## BRONCHODILATORS–SYMPATHOMIMETICS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuterol</td>
<td>4</td>
</tr>
<tr>
<td>Arformoterol</td>
<td>10</td>
</tr>
<tr>
<td>Formoterol</td>
<td>13</td>
</tr>
<tr>
<td>Levalbuterol</td>
<td>15</td>
</tr>
<tr>
<td>Pirbuterol</td>
<td>17</td>
</tr>
<tr>
<td>Salmeterol</td>
<td>19</td>
</tr>
<tr>
<td>Terbutaline</td>
<td>21</td>
</tr>
</tbody>
</table>

## BRONCHODILATORS – ANTICHOLINERGICS

<table>
<thead>
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<th>Compound</th>
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</thead>
<tbody>
<tr>
<td>Ipratropium</td>
<td>24</td>
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<tr>
<td>Tiotropium</td>
<td>26</td>
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</tbody>
</table>

## INHALED CORTICOSTEROIDS

<table>
<thead>
<tr>
<th>Compound</th>
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</thead>
<tbody>
<tr>
<td>Beclomethasone</td>
<td>30</td>
</tr>
<tr>
<td>Budesonide</td>
<td>32</td>
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<tr>
<td>Ciclesonide</td>
<td>34</td>
</tr>
<tr>
<td>Flunisolide</td>
<td>35</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>37</td>
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<tr>
<td>Mometasone</td>
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</tr>
</tbody>
</table>

## COMBINATIONS PRODUCTS

<table>
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<th>Page</th>
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<tr>
<td>41</td>
</tr>
</tbody>
</table>

## BIOLOGICAL RESPONSE MODIFIERS – MONOCLONAL ANTIBODIES

<table>
<thead>
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<th>Compound</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omalizumab</td>
<td>44</td>
</tr>
</tbody>
</table>

## LEUKOTRIENE RECEPTOR ANTAGONISTS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>Montelukast</td>
<td>47</td>
</tr>
<tr>
<td>Zafirlukast</td>
<td>49</td>
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<tr>
<td>Zileuton</td>
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## MAST CELL STABILIZERS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cromolyn</td>
<td>53</td>
</tr>
</tbody>
</table>

## METHYLXANTHINE DERIVATIVES

<table>
<thead>
<tr>
<th>Compound</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theophylline</td>
<td>57</td>
</tr>
</tbody>
</table>
Bronchodilators – Sympathomimetic

Effects:

Airway relaxation, increased ciliary beat frequency, increased force of contraction of skeletal muscles, arrest uterine smooth muscle contractions, and intracellular potassium shift.

Mechanism of Action

Drug binds to β2 receptors in airway smooth muscle, this stimulates the production of cAMP, thus causing bronchodilation and increased ciliary beat frequency. Activation of Na+/K+/ATPase leads to gluconeogenesis and increased insulin secretion, resulting in an intracellular shift of potassium which can lead to metabolic lactic acidemia.

Products available

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Trade Name</th>
<th>Dosage form</th>
<th>Duration of action</th>
<th>Receptor selectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuterol</td>
<td>ProAir® HFA</td>
<td>Inhalation</td>
<td>Intermediate</td>
<td>β1 &lt; β2</td>
</tr>
<tr>
<td></td>
<td>Proventil® HFA</td>
<td>Oral</td>
<td>Acting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ventolin® HFA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AccuNeb®</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VoSpire ER®</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arformoterol</td>
<td>Brovana®</td>
<td>Inhalation</td>
<td>Long acting</td>
<td>β1 &lt; β2</td>
</tr>
<tr>
<td>Formoterol</td>
<td>Foradil aerolizer®</td>
<td>Inhalation</td>
<td>Long acting</td>
<td>β1 &lt; β2</td>
</tr>
<tr>
<td>Levalbuterol</td>
<td>Xopenex® HFA</td>
<td>Inhalation</td>
<td>Intermediate</td>
<td>β1 &lt; β2</td>
</tr>
<tr>
<td></td>
<td>Xopenex®</td>
<td></td>
<td>Acting</td>
<td></td>
</tr>
<tr>
<td>Pirbuterol</td>
<td>Maxair autohaler™</td>
<td>Inhalation</td>
<td>Intermediate</td>
<td>β1 &lt; β2</td>
</tr>
<tr>
<td></td>
<td>Serevent diskus®</td>
<td>Oral</td>
<td>Acting</td>
<td></td>
</tr>
</tbody>
</table>

Special Populations

**Elderly:** More sensitive to tachycardia and tremor.

**Pregnancy:** Beta-agonists decrease uterine contractility, use with caution during second and third trimesters of pregnancy.

**Lactation:** Some agents are excreted in human breast milk.

**Children:** Safety and efficacy data in young children is incomplete.
Precautions/Contraindications:

- Cardiac disease
- Thyroid disease
- Hypokalemia
- Hypersensitivity to the drug or its excipients
- Diabetes mellitus
- Seizure disorder
- Pheochromocytoma
- Glaucoma
- Shock

Adverse Drug Effects:

Adverse drug reactions are usually minor. Low absorption from the lung with inhaled agents limits systemic effects. Choice of a beta2 selective agent decreases cardiac effects. However, when used at high doses, these agents are less selective for beta2 receptors.

- Palpitations
- Tachycardia
- Hypertension
- Arrhythmias
- Cough
- Wheezing
- Bronchospasm
- Dypnea
- Shakiness
- Throat dryness or irritation
- Pharyngitis
- Tremors
- Vasodilation
- Dizziness
- Headache
- Flushing
- Sweating
- Nervousness
- Excitement
- Insomnia
- Unusual or bad taste
- Anorexia
- Hypokalemia
- Lactic acidemia
- Gluconeogenesis
- Tension
Albuterol

ProAir® HFA
Proventil® HFA
Ventolin® HFA
AccuNeb®
VoSpire ER®

Class:
Bronchodilator - sympathomimetic

Use:
Bronchodilator for reversible airway obstruction in asthma or COPD. Prophylaxis for exercise-induced bronchoconstriction.

Dose -- Asthma:

(Metered Dose Inhaler~MDI): 1-2 puffs every 4-6 hours as needed (≥4 years old)

(Nebs): 2.5 mg 3-4 times daily
1.25 mg or 0.63 mg 3 times daily (2-12 years old)

(Oral): 2-4 mg 3-4 times daily
2 mg 3-4 times daily, MAX 24 mg/day (6-12 years old)

(Oral, ER): 4-8 mg every 12 hours, MAX 32 mg/day

Prevention of exercise induced bronchoconstriction:
(MDI) 2 puffs 15-30 minutes prior to exercise (≥4 years old)

Administration:

- **Metered dose inhaler (MDI):** Shake well before using. Prime inhaler by releasing four sprays away from face. Prime prior to first use, whenever the MDI is not used for >72 hours, or if inhaler is dropped.
- **Oral:** Do not chew or crush extended release tablets.
- **Nebulized solution:** Dilute 0.5mL of the 0.5% solution with normal saline to a total of 3 mL to obtain the 2.5 mg/3mL solution. Albuterol solution is compatible with ipratropium or cromolyn nebulizer solutions.
- Do not exceed recommended dose.
### How supplied:

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 08/27/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProAir® HFA</td>
<td>MDI (CFC free)</td>
<td>108 mcg/actuation</td>
<td>8.5 g (200 doses)</td>
<td>$45.99</td>
</tr>
<tr>
<td>Proventil® HFA</td>
<td>MDI (CFC free)</td>
<td>108 mcg/actuation</td>
<td>6.7 g (200 doses)</td>
<td>$55.09</td>
</tr>
<tr>
<td>Ventolin HFA®</td>
<td>MDI (CFC free)</td>
<td>108 mcg/actuation</td>
<td>18 g (200 doses)</td>
<td>$39.99</td>
</tr>
<tr>
<td>AccuNeb™</td>
<td>Nebulize Solution</td>
<td>0.63 mg/3 mL</td>
<td>25 vials</td>
<td>$47.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.25 mg/3 mL</td>
<td>25 vials</td>
<td>$49.99</td>
</tr>
<tr>
<td>Albuterol sulfate</td>
<td>Nebulize Solution</td>
<td>0.083% (3 mL)</td>
<td>25 vials</td>
<td>$18.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5%</td>
<td>20 mL</td>
<td>$20.60</td>
</tr>
<tr>
<td>Albuterol sulfate</td>
<td>Oral syrup</td>
<td>2 mg/5 mL</td>
<td>120 mL</td>
<td>$12.99</td>
</tr>
<tr>
<td>Albuterol sulfate</td>
<td>Tablet</td>
<td>2 mg</td>
<td>60 tablets</td>
<td>$15.99</td>
</tr>
<tr>
<td>VoSpire ER®</td>
<td>Extended release tablet</td>
<td>4 mg</td>
<td>60 tablets</td>
<td>$157.49</td>
</tr>
<tr>
<td>VoSpire ER®</td>
<td></td>
<td>8 mg</td>
<td>60 tablets</td>
<td>$255.11</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

### Special Populations:

**Elderly:** More sensitive to adverse effects, especially tachycardia and tremor.

**Pregnancy:** Risk factor category C. Beta-agonists decrease uterine contractility, use with caution during second and third trimesters.

