

Asthma Medications & Devices

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Objectives

- Describe the mechanism of action of the different asthma medications
- Explain where the various medications fit into the asthma guidelines
- Differentiate between the different delivery devices utilized in asthma

Pathophysiology

- Asthma is a chronic inflammatory disorder of the airways
 - Airflow obstruction, bronchospasm
- Several factors may play a part in the increasing the risk of developing and triggering asthma
- These factors can be divided into host factors (genetic) and environmental factors

www.ginasthma.org accessed 03/14/15

National Heart, Lung and Blood Institute

HOST FACTORS

Genetic, e.g.,

- Genes pre-disposing to atopy
- Genes pre-disposing to airway hyperresponsiveness

Obesity

Sex

ENVIRONMENTAL FACTORS

Allergens

- Indoor: Domestic mites, furred animals (dogs, cats, mice), cockroach allergen, fungi, molds, yeasts
- Outdoor: Pollens, fungi, molds, yeasts

Infections (predominantly viral)

Occupational sensitizers

Tobacco smoke

- Passive smoking
- Active smoking

Outdoor/Indoor Air Pollution

Diet

Pathophysiology

Asthma Trigger
(antigen)

Inflammatory
response in
airways

Inflammatory
cells (i.e. mast
cells)

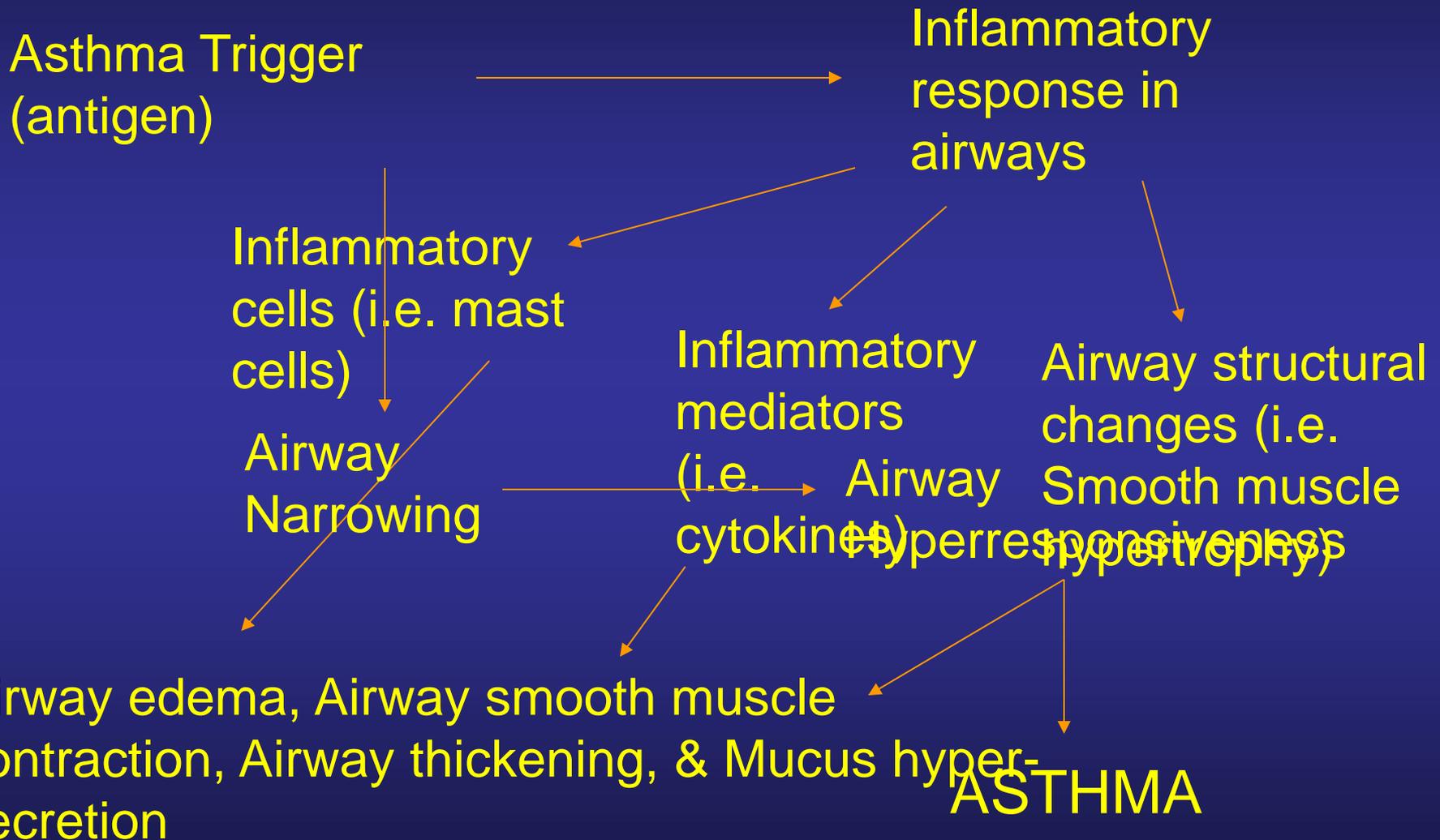
Inflammatory
mediators
(i.e.
cytokines)

