

Inhaled Medications – *Beyond Bronchodilators*



“Historically, the inhaled route of medication administration has been associated with the delivery of bronchodilators and/or corticosteroids...”



Breathe in slowly
Push down on the canister
Keep breathing in deeply

ADAM.

Inhaled Route of Medication Delivery

- Respiratory Therapists are the experts in the inhaled route of medication delivery
- Inhaled medication is optimized by
 - Placing patient in a upright or semi fowlers position
 - Instructing the patient to breathe deep with an inspiratory pause to allow the medication to settle in the target area.
 - Equipment is designed to deliver particles in the 2-5 micron range to penetrate to the target area.

Typical Inhaled Meds classified by Mechanism of Action

- Bronchodilators –
 - Beta adrenergic (direct agonist of the **Beta-2** receptor of the sympathetic nervous system)
 - Short acting – Albuterol, Levabuterol “Rescue Drugs”
 - Long acting – Formoterol, Arfomoterol
 - Anticholinergic (antagonist of parasympathetic receptors)
 - Short acting – Ipratropium Bromide
 - Long acting – Tiotropium Bromide
- Steroids – clinically significant response to anti inflammatory drugs my take repeated doses for days.
 - Budesonide
 - Fluticasone

Typical Inhaled Meds classified by Mechanism of Action

- Mucolytics / Mucokinetics
 - Normal Saline – alone or as a carrier of other inhaled medications
 - Hypertonic Saline – studies confirm the use in treatment of RSV
 - Acetylcystine (Mucomyst)
 - Always give with a bronchodilator
 - Dornase Alpha (Pulmozyme) – discussed later.

Inhaled Meds classified by Mechanism of Action

- All other types of inhaled drugs are covered by this presentation
 - Antimicrobials (based upon targeted microorganism) –discussed later
 - Other
 - Lidocaine – typically used as a airway numbing agent following bronchoscopy
 - Morphine – may help to relieve dyspnea in palliative care.
 - Lasix – may help to relieve dyspnea

FDA *Atypical* Approved Inhaled Drugs

- Insulin (DPI) – Exubera, Afrezza
 - Risks of acute bronchospasm in patients with chronic lung disease
- Antimicrobial Agents
 - Amikacin liposome (Arikayce) is a aminoglycoside antibactiral agent used with a special “Lamira Nebulizer System”



FDA Approved inhaled drugs –Antimicrobial drugs continued...

- Aztreonam (Cayston) – CF patients with pseudomonas. Delivered with “Altera” Nebulizer
- Tobramycin – liquid and DPI
 - Indicated for treatment of gram negative bacteria such as pseudomonas
 - TOBI should not be diluted or mixed with other medications in the nebulizer.



FDA Approved inhaled drugs –Antimicrobial drugs continued...

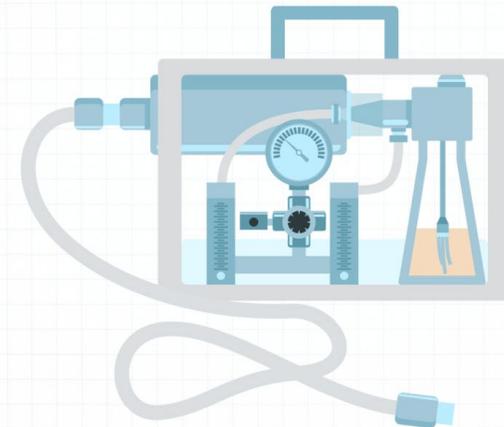
- Pentamidine

- Indicated for control of *Pneumocystis jiroveci* pneumonia (in susceptible individuals with low lymphocyte count)
- Reconstituted with sterile water – stable for up to 48 hours
- May cause bronchospasm – pre treatment with bronchodilators recommended.
- Do not mix with other inhaled drugs
- Deliver in a closed space with adequate filtration system or isolation room.



FDA Approved inhaled drugs –Antimicrobial drugs continued...

- Ribivirin (Virazole) – Delivered with SPAG
 - Antiviral - Indicated for treatment of hospitalized RSV patients
 - Investigated for treatment of other viral organisms such as metapneumovirus
 - Deliver in a closed space with adequate filtration system or isolation room.
 - Aerogen Solo nebulizer is a alternative to the SPAG nebulizer