**Lactation:** Unknown if albuterol is excreted in human breast milk.

**Children:** No safety and efficacy data for immediate release tablets in children <6 years old (<12 years old for extended release tablets, <2 years for oral syrup and nebulized albuterol).
Precautions/Contraindications:

- Diabetes mellitus
- Ischemic cardiac disease
- Coronary artery disease
- Hypertension
- Cardiac arrhythmias
- Tachycardia
- QT prolongation
- Thyroid disease
- Seizures
- Pheochromocytoma
- Hypokalemia
- Hypersensitivity to albuterol
- Hypersensitivity to levalbuterol

Adverse drug events:

**Common:** tachycardia, nervousness, palpitations, nausea, hypokalemia, and tremor

**Serious:** Stevens-Johnson syndrome (rare) and erythema multiforme in children (rare)
### Drug interactions:

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers</td>
<td>Antagonism of the effects of albuterol</td>
<td>Avoid concurrent use</td>
</tr>
<tr>
<td>CYP3A4 inducers (i.e. carbamazepine, phenytoin)</td>
<td>Decreased serum concentration of albuterol</td>
<td>Consider an alternative therapy, monitor therapeutic effects of albuterol</td>
</tr>
<tr>
<td>Theophylline derivatives</td>
<td>Increased theophylline toxicity, increased cardiotoxicity, decreased serum concentration of theophylline</td>
<td>Monitor serum concentration of theophylline, monitor serum potassium, monitor therapeutic and toxic effects of theophylline, adjust theophylline dose as needed</td>
</tr>
<tr>
<td>Halothane</td>
<td>Increased risk of arrhythmias</td>
<td>Avoid concurrent use</td>
</tr>
<tr>
<td>Ipratropium</td>
<td>Increased duration of bronchodilation</td>
<td>No action needed</td>
</tr>
<tr>
<td>Monoamine oxidase inhibitors (MAOI)</td>
<td>Increased incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Tricyclic antidepressants</td>
<td>Increased incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Sympathomimetics</td>
<td>Increased incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Increased CNS stimulation</td>
<td>Avoid or limit caffeine consumption</td>
</tr>
<tr>
<td>Ephedra</td>
<td>Increased CNS stimulation</td>
<td>Avoid combination</td>
</tr>
<tr>
<td>Yohimbine</td>
<td>Increased CNS stimulation</td>
<td>Avoid combination</td>
</tr>
<tr>
<td>Atomoxetine</td>
<td>Increased incidence of tachycardia</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>St. John’s Wort</td>
<td>Decreased serum concentration of albuterol</td>
<td>Avoid combination, select a therapeutic alternative</td>
</tr>
<tr>
<td>Loop diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium, monitor symptoms of hypokalemia</td>
</tr>
<tr>
<td>Thiazide diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium, monitor symptoms of hypokalemia</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Decreased serum concentration of digoxin</td>
<td>Monitor serum concentration of digoxin, monitor therapeutic effect of digoxin, adjust digoxin dose as needed</td>
</tr>
</tbody>
</table>
Arformoterol

Brovana®

Class:
Bronchodilator - sympathomimetic

Use:
Maintenance treatment of bronchoconstriction in patients with COPD, including bronchitis and emphysema

Dose:
COPD: 15 mcg Nebulized every 12 hours

MAX: 30 mcg / 24hrs (≥5 years old)

Administration:
Nebulize: Remove each vial from individually sealed foil pouch immediately before use. Use with standard jet nebulizer connected to an air compressor, administer with mouthpiece or face mask. Administer vial undiluted and do not mix with other medications in nebulizer.

Do not exceed recommended dose.

How supplied:

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/17/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brovana®</td>
<td>Nebulize solution</td>
<td>15 mcg/Vial (2 mL)</td>
<td>30s and 60s</td>
<td>Not available</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

Special Populations:

Elderly: More sensitive to adverse effects, especially tachycardia and tremor.
Pregnancy: Risk factor category C. Beta-agonists decrease uterine contractility, use with caution during second and third trimesters.
Lactation: Unknown if arformoterol is excreted in human breast milk.
Children: No safety and efficacy data for children.

Precautions/Contraindications

- Diabetes mellitus
- Ischemic cardiac disease
- Coronary artery disease
- Hypertension
- Cardiac arrhythmias
- Tachycardia
- QT prolongation
- Thyroid disease
- Seizures
- Pheochromocytoma
- Acute bronchospasm
- Status asthmaticus
- Hypokalemia
- Hypersensitivity to lactose
- Hypersensitivity to arformoterol

**Adverse drug events:**
**Common:** headache, dizziness, palpitations, tremor, restlessness

**Drug interactions:**
*Do not give with other long-acting beta-agonists (salmeterol).*

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers</td>
<td>Antagonism of the effects of albuterol</td>
<td>Avoid concurrent use</td>
</tr>
<tr>
<td>Atomoxetine</td>
<td>Increased incidence of tachycardia</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Sympathomimetics</td>
<td>Increase incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Decreased serum concentration of digoxin</td>
<td>Monitor serum concentration of digoxin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitor therapeutic effect of digoxin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjust digoxin dose as needed</td>
</tr>
<tr>
<td>Loop diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitor symptoms of hypokalemia</td>
</tr>
<tr>
<td>Thiazide diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitor symptoms of hypokalemia</td>
</tr>
<tr>
<td>Theophylline derivatives</td>
<td>Increased theophylline toxicity</td>
<td>Monitor serum concentration of theophylline</td>
</tr>
<tr>
<td></td>
<td>Increased cardiotoxicity</td>
<td>Monitor serum potassium</td>
</tr>
<tr>
<td></td>
<td>Decreased serum concentration of theophylline</td>
<td>Monitor therapeutic and toxic effects of theophylline</td>
</tr>
<tr>
<td></td>
<td>possible</td>
<td>Adjust theophylline dose as needed</td>
</tr>
<tr>
<td>Monoamine oxidase inhibitors</td>
<td>Increase incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
</tbody>
</table>
Long-Acting Beta-Agonists (LABAs): New Safety Requirements - February 2010

The FDA has determined that the benefits of LABAs for improvement of asthma symptoms outweigh the potential risks when used concomitantly with an asthma-controller medication (i.e., inhaled corticosteroid). Therefore, to ensure safe use of LABAs the FDA is recommending the following safety measures:

- Use of single-agent LABAs is contraindicated without the use of an asthma-controller medication
- LABAs should be used only in patients whose asthma is not adequately controlled on asthma-controller medications
- LABAs should be used for shortest duration possible to achieve control of asthma symptoms, then discontinued if possible
- Pediatric and adolescents requiring an LABA should use a combination product (LABA and corticosteroid) to ensure medication compliance.
Formoterol

Foradil® Aerolizer™ Perforomist™

Class:
Bronchodilator - sympathomimetic

Use:

Dose:
Asthma: 12 mcg capsule every 12 hours via Aerolizer™ inhaler (≥5 years old)

COPD: 12 mcg capsule every 12 hours via Aerolizer™ inhaler

Prevention of exercise induced bronchospasm:
12 mcg capsule 15 minutes prior to exercise if needed via Aerolizer™ inhaler

MAX: 24 mcg/24hrs (≥5 years old)

Administration:
Capsule containing dry powder for inhalation: Remove capsule from protective foil immediately prior to use. Capsule must be placed in the capsule-chamber in the Aerolizer™ Inhaler. After the inhaler is closed, press both side buttons once and release. (This punctures the capsule releasing the dry powder for inhalation.) Exhale deeply, hold the inhaler horizontally, and inhale deeply and rapidly. Hold breath and exhale. If powder remains in the Aerolizer™ Inhaler, repeat. Discard the empty capsule.
Do not wash the Aerolizer™ Inhaler or use with a spacer.
Do not exceed recommended dose.

