Bronchial Asthma
Pathophysiology and management

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Pulmonary medicine
What is Asthma.....Definition (GINA)

• Asthma is
  – A **chronic inflammatory disorder** of the airways in which many cells and cellular elements play a role.
  – The chronic inflammation is associated with **airway hyper-responsiveness** that leads to **recurrent episodes of wheezing**, **breathlessness**, **chest tightness** and coughing particularly at night or early morning.
  – These episodes are usually associated with widespread, but **variable airflow obstruction** within the lung that is **often reversible** either spontaneously or with treatment.
Causes/ Risk factors

- Genetic Susceptibility and Gene-Environment Interactions
- Environmental Risk Factors

Environments/ Risk factors:
- Perinatal Factors
- Indoor and Outdoor Allergens
- Smoking and Environmental Tobacco Smoke
- Other Pollutants
- Race/Ethnicity and Socioeconomic Status
- Obesity
- Respiratory Illnesses
How Asthma develops.....
PATHOGENESIS

Allergen, viruses, bacteria

DC

Th0

IL-12

IFNγ

IL-12

Th1

Th2

IL-10

IL-13, IL-4

IL-4, IL-5

IL-5, GM-CSF

B-cell/plasma cell

Mast cell

Eosinophil

Asthma
Asthma - Pathophysiology

- Acute inflammation
- Chronic inflammation
- Airway remodeling

Symptoms (bronchoconstriction)
Exacerbations nonspecific hyperreactivity
Persistent airflow obstruction

Genetic predisposition
Intrinsic vulnerability
Atopy/allergy
Inflammation underlies disease processes
Phenotype varies by individual and over time
Clinical symptoms also vary by individual and over time
Asthma: Pathological changes

[Diagram showing normal airway and airway during an asthma attack]
Pathology and consequences

- Smooth muscle mass increase
- Mucous glands increase
- Inflammatory cells persistence
- Fibrogenic growth factor release
- Elastolysis

- Severe bronchospasm during exacerbation
- Important mucous secretion during exacerbation
- Ongoing inflammation
- Collagen deposition on RBM and ECM
- Reduced elasticity of airway wall
COPD
- Neutrophils
- CD4+ T-lymphocytes
- No airway hyperresponsiveness
- Less bronchodilator response
- Limited steroid response
- Incompletely irreversible

Asthma
- Eosinophils
- CD8+ T-lymphocytes
- Airway hyperresponsiveness
- Bronchodilator response
- Steroid response
- Completely reversible

Wheezy bronchitis 10%
Physiologic Differences

**Asthma**
- Normal DLCO
- Normal lung volume
- Normal elastic recoil

**COPD**
- Abnormal DLCO
- Hyperinflation
- Decreased elastic recoil

Sciurba FC, CHEST 2004;117S-124S
<table>
<thead>
<tr>
<th>Disease Pathology</th>
<th>Asthma</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversible airflow obstruction</td>
<td>+ ++</td>
<td>+</td>
</tr>
<tr>
<td>Airway inflammation</td>
<td>+ +++</td>
<td>+ +</td>
</tr>
<tr>
<td>Mucus hypersecretion</td>
<td>+</td>
<td>+ + +</td>
</tr>
<tr>
<td>Goblet cell metaplasia</td>
<td>+</td>
<td>+ +</td>
</tr>
<tr>
<td>Impaired mucus clearance</td>
<td>+ +</td>
<td>+ +</td>
</tr>
<tr>
<td>Epithelial damage</td>
<td>++</td>
<td>—</td>
</tr>
<tr>
<td>Alveolar destruction</td>
<td>—</td>
<td>++</td>
</tr>
<tr>
<td>Smooth muscle hypertrophy</td>
<td>+ +</td>
<td>—</td>
</tr>
<tr>
<td>Basement membrane thickening</td>
<td>+++</td>
<td>—</td>
</tr>
</tbody>
</table>
Asthma-Classic presentation

- Intermittent episodic, acute/subacute onset
- Breathlessness/chest tightness usually with wheeze
- Cough nocturnal or early morning.
- Diurnal and seasonal variation
- History of atopy, family history
- Polyphonic wheeze, prolonged expiration
- However, the examination can be normal.
## Differential diagnosis

