

# *Drug Delivery Devices*

- **Metered-dose inhaler (MDI) :**

suatu alat berisi obat yang harus dihirup dengan dosis tertentu

- **Breath-actuated MDI**

Sama dengan inhaler aerosol bertekanan, kecuali bahwa alat ini memiliki mekanisme khusus di mana inhaler akan teraktivasi secara otomatis jika pasien menghirup nafas.

Keuntungan: tidak perlu ada koordinasi antara aktivasi inhaler dan bernafas → lebih mudah untuk pasien

- **Dry powder inhaler (DPI)**

Inhaler yang obatnya berbentuk serbuk kering dan dihirup langsung ke dalam paru-paru.

Serbuk kering ini bisa terdapat dalam bentuk kapsul (**Spinhaler**), dalam suatu circular disk (**Diskhaler**) atau alat khusus (**Turbuhaler**, **Accuhaler**).

- **Spacer/holding chamber**

Suatu kontainer plastik yang memudahkan pasien menggunakan inhaler, biasanya digunakan untuk anak-anak atau bayi, maupun dewasa.

- **Nebulizer**

Suatu alat nebuliser yang bekerja dengan meniupkan (blowing) udara atau oksigen melalui suatu cairan obat sehingga mengubah obat tersebut menjadi semacam kabut (mist) yang kemudian dihirup pasien mencapai saluran nafas.

Device/Drugs	Population	Optimal Technique*	Therapeutic Issues
Metered-dose inhaler (MDI) Beta <sub>2</sub> -agonists Corticosteroids Cromolyn sodium and nedocromil Anticholinergics	>5 years	<p>Actuation during a slow (30 L/min or 3-5 seconds) deep inhalation, followed by 10-second breath-holding.</p> <p>Under laboratory conditions, open-mouth technique (holding MDI 2 inches away from open mouth) enhances delivery to the lung. However, it has not consistently been shown to enhance clinical benefit compared to closed-mouth technique (closing lips around MDI mouthpiece).</p>	<p>Slow inhalation may be difficult. Difficulty with coordination of actuation and inhalation, particularly in young children and elderly. Patients may incorrectly stop inhalation at actuation. Deposition of 80 percent of actuated dose in oropharynx. Mouth washing is effective in reducing systemic absorption (Selroos and Halme 1991).</p>

<p>Breath-actuated MDI Beta<sub>2</sub>-agonists</p>	<p>&gt;5 years</p>	<p>Slow (30 L/min or 3-5 seconds) inhalation followed by 10-second breath-holding.</p>	<p>Indicated for patients unable to coordinate inhalation and actuation. May be particularly useful in elderly (Newman et al. 1991). Slow inhalation may be difficult and patients may incorrectly stop inhalation at actuation. Requires more rapid inspiration to activate than is optimal for deposition. Cannot be used with currently available spacer/holding chamber devices.</p>
<p>Dry powder inhaler (DPI) Beta<sub>2</sub>-agonists Corticosteroids</p>		<p>Rapid (60 L/min or 1-2 seconds), deep inhalation. Minimally effective inspiratory flow is device dependent.</p>	<p>Dose lost if patient exhales through device. Delivery may be &gt;MDI depending on device and technique. Can be used in children 4 years old, but effects are more consistent with children &gt;5 (Pedersen et al. 1990; Goren et al. 1994; Kemp et al. 1989; Kesten et al. 1994). Most appear to have similar delivery efficiency as MDI either with or without spacer/holding chamber, but some may have delivery &gt;MDI (Thorsson et al. 1994; Agertoft and Pedersen 1993; Kemp et al. 1989; Melchor et al. 1993; Vidgren et al. 1983). Mouth washing is effective in reducing systemic absorption (Selroos and Halme 1991).</p>

