Advances in Respiratory Care: Asthma, COPD, acute bronchitis

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Disclosure

• No real or potential conflict of interest to disclose
• No off-label, experimental or investigational use of drugs or devices will be presented.

Objectives

Objectives

• Having completed the learning activities, the participant will be able to:
  – Identify updates in guidelines for the treatment of asthma.
  – Describe a plan of pharmacologic intervention for the person with acute bronchitis.

Objectives (continued)

• Having completed the learning activities, the participant will be able to: (cont.)
  – Develop a plan of pharmacologic intervention for long-term therapy as well as COPD exacerbation using the GOLDCOPD Guidelines.

Objectives

• Having completed the learning activities, the participant will be able to:
  – Identify the pathophysiology and clinical presentation of URI and chronic bronchitis.
  – Describe a plan of pharmacologic intervention for the person with acute bronchitis or viral URI.
COPD Defined

• COPD is a preventable and treatable disease with some significant extra pulmonary effects that can contribute to its severity in individual patients.
• Its pulmonary component is characterized by airflow limitation that is not fully reversible.

Per goldcopd.org

• The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases.

(continued)

• The diagnosis should be considered in any patient with progressive dyspnea, chronic cough, or sputum production and/or history of exposure to risk factors (tobacco smoking, pollution [outdoor, indoor, or occupational]).

Assessment of COPD

<table>
<thead>
<tr>
<th>Degree of airflow limitation</th>
<th>Spirometry is required for diagnosis. When possible, use age-related values to avoid over-diagnosis in elders. FEV₁:FVC &lt; 0.70 post-bronchodilator confirms persistent airflow limitation/COPD. Classification of severity determined by FEV₁.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha₁-antitrypsin deficiency screening</td>
<td>Perform when COPD develops in patients of Caucasian descent under 45 years of age or with a strong family history of COPD.</td>
</tr>
</tbody>
</table>

Alpha₁-antitrypsin Deficiency Screening: Additional considerations

• In presence of
  – COPD
  – Emphysema, chronic bronchitis
  – Bronchiectasis
  – Asthma that is incompletely reversible after aggressive treatment
  – Chronic liver disease
  – Unexplained liver disease in children

  – Source: https://www.alpha1.org/Newly-Diagnosed/Learning-about-Alpha-1/Testing-for-Alpha-1

Alpha₁-antitrypsin Deficiency Screening: When to consider

• Panniculitis
  – Inflammation of panniculus, layer of fatty and fibrous tissue just beneath skin’s outer layers

Classification of Severity of Airflow Limitation in COPD
Based on Post-bronchodilator FEV₁

<table>
<thead>
<tr>
<th>GOLD 1</th>
<th>Mild</th>
<th>FEV₁ ≥ 80% predicted</th>
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<tr>
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<td>Moderate</td>
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<td>GOLD 3</td>
<td>Severe</td>
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</tr>
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<td>GOLD 4</td>
<td>Very severe</td>
<td>FEV₁ &lt; 30% predicted</td>
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</table>

In patients with FEV₁/FVC < 0.70

Medications Used in the Treatment of COPD:
What are the therapeutic goals of each medication class in the treatment of COPD?

Medications mentioned represent examples of the given drug class, not a comprehensive list of all options. Many of these medications are used for the same purpose in asthma.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Therapeutic goal</th>
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<tbody>
<tr>
<td>Short-acting beta₂-agonist (SABA) (albuterol), short-acting anticholinergic/muscarinic antagonist (SAMA) (ipratropium bromide)</td>
<td>Relief of acute bronchospasm Used PRN.</td>
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<td>Long-acting beta₂-agonist (LABA) (salmeterol)</td>
<td>Protracted duration bronchodilation, increased exercise tolerance, possible reduction in COPD exacerbation Used on a set schedule.</td>
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<td>Inhaled corticosteroid (ICS)</td>
<td>Minimizes risk of COPD exacerbation, modest increase in pneumonia risk Used on a set schedule.</td>
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<td>Theophylline</td>
<td>Bronchodilator, systemic medication Narrow therapeutic index (NTI) medication, significantly limits use, drug interactions Used on a set schedule.</td>
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PK Comparisons: SABA vs. LABA

Is there a PD difference?