How supplied:

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/17/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foradil® Aerolizer™</td>
<td>Capsule containing powder for inhalation</td>
<td>12 mcg/capsule</td>
<td>60 capsules</td>
<td>$170.72</td>
</tr>
<tr>
<td>Perforomist™</td>
<td>Nebulize solution</td>
<td>20 mcg/2ml</td>
<td>60 vials</td>
<td>Not available</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

Special Populations:
Elderly: More sensitive to adverse effects, especially tachycardia and tremor.
Lactation: Unknown if formoterol is excreted in human breast milk.
Children: No safety and efficacy data for children <5 years old.
Long-Acting Beta-Agonists (LABAs): New Safety Requirements - February 2010

The FDA has determined that the benefits of LABAs for improvement of asthma symptoms outweigh the potential risks when used concomitantly with an asthma-controller medication (i.e., inhaled corticosteroid). Therefore, to ensure safe use of LABAs the FDA is recommending the following safety measures:

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- LABAs should be used only in patients whose asthma is not adequately controlled on asthma-controller medications
- LABAs should be used for shortest duration possible to achieve control of asthma symptoms, then discontinued if possible
- Pediatric and adolescents requiring an LABA should use a combination product (LABA and corticosteroid) to ensure medication compliance.
**Levalbuterol**

**Xopenex®**  
**Xopenex HFA™**

**Class:**  
Bronchodilator - sympathomimetic

**Use:**  
Treatment and prevention of bronchospasm in asthma

**Dose:**  
**Asthma:** (Neb) 0.63-1.25 mg nebulized every 6-8 hours (≥12 years old)  
0.31 mg 3 times daily, MAX 0.63 mg 3 times daily (6-11 years old)  
(MDI-CFC free): 2 puffs every 4-6 hours

**Administration:**  
**Metered dose inhaler (MDI):** Shake well before using. Prime inhaler by releasing four sprays away from face. Prime prior to first use, whenever the MDI is not used for >72 hours, or if inhaler is dropped.

**Nebulized solution:** Dilute 0.5mL of the solution with normal saline to a total of 3 mL prior to use. Vials should be kept at room temperature and protected from light. Use within 2 weeks after foil package is opened. Use within 1 week if vials are stored outside the protective package.

Do not exceed recommended dose.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/17/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xopenex®</td>
<td>Nebulize solution</td>
<td>0.31 mg/3mL</td>
<td>24 vials</td>
<td>$120.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.63 mg/3mL</td>
<td>24 vials</td>
<td>$123.91</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.25 mg/3mL</td>
<td>24 vials</td>
<td>$122.47</td>
</tr>
<tr>
<td>Xopenex HFA™</td>
<td>MDI</td>
<td>45mcg/actuation</td>
<td>15gm (200 actuations)</td>
<td>$53.84</td>
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</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

**Renal Impairment:** Higher serum concentrations obtained.  
**Elderly:** More sensitive to adverse effects, especially tachycardia and tremor.  
**Pregnancy:** Risk factor category C. Beta-agonists decrease uterine contractility, use with caution during second and third trimesters.  
**Lactation:** Unknown if levalbuterol is excreted in human breast milk.  
**Children:** No safety and efficacy data for nebulized levalbuterol use in children <6 years old, or for aerosolized levalbuterol use in children <4 years old.
Precautions/Contraindications:
- Diabetes mellitus
- Ischemic cardiac disease
- Coronary artery disease
- Hypertension
- Cardiac arrhythmias
- Tachycardia
- QT prolongation
- Thyroid disease
- Seizures
- Pheochromocytoma
- Hypokalemia
- Hypersensitivity to levalbuterol
- Hypersensitivity to albuterol

Adverse drug events:
Common: sinusitis, rhinitis, viral infection, flu syndrome
Serious (rare): hypersensitivity reactions, ECG changes, cardiovascular effects, paradoxical bronchospasm

Drug interactions:

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers</td>
<td>Antagonism of the effects of levalbuterol</td>
<td>Avoid concurrent use</td>
</tr>
<tr>
<td>Atomoxetine</td>
<td>Increased incidence of tachycardia</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Sympathomimetics</td>
<td>Increase incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
</tbody>
</table>
| Digoxin           | Decreased serum concentration of digoxin | Monitor serum concentration of digoxin
 |                     |                     | Monitor therapeutic effect of digoxin
 |                     |                     | Adjust digoxin dose as needed |
| Loop diuretics    | Enhanced hypokalemic effect | Monitor serum potassium
 |                     |                     | Monitor symptoms of hypokalemia |
| Thiazide diuretics| Enhanced hypokalemic effect | Monitor serum potassium
 |                     |                     | Monitor symptoms of hypokalemia |
Pirbuterol

Maxair® Autohaler®

**Class:**
Bronchodilator - sympathomimetic

**Use:**
Treatment and prevention of reversible bronchospasm.

**Dose:**
**Asthma:** (MDI): 1-2 puffs every 4-6 hours as needed, up to 12 puffs/day (≥12 years old)

**Administration:**
Autohaler®: Holding the Autohaler® upright, move the lever to it snaps into position, perpendicular to the floor. Shake the device well. Exhale completely. Begin inhalation and move the Autohaler® lever down to original position, continue inhaling deeply. Hold breath for at least 10 seconds, then exhale slowly. The Autohaler® should be primed by spraying an actuation by pressing the white test-fire slide located at the bottom of the device. Prime when the inhaler is new or has been unused for more than 48 hours.

Do not exceed recommended dose.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/17/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxair® Autohaler®</td>
<td>Aerosol delivered by the Autohaler®</td>
<td>200 mcg/actuation</td>
<td>14 g (400 doses)</td>
<td>$169.99</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. This prices are intended only as an estimate of cash cost.

**Special Populations:**
**Elderly:** More sensitive to adverse effects, especially tachycardia and tremor.
**Pregnancy:** Risk factor category C. Beta-agonists decrease uterine contractility, use with caution during second and third trimesters.
**Lactation:** Unknown if pirbuterol is excreted into human breast milk.
**Children:** No safety and efficacy data for children <12 years old.
**Precautions/Contraindications**
- Diabetes mellitus
- Ischemic cardiac disease
- Coronary artery disease
- Hypertension
- Cardiac arrhythmias
- Tachycardia
- QT prolongation
- Thyroid disease
- Seizures
- Pheochromocytoma
- Hypersensitivity to pirbuterol
- Shock
- Narrow-angle glaucoma
- AV block associated with digitalis toxicity
- Hypokalemia

**Adverse drug events:**
- **Common:** tremor, nervousness
- **Serious:** paradoxical bronchospasm

**Drug interactions:**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers</td>
<td>Antagonism of the effects of pirbuterol</td>
<td>Avoid concurrent use</td>
</tr>
<tr>
<td>Atomoxetine</td>
<td>Increased incidence of tachycardia</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Sympathomimetics</td>
<td>Increase incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Decreased serum concentration of digoxin</td>
<td>Monitor serum concentration of digoxin</td>
</tr>
<tr>
<td>Loop diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium</td>
</tr>
<tr>
<td>Thiazide diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium</td>
</tr>
</tbody>
</table>
Salmeterol

Serevent® Diskus®

**Class:**
Bronchodilator - sympathomimetic

**Use:**
Maintenance treatment of asthma for patients who require regular treatment with short-acting beta₂-agonists bronchoconstriction in patients with COPD, and prevention of exercise induced bronchoconstriction.

**Dose:**
- **Asthma:** 1 inhalation every 12 hours (≥4 years old)
- **COPD:** 1 inhalation every 12 hours

**Prevention of exercise induced bronchospasm:**
1 inhalation 30 minutes prior to exercise (≥4 years old)

**Administration:**
Do not exceed recommended dose.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/20/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serevent®</td>
<td>Dry Powder</td>
<td>50 mcg/dose</td>
<td>1 inhaler with 60 doses</td>
<td>$169.38</td>
</tr>
<tr>
<td>Diskus®</td>
<td>Inhaler (DPI)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

- **Elderly:** More sensitive to adverse effects, especially tachycardia and tremor.
- **Pregnancy:** Risk factor category C. Beta-agonists decrease uterine contractility, use with caution during second and third trimesters.
- **Lactation:** Unknown if salmeterol is excreted into human breast milk.
- **Children:** No safety and efficacy data for children <4 years old.