Airway structural
changes (i.e.
Smooth muscle
hypertrophy)

Airway edema, Airway smooth muscle
contraction, Airway thickening, & Mucus hyper-
secretion



Pathophysiology



Asthma Guidelines

- GINA Asthma treatment guidelines were revised in 2014
- <http://www.ginasthma.org>
- 2007 Expert Panel Report by NIH
- <http://www.nhlbi.nih.gov/guidelines/asthma>
- Main area of difference = goal of asthma therapy = ASTHMA CONTROL

Asthma Guidelines

- Four keys areas of asthma care to help achieve and maintain **control**
 - Assessment & Monitoring
 - Patient Education
 - Control of factors contributing to asthma severity
 - Pharmacologic Treatment

STEP-WISE APPROACH TO THERAPY

Intermittent Asthma

Persistent Asthma: Daily Medication
 Consult asthma specialist if step 4 care or higher is required.
 Consider consultation at step 3.

Step 1
Preferred:
 SABA PRN

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

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

Step 4
Preferred:
 Medium Dose ICS + LABA
Alternative:
 Medium-dose ICS + either LTRA, Theophylline, or Zileuton

Step 5
Preferred:
 High Dose ICS + LABA
AND
 Consider Omalizumab for patients who have allergies

Step 6
Preferred:
 High dose ICS + LABA + oral corticosteroid
AND
 Consider Omalizumab for patients who have allergies

Step up if needed
 (first, check adherence, environmental control & comorbid conditions)

Assess control

Step down if possible
 (and asthma is well controlled at least 3 months)

Each Step: Patient Education and Environmental Control and management of comorbidities
 Steps 2 – 4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma

Short-Acting Beta₂ Agonists (SABA)



Short Acting Beta₂-Agonists (SABA)

Types of SABAs

- Albuterol (Ventolin HFA, ProAir HFA)
- Levalbuterol (Xopenex, Xopenex HFA)

Common ADRs

- Tachycardia
- Tremor
- Shakiness
- Cough

Mechanisms

- **Bronchodilation.** Binds to the beta₂-adrenergic receptor, producing smooth muscle relaxation following adenylate cyclase activation and increase in cyclic AMP producing functional antagonism of bronchoconstriction.