- SABA (albuterol)
  - Time to clinical effect = ½ h
  - T₁/₂ = 4 h
- LABA (salmeterol)
  - Time to clinical effect = 1–2 h
  - T₁/₂ = 8 h

True or false?

The former boxed warning attached to the LABA in the treatment of asthma did not extend to LABA using in COPD.
**Medication Therapeutic goal**

**Short-acting beta2-agonist (SABA)** (albuterol), short-acting anticholinergic/muscarinic antagonist (SAMA) (ipratropium bromide)
- Relief of acute bronchospasm
  - Used PRN.

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**Theophylline**
- Bronchodilator, systemic medication
  - Narrow therapeutic index (NTI) medication, significantly limits use, drug interactions
  - Used on a set schedule.

**PDE-4 inhibitor (roflumilast)**
- Minimizes risk of COPD exacerbation
  - Used on a set schedule.

**Muscarnic Antagonist/Anticholinergics**
- **Examples**
  - Ipratropium bromide (Atrovent®)
  - SAMA—Short-acting muscarinic antagonist
    - With albuterol (Combivent® Respimat®)
  - MDI
  - Tiotropium bromide (Spiriva®)
    - LAMA—Long-acting muscarinic antagonist
    - DPI

**With Long-acting Bronchodilator Use**
- **If adding LABA**
  - Advise patient to discontinue use of timed (by-the-clock) SABA use.

- **If adding LAMA**
  - Advise patient to discontinue use of ipratropium bromide, even PRN.

**Tachyphylaxis/Tolerance**
- No evidence of tachyphylaxis, tolerance, reduced clinical effect with inhaled anticholinergic/antimuscarinic therapy

**Inhaled Corticosteroids (ICS) Examples**
- Budesonide —Pulmicort®
- Fluticasone —Flovent®
- Mometasone —Asmanex®
### Inhaled Corticosteroids with LABA

- **Advair Diskus®=1 puff BID**
  - Fluticasone (Flovent®) with salmeterol
    - 100 mcg/50 mcg
    - 250 mcg/50 mcg
    - Recommended COPD dose
    - 500 mcg/50 mcg
- **Symbicort®=2 puff BID**
  - Budesonide (Pulmicort®) with formoterol
    - 80 mcg/4.5 mcg
    - 160 mcg/4.5 mcg
    - Recommended dose for COPD

### Theophylline vs. Caffeine: Commonalities and differences

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<td>Documented influences dependent on amount, activity of CYP 1A2</td>
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### Roflumilast (Daliresp®)

- **Per FDA direction**
  - To be dispensed with medication guide with potential risks of mental health problems
  - Changes in mood, thinking, behavior
  - Avoid use in patient with a history of depression with suicidal thoughts or behaviors.
Pharmacologic Therapy for Stable COPD

Medications mentioned represent examples of the given drug class, not a comprehensive list of all options. “Risk” refers to risk of COPD exacerbation or other untoward event.

Exacerbation: Definition, Evaluation and Treatment

An exacerbation of COPD is an event in the natural course of the disease characterized by a change in the patient’s baseline dyspnea, cough, and/or sputum beyond day-to-day variability sufficient to warrant a change in management.

Treatment of COPD Exacerbation (continued)

If baseline FEV₁<50% of predicted
Add a systemic corticosteroid such as prednisone 40 mg/d PO for 5–10 days. Study supports shorter (5-day) course equally effective with fewer adverse effects than longer (10-day) course. Consider adding inhaled corticosteroid if not currently using.

