



COMMON SENSE RESPIRATORY

"INHALED MEDICATIONS"



Learning Objectives

Common Sense Respiratory is a series of articles written for the “non-Respiratory Care Practitioner” with the purpose of conveying concepts and terminology of respiratory medicine in every-day language. Increasing understanding of these areas will allow Rotech personnel to provide a higher level of service to the patients, families, physicians, nurses, respiratory care practitioners, discharge planners, and other markets we serve. In “Inhaled Medications,” we will endeavor to answer the following questions.

Why do patients inhale medications?

Which medications can be given by inhalation and how do they work?

How does the doctor know which medication to use?

Why use more than one medication?

How are medications inhaled?

What are the devices that can be used to deliver medications by inhalation?

What are the advantages of one device over another?

Which patients should be considered for a nebulizer?

What are the keys to proper use of inhaled medications?

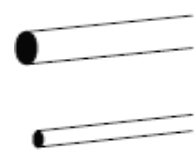
TL Petty in the Frontline Treatment of COPD states; “The regular use of bronchodilators or inhaled corticosteroids in the early stages of disease may help forestall or prevent irreversible damage and may make impairment, disability, and death from “end-stage” COPD less likely.”

Why do patients inhale medications?

In people with obstructive lung disease, the main problem is that the patient’s airways have become obstructed due to narrowing. This narrowing is caused by a variety of things including inflammation of the airway walls, contraction of the smooth muscle that surrounds the airways, and excess mucus inside the airway (Figure 1). A primary goal is to relieve the airway obstruction so that it is easier for the patient to breathe and more fresh air is able to get to the alveoli (air sacs) in the lungs.

Try It Yourself:

Obtain a normal size straw and a small coffee straw.
First breathe through the normal size straw.
Now try breathing through the smaller diameter coffee straw.
Which one is easier?



The normal straw represents breathing through normal airways. When the airways become smaller due to mucus plugging, inflammation, and bronchial muscle contraction, the inside of the airway becomes smaller like the coffee straw. Do you understand why it is so important to use medications to open the airways?

Taking medications by inhaling them is the frontline treatment for **COPD**, **asthma**, and several other respiratory conditions. A natural question is, “Why take a medication by inhaling it? Isn’t it easier to just take a pill?” Taking medicines by inhaling them versus a pill is preferable for several reasons.

When the medication is being delivered straight to the airway, a lower **dosage** can be administered than when taking the medication as a pill. When giving the medication as a pill, the medication is absorbed by the intestine and carried by the blood stream throughout the body. Only a small amount of the drug goes to the lung where it provides the desired results. The rest is distributed throughout the body.

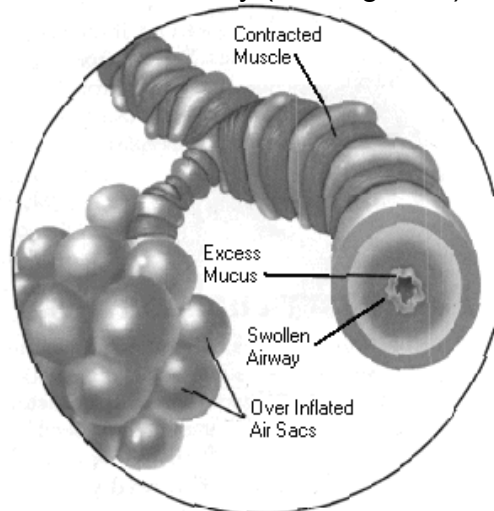
Because of the direct delivery of a lower dosage of drug to the airway, less medication goes to other parts of the body. This results in fewer problems with side effects from these medications. This is especially important for medications such as steroids where taking the medication by pill can result in significant problems with unwanted side effects.

When the medication is inhaled into the airways, it reaches the site of action almost immediately compared to a pill which goes to the stomach where it is dissolved, absorbed, and carried to the site of action by the bloodstream. Thus the response time for inhaled medications is more rapid than when taking the medication as a pill. For example, albuterol starts working almost immediately after inhalation and reaches its maximum effectiveness within minutes.

Which medications can be given by inhalation and how do they work?

There are several types of medications that can be taken by inhalation. Most of the drugs are aimed at opening airways that have become narrowed due to disease, making breathing more difficult. We will discuss the main groups and mention some of the others.

Beta Agonists- Beta agonists (aka, **beta-adrenergic agonists** or **sympathomimetics**) are one type of **bronchodilator**, drugs that are designed to open or “**dilate**” the airways (**bronchioles**). The one most commonly used is albuterol sulfate (aka, Proventil®, Ventolin®), but others include metaproterenol sulfate (aka, Alupent®), terbutaline sulfate (aka, Brethine®), isoethrine HCl (aka, Bronkosol®), and the long-acting bronchodilator salmeterol xinafoate (aka, Serevent®). They work by causing relaxation of smooth muscle that surrounds the airway (see Figure 1).