FIGURE 4–4c. USUAL DOSAGES FOR QUICK-RELIEF MEDICATIONS IN CHILDREN*

Medication	Dosage Form	0–4 Years	5–11 Years	Comments
Inhaled Short-Acting Beta₂-Agonists				
<i>MDI</i>				
Albuterol CFC	90 mcg/puff, 200 puffs/canister	1–2 puffs 5 minutes before exercise	2 puffs 5 minutes before exercise	<ul style="list-style-type: none"> ■ Differences in potencies exist, but all products are essentially comparable on a per puff basis. ■ An increasing use or lack of expected effect indicates diminished control of asthma. ■ Not recommended for long-term daily treatment. Regular use exceeding 2 days/week for symptom control (not prevention of EIB) indicates the need for additional long-term control therapy. ■ May double usual dose for mild exacerbations. ■ Should prime the inhaler by releasing 4 actuations prior to use. ■ Periodically clean HFA actuator, as drug may plug orifice. ■ Children <4 years may not generate sufficient inspiratory flow to activate an auto-inhaler. ■ Nonselective agents (i.e., epinephrine, isoproterenol, metaproterenol) are not recommended due to their potential for excessive cardiac stimulation, especially in high doses.
Albuterol HFA	90 mcg/puff, 200 puffs/canister	2 puffs every 4–6 hours as needed	2 puffs every 4–6 hours as needed	
Levalbuterol HFA	45 mcg/puff, 200 puffs/canister	Safety and efficacy not established in children <4 years	2 puffs every 4–6 hours as needed	
Pirbuterol CFC Autohaler	200 mcg/puff, 400 puffs/canister	Safety and efficacy not established	Safety and efficacy not established	
<i>Nebulizer solution</i>				
Albuterol	0.63 mg/3 mL 1.25 mg/3 mL 2.5 mg/3 mL 5 mg/mL (0.5%)	0.63–2.5 mg in 3 cc of saline q 4–6 hours, as needed	1.25–5 mg in 3 cc of saline q 4–8 hours, as needed	<ul style="list-style-type: none"> ■ May mix with cromolyn solution, budesonide inhalant suspension, or ipratropium solution for nebulization. May double dose for severe exacerbations.
Levalbuterol (R-albuterol)	0.31 mg/3 mL 0.63 mg/3 mL 1.25 mg/0.5 mL 1.25 mg/3 mL	0.31–1.25 mg in 3 cc q 4–6 hours, as needed	0.31–0.63 mg, q 8 hours, as needed	<ul style="list-style-type: none"> ■ Does not have FDA-approved labeling for children <6 years of age. ■ The product is a sterile-filled preservative-free unit dose vial. ■ Compatible with budesonide inhalant suspension.

Inhaled Short-Acting Beta₂-Agonists (SABA)

	MDI		Applies to all four SABAs
Albuterol CFC	90 mcg/puff, 200 puffs/canister	<ul style="list-style-type: none"> ■ 2 puffs 5 minutes before exercise ■ 2 puffs every 4–6 hours as needed 	<ul style="list-style-type: none"> ■ An increasing use or lack of expected effect indicates diminished control of asthma. ■ Not recommended for long-term daily treatment. Regular use exceeding 2 days/week for symptom control (not prevention of EIB) indicates the need to step up therapy. ■ Differences in potency exist, but all products are essentially comparable on a per puff basis. ■ May double usual dose for mild exacerbations. ■ Should prime the inhaler by releasing 4 actuations prior to use. ■ Periodically clean HFA activator, as drug may block/plug orifice. ■ Nonselective agents (i.e., epinephrine, isoproterenol, metaproterenol) are not recommended due to their potential for excessive cardiac stimulation, especially in high doses.
Albuterol HFA	90 mcg/puff, 200 puffs/canister		
Pirbuterol CFC	200 mcg/puff, 400 puffs/canister		
Levalbuterol HFA	45 mcg/puff, 200 puffs/canister		

	Nebulizer solution		
Albuterol	0.63 mg/3 mL 1.25 mg/3 mL 2.5 mg/3 mL 5 mg/mL (0.5%)	1.25–5 mg in 3 cc of saline q 4–8 hours as needed	<ul style="list-style-type: none"> ■ May mix with budesonide inhalant suspension, cromolyn or ipratropium nebulizer solutions. May double dose for severe exacerbations.
Levalbuterol (R-albuterol)	0.31 mg/3 mL 0.63 mg/3 mL 1.25 mg/0.5 mL 1.25 mg/3 mL	0.63 mg–1.25 mg q 8 hours as needed	<ul style="list-style-type: none"> ■ Compatible with budesonide inhalant suspension. The product is a sterile-filled, preservative-free, unit dose vial.

STEP-WISE APPROACH TO THERAPY

Intermittent Asthma

Persistent Asthma: Daily Medication
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 Consider consultation at step 3.

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 SABA PRN

Step 2

Preferred:
 Low dose ICS

Alternative:
 Cromolyn,
 LTRA,
 Nedocromil or
 Theophylline

Step 3

Preferred:
 Low-dose ICS + LABA
 OR – Medium dose ICS

Alternative:
 Low-dose ICS + either LTRA,
 Theophylline, or
 Zileuton

Step 4

Preferred:
 Medium Dose ICS + LABA

Alternative:
 Medium-dose ICS + either LTRA,
 Theophylline,
 or Zileuton

Step 5

Preferred:
 High Dose ICS + LABA

AND

Consider Omalizumab for patients who have allergies

Step 6

Preferred:
 High dose ICS + LABA + oral corticosteroid

AND

Consider Omalizumab for patients who have allergies

Step up if needed
 (first, check adherence, environmental control & comorbid conditions)

Assess control

Step down if possible
 (and asthma is well controlled at least 3 months)