First-line Therapy at Each Stage of COPD

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GOLD 1st-line Recommendations for Pharmacologic Therapy

GOLD 1–2, ≤1 Exacerbation/year

Patient Group A (low risk/less symptoms):
- SAMA or SABA

Patient Group B (low risk/more symptoms):
- LAMA or LABA

Patient Group C (high risk/less symptoms):
- (ICS + LABA) or LAMA

Patient Group D (high risk/more symptoms):
- (ICS + LABA) or LAMA

SAMA: Short-acting muscarinic antagonist (e.g., ipratropium [Atrovent®]) PRN
SABA: Short-acting beta₂-agonist (e.g., albuterol [Ventolin® HFA, Proventil® HFA]) PRN
ICS: Inhaled corticosteroid (e.g., fluticasone, budesonide)
LABA: Long-acting beta₂-agonist (e.g., salmeterol [Serevent®])
LABA: Long-acting beta₂-agonist (e.g., tiotropium [Spiriva®])
LAMA: Long-acting muscarinic antagonist (e.g., tiotropium [Spiriva®])

Use of bronchodilators

Short-acting beta₂-agonist (albuterol) and/or muscarinic antagonist (ipratropium bromide) PRN
Consider adding long-acting bronchodilator (LABA, salmeterol, LAMA tiotropium bromide) if patient currently not using one.

Antimicrobial therapy in COPD exacerbation

Likely indicated in the presence of 3 cardinal symptoms: Increased dyspnea, increased sputum volume, and increased sputum purulence, **though evidence varies**.
Antimicrobial Therapy in COPD Flare

• Aside from bacterial infection, tobacco use, air pollution, and viruses are common contributing factors to COPD flare.

Bacterial Pathogens Associated with COPD Flare

• *Haemophilus influenzae*
  – Gram-negative rod-shaped bacterium
  – ~30% beta-lactamase production rate nationwide
  – Nontypable strains contribute to COPD flare

Bacterial Pathogens Associated with COPD Flare (continued)

• *Streptococcus pneumoniae*
  – Gram-positive diplococci
  – DRSP rate nationally=25%

True or false?

• According to the CDC, up to 70% of healthy adults are carrying *S. pneumoniae* bacteria at any given time.

Antimicrobial Therapy in COPD Flare

• Causative bacterial pathogens (30–50%) include select Gram-negative (*Haemophilus influenzae*, *Haemophilus parainfluenzae*, *Moraxella catarrhalis*) and Gram-positive (*Streptococcus pneumoniae*) pathogens.
  – Less common pathogens include atypical pathogens, other Gram-positive and -negative organisms.

Antimicrobial Therapy in COPD Flare (continued)

• Consider chest x-ray only with fever and/or low SaO₂ to help rule out concomitant pneumonia.

True or false?
Bacterial Pathogens Associated with COPD Flare (continued)

- Moraxella catarrhalis
  - Gram-negative with ≥90% beta-lactamase production rate

Avoid used w/ ACEI or ARB due to hyperkalemia risk.
Vulnerable to destruction by beta-lactamase
QT-prolongation risk
Use associated with tendon rupture risk, especially when used with systemic corticosteroid
Less than 1% cross-risk in PCN allergy

Match the following antimicrobials with listed characteristics.

<table>
<thead>
<tr>
<th>A. Amoxicillin</th>
<th>D. Cefpodoxime</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. TMP-SMX</td>
<td>E. Moxifloxacin</td>
</tr>
<tr>
<td>C. Azithromycin</td>
<td></td>
</tr>
</tbody>
</table>

Fitzgerald Health Education Associates

FQ-associated Tendon Rupture

- Why tendon rupture?
  - Drug class’ high affinity for connective tissue
- Location
  - Achilles tendon most common
    - In one study=Nearly 90%

Best Documented FQ-associated Tendon Rupture

- Age >60 yrs
  - Stiffer, thinner tendons
- Concomitant systemic corticosteroid therapy
  - Particularly higher dose, >5 d of therapy
- Presence of renal dysfunction
- History of solid organ transplantation
  - Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2921747/

True or false?
Levofloxacin has been cited as the least tenotoxic fluoroquinolone in humans.