They are called beta agonists because the **receptor sites** in the airways that trigger the opening of the airways are called “**beta-receptors**.” When betareceptors are stimulated, chemical processes occur that result in smooth muscle relaxation and opening of the airway.

Beta agonists are used in asthma, COPD, and other respiratory diseases where airway obstruction is a problem. Besides causing bronchodilation, the medication also has the benefit of improving the clearance of mucus from the airway.

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- ❖ **Anticholinergics**- Anticholinergics are another type of bronchodilator. Ipratropium bromide (aka, Atrovent®) is the only commonly available anticholinergic, although atropine sulfate has also been used. These drugs work by blocking the action of acetylcholine, a chemical that causes contraction of the airway smooth muscle resulting in **bronchoconstriction** or narrowing of the airway. By blocking acetylcholine receptors, bronchoconstriction is prevented and the airways are opened. Anticholinergics are recommended as the first drug to be used in treating COPD and may have use in asthma, although this is not well established. Besides preventing bronchoconstriction, the medication has the added benefit of decreasing the amount of mucus in the airway, which is a common problem in many patients with COPD.
- ❖ **Corticosteroids**- Also known as **glucocorticoids**, this group of steroids is used primarily for their **anti-inflammatory** properties. Swelling of the airway walls is a common problem in asthma and chronic bronchitis. By reducing inflammation in the airways, the airway **lumen** is enlarged. Commonly used inhaled corticosteroids include triamcinolone acetonide (aka, Azmacort®), beclomethasone dipropionate (aka, Vanceril®), fluticasone propionate (Flovent®), and flunisolide (aka, Aerobid®).

Inhaled steroids have moved into a lead role in the treatment of asthma where relieving swelling in the airway is a primary concern. Although steroids are commonly used in the treatment of COPD, only a small percentage of patients (10-30%) demonstrate any benefit in clinical studies. Patients placed on steroids for the treatment of COPD should have **spirometry testing** performed prior to and 30 days after starting steroids. If a significant improvement (eg, > 15% in FEV1 or FVC) is not noted in spirometry values and/or in symptoms, steroids should be discontinued. If improvement is noted, steroids should be weaned to the lowest effective dose. Even patients that do not benefit from **chronic** use of steroids may benefit from shortterm use during **acute exacerbations** (eg, respiratory infections, pneumonia).



Other Medications:

Several other medications may be given by inhalation including:

- ❖ **Antibiotics**- Pentamidine is given to treat pneumocystis carinii, a pneumonia commonly associated with AIDS patients. Other antibiotics have been used to treat lung infections in conditions associated with thick secretions and chronic infections. Amphotericin B has been **aerosolized** to treat fungal infections of the lungs.
- ❖ **Mediator-Modifying Agents**- One of the most promising areas of development for asthma is drugs aimed at blocking or modifying the release of chemical mediators that cause many of the problems associated with asthma (ie, bronchospasm, airway swelling, mucus production). Cromolyn sodium (Intal®) is one such drug. Nedocromil and zifirlukast have also become available and more are on the way.
- ❖ **Future**- Other medications which have been used by inhalation to treat respiratory disease include morphine sulfate for dyspnea, lidocaine for asthma, and ethyl alcohol for pulmonary edema. It is certain that inhaled medications will continue to play a key role in the management of respiratory disease and new drugs will be developed on an ongoing basis.

How does the doctor know which medication to use?

Disease management guidelines have been established to guide the physician in which medication to use. When physicians start a new medication, they should document improvement, either by symptoms or by spirometry. If no improvement occurs, the medication should be discontinued. However, an important point to remember is that many COPD patients may not show significant improvement in spirometry values after a single treatment with a bronchodilator. Only about one third of patients improve with a single treatment, another third show improvement after multiple treatments, but even in the absence of improvement in spirometry, bronchodilator therapy should not be withheld. Many patients will show symptomatic improvement in the absence of any change in spirometry.