**Precautions/Contraindications:**
- Acute bronchospasm
- Status asthmaticus
- Hypersensitivity to salmeterol
- Diabetes mellitus
- Ischemic cardiac disease
- Coronary artery disease
- Hypertension
• Cardiac arrhythmia
• Tachycardia
• QT prolongation
• Thyroid disease
• Seizures
• Pheochromocytoma

**Adverse drug events:**
*Common:* tachycardia, dizziness, headache, sore throat, tremor
*Serious:* worsening of asthma-related events, asthma-related death

**Drug interactions:**
*Do not use with other long-acting beta agonists (formoterol).*

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers</td>
<td>Antagonism of the effects of salmeterol</td>
<td>Avoid concurrent use</td>
</tr>
<tr>
<td>Atomoxetine</td>
<td>Increased incidence of tachycardia</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Sympathomimetics</td>
<td>Increase incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Decreased serum concentration of digoxin</td>
<td>Monitor serum concentration of digoxin Adjust digoxin dose as needed</td>
</tr>
<tr>
<td>Loop diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium</td>
</tr>
<tr>
<td>Thiazide diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium</td>
</tr>
</tbody>
</table>

**Long-Acting Beta-Agonists (LABAs): New Safety Requirements - February 2010**

The FDA has determined that the benefits of LABAs for improvement of asthma symptoms outweigh the potential risks when used concomitantly with an asthma-controller medication (i.e., inhaled corticosteroid). Therefore, to ensure safe use of LABAs the FDA is recommending the following safety measures:

- Use of single-agent LABAs is contraindicated without the use of an asthma-controller medication
- LABAs should be used only in patients whose asthma is not adequately controlled on asthma-controller medications
- LABAs should be used for shortest duration possible to achieve control of asthma symptoms, then discontinued if possible
- Pediatric and adolescents requiring an LABA should use a combination product (LABA and corticosteroid) to ensure medication compliance.
Terbutaline

Brethine®

Class:
Bronchodilator - sympathomimetic

Use:
Bronchodilator in asthma and COPD with reversible airway obstruction.

Dose:
Bronchospasm:
(Oral) 2.5-5 mg three times daily, MAX 15mg/day (adult)
2.5-5 mg three times daily, MAX 7.5mg/day (12-15 years old)
0.05-0.15 mg/kg/dose three times daily, MAX 5mg/day (6-12 years old)

Administration:
Do not exceed recommended dose.

How supplied:

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/20/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brethine®</td>
<td>Tablet</td>
<td>2.5 mg</td>
<td>90 tablets</td>
<td>$43.47</td>
</tr>
<tr>
<td>Terbutaline Sulfate</td>
<td>Tablet</td>
<td>2.5 mg</td>
<td>90 tablets</td>
<td>$44.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg</td>
<td>90 tablets</td>
<td>$45.99</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

Special Populations:
Pregnancy: Risk factor category B. Fetal tachycardia has occurred secondary to parenteral administration. Beta-agonists decrease uterine contractility, use with caution during second and third trimesters.
Lactation: Terbutaline is excreted into human breast milk.

Precautions/Contraindications:
- Tachycardia
- Continuous use >12 months
- Diabetes mellitus
- Ischemic cardiac disease
- Coronary artery disease
- Hypertension
- Cardiac arrhythmias
- QT prolongation
- Thyroid disease
- Seizures
- Pheochromocytoma
**Adverse drug events:**
**Common:** tachycardia, nervousness, tremor, headache, seizures, palpitations
**Serious:** paradoxical bronchospasm, cardiac arrhythmias

**Drug interactions:**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers</td>
<td>Antagonism of the effects of terbutaline</td>
<td>Avoid concurrent use</td>
</tr>
<tr>
<td>Atomoxetine</td>
<td>Increased incidence of tachycardia</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Sympathomimetics</td>
<td>Increase incidence of side effects</td>
<td>Monitor heart rate and blood pressure</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Decreased serum concentration of digoxin</td>
<td>Monitor serum concentration of digoxin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitor therapeutic effect of digoxin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjust digoxin dose as needed</td>
</tr>
<tr>
<td>Loop diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor serum potassium</td>
</tr>
<tr>
<td>Thiazide diuretics</td>
<td>Enhanced hypokalemic effect</td>
<td>Monitor symptoms of hypokalemia</td>
</tr>
</tbody>
</table>
Bronchodilators – Anticholinergic

**Effects:**
Bronchodilation through inhibition of bronchoconstriction secondary to blockade of the effects of acetylcholine.

**Mechanism of Action:**
The non-selective antagonism of muscarinic receptors leads to down regulation of cGMP which results in bronchodilation. Additional acetylcholine is released in response, thus overcoming the effect in smooth muscle.

**Adverse Drug Reactions:**
Administering the agent by inhalation increases selectivity for respiratory muscarinic receptors. Side effects of systemic absorption include blurred vision, CNS stimulation, dryness of secretions, and constipation.

**Products Available:**

<table>
<thead>
<tr>
<th>Generic</th>
<th>Trade Name</th>
<th>Dosage Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipratropium</td>
<td>Atrovent®, Atrovent® HFA.</td>
<td>Nebulized solution, Metered dose inhaler (MDI-CFC free), Nasal</td>
</tr>
<tr>
<td></td>
<td>Atrovent® nasal</td>
<td></td>
</tr>
<tr>
<td>Tiotropium*</td>
<td>Spiriva® Handihaler®</td>
<td>DPI</td>
</tr>
</tbody>
</table>

**Special Populations:**

**Elderly:** Greater risk for anticholinergic side effects.

**Pregnancy:** Insufficient data to recommend using during pregnancy.

**Lactation:** Anticholinergic effects may dry breast milk.

**Children:** Safety and efficacy data incomplete in young children.

**Precautions/Contraindications:**
- Cardiac arrhythmias
- Glaucoma
- Contact lenses
- Urinary retention
- Benign prostatic hypertrophy
- Driving or performing hazardous tasks
- Hypersensitivity to the drug or its excipients

**Adverse drug effects:**
Low absorption from the lung with inhaled agents limits systemic effects.

Nasal dryness | Bitter taste | Respiratory tract infection
Nasal congestion | Blurred vision | Urinary retention
Dry mouth | Increased heart rate | Constipation
Dry eyes

* Tiotropium is currently only FDA approved for COPD.*
Ipratropium

Atrovent®
Atrovent® HFA
Atrovent® nasal

**Class:**
Bronchodilator - anticholinergic

**Use:**
Treatment of bronchospasm in bronchitis, COPD, and emphysema. Treatment of rhinorrhea.

**Dose:**

**Bronchospasm:**
(MDI-CFC free): 2 puffs four times daily, up to 12 puffs/day
1-2 puffs three times daily, up to 6 puffs/day (3-14 years old)

(Nebs): 500 mcg three to four times daily
125-250 mcg three times daily (infants)
25 mcg/kg three times daily (neonates)

**Rhinorrhea, non-allergic or perennial allergic:**
(Nasal) 2 sprays (0.03%) in each nostril 2-3 times daily (≥6 years old)

**Rhinorrhea, common cold:**
(Nasal) 2 sprays (0.06%) in each nostril 3-4 times daily, up to 4 days (≥5 years old)

**Rhinorrhea, seasonal allergy:**
(Nasal) 2 sprays (0.06%) in each nostril 4 times daily, up to 3 weeks (≥5 years old)

**Administration:**
Prime inhaler with two test sprays when inhaler is new or has not been used >72 hours.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/20/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrovent® HFA</td>
<td>MDI (CFC free)</td>
<td>17 mcg/actuation</td>
<td>12.9 vials</td>
<td>$156.51</td>
</tr>
<tr>
<td>Ipratropium</td>
<td>Nebulize solution</td>
<td>0.02%</td>
<td>20 vials</td>
<td>$48.00</td>
</tr>
<tr>
<td>Atrovent®</td>
<td>Nasal spray</td>
<td>0.03%</td>
<td>30 mL</td>
<td>$93.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.06%</td>
<td>15 mL</td>
<td>$84.68</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.
**Special Populations:**
*Pregnancy:* Risk factor category B.
*Lactation:* Ipratropium is excreted into human breast milk.
*Children:* No safety and efficacy data for children <5 years old.