FQ-associated Tendinopathy

Clinical Presentation

- Tendon pain
  - Usually sudden onset
    - Approx. 50% in one study of Achilles tendon rupture=No pain
- Tendon inflammation, swelling
When is FQ-associated tendon rupture most likely to be noted?

- Wide time range
  - Within 2 hours of taking the medication
  - As long as 6 months after treatment ends
  - Median time of onset of 6 days
- In 1st month
  - 85% present
- Occurring after completion of therapy
  - Approx. 50%

True or false?

- Patients prescribed both fluoroquinolones and systemic corticosteroids had a 46-fold greater risk of Achilles tendon rupture than those taking neither medication.

Mild to moderate COPD exacerbation

Antimicrobial therapy usually not indicated.

If prescribed, consider spectrum of antimicrobial activity with each product.

- Moxi-, levofloxacin
- Respiratory fluoroquinolone
- Beta-lactam: Amoxicillin-clavulanate, Cephalosporin (cefdinir, cefpodoxime, others)
- Macrolide: Azithromycin, Clarithromycin

If prescribed, one of the following

- Amoxicillin:
  - Lacks stability in presence of beta-lactamase
- TMP-SMX:
  - 1 in 4 treatment failure rate
- Doxycycline:
  - Effective against non-resistant S. pneumoniae, pertinent Gram-negs, stable in presence beta-lactamase

More severe COPD exacerbation/acute exacerbation of chronic bronchitis

Role of antimicrobial therapy debated even for severe disease. If prescribed, consider spectrum of antimicrobial activity and benefit vs. risk ratio with each product including drug interactions.

Consider severity of COPD and comorbidities in decision-making process.

Use one of the following agents

- Beta-lactam
  - Amoxicillin-clavulanate
  - Cephalosporin (cefdinir, cefpodoxime, others)
- Macrolide
  - Azithromycin
  - Clarithromycin
- Respiratory fluoroquinolone
  - Moxi-, levofoxacin
Factors Contributing to Poor Asthma Control

- Improper inhaler technique is seen in at least what percentage of patients with poorly controlled asthma?
  A. 20%
  B. 40%
  C. 60%
  D. 80%

Factors Contributing to Poor Asthma Control (continued)

- Suboptimal use of asthma control drug is noted in up to approximately what percentage of patients with poorly controlled asthma?
  A. 25%
  B. 50%
  C. 75%
  D. Nearly 100%

True or false?

- With well controlled asthma, one SABA MDI should last for at least 12 months.
- The use of ≥ one SABA MDI (200 puffs total) per month is associated with an increased risk of asthma death.

Estimated Comparative Daily Dosages for ICS in Patients Aged ≥12 Years

<table>
<thead>
<tr>
<th>Drug and Dosage Form</th>
<th>Low Daily Dose</th>
<th>Medium Daily Dose</th>
<th>High Daily Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budesonide HFA 40 mcg</td>
<td>80 mcg</td>
<td>&gt;240 mcg</td>
<td>&gt;480 mcg</td>
</tr>
<tr>
<td>Budesonide DPI 200 mcg</td>
<td>200 mcg</td>
<td>&gt;600–1200 mcg</td>
<td>&gt;1200 mcg</td>
</tr>
<tr>
<td>Fluticasone DPI 250 mcg</td>
<td>500–1000 mcg</td>
<td>1000–2000 mcg</td>
<td>&gt;2000 mcg</td>
</tr>
<tr>
<td>Fluticasone HFA 80 mcg/puff</td>
<td>120 mcg</td>
<td>320–640 mcg</td>
<td>&gt;640 mcg</td>
</tr>
<tr>
<td>Mometasone MDI 44 mcg</td>
<td>88–264 mcg</td>
<td>264–440 mcg</td>
<td>&gt;440 mcg</td>
</tr>
<tr>
<td>Fluticasone DPI 50, 100, or 250 mcg/puff</td>
<td>100–300 mcg</td>
<td>300–500 mcg</td>
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<td>Mometasone DPI 200 mcg/puff</td>
<td>200 mcg</td>
<td>400 mcg</td>
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Source: [https://www.nhlbi.nih.gov/guidelines/asthma/asthsumm.pdf](https://www.nhlbi.nih.gov/guidelines/asthma/asthsumm.pdf)
LAMA Use in Asthma