Quotable Quotes

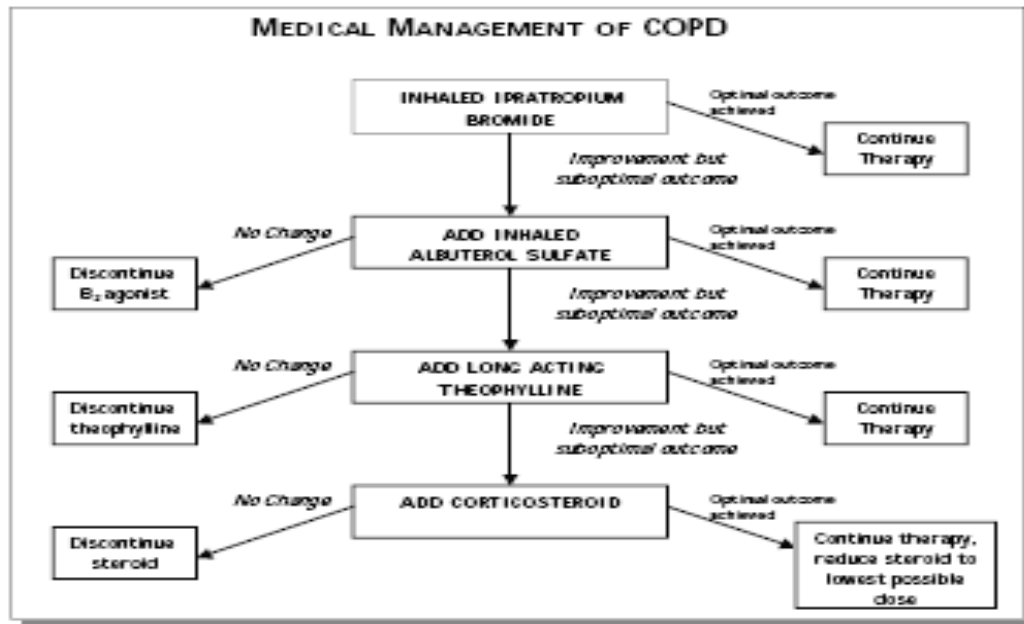
“Failure to respond [to bronchodilators during spirometry does not necessarily mean that a patient will not find bronchodilators or corticosteroids helpful.”

Frontline Treatment of
COPD

Current Management Guidelines

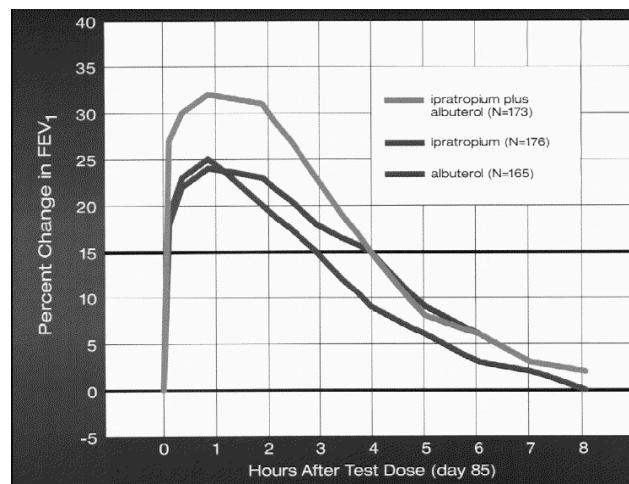
Guidelines for the management of asthma and COPD are available to assist the physician in the management of these patients. Guidelines for the treatment of asthma are available from the National Heart, Lung, and Blood Institute's National Asthma Education and Prevention Program. Guidelines for the Diagnosis and Treatment of Asthma- Highlights of the Expert Panel Report is available from the National Institute of Health, Publication No. 97-4051A. It can also be downloaded at www.nhlbi.nih.gov/nhlbi/nhlbi.htm.

The American Thoracic Society's Standards for the Diagnosis and Care of Patients with COPD appeared in the American Journal of Respiratory Care Medicine 1995; Volume 152: S77-S120. An algorithm for the medical management of COPD developed in accordance with these guidelines is shown below.



Why use more than one medication?

Many patients with asthma and COPD may end up on multiple inhaled medications. Because these medications work by different pathways, the use of two or more inhaled medications is often appropriate and necessary to optimally manage their condition. A common example is the use of ipratropium bromide and albuterol sulfate together in the management of COPD. Referred to as “combination therapy,” the use of these two drugs together has been shown to result in an increased benefit compared to using either drug alone.



In asthma management, patients may use an inhaled steroid (eg, triamcinolone), a mediator-modifier (eg, cromolyn sodium), a long-acting bronchodilator (eg, Serevent®),

and a quick-acting rescue bronchodilator (eg, albuterol) simultaneously to optimally treat their condition.

How are medications inhaled?

For a medication to be inhaled, it must first be **aerosolized**. This means taking a liquid and turning it into an **aerosol** of tiny droplets that are inhaled and land on the surface of the airways. If the droplets are too large (> 5 **microns**), they will “rain out” in the mouth and throat before they reach the airways. If they are too small (< 2 microns), they will remain suspended in the air and be exhaled. Use of a device that will appropriately deliver the medication is a key to the proper use of inhaled medications.

What are the devices that can be used to deliver medications by inhalation?

