must you and your patient be aware of with respect to aerosol therapy?
6. What complications and hazards must you and your patient be aware of with respect to medication aerosol therapy?

Objective 5

When you complete this objective you will be able to...

Explain how penetration, deposition, and clearance of an aerosol can be influenced in terms of:

- Gravity
- physical nature of particles
- inertial impaction
- Stoke's Law of sedimentation
- kinetic activity of gas molecules
- ventilatory pattern
- particle size

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read pages 111 - 115 from Cairo, J.M., Mosby's Respiratory Care Equipment, 7th Edition.

Answer the following questions:

1. Explain how penetration, deposition, and clearance of an aerosol can be influenced in terms of:
 - gravity –
 - physical nature of particles –
 - inertial impaction –
 - Stoke's Law of sedimentation –
 - kinetic activity of gas molecules –
 - ventilatory pattern –
 - particle size –

Objective 6

When you complete this objective you will be able to...

Explain a variety of pharmacological terms:

- affinity
- loading dose
- maintenance dose
- agonist
- antagonism
- anaphylaxis
- pKa
- potentiation
- cumulative effect
- synergistic effect
- effective dose 50
- lethal dose 50
- tachyphylaxis
- efficacy
- therapeutic index
- half life
- tolerance

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Units II and IV in Lehne, R.A., Pharmacology for Nursing Care, 3rd Edition. Also read Chapter 2 in Rau, J.L., Respiratory Care Pharmacology, 6th Edition.

Answer the following questions:

1. Provide a brief explanation of these pharmacological terms with respect to drug administration:
 - affinity –
 - loading dose –
 - maintenance dose –
 - agonist –
 - antagonism –
 - anaphylaxis –
 - pKa –
 - potentiate –
 - cumulative effect –
 - synergistic effect –
 - effective dose 50 –
 - lethal dose 50 –
 - tachyphylaxis –
 - efficacy –
 - therapeutic index –
 - half life –
 - tolerance –

Objective 7

When you complete this objective you will be able to...

Describe the receptor site theory, sympathetic stimulation, and cholinergic/ anticholinergic effects on the cardiopulmonary system.

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Chapters 14, 15, 16, and 69 in Lehne, R.A., Pharmacology for Nursing Care, 3rd Edition. Also read Chapter 5 in Rau, J.L., Respiratory Care Pharmacology, 6th Edition.

Answer the following questions:

2. What is the basic premise of the receptor site theory in your own words?
3. Complete the following table by recording the effect on both the cardiac and respiratory system to the given triggers:

	<i>Cardiac System</i>	<i>Pulmonary System</i>
Sympathetic stimulation		
Cholinergic effect		
Anticholinergic effect		

Objective 8

When you complete this objective you will be able to...

Differentiate between sympathomimetic, parasympatholytic, and xanthine bronchodilators in terms of:

- Indications
- routes of administration
- action site
- side effects
- onset and duration of action
- toxic range
- pharmacological effects
- factors used in determining dosage

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Unit II in Lehne, R.A., Pharmacology for Nursing Care, 3rd Edition. Also read Chapters 6, 7, and 8 in Rau, J.L., Respiratory Care Pharmacology, 6th Edition.

Answer the following questions:

1. The most common protein used in the distribution of drugs is:
 - a. Albumin
 - b. Hemoglobin
 - c. Myoglobin
 - d. Histamine
2. Which of the following medications would be the most useful in treating bronchospasm associated with an acute asthma attack?
 - a. Serevent
 - b. Atrovent
 - c. Salbutamol
 - d. Theophylline
 - e. Epinephrine
3. Complete the following table:

	<i>Site of action</i>	<i>Drugs in this class by name</i>	<i>Side effects</i>
Sympathomimetic			
Parasympatholytic			
Xanthine			

4. When is onset of action of a drug important?
5. What factors are taken into consideration regarding a specific dose for any given patient?
6. With regard to bronchodilator medications, what are the most likely toxic effect presentations and how will these be avoided?

Objective 9

When you complete this objective you will be able to...

Describe the physiological effects of corticosteroids.

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Chapters 56, 63 - 65 in Lehne, R.A., Pharmacology for Nursing Care, 3rd Edition. Also read Chapter 11 in Rau, J.L., Respiratory Care Pharmacology, 6th Edition.

Answer the following questions:

1. Identify the organ responsible for secreting mineralocorticoid and glucocorticoid steroids.
2. Contrast the role of glucocorticoids and mineralocorticoids.
3. Describe the effect of glucocorticoids on the immune system.
4. Provide an explanation of the beneficial effect of inflammatory response to an infection.
5. Identify the clinical manifestations and lab data used to identify a pulmonary infection.

Objective 10

When you complete this objective you will be able to...

Discuss drug preparation and compare systemic vs. inhalation/instillation delivery of drugs using the following terms:

- Drug preparation
 - dosage calculations
 - compatibility
 - hazards
- Systemic vs. inhalation/instillation delivery
 - Indication
 - Dosage
 - action site
 - side effects

Learning Activity

Complete each of the Learning Activities listed below.

Objective Content – Read Chapter 4 in Rau, J.L., Respiratory Care Pharmacology, 6th Edition.

Answer the following questions:

1. One milligram equals how many kilograms?
2. One kilogram equals how many pounds?
3. Complete the following table:

Source	Volume to be drawn up
35 mg from a 5 mg/ml source	
0.5 mg from a 7.5 mg/ml source	
100 mcg from a 1 mg/ml source	
50 mg from a 10 mg/20 ml source	
15 ml from a 5 mg/ml source	
0.5 ml from a 250 mcg/ml source	
100 ml from a 9g/1000 ml source	

4. What would be the best resource for discovering if one drug was compatible with another?
What section of this resource would be best?
5. Complete the following table:

Drug dose in mg	Volume to be drawn up
10 mg from a 10% solution	
250 mg from a 5% solution	
250 mg from a 5% solution	

6. When introducing Ventolin to a newly diagnosed asthmatic patient, what side effects should you make them aware of? If this patient is now also on an inhaled steroid, what would you want to educate them about regarding its administration?
7. What cell type(s) do broncodilator medications target in the airway?