**Precautions/Contraindications:**
- Hypersensitivity to soya lecithin
- Hypersensitivity to peanut oil
- Hypersensitivity to atropine
- Hypersensitivity to bromide
- Closed-angle glaucoma
- Contact lenses
- Urinary tract obstruction
- Benign prostatic hypertrophy
- Urinary retention

**Adverse drug events:**
*Common:* nasal congestion, nasal dryness, bitter taste, dry mouth
*Serious:* paralytic ileus (rare), hypersensitivity reactions (rare)

**Drug Interactions**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pramlintide</td>
<td>Increased anticholinergic effect&lt;br&gt;Decreased GI motility</td>
<td>Avoid combination if possible&lt;br&gt;Monitor side effects</td>
</tr>
<tr>
<td>Anticholinergics</td>
<td>Increased anticholinergic effects</td>
<td>Monitor anticholinergic side effects&lt;br&gt;Use with caution</td>
</tr>
</tbody>
</table>
Tiotropium

Spiriva® HandiHaler®

**Class:**
Bronchodilator - anticholinergic

**Use:**
Prevention and treatment of bronchospasm in COPD. Not currently approved for treatment of asthma.

**Dose:**
Bronchospasm: 1 capsule (18 mcg) daily via the HandiHaler® inhaler (≥18 years old)

**Administration:**
Not compatible with other delivery systems.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/20/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spiriva® HandiHaler®</td>
<td>Dry Powered Inhaler (DPI)</td>
<td>18 mcg/capsule</td>
<td>30 capsules</td>
<td>$229.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6 capsules</td>
<td>$41.99</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

**Elderly:** Greater risk for anticholinergic side effects and complications.

**Pregnancy:** Risk factor category C.

**Lactation:** Unknown if tiotropium is excreted in human breast milk.

**Children:** No safety and efficacy data in children <18 years old.

**Precautions/Contraindications**
- Hypersensitivity to tiotropium
- Hypersensitivity to ipratropium
- Hypersensitivity to lactose
- Closed-angle glaucoma
- Cardiac arrhythmias
- Driving or operating machinery
- Ophthalmic administration
- Contact lenses
- Urinary tract obstruction
- Benign prostatic hypertrophy
- Urinary retention
**Adverse drug events:**
**Common:** dry mouth, blurred vision, glaucoma, sinusitis, increased heart rate, respiratory tract infection, urinary difficulty/retention, constipation

**Drug interactions:**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pramlintide</td>
<td>Increased anticholinergic effects</td>
<td>Avoid combination if possible</td>
</tr>
<tr>
<td></td>
<td>Decreased GI motility</td>
<td>Monitor side effects</td>
</tr>
<tr>
<td>Anticholinergics</td>
<td>Increased anticholinergic effects</td>
<td>Monitor anticholinergic side effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use with caution</td>
</tr>
<tr>
<td>Cimetidine</td>
<td>Decreased metabolism of tiotropium</td>
<td>No action required.</td>
</tr>
</tbody>
</table>
Inhaled Corticosteroids

**Effects:**
Reduced airway inflammation. Overall airway bronchial hyper-responsiveness decreased. Improved asthma control. Increased sensitivity of beta-receptors in smooth muscle.

**Mechanism of Action:**
Agents suppress granuloma formation, reduce arachidonic acid metabolism, up regulate beta-adrenergic receptors on leukocytes, and decrease synthesis of prostaglandins and leukotrienes.

**Products available:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Formulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beclomethasone</td>
<td>Metered dose inhaler (MDI-CFC free) Nasal</td>
</tr>
<tr>
<td>Budesonide</td>
<td>Dry Powdered Inhaler (DPI)</td>
</tr>
<tr>
<td></td>
<td>Nebulization</td>
</tr>
<tr>
<td></td>
<td>Nasal</td>
</tr>
<tr>
<td></td>
<td>Oral</td>
</tr>
<tr>
<td>Ciclesonide</td>
<td>(MDI-CFC free)</td>
</tr>
<tr>
<td>Flunisolide</td>
<td>MDI</td>
</tr>
<tr>
<td></td>
<td>Nasal</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>MDI-CFC free</td>
</tr>
<tr>
<td></td>
<td>Nasal</td>
</tr>
<tr>
<td>Mometasone</td>
<td>DPI</td>
</tr>
<tr>
<td></td>
<td>Nasal</td>
</tr>
<tr>
<td>Triamcinolone</td>
<td>Nasal</td>
</tr>
</tbody>
</table>

**Special populations:**
- **Renal Impairment:** Dose reduction may be necessary.
- **Hepatic Impairment:** Dose reduction may be necessary.
- **Pregnancy:** Insufficient data to recommend using during pregnancy.
- **Lactation:** Some agents are excreted in breast milk.
- **Children:** Safety and efficacy data incomplete in young children.
Precautions/Contraindications:
- Coagulopathy
- Acute bronchospasm
- Status asthmaticus
- Hypersensitivity to the drug or its excipients
- Cushing’s disease
- Diabetes mellitus
- Glaucoma
- Hypertension
- Osteoporosis
- Seizure disorder
- Tuberculosis
- Active infection
- Nasal trauma
- Myasthenia gravis
- Peptic ulcer disease
- Abrupt withdrawal
- Hypothyroidism

Adverse Drug Reactions:
Side effects are due to systemic absorption. Corticosteroids delivered by inhalation or nasally have less systemic absorption, thus cause fewer adverse drug reactions.

| Candidiasis | Nasal dryness | Anaphylaxis |
| Nasopharyngeal irritation | Throat irritation | Infection |
| Glaucoma | Cushing's syndrome | Hypertension |
| Cataracts | Dysphonia | GI distress |
| Adrenal suppression | Palpitations | Growth suppression |
| Osteoporosis | Epistaxis | Impaired healing |
| Headache | Hypersensitivity reaction | Hyperglycemia |
| Nasal stinging | | |
Beclomethasone

QVAR®
Beconase® AQ

**Class:**
Corticosteroid

**Use:**
Treatment and prophylaxis of asthma, nasal preparation for allergic rhinitis.

**Dose:**

**Asthma:**
(Nebs) 40 mcg twice daily, MAX 80 mcg twice daily (5-11 years old)
40-160 mcg twice daily, MAX 320 mcg twice daily (≥6 years old)

**Allergic rhinitis:**
(Nasal) 1-2 sprays each nostril twice daily, TOTAL 168-336 mcg/day

**Administration:**
Not for treatment of acute bronchospasm. Rinse mouth after use of oral inhaler.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/20/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QVAR®</td>
<td>MDI (CFC-Free)</td>
<td>40 mcg/actuation</td>
<td>7.3 g (100 doses)</td>
<td>$91.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80 mcg/actuation</td>
<td>7.3 g (100 doses)</td>
<td>$105.99</td>
</tr>
<tr>
<td>Beconase® AQ</td>
<td>Aqueous nasal spray</td>
<td>42 mcg/ spray</td>
<td>25 g (180 doses)</td>
<td>$149.99</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

**Pregnancy:** Risk factor category C.

**Lactation:** Excreted in breast milk.

**Children:** No safety and efficacy data for children < 6 years old or for QVAR® use in children <5 years old.
Precautions/Contraindications:
• Status asthmaticus
• Hypersensitivity to beclomethasone
• Cushing’s disease
• Diabetes mellitus
• Glaucoma
• Tuberculosis
• Active infection
• Abrasions/trauma at site of application

Adverse drug events:
Common: headache, candidiasis, nasopharyngeal irritation
Serious: glaucoma, cataract, adrenal suppression, osteoporosis

Drug interactions:
No clinically significant interactions currently identified.
# Budesonide

**Pulmicort Turbuhaler™**
**Pulmicort Respules®**
**Rhinocort® Aqua®**

**Class:**
Corticosteroid

**Use:**
Maintenance treatment of asthma. Intranasal for rhinitis symptoms.

**Dose:**
**Asthma:**
DPI 180-720 mcg twice daily, MAX 2 puffs 720 mcg twice daily
180 mcg twice daily, MAX 360 mcg twice daily (≥6 years old)

(Nebs) 0.5 mg once daily or divided twice daily, MAX 1 mg/day (1-8 years old)

**Rhinitis:**
1 spray each nostril daily, MAX 4 sprays/nostril daily (≥12 years old)
1 spray each nostril daily, MAX 2 sprays/nostril daily (6-12 years old)