Several devices have been used over the years to deliver inhaled medications. We will concentrate on the two most commonly used devices, the **metered dose inhaler (MDI)** and the **nebulizer**. Other devices, including dry powder inhalers, are available but not commonly used at the present time. The MDI is a small canister that contains both the medication and a **propellant**, along with a plastic delivery system. The MDI is first shaken by the patient to mix the propellant and the medication. Then the patient is taught to hold the inhaler upright while placing the mouthpiece into, or 2 inches in front of, the mouth. After exhaling, the patient starts an inhalation and just after starting to inhale, **actuates** the inhaler by pressing down on the top of it. This releases a spray of medication, which the patient inhales by taking a slow, deep breath. The patient is instructed to hold the breath for 5-10 seconds to allow for maximum **deposition** of the medication. This is then repeated 2-6 times as ordered by the physician for each medication.

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The inhaler can also be used with a spacer/chamber device to increase delivery of the medication. Due to their added size, some patients are not diligent about carrying these devices. Many patients have received one of these devices, but compliance in using the device is often a problem.

Quotable Quotes
“Patients with advanced COPD or those who have difficulty using a metered-dose inhaler, either routinely or during acute exacerbations, may benefit from the use

A nebulizer uses air pressure to create the aerosol. The liquid medication is placed in the nebulizer and the nebulizer is connected to an air compressor by tubing. Air from the compressor travels to the nebulizer where it picks up a small amount of the liquid medication and “sprays” it within the nebulizer, creating the aerosol



Another type of nebulizer called an **ultrasonic nebulizer (USN)** uses ultrasonic sound waves to aerosolize the liquid. The patient may then inhale the aerosol through a mouthpiece or by wearing a mask which covers the nose and mouth.

What are the advantages of one device over another?

It is important for the prescribing physician to consider the strengths and weaknesses of each system when choosing which one to use for each patient. An advantage of the MDI includes its small size. This makes it easier for the patient to carry with them. It can be quicker to use, although this advantage is lost as the patient takes additional medications or repeated puffs. There are also more medications available via the MDI although this is not a significant issue as the most commonly used medications are available via both routes.

The nebulizer offers several advantages as well.

- ❖ With a nebulizer, adequate delivery of the medication to the airway is not dependent on the patient's technique, as it is with an MDI. As seen above, using an MDI requires up to 10 steps for correct use. Studies have shown that 50-75% of patients using MDI's don't demonstrate good technique and may not receive the desired results from the medication.
- ❖ For many patients (eg, those on Medicare), the cost of the nebulizer and medication is covered by insurance and the inhaler is not. For a patient on multiple medications, the out-of-pocket expense for inhalers may be \$150 per month or more. Many patients may ration or stop using inhalers due to the expense, resulting in poorly managed patients.
- ❖ The nebulizer delivers a higher dosage of medication that many patients require for **optimal** treatment. Studies have shown that the optimal dosage for ipratropium and albuterol may be 3-4 times higher than the commonly ordered 2

puffs **QID**. Delivering this higher dosage by MDI can be both cost and time prohibitive.

- ❖ The patient is educated in the proper use and care of the nebulizer by trained personnel. Education is often lacking or absent for the MDI.
- ❖ The nebulizer may be more convenient as supplies and the medication are delivered directly to the home. This can be significant for patients who have difficulty traveling outside their home.

Quotable Quotes

“Thirteen [of twenty three] patients who were observed to make inhalation errors showed a significant loss of bronchodilation (30%)... It is concluded that when

Which patients should be considered for a nebulizer?

- ❖ **Patients at risk for poor MDI use-** If used appropriately, both inhalers and nebulizers are effective in delivering medication to the airway. The big if here is “If used appropriately.” Multiple clinical studies have demonstrated that MDI users frequently have poor technique when using an inhaler. As discussed previously, using an MDI appropriately requires up to 10 steps. Many patients are unable to demonstrate proper technique even after instruction. Studies have shown that 50-75% of MDI users do not use proper technique. Lack of proper technique often leads to poor delivery of the medication and a **suboptimal** response. In clinical trials, several factors have been shown to be predictive of those likely to have poor MDI technique.
 1. Patients 65 years old and over are shown to have a higher likelihood of misuse. This is important as most COPD patients fall into this age group.
 2. Altered mental status is a risk factor and is also common in COPD. Poor memory and lack of concentration are common secondary to both age and hypoxemia, hypercapnia, poor sleep, and other conditions commonly encountered in COPD.
 3. Impaired hand strength or dexterity occurs frequently in the elderly, in weakened COPDers, and those with coexisting conditions (eg, arthritis). An incomplete dose may result if the inhaler is not adequately actuated.
 4. Interestingly, females were significantly more likely to misuse inhalers. The reason for this was not completely explored in the study.
- ❖ **Patients requiring larger dosages-** As stated previously, many patients with COPD require 6 puffs or more of medication for an optimal dose. Delivering this much medication by inhaler can be both time and cost prohibitive (i.e., new inhaler every 8 days). The nebulizer delivers the higher dosage with a single treatment.
- ❖ **Noncompliant Patients-** Noncompliance with inhaled medications is a major problem and may be present for a number of reasons.
 1. **Out of Pocket Expense-** Patients paying for inhaled medications out of their own pocket may have expenses of \$150 per month or more for multiple inhaled medications. Out of financial necessity, patients may ration or stop taking medications. As nebulizer and nebulizer medications are covered by Medicare

when appropriate, out-of-pocket expense for nebulizers is generally less.

