WELCOME TO NEBULIZATION 101

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• Why Use Inhaled Medications? Classes of Nebulized Medications • Types of Nebulizers Selecting a Device For Your Patients Nebulization Safety Additional Resources Patient Materials



The Inhalation Route Is Preferred for Most Pulmonary Medications¹

Delivery via the inhalation route allows medications – to be delivered directly to the entire respiratory tract.

This allows medication molecules to be delivered directly to the site of action, allowing for:







Inhaled Medication Therapy is Flexible

- Multiple medication classes available to accurately target pathophysiology
- Multiple device types to tailor therapy to individual needs/abilities/preferences
- Can be used with artificial airways (e.g., tracheostomies or endotracheal tubes)





Beta₂ Agonists³

- Stimulate beta₂ receptors in the airways, increasing intracellular cAMP and inhibiting airway smooth muscle contraction, thereby reducing bronchospasm.
- Potential for "off-target" stimulation resulting in adverse effects, such as:
 - Tachycardia
 - Musculoskeletal tremor
 - Headache
 - Mild hypokalemia
- Both short- and long-acting molecules are available.





Muscarinic Antagonists³

- Competitively bind muscarinic receptors (primarily M3-type) in airway cells, preventing activation by acetylcholine.
- Possible activation of muscarinic receptors outside the respiratory system with associated adverse effects:
 - Dry eyes
 - Dry mouth
 - Urinary retention
- Both short- and long-acting molecules are available.



Inhaled Corticosteroids⁴

- Reduce capillary permeability and promote lysosomal membrane stabilization in airway cells, reducing inflammation.
- Variety of adverse effects, largely dependent on dose and duration.
 - Dysphonia
 - Oral candidiasis
 - Metabolic alterations
 - Pneumonia
 - Skeletal changes
 - Ocular changes
- Long-acting molecules only, with gradual onset of action.



Mucolytics⁶

- Alter mucus structure to reduce viscosity and elasticity, promoting sputum clearance.
 - Hypertonic saline: Reduces viscosity through increased hydration of mucus
 - **Dornase alfa:** Reduces viscosity through depolymerization of neutrophil DNA
- Adverse effects are generally considered mild:
 - Laryngitis/pharyngitis
 - Voice changes
- Long-acting with daily or twice-daily dosing.



Antibiotics⁷

- Least commonly used aerosolized medication class
 - Increasing evidence for prevention of multidrug resistant organisms (MDROs) in the inpatient setting
 - Also used in cystic fibrosis and non-CF bronchiectasis where colonization with MDROs is prevalent
- Dosing schedule varies widely
- Adverse effects can be similar to other antibiotics, but there is a lower risk of systemic effects:
 - Cough
 - Voice changes
 - Transient hearing loss



Types of Nebulizers



A Nebulizer Is Not an Inhaler!⁸

Nebulizers

- Require a power source (wall plug or battery)
- Considered durable medical equipment
- No special inhalation technique



Inhalers

- Powered by propellant or breath
- benefit

pMDI: Pressurized Metered Dose Inhaler SMI: Soft Mist Inhaler DPI: Dry Powder Inhaler



 Requires coordination (pMDIs/SMIs) or substantial inspiratory flow rate (DPIs)



Pneumatic Nebulizer⁹

- Also called jet or updraft nebulizers.
- Aerosol generated by air pressure.
 - Most commonly using an electric compressor.
 - Can also be driven by compressed gas source (e.g. an oxygen tank).
- Inexpensive.
- Disposable tubing and supplies.





Ultrasonic Nebulizer⁹

- Aerosol generated by a piezoelectric crystal vibrating at 1-3 megahertz (MHz).
- Improved efficiency versus pneumatic nebulizers.
- More expensive.
- Incompatible with certain solutions.





Vibrating Mesh Nebulizer⁹

- Aerosol generated by forcing solution through precision-machined mesh (also known as a "micropump").
- Most efficient aerosol generation, most consistent particle size, most quiet devices.
- Most expensive devices (also may not be covered by insurers).
- May require dosage adjustment due to extreme efficiency.