**Administration:**
Not for treatment of acute bronchospasm. Rinse mouth after use of Flexhaler™.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmicort Flexhaler™</td>
<td>DPI</td>
<td>90 mcg/actuation</td>
<td>60 doses</td>
<td>$114.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>180 mcg/actuation</td>
<td>120 doses</td>
<td>$151.75</td>
</tr>
<tr>
<td>Rhinocort® Aqua®</td>
<td>Nasal spray</td>
<td>32 mcg/actuation</td>
<td>8.6 g</td>
<td>$111.96</td>
</tr>
<tr>
<td>Pulmicort Respules®</td>
<td>Nebulize solution</td>
<td>0.25 mg/2mL</td>
<td>30 vials</td>
<td>$220.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 mg/2mL</td>
<td>30 vials</td>
<td>$259.58</td>
</tr>
<tr>
<td>Budesonide</td>
<td>Nebulize solution</td>
<td>0.25 mg/2mL</td>
<td>30 vials</td>
<td>$135.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 mg/2mL</td>
<td>30 vials</td>
<td>$145.99</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.
Special Populations:
Renal Impairment: Drug may exacerbate impairment.
Elderly: Increased risk for liver dysfunction.
Pregnancy: Pulmicort Flexhaler® Turbuhaler®, Pulmicort Respules®, and Rhinocort® Aqua® fall into pregnancy risk factor category B. All other forms of budesonide are considered to be in pregnancy risk factor category C.
Lactation: Budesonide is excreted in human breast milk.
Children: Nebulized budesonide is indicated in children ≥ 6 months old.

Precautions/Contraindications:
- Status asthmaticus
- Hypersensitivity to budesonide
- Tuberculosis
- Active infection
- Cushing’s disease
- Myasthenia gravis
- Abrasion/trauma at site of drug application
- Hypertension
- Osteoporosis
- Psychosis
- Diabetes mellitus
- Seizure disorder
- Peptic ulcer disease
- Glaucoma
- High risk for intestinal perforation

Adverse drug events:
Common: headache, nasal stinging, nasal dryness, throat irritation, epistaxis, Cushing’s syndrome
Serious: cataract, glaucoma, adrenal suppression

Drug interactions

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYP3A4 inhibitors (i.e. cimetidine)</td>
<td>Decreased metabolism of budesonide</td>
<td>Monitor therapeutic effects of budesonide</td>
</tr>
<tr>
<td>Antacids</td>
<td>Decreased bioavailability of oral budesonide</td>
<td>Separate doses by two or more hours. Monitor therapeutic effects of budesonide</td>
</tr>
<tr>
<td>Bile acid binders</td>
<td>Decreased oral absorption of budesonide</td>
<td>Separate doses by two or more hours. Monitor therapeutic effects of budesonide</td>
</tr>
<tr>
<td>Imidazole antifungals</td>
<td>Decreased metabolism of budesonide</td>
<td>Monitor toxic effects of budesonide, i.e. adrenal suppression</td>
</tr>
<tr>
<td>Protease inhibitors</td>
<td>Decreased metabolism of budesonide</td>
<td>Monitor toxic effects of budesonide</td>
</tr>
</tbody>
</table>
Ciclesonide

Alvesco®
Omnaris™

Class:
Corticosteroid

Use:
Management of asthma and seasonal and perennial allergic rhinitis.

Dose:
Asthma: (MDI-CFC) 80 to 360 mcg inhaled twice daily, MAX 640 mcg/ day (≥12 years old)
Allergic Rhinitis
(Nasal spray); 2 sprays each nostril twice daily (≥6 years old)

Administration:
Rinse mouth after use of oral inhalation. Not for treatement of acute bronchospasm.

How supplied:

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/23/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alvesco®</td>
<td>MDI-CFC free</td>
<td>80 mcg</td>
<td>6.1 gm(60 doses) actuation</td>
<td>$154.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>160 mcg</td>
<td>6.1 gm(60 doses) actuation</td>
<td>$155.98</td>
</tr>
<tr>
<td>Omnaris™</td>
<td>Nasal Spray</td>
<td>50 mcg/spray</td>
<td>12.5 gm(120 doses)</td>
<td>$98.39</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

Special Populations:
Pregnancy: Category C.
Lactation: Unknown if excreted into breast milk.
Children: No safety and efficacy data for children <12 years old with asthma (<6 years old with allergic rhinitis).

Precautions/Contraindications:
- Hypersensitivity to ciclesonide
- Status asthmaticus
- Acute bronchospasm
- Glaucoma
- Tuberculosis
- Active infection
- Oral or nasal trauma or abrasion

Adverse drug events:
Common: Headache, throat irritation, nose irritation, oral candidiasis, hoarseness, epistaxis
Serious: Adrenal insufficiency, glaucoma (rare), hypersensitivity disorder (rare)
Drug interactions: Strong CYP3A4 inhibitors may increase serum concentration of ciclesonide.
Flunisolide

AeroBid®

AeroBid® M (contains menthol as a flavoring agent)

Nasarel®

**Class:**
Corticosteroid

**Use:**
Management of steroid-dependent asthma, nasal preparation for allergic rhinitis.

**Dose:**

**Asthma:**
(MDI) 2 puffs twice daily, MAX 4 puffs twice daily (2 mg/day) 2 puffs twice daily, 
MAX 2 puffs twice daily (1 mg/day) (6-14 years old)

**Allergic rhinitis:**
(Nasal) 2 sprays/nostril twice daily, MAX 8 sprays each nostril daily
1-4 sprays/nostril 1-3 times daily, MAX 4 sprays/nostril/day (6-14 years old)

**Administration:**
Rinse mouth after use of oral inhalation. Not for treatment of acute bronchospasm.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroBid®</td>
<td>MDI</td>
<td>250 mcg/actuation</td>
<td>7 g (100 doses)</td>
<td>$96.44</td>
</tr>
<tr>
<td>AeroBid® M</td>
<td>MDI</td>
<td>250 mcg/actuation</td>
<td>7 g (100 doses)</td>
<td>$97.51</td>
</tr>
<tr>
<td>Flunisolide</td>
<td>Nasal spray</td>
<td>0.025%</td>
<td>25 mL</td>
<td>$39.99</td>
</tr>
<tr>
<td>Flunisolide</td>
<td>Nasal spray</td>
<td>29 mcg/actuation</td>
<td>25 mL</td>
<td>$45.99</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.
**Special Populations:**

**Pregnancy:** Risk factor category C.

**Lactation:** Unknown if excreted in breast milk.

**Children:** No safety and efficacy data for children < 6 years old.

**Precautions/Contraindications:**

- Status asthmaticus
- Cushing's disease
- Tuberculosis
- Active infection
- Hypersensitivity to flunisolide
- Oral or nasal trauma or ulcers
- Systemic fungal infection
- Osteoporosis

**Adverse drug events:**

**Common:** Headache, nausea, vomiting, nasal irritation, mouth and throat candidiasis, dysphonia, palpitations

**Serious:** Adrenal insufficiency

**Drug interactions:**

No clinically significant interactions currently identified.
Fluticasone

Flonase®
Flovent® HFA
Flovent® Diskus®
Veramyst®

**Class:**
Corticosteroid

**Use:**
Maintenance and prophylaxis of asthma, nasal preparation for rhinitis.

**Dose:**

**Asthma:**
(MDI-CFC free): 88mcg -440 mcg twice daily, MAX 1760 mg/day (≥12 years old)
88 mcg twice daily, MAX 88 mcg twice daily (4-11 years old)
(DPI): 100mcg -1000 mcg twice daily, MAX 2000 mg/day (≥12 years old)
50 mcg- 100 mcg twice daily, MAX 200 mcg twice daily (4-11 years old)

**Rhinitis:**
(Nasal)1-2 sprays each nostril 1-2 times daily, MAX 2 sprays/nostril/day
1 spray each nostril daily, MAX 2 sprays each nostril daily (2-11 years old)

**Administration:**
Rinse mouth after each use of oral inhalation. Not for treatment of acute bronchospasm.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flonase®</td>
<td>Nasal spray</td>
<td>50 mcg/actuation</td>
<td>16 g</td>
<td>$85.98</td>
</tr>
<tr>
<td></td>
<td>Generic Nasal spray</td>
<td>50 mcg/actuation</td>
<td>16 g</td>
<td>$59.99</td>
</tr>
<tr>
<td>Flovent® HFA</td>
<td>MDI (CFC free)</td>
<td>44 mcg/actuation</td>
<td>10.6 g</td>
<td>$109.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>110 mcg/actuation</td>
<td>12 g</td>
<td>$138.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>220 mcg/actuation</td>
<td>12 g</td>
<td>$224.97</td>
</tr>
</tbody>
</table>
Fluticasone