Each Step: Patient Education and Environmental Control and management of comorbidities
 Steps 2 – 4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma

Inhaled Corticosteroids (ICS)



ICS's

- Many different inhaled corticosteroids exist on the U.S. market
 - Beclomethasone (Qvar)
 - Budesonide (Pulmicort Flexhaler)
 - Ciclesonide (Alvesco)
 - Flunisolide (Aerospan)
 - Fluticasone (Flovent HFA)
 - Mometasone (Asmanex)
- These vary based on dosing (due to varied potency)

ADRs

- Dysphonia
- Oral candidiasis (thrush)
- Cough
- URTIs

Mechanisms

- **Anti-inflammatory.** Block late reaction to allergen and reduce airway hyperresponsiveness. Inhibit cytokine production, adhesion protein activation, and inflammatory cell migration and activation.
- Reverse beta₂-receptor downregulation. Inhibit microvascular leakage.

Low-Dose ICS

FIGURE 4-4b. ESTIMATED COMPARATIVE DAILY DOSAGES FOR INHALED CORTICOSTEROIDS IN CHILDREN

Drug	Low Daily Dose		Medium Daily Dose		High Daily Dose	
	Child 0-4	Child 5-11	Child 0-4	Child 5-11	Child 0-4	Child 5-11
Beclomethasone HFA 40 or 80 mcg/puff	NA	80-160 mcg	NA	>160-320 mcg	NA	>320 mcg
Budesonide DPI 90, 180, or 200 mcg/inhalation	NA	180-400 mcg	NA	>400-800 mcg	NA	>800 mcg
Budesonide inhaled Inhalation suspension for nebulization (child dose)	0.25-0.5 mg	0.5 mg	>0.5-1.0 mg	1.0 mg	>1.0 mg	2.0 mg
Flunisolide 250 mcg/puff	NA	500-750 mcg	NA	1,000-1,250 mcg	NA	>1,250 mcg
Flunisolide HFA 80 mcg/puff	NA	160 mcg	NA	320 mcg	NA	≥640 mcg
Fluticasone HFA/MDI: 44, 110, or 220 mcg/puff	176 mcg	88-176 mcg	>176-352 mcg	>176-352 mcg	>352 mcg	>352 mcg
DPI: 50, 100, or 250 mcg/inhalation	NA	100-200 mcg	NA	>200-400 mcg	NA	>400 mcg
Mometasone DPI 200 mcg/inhalation	NA	NA	NA	NA	NA	NA

Low-Dose ICS

FIGURE 4–8b. ESTIMATED COMPARATIVE DAILY DOSAGES FOR INHALED CORTICOSTEROIDS FOR YOUTHS ≥12 YEARS OF AGE AND ADULTS

Drug	Low Daily Dose Adult	Medium Daily Dose Adult	High Daily Dose Adult
Beclomethasone HFA 40 or 80 mcg/puff	80–240 mcg	>240–480 mcg	>480 mcg
Budesonide DPI 90, 180, or 200 mcg/inhalation	180–600 mcg	>600–1,200 mcg	>1,200 mcg
Flunisolide 250 mcg/puff	500–1,000 mcg	>1,000–2,000 mcg	>2,000 mcg
Flunisolide HFA 80 mcg/puff	320 mcg	>320–640 mcg	>640 mcg
Fluticasone HFA/MDI: 44, 110, or 220 mcg/puff DPI: 50, 100, or 250 mcg/inhalation	88–264 mcg 100–300 mcg	>264–440 mcg >300–500 mcg	>440 mcg >500 mcg
Mometasone DPI 200 mcg/inhalation	200 mcg	400 mcg	>400 mcg



www.google.com accessed
01/30/14

Leukotriene Modifying Agents

- Two medications exist on U.S. market
 - Zafirlukast (Accolate®)
 - Montelukast (Singular®)
- ADRs
 - URTIs, headache, abdominal pain, Incr. LFTs, dizziness, pharyngitis, sinusitis

Leukotriene Receptor Antagonists (LTRAs)

Mechanisms

- **Leukotriene receptor antagonist**; selective competitive inhibitor of CysLT₁ receptor.