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases causing recurrent episodic dyspnea</td>
<td>Chronic obstructive pulmonary disease, coronary artery disease, congestive heart failure, pulmonary emboli, recurrent gastroesophageal reflux with aspiration, recurrent anaphylaxis, systemic mastocytosis, carcinoid syndrome</td>
</tr>
<tr>
<td>Common diseases causing cough</td>
<td>Rhinitis, sinusitis, otitis, bronchitis (chronic or postviral), bronchiectasis, cystic fibrosis, pneumonia, diffuse pulmonary fibrosis</td>
</tr>
<tr>
<td>Common diseases causing airflow obstruction</td>
<td>Chronic obstructive bronchitis and emphysema, bronchiolitis obliterans, cystic fibrosis, organic or functional laryngeal narrowing, extrinsic or intrinsic narrowing of trachea or major bronchus.</td>
</tr>
</tbody>
</table>
DIAGNOSIS
Cough, wheezing and Breathlessness

- Minimal or no expectoration
  - Associated chest tightness

- Symptoms variable, Intermittent, recurrent, seasonal, worse at night and provoked by triggers

- History of atopy in self or atopy/eczema in family

- Breath Sound intensity normal
  - Prominent rhonchi – bilateral, diffuse, polyphonic, expiratory

MANAGE AS ASTHMA

- Expectoration mucoid or mucopurulent

- Symptoms chronic/progressive/persistent

- History of smoking (active or ETS exposure)

- Hyperinflation, pursed lip breathing, diminished intensity of breath sounds

Normal

- Localized signs

Sputum for AFB (x3)

- Positive

- Negative

TUBERCULOSIS (Refer to RNTCP)

MANAGE AS COPD

SUSPECT OTHER DIAGNOSES OR COMPLICATIONS

- Associated fever, chest pain, constitutional symptoms

- SUSPECT OTHER DIAGNOSES OR COMPLICATIONS

Referral
Key indicators for considering a diagnosis of asthma

- Typical history
- Intermittent symptoms (reversible)
- Association of symptoms to weather changes, dust, smoke, exercise, viral infection, animals with fur or feathers, house-dust mites, mold, pollen, strong emotional expression (laughing or crying hard), airborne chemicals or dust
- Diurnal variation
- Family history
- Presence of atopy, allergic rhinitis, skin allergies
Routine Investigations

• Hemogram including eosinophil count
• Blood gas analysis
• X-ray chest
• Serum electrolytes (Mg, Na, K)
• Spirometry
• Other test to rule out specific diseases
Spirometry

- Spirometry measurements (FEV₁, FVC, FEV₁/FVC) before and after bronchodilator helps determine whether there is airflow obstruction and whether it is reversible over the short term

- (12% in increase in FEV₁ and absolute increase in 200ml after 200ug of salbutamol inhalation)
Spirometry

- Spirometry should be done
  - at the time of initial assessment
  - after treatment is initiated and symptoms and peak expiratory flow (PEF) have been stabilized
  - at least every 1 to 2 years to assess the maintenance of airway function
TREATMENT
Goals of Asthma Therapy

- Prevent recurrent exacerbations and minimize the need for emergency department visits or hospitalizations
- Maintain (near-) “normal” pulmonary function
- Maintain normal activity levels (including exercise and other physical activity)
- Provide optimal pharmacotherapy with minimal or no adverse effects
## GINA Levels of Asthma Control

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Controlled</th>
<th>Partly controlled (Any present in any week)</th>
<th>Uncontrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime symptoms</td>
<td>None (2 or less / week)</td>
<td>More than twice / week</td>
<td>3 or more features of partly controlled asthma present in any week</td>
</tr>
<tr>
<td>Limitations of activities</td>
<td>None</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Nocturnal symptoms / awakening</td>
<td>None</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Need for rescue / “reliever” treatment</td>
<td>None (2 or less / week)</td>
<td>More than twice / week</td>
<td></td>
</tr>
<tr>
<td>Lung function (PEF or FEV$_1$)</td>
<td>Normal</td>
<td>&lt; 80% predicted or personal best (if known) on any day</td>
<td></td>
</tr>
<tr>
<td>Exacerbation</td>
<td>None</td>
<td>One or more / year</td>
<td>1 in any week</td>
</tr>
</tbody>
</table>
Levels of prevention

- **Genetic predisposition**

  + **Environmental factors**
    - Maternal smoking, reduced rate of infection in early life, dietary factors, effects of indoor or outdoor environments