<table>
<thead>
<tr>
<th>Flovent® Diskus®</th>
<th>DPI</th>
<th>50 mcg/actuation</th>
<th>60 doses</th>
<th>$104.74</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>100mcg/actuation</td>
<td>60 doses</td>
<td>$104.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250mcg/actuation</td>
<td>60 doses</td>
<td>$139.99</td>
</tr>
<tr>
<td>Veramyst®</td>
<td>Nasal spray</td>
<td>27.5 actuation</td>
<td>10 g</td>
<td>$105.61</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

**Pregnancy:** Risk factor category C.

**Lactation:** Unknown if excreted in breast milk.

**Children:** No safety and efficacy data in children < 4 years old.

**Precautions/Contraindications:**

- Hypersensitivity to fluticasone
- Milk protein hypersensitivity
- Status asthmaticus
- Acute bronchospasm
- Tuberculosis
- Active infection
- Systemic fungal infection
- Cushing’s disease
- Abrasions/trauma at site of application
- Diabetes mellitus
- Osteoporosis

**Adverse drug events:**

**Common:** pharyngitis, epistaxis, oropharyngeal candidiasis

**Serious:** adrenal suppression, glaucoma (rare), anaphylaxis (rare), hypersensitivity reaction (rare)

**Drug interactions:**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYP3A4 inhibitors (i.e., cimetidine)</td>
<td>Decreased effect of fluticasone</td>
<td>Monitor therapeutic effects of fluticasone</td>
</tr>
<tr>
<td>Imidazole antifungals</td>
<td>Decreased metabolism of fluticasone</td>
<td>Monitor toxic effects of fluticasone</td>
</tr>
<tr>
<td>Protease inhibitors</td>
<td>Decreased metabolism of fluticasone</td>
<td>Monitor toxic effects of fluticasone</td>
</tr>
</tbody>
</table>
Mometasone

Nasonex®
Asmanex® Twisthaler®

Class:
Corticosteroid

Use:
Treatment of allergic rhinitis and management of asthma.

Dose:

Asthma:
(DPI): 1 puff (220 mcg) daily, MAX 440 mcg/day (≥12 years old)
1 puff (110 mcg) daily, MAX 110 mcg/day (4-11 years old)

Allergic Rhinitis:
(Nasal) 2 sprays each nostril daily (≥12 years old)
1 spray each nostril daily (2-11 years old)

Administration:
(Nasal): Prime nasal spray by pumping ten times or until a fine mist appears. Prime the device when new or unused for more than a week.
(DPI): Inhale quickly and deeply. Rinse mouth after use.

How supplied:

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasonex®</td>
<td>Nasal spray</td>
<td>50 mcg/actuation</td>
<td>17 g</td>
<td>$67.99</td>
</tr>
<tr>
<td>Asmanex® Twisthaler®</td>
<td>DPI</td>
<td>0.11 mg/actuation</td>
<td>30 doseses</td>
<td>$116.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.22 mg/actuation</td>
<td>60 doseses</td>
<td>$152.74</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

Special Populations:

Pregnancy: Risk factor category C.
Lactation: Unknown if nasal mometasone is excreted in human breast milk.
Children: No safety or efficacy data for children < 2 years old.
Precautions/Contraindications:
- Status asthmaticus
- Hypersensitivity
- Diabetes mellitus
- Cushing’s syndrome
- Abrupt discontinuation
- Nasal trauma
- Glaucoma
- Tuberculosis
- Active infection

Adverse drug events:
Common: epistaxis, headache, viral infection
Serious: glaucoma, adrenal suppression

Drug interactions:
No clinically significant interactions currently identified.
Combination Products

**Advair Diskus®**
**Advair® HFA**
**Combivent®**
**DuoNeb®**
**Dulera®**
**Symbicort®**

**Use:**
Maintenance of asthma

**Mechanism of Action:** See individual agents

**Dose:**

- **Advair Diskus®**
  One inhalation twice daily, separated by 12 hours (>12 years old)
  One inhalation of 100-50 mcg twice daily, separated by 12 hours (4-11 yrs old)

- **Advair® HFA**
  Two inhalations twice daily, separated by 12 hours

- **Combivent®**
  MDI: Two inhalations 4 times daily, MAX of 12 inhalations per 24 hours
  Nebs: Inhale 3 mL every 6 hours via nebulizer, MAX of 3 mL every 4 hours

- **Dulera®**
  Two inhalations twice daily
  Only in patients ≥12 years old

- **Symbicort®**
  Two inhalations twice daily (>12 years old)
  Two inhalations of 80-4.5 mcg twice daily, MAX of 4 inhalations per day (5-11 yrs old)

**Special Populations:**
See individual agents

**Precautions/Contraindications**
See individual agents

**Adverse drug events:**
See individual agents
### Products Available:

<table>
<thead>
<tr>
<th>Drug Names</th>
<th>Brand Names</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/20/10 (<a href="http://www.drugstore.com">www.drugstore.com</a>)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluticasone-Salmeterol</td>
<td>Advair Diskus®</td>
<td>DPI</td>
<td>100-50 mcg/actuation</td>
<td>60 doses</td>
<td>$175.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>250-50 mcg/actuation</td>
<td>60 doses</td>
<td>$215.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>500-50 mcg/actuation</td>
<td>60 doses</td>
<td>$274.97</td>
</tr>
<tr>
<td></td>
<td>Advair® HFA</td>
<td>MDI-CFC free</td>
<td>45-21 mcg/actuation</td>
<td>12 gm</td>
<td>$187.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>115-21 mcg/actuation</td>
<td>12 gm</td>
<td>$219.39</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>230-21 mcg/actuation</td>
<td>12 gm</td>
<td>$295.00</td>
</tr>
<tr>
<td>Ipratropium-Albuterol</td>
<td>Combivent®</td>
<td>MDI</td>
<td>103-18mcg/actuation</td>
<td>14.7 g</td>
<td>$172.97</td>
</tr>
<tr>
<td></td>
<td>DuoNeb®</td>
<td>NEB</td>
<td>0.5-2.5mcg/actuation</td>
<td>90 vials</td>
<td>$73.58</td>
</tr>
<tr>
<td>Mometasone-Formoterol</td>
<td>Dulera®</td>
<td>MDI-CFC free</td>
<td>100-5mcg/actuation</td>
<td>13 gm (120 doses)</td>
<td>$209.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200-5mcg/actuation</td>
<td>13 gm (120 doses)</td>
<td>$209.99</td>
</tr>
<tr>
<td>Budesonide-Formoterol</td>
<td>Symbicort®</td>
<td>MDI-CFC free</td>
<td>80-4.5mcg/actuation</td>
<td>10.2 gm</td>
<td>$185.10</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>160-4.5mcg/actuation</td>
<td>10.2 gm</td>
<td>$217.79</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.
Biological Response Modifiers – Monoclonal Antibodies

Effects:
Decreased frequency of allergen-induced asthma exacerbations. Reduced need for inhaled corticosteroids in maintenance treatment of asthma.

Mechanism of Action:
The monoclonal antibody binds to IgE, thus interfering with mast cell binding. This prevents mast cell degranulation and release of inflammatory mediators. Cytokine release seen in the late phase of an allergic reaction is also prevented through blocking the receptors on dendritic cells, epithelial cells, eosinophils, monocytes, and platelets.

Products Available:

<table>
<thead>
<tr>
<th>Generic</th>
<th>Trade Name</th>
<th>Dosage Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omalizumab</td>
<td>Xolair®</td>
<td>Subcutaneous injection (SC)</td>
</tr>
</tbody>
</table>

Special Populations:
Pregnancy: Risk factor category B.
Lactation: Unknown if excreted in human breast milk. However, IgG is excreted in breast milk, therefore it suspected that monoclonal antibodies are as well.
Children: No safety and efficacy data for children <12 years old.