Leukotriene Modifying Agents

0-4 years

5-11 years

Leukotriene Receptor Antagonists (LTRAs)

Montelukast	4 mg or 5 mg chewable tablet 4 mg granule packets	4 mg qhs (1–5 years of age)	5 mg qhs (6–14 years of age)	<ul style="list-style-type: none">■ Montelukast exhibits a flat dose-response curve.■ No more efficacious than placebo in infants 6–24 months (van Adelsberg et al. 2005).
Zafirlukast	10 mg tablet	Safety and efficacy not established	10 mg bid (7–11 years of age)	<ul style="list-style-type: none">■ For zafirlukast, administration with meals decreases bioavailability; take at least 1 hour before or 2 hours after meals.■ Monitor for signs and symptoms of hepatic dysfunction.

Leukotriene Modifying Agents

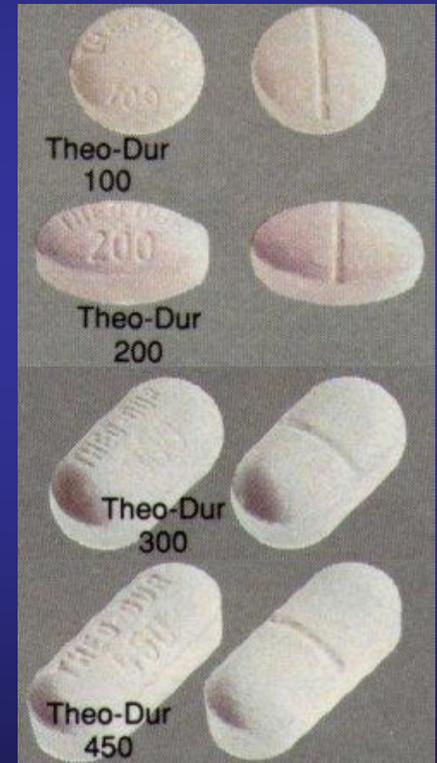
Adults

Leukotriene Modifiers

Leukotriene Receptor Antagonists

Montelukast	4 mg or 5 mg chewable tablet 10 mg tablet	10 mg qhs	<ul style="list-style-type: none">■ Montelukast exhibits a flat dose-response curve. Doses >10 mg will not produce a greater response in adults.
Zafirlukast	10 or 20 mg tablet	40 mg daily (20 mg tablet bid)	<ul style="list-style-type: none">■ For zafirlukast, administration with meals decreases bioavailability; take at least 1 hour before or 2 hours after meals.■ Monitor for signs and symptoms of hepatic dysfunction.

Methylxanthines



Methylxanthines

- Theophylline (Elixophyllin, Theolair, Theo-24,
- Aminophylline

ADRs

- Nausea, headache, tachycardia, insomnia, tremor, nervousness
- Signs of toxicity: persistent vomiting, Vtach, seizures

Mechanisms

- **Bronchodilation.** Smooth muscle relaxation from phosphodiesterase inhibition and possibly adenosine antagonism.
- May affect eosinophilic infiltration into bronchial mucosa as well as decreases T-lymphocyte numbers in epithelium.
- Increases diaphragm contractility and mucociliary clearance.

Methylxanthines

0-4 years

5-11 years

Methylxanthines

Theophylline

Liquids, sustained-release tablets, and capsules

Starting dose 10 mg/kg/day; usual maximum:

- <1 year of age: $0.2 (\text{age in weeks}) + 5 = \text{mg/kg/day}$
- ≥ 1 year of age: 16 mg/kg/day

Starting dose 10 mg/kg/day; usual maximum: 16 mg/kg/day

- Adjust dosage to achieve serum concentration of 5–15 mcg/mL at steady-state (at least 48 hours on same dosage).
- Due to wide interpatient variability in theophylline metabolic clearance, routine serum theophylline level monitoring is essential.
- See next page for factors that can affect theophylline levels.

Methylxanthines

Adults

Methylxanthines

Theophylline

Liquids, sustained-release tablets, and capsules

Starting dose 10 mg/kg/day up to 300 mg maximum; usual maximum 800 mg/day

- Adjust dosage to achieve serum concentration of 5–15 mcg/mL at steady-state (at least 48 hours on same dosage).
- Due to wide interpatient variability in theophylline metabolic clearance, routine serum theophylline level monitoring is important.
- See next page for factors that can affect theophylline levels.

Long-Acting Beta₂-Agonists (LABA)



Long-Acting Beta₂-Agonists (LABA)

- Salmeterol (Serevent Diskus)
- Formoterol (Foradil Aerolizer)
- Combinations with ICS

ADRs

- Same as SABAs (tremor, cough, increased heart rate, etc)

Mechanisms

- **Bronchodilation.** Smooth muscle relaxation following adenylate cyclase activation and increase in cyclic AMP, producing functional antagonism of bronchoconstriction.
- Compared to SABA, salmeterol (but not formoterol) has slower onset of action (15–30 minutes). Both salmeterol and formoterol have longer duration (>12 hours) compared to SABA.