  - **Sensitization**

  + **Airway inflammation**

  - **Airway hyperresponsiveness**

  + **Environmental factors**
    - Viral infection, allergen exposure, passive smoking, exercise, cold air, traffic pollution

  - **Asthma**
    - Coughing, wheezing, chest tightness and breathlessness

  - **Second primary prevention**
    - Regular anti-inflammatory treatment

  - **Second secondary prevention**
    - Avoidance

  - **Second secondary prevention**
    - First aid relieving bronchodilator therapy
## Asthma drug classification

<table>
<thead>
<tr>
<th>CONTROLLERS</th>
<th>RELIEVERS</th>
</tr>
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<tbody>
<tr>
<td><strong>Anti-inflammatory action to prevent asthma attacks</strong></td>
<td><strong>Sustained bronchodilator action but weak or unproven anti-inflammatory effect</strong></td>
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<td><strong>Inhaled corticosteroids</strong></td>
<td><strong>Long-acting beta-agonists</strong></td>
</tr>
<tr>
<td>2. Budesonide</td>
<td>2. Formoterol</td>
</tr>
<tr>
<td>3. Fluticasone</td>
<td></td>
</tr>
<tr>
<td>4. Ciclasone</td>
<td></td>
</tr>
<tr>
<td><strong>Leukotriene modifiers</strong></td>
<td><strong>Sustained-release theophylline preparations</strong></td>
</tr>
<tr>
<td>1. Montelukast</td>
<td></td>
</tr>
<tr>
<td>2. Zafirlukast</td>
<td></td>
</tr>
<tr>
<td><strong>Oral corticosteroids</strong></td>
<td></td>
</tr>
<tr>
<td>1. Prednisone</td>
<td></td>
</tr>
<tr>
<td>2. Prednisolone</td>
<td></td>
</tr>
<tr>
<td>3. Methylprednisone</td>
<td></td>
</tr>
<tr>
<td>4. Methylprednisolone</td>
<td></td>
</tr>
</tbody>
</table>
What are Controllers?

Control/treat chronic inflammation

Prevent future attacks

Long term control

Prevent airway remodeling

### Table

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</tr>
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What Are Relievers?

- Rescue medications to treat acute bronchospasm
- Quick relief of symptoms
- Used during acute attacks
- Action usually lasts 4-6 hrs

For quick relief of symptoms and use in acute attacks as PRN dosage only

**Short-acting beta-agonists**
1. Salbutamol
2. Fenoterol
3. Terbutaline

**Anti-cholinergenics**
Ipratropium bromide
Methods of Medication Delivery

- Metered-dose inhaler (MDI)
  - Spacer/holding chamber/face mask
- Dry-powder inhaler (DPI)
- Nebulizer
- Oral Medication
  - Tablets, Liquids
- Intravenous Medication
  - IV Corticosteroids, IV Aminophylline
CONTROLLERS

Inhaled Corticosteroids

- **Treatment of choice for** long-term control of persistent asthma

- **Benefits**
  - Reduced airway inflammation through topical activity
  - Decreases airway hyper-responsiveness.
  - Improve lung function and quality of life
  - Reduce the frequency of exacerbations
  - Reduced use of quick-relief medicine

**NEVER FOR RESCUE PURPOSES**
CONTROLLERS
Corticosteroids

- Inhaled
  - Beclomethasone
  - Fluticasone
  - Triamcinolone
  - Budesonide
  - Flunisolide
Anti-inflammatory Effect of Glucocorticoid

GLUCOCORTICOID

inflammatory cells

- Eosinophil
  - ↓ Numbers (apoptosis)
  - ↓ Cytokines

- T-lymphocyte
  - ↓ Numbers

- Mast cell
  - ↓ Cytokines

- Macrophage
  - ↓ Numbers

- Dendritic cell

Structural cells

- Epithelial cell
  - ↓ Cytokines Mediators

- Endothelial cell
  - ↓ Leak

- Airway smooth muscle
  - ↑ β₂-Rece

- Mucus gland
  - ↓ Mucus secretion
## Estimated Comparative Daily Dosages for Adults of Inhaled Corticosteroids