2. **Lack of Monitoring**- Patients are not routinely monitored for compliance when using inhalers. With the nebulizer program, patients are contacted once per month for reorders. If a patient is noncompliant, follow up education can be provided and the physician contacted when necessary.

3. **Lack of Education**- Education on how to use inhalers is often absent or lacking. When the nebulizer is set up, trained personnel provide education on the proper use and care of the equipment. If needed, follow up training should be performed.

4. **Inconvenience**- Many patients with COPD have difficulty getting out of their homes and may be more compliant when medication and supplies are delivered directly to their homes.

What are the keys to proper use of inhaled medications?

Education of both patients and physicians in the important elements of inhaled medications is a key to optimal treatment. All Rotech personnel, including clinicians, driver/techs, customer service representatives, marketers, and managers must have a strong knowledge of the use of inhaled medications consistent with their level of responsibility. The more knowledgeable we are, the better we will be able to inform the physicians and train our patients. Proper education of the patient is necessary to obtain compliance. Patients should understand why they are taking the medications and the importance of regular use (see the enclosed education sheets).

Quotable Quotes
“Educating the patient and his or her family about COPD, the importance of complying with medication regimens, and the value of exercise is vital to the successful

In summary, there are four points to optimal treatment with inhaled medications.

- Choosing appropriate medications
- Using appropriate dosages
- Using a delivery device which will work for the patient
- Keeping the patient compliant with the therapy by proper education



Glossary of Terms

These definitions, although written to be accurate, are simplified and may be incomplete.

For a more complete (and complicated) definition, refer to an acceptable medical dictionary (eg, Dorland's). Abbreviations used may include aka,- "also known as," eg,- "for example," and ie,- "that is." Words that appear in italics within the definition are also defined within the glossary.

Actuate- Pressing down on the top of an inhaler canister to trigger the "puff" or "spray" of medication.

Acute- Having a short and relatively severe course.

Aerosol- Very small droplets suspended in air. A liquid medication is typically aerosolized so that it can be inhaled into the lungs.

Airflow- Airflow is how fast air is moving in (inspiratory flows) or out (expiratory flows) of the airways. It is usually measured in liters per minute (l/m) or liters per second (l/s).

Airways- Airways are the tubes that provide a path for air movement from the atmosphere to the alveoli (air sacs) in the lungs.

Alveoli- Microscopic air sacs in the lungs that are responsible for getting oxygen into, and carbon dioxide out of, the bloodstream.

Antibiotics- Medications aimed at suppressing or eliminating certain harmful microorganisms (eg, bacteria, fungi, viruses) in the body.

Anticholinergic- A type of bronchodilator medication that works by blocking the action of acetylcholine, a chemical that causes airway smooth muscle contraction resulting in narrowing of the airways (bronchoconstriction).

Anti-Inflammatory- An agent that blocks or suppresses inflammation (swelling).

Asthma- Asthma is a condition characterized by periods of decreased airflow through the airways. This is due to blockage of the airways from swelling, spasm of the muscle around the airway, and increased secretions in the airways.

Beta-Agonist (aka, Beta-Adrenergic Agonist or Sympathomimetics) - A class of medications designed to stimulate Beta-receptor sites in the lungs. When these sites are stimulated, the smooth muscle that surrounds the airway relaxes and the airways become more open (bronchodilation).

Beta-Receptor (aka Beta-Adrenergic Receptors)- Located mainly in the heart (Beta1 receptors) and the lungs (Beta2 receptors), when Beta2 sites are stimulated, the smooth muscle that surrounds the airway relaxes and the airways become more open (bronchodilation). Other effects include improving the clearance of mucus from the chest (desirable effect) and muscle tremor (undesirable side effect).

Bronchioles (aka, Bronchiolus)- One of the smaller divisions of the bronchiole tree, the system of airways they carry air to the alveoli (air sacs) in the lungs. When an airway is 1 mm or less in diameter, it is referred to as a bronchiole. When it is larger and contains supportive cartilage, it is called a bronchus (pl.- bronchi).

Bronchoconstriction- A reduction in the diameter of the bronchiole (airway), usually as a result of contraction of the smooth muscle that surrounds the airways.

Bronchodilation- An increase in the inside diameter of the bronchiole (airway lumen), usually as the result of relaxation of the smooth muscle that surrounds the airways.