LABA's

- Formoterol (Foradil aerolizer)
 - DPI: 1 capsule via inhaler BID (>5yrs)
 - Indicated for asthma and exercise induced bronchospasm
- Salmeterol (Serevent diskus):
 - DPI: 1 puff BID (>4-11yrs)
 - Indicated for asthma and exercise induced bronchospasm
- DO NOT USE FOR ACUTE EXACERBATIONS
- ADR
 - Same as SABAs (tremor, cough, increased heart rate, etc)

STEP-WISE APPROACH TO THERAPY

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

Step 1

Preferred:
 SABA PRN

Step 2

Preferred:
 Low dose ICS

Alternative:
 Cromolyn,
 LTRA,
 Nedocromil or
 Theophylline

Step 3

Preferred:
 Low-dose ICS +
 LABA
**OR – Medium
 dose ICS**

Alternative:
 Low-dose ICS +
 either LTRA,
 Theophylline, or
 Zileuton

Step 4

Preferred:
 Medium Dose
 ICS + LABA

Alternative:
 Medium-dose
 ICS + either
 LTRA,
 Theophylline,
 or Zileuton

Step 5

Preferred:
 High
 Dose ICS +
 LABA

AND

Consider
 Omalizumab
 for patients
 who have
 allergies

Step 6

Preferred:
 High dose ICS
 + LABA + oral
 corticosteroid

AND

Consider
 Omalizumab
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**Step up if
 needed**
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 adherence,
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**Assess
 control**

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 down if
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 (and asthma
 is well
 controlled at
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Combination therapy (ICS+ LABA)



Fluticasone/salmeterol



Fluticasone/salmeterol



Budesonide/formoterol



Mometasone/formoterol

Combination therapy (ICS + LABA)

- Fluticasone/Salmeterol (Advair)
 - DPI (Advair diskus)-Dose 1 puff BID
 - 100/50mcg (>4-11yrs)
 - 250/50mcg (>12yrs)
 - 500/50mcg (>12yrs)
 - MDI (Advair HFA)-Dose 2 puffs BID
 - 45/21mcg (>12yrs)
 - 115/21mcg (>12yrs)
 - 230/21mcg (>12yrs)
- Budesonide/Formoterol
 - MDI (Symbicort HFA)- 2 puffs BID
 - 80/4.5mcg, 160/4.5mcg (>12yrs)

Combination therapy (ICS+ LABA)

- Mometasone/Formoterol
 - MDI (Dulera)- 2 puffs BID
 - 100/5mcg, 200/5mcg (>12yrs)
- ADR
 - see LABA & ICS

Medium-Dose ICS

FIGURE 4-4b. ESTIMATED COMPARATIVE DAILY DOSAGES FOR INHALED CORTICOSTEROIDS IN CHILDREN

Drug	Low Daily Dose		Medium Daily Dose		High Daily Dose	
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Flunisolide 250 mcg/puff	NA	500-750 mcg	NA	1,000-1,250 mcg	NA	>1,250 mcg
Flunisolide HFA 80 mcg/puff	NA	160 mcg	NA	320 mcg	NA	≥640 mcg
Fluticasone HFA/MDI: 44, 110, or 220 mcg/puff	176 mcg	88-176 mcg	>176-352 mcg	>176-352 mcg	>352 mcg	>352 mcg
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DPI: 50, 100, or 250 mcg/inhalation	NA	100-200 mcg	NA	>200-400 mcg	NA	>400 mcg
Mometasone DPI 200 mcg/inhalation	NA	NA	NA	NA	NA	NA

High-Dose ICS

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Flunisolide 250 mcg/puff	500–1,000 mcg	>1,000–2,000 mcg	>2,000 mcg
Flunisolide HFA 80 mcg/puff	320 mcg	>320–640 mcg	>640 mcg
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Mometasone DPI 200 mcg/inhalation	200 mcg	400 mcg	>400 mcg



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Oral Corticosteroids

Types

- Methylprednisolone
 - (Solu-Medrol, Medro Dosepak)
- Prednisone
- Prednisolone
 - (Orapred, Prelone)

Short-term ADRs

- Incr. appetite, weight gain
- Fluid retention
- Mood changes
- Insomnia
- GI upset

Mechanisms

- **Anti-inflammatory.** Block late reaction to allergen and reduce airway hyperresponsiveness. Inhibit cytokine production, adhesion protein activation, and inflammatory cell migration and activation.
- Reverse beta₂-receptor downregulation. Inhibit microvascular leakage.