- Tiotropium bromide
  - Spiriva® Respimat®
  - First in class approved for asthma care
  - Once-daily maintenance treatment for patients with asthma age ≥12 years for patients who remain symptomatic on ICS or ICS/LABA
  - Not for the relief of acute bronchospasm

LAMA Use in Asthma vs. COPD

- In asthma age ≥12 years and older
  - 2 inhalations of Spiriva® Respimat® 1.25 mcg once-daily
- In COPD
  - 2 inhalations of Spiriva® Respimat® 2.5 mcg once-daily
  - Likely need 4–8 weeks of use prior to full clinical effect

Tiotropium in Asthma Poorly Controlled with Standard Combination Therapy

Source: Huib A.M. Kerstjens, M.D., Michael Engel, M.D., Ronald Dahl, M.D., Pierluigi Paggiaro, M.D., Ekkehard Beck, M.D., Mark Vandewalker, M.D., Ralf Sigmund, Dipl.Math., Wolfgang Seibold, M.D., Petra Moroni-Zentgraf, M.D., and Eric D. Bateman, M.D.

N Engl J Med
Volume 367(13):1198-1207
September 27, 2012

Lung Function and Severe Exacerbations


Conclusion

- In patients with poorly controlled asthma despite the use of inhaled glucocorticoids and LABAs, the addition of tiotropium significantly increased the time to the first severe exacerbation and provided modest sustained bronchodilation.

Antihypertensive Medication Use in Person with COPD/asthma

- In COPD or asthma, increased risk of ACEI-induced cough?
- Cardioselective beta blocker therapy safe to use in COPD or asthma?
- Additional potential benefits of beta blocker therapy?
Renin-angiotensin Cascade: What works where?

ACEI-induced Cough

- The mechanism of ACE inhibitor-induced cough remains unresolved, but likely involves the protussive mediators bradykinin and substance P, agents that are degraded by ACE and therefore accumulate in the upper respiratory tract or lung when the enzyme is inhibited, and prostaglandins, the production of which may be stimulated by bradykinin.

  – Source: https://journal.chestnet.org/article/S0012-3692(15)52845-6/fulltext

Effect of Beta Blockers in Treatment of Chronic Obstructive Pulmonary Disease: A Retrospective Cohort Study

- Conclusions—β blockers may reduce mortality and COPD exacerbations when added to established inhaled stepwise therapy for COPD, independently of overt cardiovascular disease and cardiac drugs, and without adverse effects on pulmonary function.


Beta Blocker Therapy: Examples

- Non cardioselective
  - β1-, β2-blockade
    - Propranolol
    - Nadolol
    - Pindolol
    - Sotalol
    - Carvedilol
    - Also alpha1-blockade

- Cardioselective
  - β1-receptor selective
    - Metoprolol
    - Bisoprolol
    - Betaxolol
    - Atenolol

Considering Route and Method of Administration for Medications in Asthma and COPD

- Albuterol Nebulizer vs. MDI
  - Typical nebulized albuterol dose=2.5 mg with 12% deposition=300 mcg
  - Typical MDI albuterol dose=180 mcg with 20% deposition=36 mcg
  - Equivalent to approx. 8 puffs from MDI

Benefits vs. Drawbacks of Nebulized Medications in Asthma/COPD

• Potential benefits
  – Delivery with lower lung volumes
  – Potential to deliver larger medication doses (i.e., nebulized albuterol during COPD flare)
  – Does not require breath holding, coordinated breath as with many MDI, DPI

• Drawback
  – Need for specialized device
  – Possible medication overuse
  – Potential for limited mobility
  – “Attached to the machine”

True or false?