Bronchodilator- A medication which causes the airways to open (bronchodilate).

Bronchospasm- A sudden reduction in the diameter of the bronchiole (airway), usually as a result of contraction of the smooth muscle that surrounds the airways.

Chronic- Lasting for, or occurring over, a longer period of time.

Chronic Obstructive Pulmonary Disease (COPD)- COPD is a diagnosis which includes conditions such as emphysema, chronic bronchitis, and asthmatic bronchitis which produce chronic reduction of the airflow out of the lungs. Because these conditions often coexist to some degree, it is often easier to group patients under COPD rather than “emphysema with some chronic bronchitis” or “chronic bronchitis with an asthmatic component.”

Corticosteroids (aka, Glucocorticoids)- Medication group, includes prednisone, dexamethasone, and triamcinolone, which is used to reduce inflammation. Used in a variety of illnesses including lung disease and arthritis.

Deposition- The act of medication droplets (from an aerosol) landing on the surface of the airway.

Dilate- Making an opening larger.

Dosage/Dose- The amount of medication given to a patient. The dosage should include how much they take (eg, 1 tablet, 2 puffs), how often they take it (eg, QID), and how long they should continue to take it (eg, times seven days).

Exacerbation- A sudden worsening of the patient's condition. In lung disease, the two most common causes of exacerbation are infection and heart failure.

Glucocorticoids- See “Corticosteroid”

Inhale/Inhalation- That part of the breathing cycle when air is flowing into the lungs.

Inflammation- Swelling in an area as a natural body response to irritation. One example is when an irritant contacts our skin and the area becomes red and swollen.

Lumen- The inside diameter of a tube such as an airway.

Lungs- The lungs are the organs of gas exchange in the body. Composed of millions of tiny alveoli (air sacs), they are designed to get oxygen into the bloodstream and carbon dioxide out of the blood. Each alveolus is bordered by its accompanying capillary, which allows red blood cells to flow in very close proximity to the fresh air inside the alveoli. This allows for ready movement of oxygen into, and carbon dioxide out of, the blood stream.

Mediator-Modifying Agents- Medications designed to suppress or block the action of “chemical mediators.” These mediators cause unwanted effects such as swelling of the airway and mucus production.

Metered Dose Inhaler (aka, MDI, Inhaler, “Puffer”)- A device for delivering a medication mist to the airway. It is comprised of a canister of medication and propellant along with a small plastic delivery system, which creates the “spray” that is inhaled by the patient.

Microns- A unit of measurement equal to 1/1,000 of a millimeter. **Mucus-** A sticky substance that lines our airways and traps inhaled particles (eg, pollen, dust, bacteria, and viruses) to protect the lungs. Mucus glands and goblet cells that line the larger airways produce it.

Nebulizer- A device that takes a liquid medication and creates a fine mist (aerosol) that is inhaled by the patient into the airways. The two main types are the hand-held nebulizer that uses air flow to create the mist and the ultrasonic nebulizer, which uses sound waves.

Noncompliant- Refusing to follow the instructions given. (Eg, If a patient refuses to follow the doctor’s order to use oxygen, they are noncompliant.)

Obstruction or Obstructive Defect- When there is impairment in how quickly the air is able to move out of the lungs, this is an obstructive defect. It is indicative of obstructive diseases such as asthma, COPD, and bronchiectasis. A reduction in the FEV1/FVC ratio is the best indicator of an obstructive defect.

Optimal Response- The best reasonable outcome as the result of some intervention. (Eg, In an asthma patient treated with a bronchodilator, the optimal response is the total relief of any problems they were having prior to the medication.)

Propellant- A compound that is mixed with the medication in an inhaler canister. When shaken, the propellant creates pressure inside the canister so when the canister is pressed (actuated), the medication sprays out.

QID- Four times daily.

Receptor Sites- A part of a sensory nerve that responds to some type of stimulus (eg, chemical) by producing a response.

Smooth Muscle- Muscle that surrounds the airways and other body organs. This muscle is involuntary- that is, it is not controlled by a voluntary decision to “move” it, such as is true of the voluntary skeletal muscles (eg, biceps, triceps). Instead, the muscle’s tone (level of contraction) is controlled by the level of certain chemicals (eg, acetylcholine) that occur in the body.

Spirometer- A device used to measure basic lung function by quantifying the volume and flow rate of air out of the lungs during basic spirometry testing. This device should be available to all physicians involved in the treatment of patients with lung disease.

Spirometry Testing- Basic spirometry is the term typically used to denote the measurement of basic lung function (eg, volume and airflow) by the use of a spirometer.

Suboptimal Response- A response something less than what was desired. Eg, If an asthma patient continues to exhibit wheezing after being started on bronchodilators have exhibited a suboptimal response.