Oral Corticosteroids

- Dose varies by patient response and severity
- Used for acute exacerbations and in very severe disease (Step 6)
- Used in asthma action plans for use at home if needed

Oral Corticosteroids

0-4 years

5-11 years

Systemic Corticosteroids

Methylprednisolone	2, 4, 8, 16, 32 mg tablets	0.25–2 mg/kg daily in single dose in a.m. or qod as needed for control	0.25–2 mg/kg daily in single dose in a.m. or qod as needed for control
Prednisolone	5 mg tablets, 5 mg/5 cc, 15 mg/5 cc	Short-course “burst”: 1–2 mg/kg/day, maximum 30 mg/day for 3–10 days	Short-course “burst”: 1–2 mg/kg/day, maximum 60 mg/day for 3– 10 days
Prednisone	1, 2.5, 5, 10, 20, 50 mg tablets; 5 mg/cc, 5 mg/5 cc		

(Applies to all three corticosteroids)

- For long-term treatment of severe persistent asthma, administer single dose in a.m. either daily or on alternate days (alternate-day therapy may produce less adrenal suppression).
- Short courses or “bursts” are effective for establishing control when initiating therapy or during a period of gradual deterioration.
- There is no evidence that tapering the dose following improvement in symptom control and pulmonary function prevents relapse.
- Patients receiving the lower dose (1 mg/kg/day) experience fewer behavioral side effects (Kayani and Shannon 2002), and it appears to be equally efficacious (Rachelefsky 2003).
- For patients unable to tolerate the liquid preparations, dexamethasone syrup at 0.4 mg/kg/day may be an alternative. Studies are limited, however, and the longer duration of activity increases the risk of adrenal suppression (Hendeles 2003).

Oral Corticosteroids

Adults

Systemic Corticosteroids

Methylprednisolone 2, 4, 8, 16, 32 mg
tablets

7.5–60 mg daily in a
single dose in a.m. or
qod as needed for
control

Prednisolone 5 mg tablets,
5 mg/5 cc,
15 mg/5 cc

Short-course “burst”: to
achieve control, 40–60
mg per day as single or
2 divided doses for 3–
10 days

Prednisone 1, 2.5, 5, 10, 20, 50 mg
tablets;
5 mg/cc,
5 mg/5 cc

(Applies to all three corticosteroids)

- For long-term treatment of severe persistent asthma, administer single dose in a.m. either daily or on alternate days (alternate-day therapy may produce less adrenal suppression). Short courses or “bursts” are effective for establishing control when initiating therapy or during a period of gradual deterioration.
- There is no evidence that tapering the dose following improvement in symptom control and pulmonary function prevents relapse.

Anti-IgE Therapy

- Omalizumab (Xolair)



Mechanisms

- Binds to circulating IgE, preventing it from binding to the high-affinity (Fc ϵ RI) receptors on basophils and mast cells.
- Decreases mast cell mediator release from allergen exposure.
- Decreases the number of Fc ϵ RI in basophils and submucosal cells.

Omalizumab (Xolair)

- Only used in moderate-severe persistent asthma who are inadequately controlled on inhaled steroids (step 5 or 6).
- Given in doctor's office
- ADRs
 - Headache, URTIs, viral infection, sinusitis, arthralgia
- Black Box Warning
 - Anaphylaxis (including delayed-onset)

Inhaler Devices & Technique

Factors affecting lung deposition

- Only 5-15% of metered dose reaches the lungs
- Two main factors
 - **Particle size**
 - **Speed of inhalation**
- Additional factors
 - **Breath holding for a minimum of 2 seconds**
 - **Allow at least 30 seconds between consecutive doses**

The Importance of Inhaler technique

“There are well designed studies that demonstrate that the medicine has to be in you to be effective!”