• The diagnosis of acute bronchitis is usually limited to those without chronic airway disease (e.g., asthma or COPD).

Cough associated with acute bronchitis can typically last up to:
A. 1 week.
B. 2 weeks.
C. 3 weeks.
D. 3 months.

Which of the following is the most common pathogen implicated in acute bronchitis?
A. S. pneumoniae
B. H. influenzae
C. M. pneumoniae
D. Respiratory virus
Acute Bronchitis: Likely Causative Pathogens

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<th>%</th>
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<td>Respiratory tract viruses</td>
<td>Consider using anticholinergic bronchodilator, such as ipratropium bromide (Atrovent®), inhaled beta₂-agonist, such as albuterol, or short course of oral corticosteroid (for example, prednisone 40 mg PO daily dose for 3–5 days) with protracted, problematic cough</td>
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Bacterial pathogens, such as M. pneumoniae, C. pneumoniae, B. pertussis

Consider use of macrolide or tetracycline form such as doxycycline when antimicrobial therapy indicated.

Conclusion

Thank you for your time and attention.

Vanessa Pomarico-Denino, EdD, FNP-BC, FAANP

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First-line Therapy at Each Stage of COPD

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GOLD 1st-line Recommendations for Pharmacologic Therapy

GOLD 1–2, ≤1 Exacerbation/year

Patient Group A (low risk/less symptoms):

SAMA or SABA

Patient Group B (low risk/more symptoms):

LAMA or LABA

Patient Group C (high risk/less symptoms):

(ICS + LABA) or LAMA

Patient Group D (high risk/more symptoms):

(ICS + LABA) or LAMA

SAMA: Short-acting muscarinic antagonist (e.g., ipratropium [Atrovent®]) PRN
SABA: Short-acting beta₂-agonist (e.g., albuterol [Ventolin® HFA, Proventil® HFA]) PRN
LAMA: Long-acting muscarinic antagonist (e.g., tiotropium [Spiriva®])
LABA: Long-acting beta₂-agonist (e.g., salmeterol [Serevent®])
ICS: Inhaled corticosteroid (e.g., fluticasone, budesonide)


Stepwise Approach for Managing Asthma in Patients Age ≥12 Years

Intermittent Asthma

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

Persistent Asthma: Daily Medication

Step 1 Preferred: SABA PRN

Step 2 Preferred: Low-dose ICS

Alternative Cromolyn, LTRA, Nedocromil*, or Theophylline

Step 3 Preferred: Low-dose ICS + LABA

Step 4 Preferred: Medium-dose ICS + LABA

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

Step 5 Preferred: High-dose ICS + LABA

Consider Omalizumab for Patients Who Have Allergies

Step 6 Preferred: High-dose ICS + LABA + Oral Corticosteroid

AND Consider Omalizumab for Patients Who Have Allergies

Steps 2-4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma

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 systemic oral 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

*Not available

**Seldom used

Assess Control

Step Up if Needed (first, check adherence, environmental control, and comorbid conditions)

Step Down if Possible (and asthma is well controlled at least 3 months)

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www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf

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Estimated Comparative Daily Dosages for ICS in Patients Aged ≥12 Years

<table>
<thead>
<tr>
<th></th>
<th>Low Daily Dose</th>
<th>Medium Daily Dose</th>
<th>High Daily Dose</th>
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<tbody>
<tr>
<td>Beclomethasone HFA</td>
<td>80–240 mcg</td>
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<td>40 or 80 mcg/puff</td>
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<td>Budesonide DPI</td>
<td>200–600 mcg</td>
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<td>200 mcg/inhalation</td>
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<td>250 mcg/puff</td>
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<td>Fluticasone HFA MDI</td>
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Source: [https://www.nhlbi.nih.gov/guidelines/asthma/asthsumm.pdf](https://www.nhlbi.nih.gov/guidelines/asthma/asthsumm.pdf)

Lung Function and Severe Exacerbations