Sympathomimetic- See “Beta Adrenergic”

Ultrasonic Nebulizer (aka, USN) - See “Nebulizer”

Questions/Assignments

1. Causes of airflow obstruction include all but which of the following?
 - a. Swelling of the airway walls
 - b. Excess mucus in the airways
 - c. Contraction of smooth muscle that surrounds the airway
 - d. Over-inflated air sacs
2. Advantages of delivering medication by inhaling medication compared to taking a pill include all but which of the following?
 - a. Less expensive
 - b. Quicker onset of action
 - c. Fewer side effects
 - d. Less drug required
3. Beta-agonist bronchodilators (eg, albuterol) work primarily by
 - a. Preventing airway smooth muscle contraction
 - b. Relaxing the airway smooth muscle
 - c. Reducing the volume of mucus in the airway
 - d. Reducing inflammation of the airway walls
4. Anticholinergic bronchodilators (eg, ipratropium) work primarily by
 - a. Preventing airway smooth muscle contraction
 - b. Relaxing the airway smooth muscle
 - c. Increasing the clearance of mucus from the airways
 - d. Reducing inflammation of the airway walls
5. Corticosteroids (eg, Azmacort®) work primarily by
 - a. Preventing airway smooth muscle contraction
 - b. Relaxing the airway smooth muscle
 - c. Reducing the volume of mucus in the airway
 - d. Reducing inflammation of the airway walls

6. True or False- If a patient fails to show at least a 15% improvement in spirometry values after starting the medication, it should be discontinued.

7. The first drug that should be used in treating COPD is

- a. Ipratropium bromide
- b. Albuterol sulfate
- c. Azmacort
- d. Theophylline

8. Why do many patients benefit from the use of combination therapy (ie, ipratropium and albuterol)?

- a. It provides a higher total dose
- b. They work by two different pathways to produce bronchodilation
- c. Ipratropium relaxes smooth muscle and albuterol prevents smooth muscle contraction
- d. None of the above

9. Advantages of the inhaler include which of the following?

- a. It typically costs the patient less out of pocket
- b. It is less complicated to use
- c. It provides a higher dosage of medication
- d. None of the above

10. Advantages of the nebulizer include which of the following?

- a. Medication delivery is primarily independent of patient technique
- b. It typically costs the patient less out of pocket
- c. It provides a higher dosage of medication at standard dosages
- d. All of the above

11. True or False- Patients who do not use their inhalers properly still receive adequate medication.

12. Patients who are at increased risk for poor inhaler use include which of the following?

- a. Patients over 65 years old
- b. Patients with an altered mental status
- c. Patients with impaired hand strength or dexterity
- d. All of the above

Match each of the following medication generic names with their common brand names.

- | | |
|----------------------------|---------------|
| 13. Albuterol sulfate | a. Vanceril® |
| 14. Ipratropium bromide | b. Serevent® |
| 15. Metaproterenol sulfate | c. Proventil® |

- 16. Triamcinolone acetonide
- 17. Beclomethasone dipropionate
- 18. Salmeterol xinafoate

- d. Atrovent®
- e. Azmacort®
- f. Alupent®

Assignment: Observe some patients using an inhaler. Do they use it correctly? Which steps do they perform correctly? Which ones do they leave out? Ask the patient which inhalers they think give them the most benefit.

Reference List, Supplemental Reading, and Answers to Test Questions

Frontline Treatment of COPD: A Monograph for the Primary Care Physician. Murray JF and Petty TL. Snowdrift Pulmonary Conference- Booklet written by 8 pulmonologists to guide the primary care physician in the diagnosis and management of COPD. An excellent resource and strong reference for using spirometry and oximetry for identifying early disease.

National Heart, Lung, and Blood Institute's National Asthma Education and Prevention Program. Guidelines for the Diagnosis and Treatment of Asthma- Highlights of the Expert Panel Report 2 National Institute of Health, Publication No. 97-4051A. It can also be downloaded at www.nhlbi.nih.gov/nhlbi/nhlbi.htm.

American Thoracic Society's Standards for the Diagnosis and Care of Patients with COPD appeared in the American Journal of Respiratory Care Medicine 1995; Volume 152: S77-S120.

Using Your Nebulizer and Medication- This patient education sheet provides a basic explanation of the two most common classes of medication used in treating COPD, beta agonists and anticholinergic. It is included with this packet and designed to be imprinted with your logo.

Nebulizer or Inhaler? - An educational sheet for physicians and other clinicians, this information can be used to educate physicians on when a nebulizer should be considered. It discusses six reasons why the nebulizer may be a better alternative for inhaled medications. It is included with this packet.