<table>
<thead>
<tr>
<th>Drug</th>
<th>Low Dose</th>
<th>Medium Dose</th>
<th>High Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Step 2</td>
<td>Step 3</td>
<td>Step 4</td>
</tr>
<tr>
<td>Beclomethasone</td>
<td>1-3 puffs</td>
<td>3-6 puffs</td>
<td>&gt;6 puffs</td>
</tr>
<tr>
<td></td>
<td>80 - 240 mcg</td>
<td>240 - 480 mcg</td>
<td>&gt; 480 mcg</td>
</tr>
<tr>
<td>Budesonide DPI</td>
<td>1-3 puffs</td>
<td>3-6 puffs</td>
<td>&gt; 6 puffs</td>
</tr>
<tr>
<td></td>
<td>200 – 600 mcg</td>
<td>600 – 1,200 mcg</td>
<td>&gt; 600 mcg</td>
</tr>
<tr>
<td>Flunisolide</td>
<td>2-4 puffs</td>
<td>4-8 puffs</td>
<td>&gt; 8 puffs</td>
</tr>
<tr>
<td></td>
<td>500–1,000 mcg</td>
<td>1,000–2,000 mcg</td>
<td>&gt; 2,000 mcg</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>2-6 puffs (44)</td>
<td>2-6 puffs (110)</td>
<td>&gt; 6 puffs (110)</td>
</tr>
<tr>
<td></td>
<td>88-264 mcg</td>
<td>264-660 mcg</td>
<td>&gt; 660 mcg</td>
</tr>
<tr>
<td>Triamcinolone</td>
<td>4-10 puffs</td>
<td>10-20 puffs</td>
<td>&gt; 20 puff</td>
</tr>
<tr>
<td></td>
<td>400-1,000 mcg</td>
<td>1,000–2,000 mcg</td>
<td>&gt; 2,000 mcg</td>
</tr>
</tbody>
</table>
## Corticosteroid Side Effects

<table>
<thead>
<tr>
<th>Inhaled Local</th>
<th>Systemic (oral, IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Dysphonia</td>
<td>• Fluid retention</td>
</tr>
<tr>
<td>• Cough/throat irritation</td>
<td>• Muscle weakness</td>
</tr>
<tr>
<td>• Thrush</td>
<td>• Ulcers</td>
</tr>
<tr>
<td>• Impaired growth (high dose)?</td>
<td>• Malaise</td>
</tr>
<tr>
<td></td>
<td>• Impaired wound healing</td>
</tr>
<tr>
<td></td>
<td>• Nausea/Vomiting, HA</td>
</tr>
<tr>
<td></td>
<td>• Osteoporosis (adults)</td>
</tr>
<tr>
<td></td>
<td>• Cataracts (adults)</td>
</tr>
<tr>
<td></td>
<td>• Glaucoma (adults)</td>
</tr>
</tbody>
</table>
CONTROLLERS

Long-acting Beta\textsubscript{2}-agonists

- Salmeterol, Formoterol
  - Indication: Daily long-term control

Advantages

- Blunt exercise induced symptoms for longer time
- Decrease nocturnal symptoms
- Improve quality of life

Combination therapy beneficial when added to inhaled corticosteroids
CONTROLLERS
Long-acting Beta$_2$-agonists

- **NOT** for acute symptoms or exacerbations
  - Onset of effect $\rightarrow$ 30 minutes
  - Peak effect $\rightarrow$ 1-2 hours
  - Duration of effect $\rightarrow$ up to 12 hours

- **NOT** a substitute for anti-inflammatory therapy

- **NOT** appropriate for monotherapy
Useful Beta Adrenergic Effects

- Relax bronchial smooth muscle
- Inhibit mediator release from mast cells, eosinophils, macrophages
- Decrease mucous secretion (submucosal gl)
- Increase mucociliary transport
- Inhibit bronchial oedema
- Inhibit cholinergic transmission
- Decrease airway hyperresponsiveness
CONTROLLERS

Leukotriene Modifiers

- Cysteinyl Leukotriene Receptor Antagonists
  - Montelukast – Once a day dose
  - Zafirlukast – Twice daily – Empty Stomach

- 5-Lipoxygenase inhibitors
  - Zileuton – Four times daily
    - Many drug interactions
Add-on Controllers
Leukotriene Modifiers

- Montelukast
  - Improves lung function and asthma control
  - May protect against exercise induced bronchoconstriction
  - Not as effective as inhaled corticosteroids
  - No food restrictions
RELIEVERS