Device/Drugs	Population	Optimal Technique*	Therapeutic Issues
Spacer/holding chamber	>4 years <4 years with face mask	<p>Slow (30 L/min or 3-5 seconds) inhalation or tidal breathing immediately following actuation.</p> <p>Actuation only once into spacer/holding chamber per inhalation (O'Callaghan et al. 1994). If face mask is used, allow 3-5 inhalations per actuation (Everard et al. 1992).</p>	<p>Easier to use than MDI alone. With a face mask, enables MDI to be used with small children (Everard et al. 1992; Connett et al. 1993). Simple tubes do not obviate coordinating actuation and inhalation. Bulky. Output may be reduced in some devices after cleaning. The larger volume spacers/holding chambers (&gt;600 cc) may increase lung delivery over MDI alone in patients with poor MDI technique. The effect of a spacer/holding chamber on output from an MDI is dependent on both MDI and spacer type; thus data from one combination should not be extrapolated to all others (Ahrens et al. 1995; Kim et al. 1987).</p> <p>Spacers/holding chambers decrease oropharyngeal deposition and will reduce potential system absorption of inhaled corticosteroid preparations that have higher oral bioavailability (Newman et al. 1984; Brown et al. 1990; Lipworth 1995; Selroos and Halme 1991). Spacers/holding chambers are recommended for all patients on medium-to-high doses of inhaled corticosteroids.</p> <p>May be as effective as nebulizer in delivering high doses of beta<sub>2</sub>-agonists during severe exacerbations.</p>

Nebulizer

Beta<sub>2</sub>-agonists  
Cromolyn  
Anticholinergics  
Corticosteroids

<2 years

Patients of any age who cannot use MDI with spacer/holding chamber or spacer and face mask (e.g., during exacerbations)

Slow tidal breathing with occasional deep breaths.  
Tightly fitting face mask for those unable to use mouthpiece.

Less dependent on patient coordination or cooperation.

Delivery method of choice for cromolyn in children and for high-dose beta<sub>2</sub>-agonists and anticholinergics in moderate-to-severe exacerbations in all patients.

Expensive; time consuming; bulky; output is device dependent; and there are significant internebulizer and intranebulizer output variances.



Inhaler



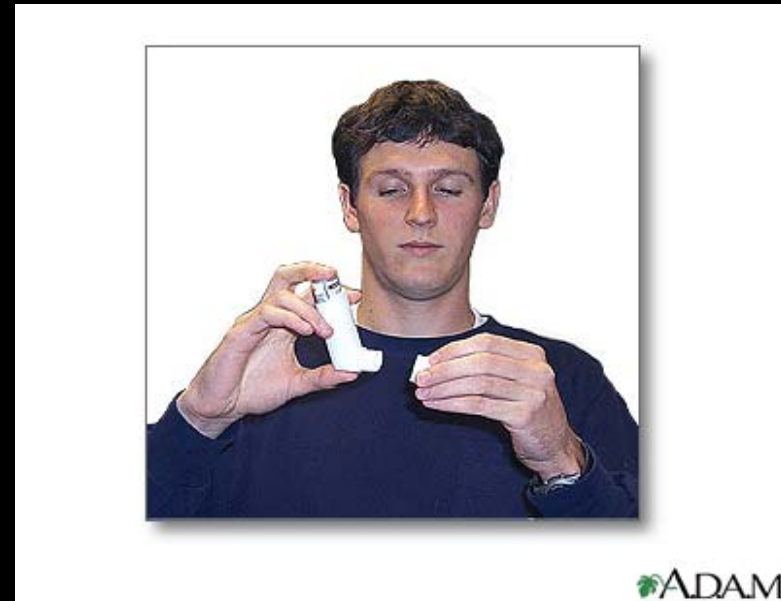
Nebulizer



Spacer



# *Metered-dose inhaler use*



**Take off the cap and shake the inhaler hard.**

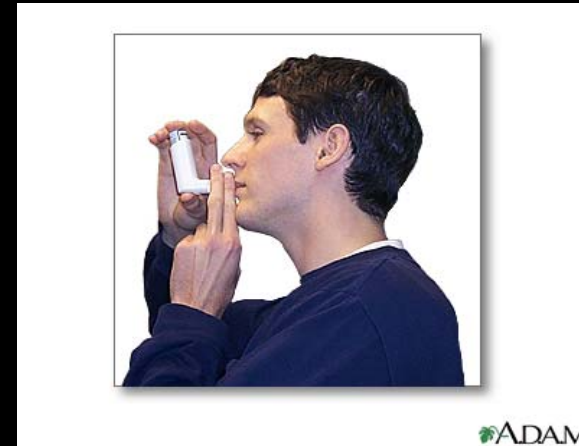


## Step 1



Breathe out all the way.