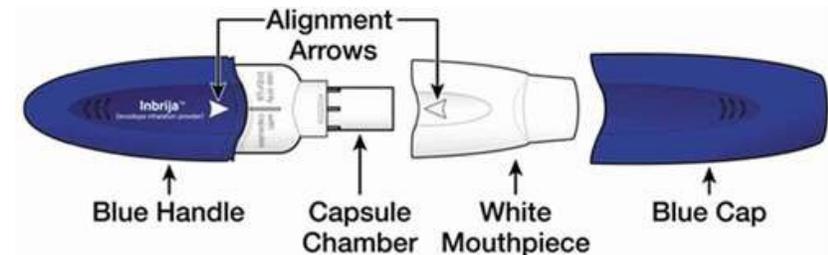
FDA Approved inhaled drugs – Pulmonary Hypertension Agents

- Iloprost (Ventavis)
 - Only delivered with the I-neb AAD system device
- Treprostinil (Tyvasco)



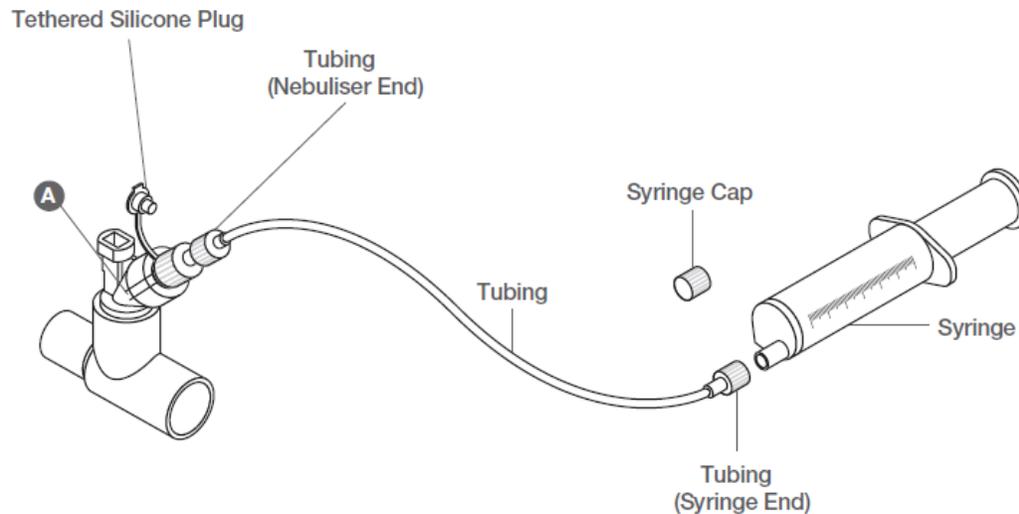
FDA Approved inhaled drugs – Other

- Dornase Alfa (Pulmozyme)
 - Recombinant DNase enzyme to combat secretions
 - FDA approved for CF patients only.
 - Must be refrigerated
 - Do not mix with other drugs
- Levodopa inhalation powder (Inbrija)
 - For treatment of Parkinson's disease.
- Loxapine (Adasuve) powder- antipsychotic



Off-Label Agents Used for Inhalation

- Pulmonary artery hypertension
 - Epoprosterfol (Floan, Veletri)
 - The inhaled version is off-label
 - Delivery with Aerogen vibrating mesh nebulizer



- Milrinone - vasodilator

Floan		Pt. kilograms:
Drug concentration ng/ml	1500	3
Dr. ordered ng/kg/min	10	Run pump at: ml/hr
Available concentrations:		1.2
600 ng/ml		
1500 ng/ml		
2000 ng/ml		
5000 ng/ml		

Off-Label Agents Used for Inhalation

- Off label antibiotics
 - Colistin – Must be used immediately after mixing or becomes toxic
 - Gentamicin
 - Ceftazidime

Off-Label Agents Used for Inhalation

- Miscellaneous Off Label inhaled treatments
 - Tranexamic Acid (TXA)
 - Indicated for pulmonary hemorrhage
 - 500 mg TID most commonly used.
 - 500 mg is mixed with 5ml for a dose of 100mg/ml
 - Delivered with nebulizer TID
 - Can be directly instilled
 - No significant adverse effects have been reported



Off-Label Agents Used for Inhalation

- Off-Label Agents Used for Inhalation continued...
 - Heparin
 - Used for acute lung injury
 - 30,000 to 40,000 U/day delivered by jet or mesh nebulizer
 - Milrinone – pulmonary vasodilator
 - Indicated for pulmonary hypertension during cardiac surgery
 - Chemotherapy? The possibility this is being explored for treatment of lung cancer

Final Thoughts

- It's often been thought that the pH of the substance being delivered by the inhaled route is a major factor in whether or not the solution is safe to inhale, but not the only factor. Safety and effectiveness studies need to be done.
- Careful consultation between the physician, pharmacist, and respiratory care practitioner are necessary to insure patient safety and appropriateness.
- Always monitor and report any adverse reactions.
- Get a written order before delivery.
- Be sure to document thoroughly and completely.