Short-Acting Beta$_2$-agonist

- Salbutamol
- Terbutaline
- levosalbutamol
RELIEVERS

Short-Acting Beta$_2$-Agonists

- Most effective medication for relief of acute bronchospasm
- Increased need for these medications indicates uncontrolled asthma (and inflammation)
- Use “as needed” as regular use
  - May lower effectiveness
  - May increase airway hyperresponsiveness
RELIEVERS

Short-Acting Beta$_2$-Agonists

- Side Effects:
  - Increased Heart Rate
  - Palpitations
  - Nervousness
  - Sleeplessness
  - Headache
  - Tremor
Unwanted Beta Adrenergic Effects

- Hypokalemia (K shift into muscle tissue)
- Hyperglycemia (glycogenolysis)
- Hypoxia (pulmonary vasodilation causing increased ventilation/perfusion mismatch)
Oral Steroid Short Course

• Prednisone 30-40mg x 10-14 days for acute exacerbation of Asthma
• no weaning of dose unless long term use
Step 1 Treatment for Adults and Children > 5: Mild Intermittent

**Controller – Daily**
- Not needed

**Reliever – Quick Relief**
- Short-acting inhaled beta$_2$-agonist
  - Increasing use, or use more than 2x/week, may indicate need for long-term-control therapy

Step 2 Treatment for Adults and Children > 5: Mild Persistent

- **Controller – Preferred Daily**
  - Low dose inhaled corticosteroid

- **Alternatives**
  - leukotriene modifier,
  - **OR**
  - Sustained-release theophylline
Step 3 Treatment for Adults and Children > 5: Moderate Persistent

**Controller – Preferred Daily**
- Low to medium dose inhaled corticosteroid (medium dose) and long-acting beta$_2$-agonist

**Alternatives**
- Increase inhaled corticosteroids to medium-dose range

**OR**
- Low to medium dose inhaled corticosteroid (medium dose) and either leukotriene modifier or theophylline
Step 3 Treatment for Adults and Children > 5: Moderate Persistent

(patients with recurring severe exacerbations)

**Controller**
- Medium dose inhaled corticosteroid
  (medium dose) and long-acting beta$_2$-agonist

**Alternatives**
- Medium dose inhaled corticosteroid
  (medium dose) and either leukotriene modifier or theophylline
- High dose inhaled corticosteroid

- Consider referral to a specialist
Step 4 Treatment for Adults and Children > 5: Severe Persistent

Controller – Daily

- High-dose inhaled corticosteroid AND
- Long-acting inhaled beta$_2$-agonist
  AND, if needed,

- Add leukotriene antagonists & theophylline

- Corticosteroid tablets

STEP 5
Intermittent asthma

Consult with asthma specialist if step 4 care or higher is required.
Consider consultation at step 3.

Step 1
Preferred:
Low-dose ICS
Alternative:
SABA PRN

Step 2
Preferred:
Low-dose ICS + LABA
Alternative:
Cromolyn, LTRA, Nedocromil, or Theophylline

Step 3
Preferred:
Medium-dose ICS + LABA
Alternative:
Low-dose ICS + either LTRA, Theophylline, or Zileuton

Step 4
Preferred:
High-dose ICS + LABA + oral corticosteroid
AND
Consider Omalizumab for patients who have allergies

Step 5
Preferred:
High-dose ICS + LABA + oral corticosteroid + LTRA, Theophylline, or Zileuton
AND
Consider Omalizumab for patients who have allergies

Step 6

Step up if needed
(first, check adherence, environmental control, and comorbid conditions)
Assess control
Step down if possible
(and asthma is well controlled at least 3 months)

Each step: Patient education, environmental control, and management of comorbidities.

Steps 2–4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma (see notes).

Quick-relief medication for all patients

- SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-minute intervals as needed. Short course of oral systemic corticosteroids may be needed.
- Use of SABA >2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and the need to step up treatment.
Monitor Asthma Control

**PARTLY CONTROLLED**
- Daytime symptoms > twice/week
- Any limitation of activity
- Any nocturnal symptoms/awakening
- Need for reliever medication > twice/week
- Lung function <80% predicted or personal best
- <1 exacerbation per year

Check adherence and inhaler technique
Step up treatment

**Assess control**
- Daytime symptoms
- Limitation of activities
- Nocturnal symptoms/awakening
- Need for reliever medication
- Lung function (PEF or FEV1)
- Exacerbations