Inhalation Device Feature Comparison⁸

Inhalation Device	pMDI	DPI	SMI	Standard Jet Nebulizer	Vibrating Mesh Nebulizer	Ultrasonic Nebulizer
PORTABILITY	Compact and portable	Compact and portable	Compact and portable	Limited portability	Fast, quiet, and portable (self-contained power source)	Fast, quiet, and portable
ASSEMBLY AND CLEANING	Little preparation required	Short preparation required	Complex assembly	Complex assembly and cleaning required	Cleaning can be difficult	Complex cleaning process
COORDINATION REQUIREMENTS	Requires coordinated actuation and inhalation	No coordination needed (breath actuated)	Requires coordinated actuation and inhalation	Minimal coordination needed	Minimal coordination needed	Minimal coordination needed
OTHER FEATURES	Multidose device with high reproducibility from dose to dose Potential for high pharyngeal deposition	Requires moderate to high inspiratory flow Relatively high oropharyngeal impaction Multidose devices available	Multidose device Not dependent on inspiratory effort No ICS available	Normal breathing pattern can be used May be appropriate in patients who have difficulty with handhold inhalers	More efficient than other nebulizers Not compatible with viscous liquids or other liquids that crystallize on drying	Most efficient nebulizer Can be expensive Not compatible with suspensions (e.g., inhaled corticosteroids)



In a 127-question, quantitative, web-based, descriptive, cross-sectional survey conducted by the ACCP of 499 patients with COPD in the United States:

79% reported **1 or more** potential impediments to device use.



Percentage of Patients Reporting Potential Impediments to Optimal Device Technique (N=499)¹⁰



Study participants were aged 55 to 74 years, predominantly former smokers, and were randomly chosen from a panel of individuals in the United States with self-identified COPD.



Nebulizers Inspire Confidence In Users

While many patients feel confident they used their delivery device correctly, patients using nebulizers were the MOST confident.¹¹







Factors to Consider When Prescribing Medication/Device Combination¹⁰

TECHNIQUE

CAN the person use the device?

PREFERENCES

WILL the person use the device?

DO they understand when and why to use it?

COSTS

IS it on the person's formulary?

IS the copay affordable for the person?

ARE there patient assistance programs, coupons, or other cost mitigation strategies available?



OTHER MEDICATIONS

IS this administration device similar to others currently in use by the person?





Understanding Potential Risks¹²

Fugitive Medical Aerosols



Contaminated Bioaerosols



CoughSneeze



Are Fugitive Aerosols a Concern?¹³

Potential risks appear **minimal** but are incompletely understood.

Research is ongoing

• Use of proper personal protective equipment (PPE) is essential Environmental conditions

- Care venue
- Room ventilation flow
- Nebulizer type and position
- Use of bacterial/viral filters
- Gas flow speed

Host factors

- Respiratory rate and pattern
- Pathogen load
- Cough frequency

Distance from source (patient) Medication formulation





What About Contaminated Bioaerosols?

Incidence of Cough With Albuterol-Containing Medications

PRODUCT		FORMULATION	% CO
Albuterol Sulfate 0.083%		Nebulization Solution	3
ProAir [®] HFA		pMDI	_
ProAir RespiClick®	PLOY BOARD	DPI	≥
PROVENTIL® HFA	Province Control of Co	pMDI	_
VENTOLIN® HFA	Compared and the second and the seco	pMDI	Ę
COMBIVENT® RESPIMAT®6	Character register Character register Charac	SMI	
DuoNeb®		Nebulization Solution	1.



Nebulizers generally induce cough at rates at or below inhalers.¹⁴



Summary

- Nebulized medications are an excellent option for ongoing therapy as well as urgent/emergent care.
- A variety of medications and nebulizer types allow matching between patient needs and therapy goals.
- If a patient is experiencing therapeutic failure with other inhaled medications, consider the use of nebulized meds of a similar class before advancing therapy.
- Nebulization poses minimal risk for caregivers even in the presence of infectious respiratory pathogens.