Answers to Test Questions:

- | | | | |
|------|----------|-----------|-------|
| 1. D | 6. False | 11. False | 16. E |
| 2. A | 7. A | 12. D | 17. A |
| 3. B | 8. B | 13. C | 18. B |
| 4. A | 9. D | 14. D | |
| 5. D | 10. D | 15. F | |



USING YOUR NEBULIZER AND MEDICATION

Your physician has prescribed a nebulizer and medication for treatment of your breathing problems. A nebulizer takes a liquid medication and turns it into a mist that you breathe into your airways. For the medication to work properly, **it is very important for you to use the nebulizer exactly as ordered by your physician for proper treatment of your breathing problems.**

Your physician has ordered a nebulizer for you to use with the following types of medication.

Beta Agonist- _____ to be used _____ times every day.

This medication is a “bronchodilator,” which means it helps to open up or “dilate” your breathing tubes also called bronchioles. It works by relaxing the muscles that surround these tubes, allowing air to get in and out more easily. Because the air passages are more open, it allows you to breathe deeper and this may assist you in coughing more effectively. This will help to clear your lungs of mucus, which is very important in preventing lung infections and pneumonia. The most commonly used bronchodilator is albuterol sulfate (aka, Proventil®), but metaproterenol (aka, Alupent®) and others are used as well. The effect of this medication only lasts 4-6 hours, so it is very important to take it regularly, as ordered by your doctor.



Anticholinergic- _____ to be used _____ times every day. Anticholinergics block the effects of a chemical that causes our airway

muscles to contract making the airways smaller and produce more mucus. Both of these are detrimental if you have breathing problems. By blocking this action, it helps to keep airways open and decreases mucus production. Ipratropium bromide is the medication commonly used. It is often used along with a bronchodilator, as the two have been shown to work together to produce more open airways than either medication used alone. The effect of this medication only lasts 4-6 hours, so it is very important to take it regularly, as ordered by your doctor.

Other medications ordered for use with your nebulizer include:

_____ to be used _____ times
every day.

_____ to be used _____ times
every day.

_____ to be used _____ times every
day.

NEBULIZER OR INHALER?

The use of inhaled medication plays a important role in the treatment of most respiratory disease. The frontline medications for both COPD and asthma are all inhaled medications including beta2 agonists (eg, albuterol

Proventil®), anticholinergics (eg, ipratropium bromide- Atrovent®), and corticosteroids (eg, triamcinolone- Azmacort®). For these medications to work effectively, clinicians must ensure that an appropriate delivery system is used to deposit the aerosolized drug to the airway. When used appropriately, both nebulizers and inhalers perform adequately in delivering medication. The problem often comes in the three little words, “**when used appropriately.**” Nearly all patients are started on inhalers first but there are several important considerations in deciding which patients may do better with the nebulizer.

- **Poor Inhaler Technique-** Clinical studies have demonstrated that most people using inhalers do not use them correctly which can result in poor delivery of the medication. Using an inhaler properly requires the patient to perform up to 10 steps. As many as 75% of patients do not demonstrate proper inhaler technique. Factors which have been shown to increase the likelihood of poor inhaler use include:

- **Age over 65**
- **Altered Mental Status**
- **Poor Hand Strength**
- **Limited Income**
- **Poor Memory**
- **Poor Dexterity**

- **Out-of-Pocket Expense-** Inhalers are typically paid for by the patient as an “out-of-pocket” expense. For patients on multiple inhalers, this expense can be as high as \$150 per month or more. Many patients, especially those on limited incomes, are forced to “ration” their medications to make ends meet. This can

result in poor control of their disease. Nebulizers and the nebulizer medication are both covered by Medicare when appropriate. Increased compliance will result in better control of the disease and may prevent the need for hospitalizations, ER visits, and unplanned physician visits saving money.

- **Suboptimal Dosing with Inhalers-** The standard dosage used by most physicians for ipratropium bromide (aka, Atrovent ®) is 2 puffs four times per day. Clinical studies have shown that the best or “optimal” dosage is often 3-4 times this amount in many COPD patients. The same is true in many patients for albuterol sulfate (aka Proventil ®, Ventolin®). If a patient uses their inhalers at optimal levels, the inconvenience and the cost would be prohibitive. Because the nebulizer delivers a larger dose with each treatment, optimal dosages are more likely to be obtained with each treatment resulting in better control of symptoms.
- **No Monitoring of Over- or Under-Use of Inhalers-** Patients can routinely under-use and overuse their inhalers which can be dangerous. Pharmacists and physicians typically do not have the time to monitor usage patterns. We call each nebulizer patient once a month to monitor compliance. If there is a problem, we contact the patient’s physician.
- **Education-** The patient is educated in the use and care of their nebulizer and medication. Respiratory clinicians are available to counsel patients on the purpose and proper use of their medications.
- **Convenience-** The nebulizer and medications are delivered to the patient’s home. If the patient is experiencing any problems, a respiratory clinician is available for follow up.