## Step 2



Hold the inhaler 1 to 2 inches **in front of your mouth (about the width of two fingers)**



## Step 3



ADAM.

Start breathing in slowly through your mouth, and then press down on the inhaler one time. Breathe in slowly, as deeply as you can

## Step 4



ADAM.

Slowly count to 10 while you hold your breath (if you can). This lets the medicine reach deep into your lungs

## Step 5



If your doctor prescribed more than one puff of medicine, repeat this procedure, starting with step 2. For inhaled quick-relief medicine (beta-agonists), wait about one minute between puffs. There is no need to wait between puffs for other medicines

## Step 6



**Rinse your mouth afterward to help reduce unwanted side effects**

# *Penggunaan Nebulizer*



Nebulizers are used to treat asthma, Chronic Obstructive Pulmonary Disease (COPD), and other conditions where inhaled medicines are indicated.

Nebulizers deliver a stream of medicated air to the lungs over a period of time

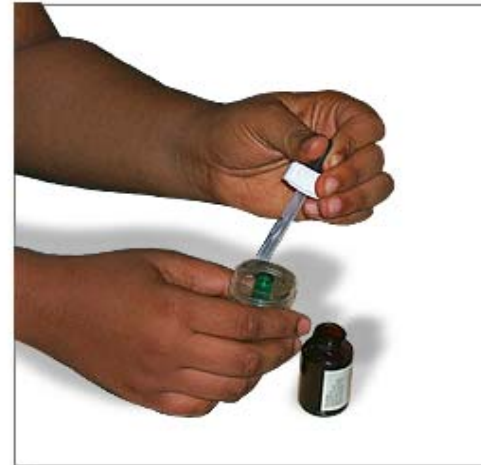
## Step 1



ADAM.

**Assemble the nebulizer according to its instructions. Connect the hose to an air compressor**

## Step 2



ADAM.

**Fill the medicine cup with your prescription, according to the instructions**

## Step 3



ADAM.

Attach the hose and mouthpiece to the medicine cup

## Step 4



ADAM.

Place the mouthpiece in your mouth. Breathe through your mouth until all the medicine is used, about 10-15 minutes. Some people use a nose clip to help them breathe only through the mouth

## Step 5



ADAM.

**Some people prefer to use a mask**

## Step 6



ADAM.

**Wash the medicine cup and mouthpiece with water, and air-dry until your next treatment**

## *Menggunakan spacers*



**Spacers (also called holding chambers) work with your metered dose inhaler (MDI) to deliver inhaled medication more easily and effectively, and can reduce side effects. They are useful for people of all ages.**



## Step 1



ADAM.

**First, insert the mouthpiece of your inhaler into the opening at the flat end of the spacer.**

## Step 2



ADAM.

**Hold your spacer and inhaler together and shake well, at least four times**

### Step 3



ADAM.

**Seal your lips tightly around the mouthpiece on the spacer.**

### Step 4



ADAM.

**Keep your body straight and your eyes forward. Exhale.**

## Step 5



ADAM.

Spray one puff of medicine into the spacer, and immediately begin to inhale slowly, taking a full deep breath.

## Step 6



ADAM.

Remove the spacer from your mouth. Hold your breath and count to 10. Slowly exhale. If your doctor has instructed you to take more than one puff of medication, repeat this procedure.



Children using inhaled medications by four methods:

Upper left: metered dose inhaler (MDI) - note mist leaking from child's mouth, illustrating difficulty young children have coordinating use of MDIs;

Upper right: MDI through AeroChamber with appropriate size of soft flexible face mask

Lower left: MDI through InspirEase

Lower right: MDI through AeroChamber with mouthpiece