COPD Pocket Consultant Guide

- Free
- Available for <u>iOS</u> and <u>Android</u>
- Contains both Provider View & Patient/Caregiver View to facilitate communication
- Includes use and maintenance videos for different types of nebulizers





COPD Foundation Nebulizer Consortium



RESEARCH

Conduct basic science, clinical and patient-focused projects, and publication of relevant findings.



EDUCATION

Raise community awareness on nebulizer use in the COVID-19 environment and provide useful information to health care providers and those living with or caring for people with respiratory diseases.



GUIDANCE

Work with stakeholders to develop and promote guidelines for nebulizer use in various settings, including recommendations for health care providers.



INDUSTRY (4 companies)

CLINICAL & SPECIFIC EXPERTS (15 experts)

GOVERNMENT & MEDICAL PROFESSIONAL SOCIETIES

COPD COMMUNITY



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Patient Materials



What Is a Nebulizer?

A nebulizer turns liquid medication into a mist that you can breathe. Your health care professional may prescribe a nebulizer to help with breathing problems like COPD or asthma.

Compressor Air Openings

On/Off Power Switch **Compressor Air Outlet**

Medicines that are inhaled work directly at the site of problems (the lungs), meaning that less medicine is needed and the risk of side effects is lower.

Different nebulizers may look or work slightly differently. Always be sure to follow the instructions provided with your nebulizer machine, as well as your health care professional's advice. And don't forget to wash your hands!

Nebulizers vs. Inhalers

Although certain medications (like albuterol) are available in both nebulizers and inhalers, there are important differences between the two.

NEBULIZERS

Drug & Device: Sold separately **Power:** Needs a battery or plug Size: Tabletop or handheld **Breathing Technique: Normal Treatment time: Minutes**

Treatment time: Seconds

INHALERS

- **Drug & Device:** Sold together
 - **Power:** No power needed
 - Size: Pocket-sized
- **Breathing Technique:** Coordinated, depends on device

Nebulizer Tips

- Know how to use your nebulizer correctly.
- Clean your nebulizer daily to reduce the risk of infections.
- Put the compressor on a hard, flat, CLEAN surface.
- Do not cover any air vents or openings.
- Many nebulizer parts must be changed over time. Ask your health care professional how often to change them.
- Tell your health care professional if the medicine is working or not.

Nebulizer Myths Debunked

MYTHS		BUSTED
All nebulizers get contaminated by patient secretions.		Wash hands before using nebulizer. All parts show manufacturer recommendations. Contamination of of nebulizer parts or medication.
If sick people use nebulizers, they can spread germs to others.		The mist that comes out of the nebulizer has not Proper hand washing prior to use of nebulizer eq nebulizer after use is essential. If you are concerr about using an expiratory filter.
Nebulizers increase infection among health care workers.		When proper personal protective equipment (PPE health care workers, there is a very low risk of inf that nebulizers increase risk of infection.
Nebulizers should not be used in people with active respiratory infections.		At home, if you have a viral or bacterial infection, with good air flow (on a porch or near a window) using a filter, if recommended by your doctor. Alw recommended by the manufacturer.
Inhalers should be used instead of nebulizers during pandemics.	PT St	Your doctor has determined the best medicine fo for you. You should not change without discussin

ould be cleaned/disinfected per can occur due to improper care

t been shown to spread germs. quipment and proper cleaning of rned, you can talk to your doctor

PE) and procedures are used by nfection. There is no evidence

n, use your nebulizer in a location) or away from others. Consider ways clean your nebulizer as

ormulation and delivery system ng with your doctor.

Additional Resources

The COPD Foundation invites you to check out our resources to help you learn more about COPD!

Guides for Better Living: Learn about different aspects about COPD, including how to cope with symptoms, therapies to improve your quality of life, and how to recognize flare-ups. http://copdf.co/education-materials

COPD360social: Connect with others on the COPD journey, share thoughts and ideas, and ask questions to both peers and clinical experts in our specialized online community. http://copdf.co/COPD360social

Download our COPD Pocket Consultant Guide app (free for both <u>Android</u> and <u>iOS</u>) to develop an individual COPD action plan, get prompts and reminders for your next office visit, and much more.

These educational materials are supported by