Dr. Wayne Samuelson, MD

Professor of Medicine

University of Utah

University of Utah Adult Asthma Center Director

MDI technique

- 50% of adults and children do not perform all steps correctly (Crompton GK. Lung 1990;Suppl 168:658-662)
- Reasons for noncompliance
 - **Not taking off cap**
 - **Not shaking**
 - **Failure to coordinate actuation with inspiration**
 - **Inhale through nose and not mouth**
 - **Inhale too fast**
 - **Failure to breath-hold after dose**
 - **“Cold freon” effect**
 - **Holding MDI upside down**

MDI technique

- Plaza et al. Resp 1998;65:195-198
 - 9% of patients, 15% of nurses, and 28% of physicians showed correct MDI-technique.
- Interiano et al. Arch Intern Med 1993;153:81-85
 - 65% of patients, 39% of housestaff, 82% of nurses were categorized as having “poor” MDI-technique.

9-steps of MDI-technique

1. Stand or sit upright with your head and neck straight or tilted slightly back.
2. Hold the canister upright and shake the inhaler well. Remove the mouthpiece cap.
3. Breathe out normally through your mouth.
4. With the canister upright, position inhaler either 1-2 inches away from “open mouth” or in the mouth with lips closed tightly around the inhaler mouthpiece “closed mouth”
5. As you start to breathe in slowly, press down on the top of the inhaler firmly once. Continue to breathe in slowly (over 3-5 seconds) and deeply until your lungs are full of air.
6. Hold your breath for 5-10 seconds or as long as you can and exhale slowly.
7. If more than one puff is needed, wait 1 minute before taking your next puff and repeat step 1-7.
8. Rinse your mouth out with water and spit.
9. Replace the mouthpiece cap after you are finished.



Spacer/Holding Chambers

- **Advantages**
 - **Increase lung deposition 10-15%**
 - **Eliminate need for coordination**
 - **Reduce cough and “cold freon” effect**
- **Disadvantages**
 - **Not “cool”**
 - **Not compact enough**
 - **Not compatible with all inhalers**
 - **Require regular cleaning**

Dry-Powdered Inhalers (DPI)



DPI

- Advantages

- eliminates the need for coordination
- may reduce incidence of local adverse effects
- “environmentally friendly”
- easy to use
- not affected by cold air
- useful in arthritic or elderly patients

- Disadvantages

- must generate required inspiratory flow rate
- may be affected by humidity
- each device has unique dose loading system
- may waste medication if device is turned upside down

9-steps of DPI-technique

1. Remove the cover.
2. Load a single dose according to the specific device used.
3. Breathe out normally through your mouth.
4. Put the inhaler mouthpiece into your mouth, closing your lips tightly around it.
5. Inhale deeply and forcefully.
6. Hold your breath for 5-10 seconds or as long as you can and then exhale slowly.
7. If more than one dose is needed, wait 1 minute before taking your next dose and repeat steps 2-7.
8. Rinse your mouth out with water and spit.
9. Replace the mouthpiece cap after you are finished.

Peak flow meters



Recommended Peak Flow Monitoring (NAEPP, 2007)

- Patients who have moderate or severe persistent asthma
- Patients who have a history of severe exacerbations
- Patients who poorly perceive airflow obstruction and worsening asthma
- Patients who prefer this monitoring method

Peak flow meters

- Advantages:
 - gives objective measure of the patients condition
 - helps patient predict impending exacerbation's
 - helps patients identify possible asthma triggers
 - helps patients decide if condition is serious enough to seek medical attention
- Disadvantages:
 - highly effort dependent
 - patients must be highly motivated and interested in their disease process

8-Steps to Peak Flow Monitoring

1. Place the pointer at the bottom of the numbered scale (set it to zero).
2. Stand or sit upright.
3. Take a deep breath, filling your lungs completely.
4. Place the meter in your mouth and close your lips around the mouthpiece. DO NOT put your tongue inside the hole.
5. Blow out as hard and as fast as you can.
6. Write down the number indicated by the pointer.
7. Repeat steps 1-6 two more times.
8. Write down the highest of the three numbers in your peak flow diary.

Education Resources

- Google: Asthma Care Pharmacy Utah or
 - <http://health.utah.gov/asthma/professionals/pharmacy.htm>
- Inhaler technique
 - <https://www.youtube.com/watch?v=Rdb3p9RZoR4>

Conclusions

- Asthma is a very serious problem
- Guidelines have been developed & recently amended to focus on control
- Medications vary by their mechanism of action & purpose
- Cooperation between patient, family, medical team is essential

References

- Global Strategy for Asthma Management and Prevention. 2011.
www.ginaasthma.org
- EPR 3. Expert panel report 3: guidelines for the diagnosis and management of asthma (EPR—3 2007).
<http://www.nhlbi.nih.gov/guidelines/asthma>