**CONTROLLED**
- < 2 daytime symptoms per week
- No limitation of activity
- No nocturnal symptoms/awakening
- Reliever medication - twice/week
- Normal lung function
- No exacerbations

Consider step down if controlled for 3 or more months

**UNCONTROLLED**
- Three or more features of partly controlled asthma in any week.
- An exacerbation in any week

Check adherence and inhaler technique
Step up treatment
Treating to Maintain Asthma Control

Stepping down treatment when asthma is controlled

- When controlled on medium- to high-dose inhaled glucocorticosteroids: 50% dose reduction at 3 month intervals (Evidence B)

- When controlled on low-dose inhaled glucocorticosteroids: switch to once-daily dosing (Evidence A)
Treating to Maintain Asthma Control

Stepping up treatment in response to loss of control

- Rapid-onset, short-acting or long-acting inhaled β2-agonist bronchodilators provide temporary relief
- Need for repeated dosing over more than one/two days signals need for possible increase in controller therapy
Managing the well controlled patient

As soon as good control:
• Reduce oral steroids first, then stop
• Reduce relievers before controllers

When good control for 3+ months:
• Reduce inhaled steroids
Therapy to avoid!

- Sedatives & hypnotics
- Cough syrups
- Anti-histamines
- Immunosuppressive drugs
- Immunotherapy
- Maintenance oral prednisone >10mg/day
Managing partly/uncontrolled asthma

• Check the inhaler technique
• Check adherence and understanding of medication
• Consider aggravation by:
  – Exposure to triggers/allergens at home or work
  – Co-morbid conditions: GI reflux, rhinitis/sinusitis, cardiac problem
  – Medications: Beta-blockers, NSAIDs, Aspirin
The Asthma Action Plan

• Helps patients/caregivers manage asthma
  ▪ Uses Peak Flows
  ▪ Spells out medication instructions

• Green Zone 80-100% Peak Flow
• Yellow Zone 50-80% Peak Flow
• Red Zone Below 50% Peak Flow
Medication Delivery Demonstrations

- Breath Actuated Inhalers
- Metered Dose Inhalers with Spacer/Holding Chamber
- Dry Powder Inhalers
- Nebulizers
# pMDIs

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>Small and portable</td>
<td>difficult to learn technique</td>
</tr>
<tr>
<td></td>
<td>Unsuitable for children &lt; 5-6</td>
</tr>
<tr>
<td>Quick to use</td>
<td>Unsuitable for the elderly,</td>
</tr>
<tr>
<td></td>
<td>Cold jet may irritate throat</td>
</tr>
<tr>
<td></td>
<td>Limited amount of drug delivered per puff</td>
</tr>
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</table>
Spacers and Holding Chambers

A spacer device enhances delivery by decreasing the velocity of the particles and reducing the number of large particles, allowing smaller particles of drug to be inhaled.

- A spacer device with a one-way valve, i.e., holding chamber, eliminates the need for the patient to coordinate actuation with inhalation and optimizes drug delivery.

- A simple spacer device without a valve requires coordination between inhalation and actuation.
DPIs

- Generally easier to use
- A minimal inspiratory flow rate is necessary to inhale from a DPI; difficult for some pts to use during an exacerbation
- More ecological than MDIs
- Storage may be difficult in humid climates
## Nebulizer

<table>
<thead>
<tr>
<th><strong>Advantages</strong></th>
<th><strong>Disadvantages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Coordination required</td>
<td>Cumbersome</td>
</tr>
<tr>
<td>Can be used for all ages</td>
<td>Expensive</td>
</tr>
<tr>
<td>Effective in severe asthma</td>
<td>Noisy</td>
</tr>
<tr>
<td></td>
<td>Treatment takes time</td>
</tr>
</tbody>
</table>
Which inhalation device for which patient?

- Infants and children up 5 y/o: pMDI+spacer, nebulizer
- Children 5-9 y/o: pMDI+spacer, nebulizer, DPI
- Competent older children and adults: pMDI, DPI
- Incompetent older children/adults: pMDI+spacer, nebulizer
Key Messages

• Asthma is common and can start at any age

• Asthma can be effectively controlled

• Effective asthma management programs include education, objective measures of lung function, environmental control, and pharmacologic therapy.

• A stepwise approach to pharmacologic therapy is recommended.

• The aim is to accomplish the goals of therapy with the least possible medication.
Thank you