Precautions/Contraindications:
• Hypersensitivity to hamster protein
• Hypersensitivity to the drug or its excipients
• Acute bronchospasm
• Status asthmaticus
• Corticosteroid withdrawal
• Neoplastic disease
• Populations at high risk for malignancy
• Live virus vaccines

Adverse drug effects:
Infection  Pharyngitis  Otalgia
Hematoma  Pruritis  Headache
Antibody formation  Rash  Diarrhea
Anaphylaxis  Sinusitis  Dysmenorrhea
Injection site reaction  Arthralgia  Menorrhagia
Abdominal pain  Urticaria  Nausea
Bleeding  Malignancy  Vomiting
Dizziness  Epistaxis  Fatigue
Erythema  

health.utah.gov/asthma
# Omalizumab

**Xolair®**

**Class:** Biological response modifier – monoclonal antibody

**Use:** Treatment of asthma not adequately controlled by inhaled corticosteroids.

**Dose:** Initial dosing is based on weight and serum IgE levels.

*MAX dose: 750 mg/4 weeks*

N/A = No dose recommendations available.

## Baseline serum IgE level (IU/mL)

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>30-100</th>
<th>101-200</th>
<th>201-300</th>
<th>301-400</th>
<th>401-500</th>
<th>501-600</th>
<th>601-700</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-60</td>
<td>150 mg SC every 4 weeks</td>
<td>300 mg SC every 4 weeks</td>
<td>300 mg SC every 4 weeks</td>
<td>225 mg SC every 2 weeks</td>
<td>300 mg SC every 2 weeks</td>
<td>300 mg SC every 2 weeks</td>
<td>375 mg SC every 2 weeks</td>
</tr>
<tr>
<td>61-70</td>
<td>150 mg SC every 4 weeks</td>
<td>300 mg SC every 4 weeks</td>
<td>225 mg SC every 2 weeks</td>
<td>225 mg SC every 2 weeks</td>
<td>300 mg SC every 2 weeks</td>
<td>375 mg SC every 2 weeks</td>
<td>N/A</td>
</tr>
<tr>
<td>71-90</td>
<td>150 mg SC every 4 weeks</td>
<td>300 mg SC every 4 weeks</td>
<td>225 mg SC every 2 weeks</td>
<td>300 mg SC every 2 weeks</td>
<td>375 mg SC every 2 weeks</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>91-150</td>
<td>300 mg SC every 4 weeks</td>
<td>225 mg SC every 4 weeks</td>
<td>300 mg SC every 2 weeks</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Administration:** Omalizumab is administered by subcutaneous (SC) injection only. Do not shake the reconstituted vial – swirl gently. The reconstituted solution is viscous and may take several seconds to administer. Give doses >150 mg divided at multiple injection sites.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10 (<a href="http://www.drugstore.com">www.drugstore.com</a>)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xolair®</td>
<td>Subcutaneous injection (SC)</td>
<td>150 mg / vial</td>
<td>1 vial</td>
<td>$737.81</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.
**Special Populations:**

**Pregnancy:** Risk factor category B.

**Lactation:** Unknown if excreted in human breast milk. However, IgG is excreted in breast milk, therefore it suspected that monoclonal antibodies are as well.

**Children:** No safety and efficacy data for children <12 years old.

**Precautions/Contraindications:**
- Hypersensitivity to hamster protein
- Hypersensitivity to the drug or its excipients
- Acute bronchospasm
- Status asthmaticus
- Corticosteroid withdrawal
- Neoplastic disease
- Populations at high risk for malignancy
- Live virus vaccines

**Adverse drug events:**

**Common:** injection site reaction, headache, pain

**Serious:** anaphylaxis

**Drug interactions:**
No clinically significant interactions currently identified.
Leukotriene Receptor Antagonists

**Effects:** Prevention of allergen-induced bronchoconstriction.

**Mechanism of Action:** Antagonism of cysteinyl-leukotriene receptors, thus preventing histamine release.

**Products available:**

<table>
<thead>
<tr>
<th>Generic name</th>
<th>Trade name</th>
<th>Dosage form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Montelukast</td>
<td>Singulair®</td>
<td>Oral tablet</td>
</tr>
<tr>
<td>Zafirlukast</td>
<td>Accolate®</td>
<td>Oral tablet</td>
</tr>
<tr>
<td>Zileuton</td>
<td>Zyflo®</td>
<td>Oral tablet</td>
</tr>
<tr>
<td></td>
<td>Zyflo CR®</td>
<td>Oral tablet</td>
</tr>
</tbody>
</table>

**Special populations:**

- **Hepatic impairment:** Use with caution.
- **Elderly:** Higher incidence of some side effects.
- **Pregnancy:** Risk factor category B.
- **Lactation:** Not recommended.
- **Children:** Safety and efficacy data incomplete in young children.

**Precautions/Contraindications:**

- Status asthmaticus
- Acute bronchospasm
- Phenylketonuria
- Hepatic disease
- Corticosteroid withdrawal
- Hypersensitivity to the drug or its excipients

**Adverse drug reactions:**

- Aggression
- Hallucinations
- Hepatic failure
- Churg-Strauss syndrome
- Dream abnormalities
- Hepatitis
Montelukast

Singulair®

**Class:**
Leukotriene receptor antagonist

**Use:**
Prophylaxis and treatment of asthma and allergic rhinitis symptoms.

**Dose:**

**Asthma or allergic rhinitis:**
(Oral) 10 mg in the evening (≥15 years old)
(Oral) 4 mg in the evening (1-5 years old)
(Oral) 5 mg in the evening (6-14 years)

**Administration:**
Not for treatment of acute bronchospasm.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10 (<a href="http://www.drugstore.com">www.drugstore.com</a>)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singulair®</td>
<td>Oral granules</td>
<td>4 mg/packet</td>
<td>30 packets</td>
<td>$145.66</td>
</tr>
<tr>
<td></td>
<td>Oral tablet</td>
<td>10 mg</td>
<td>30 tablets</td>
<td>$140.36</td>
</tr>
<tr>
<td></td>
<td>Oral chewable tablet</td>
<td>4 mg</td>
<td>30 tablets</td>
<td>$144.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg</td>
<td>30 tablets</td>
<td>$144.53</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

**Hepatic Impairment:** Use with caution.

**Pregnancy:** Risk factor category B.

**Lactation:** Unknown if excreted in breast milk.

**Children:** No safety and efficacy data for children <6 months old.

**Precautions/Contraindications:**
- Status asthmaticus
- Acute bronchospasm
- Corticosteroid withdrawal
- Phenylketonuria
- Hypersensitivity to montelukast
**Adverse drug events:**

**Serious:** dream abnormalities, aggression, hallucinations, cholestatic hepatitis (rare), Churg-Strauss syndrome (rare)

**Drug interactions:**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYP2C8/9 Inducers (i.e. carbamazepine,</td>
<td>Increased metabolism of montelukast</td>
<td>Consider a therapeutic alternative</td>
</tr>
<tr>
<td>phenytoin)</td>
<td></td>
<td>Monitor therapeutic effects of montelukast</td>
</tr>
<tr>
<td>CYP3A4 Inducers (i.e. carbamazepine,</td>
<td>Increased metabolism of montelukast</td>
<td>Consider a therapeutic alternative</td>
</tr>
<tr>
<td>phenytoin)</td>
<td></td>
<td>Monitor therapeutic effects of montelukast</td>
</tr>
<tr>
<td>St. John's Wort</td>
<td>Increased metabolism of montelukast</td>
<td>Consider a therapeutic alternative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitor therapeutic effects of montelukast</td>
</tr>
<tr>
<td>Salicylates</td>
<td>Increased serum concentration of montelukast</td>
<td>No action required</td>
</tr>
</tbody>
</table>
Zafirlukast

Accolate®

**Class:**
Leukotriene receptor antagonist

**Use:**
Prophylaxis and treatment of asthma.

**Dose:**
**Asthma:** (Oral) 20 mg twice daily (≥12 years old); 10 mg twice daily (5-11 years old)

**Administration:** Take without food. Give one hour before or two hours after a meal.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accolate®</td>
<td>Oral tablet</td>
<td>10 mg</td>
<td>60 tablets</td>
<td>$111.28</td>
</tr>
<tr>
<td></td>
<td>Oral tablet</td>
<td>20 mg</td>
<td>60 tablets</td>
<td>$115.74</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

**Hepatic Impairment:** Dosage reduction recommended.

**Elderly:** Higher incidence of some side effects.

**Pregnancy:** Risk factor category B.

**Lactation:** Zafirlukast is excreted in human breast milk. Animal studies suggest that neonates and infants are more sensitive to zafirlukast. Use of zafirlukast is not recommended.

**Children:** No safety and efficacy data for children < 5 years old.

**Precautions/Contraindications:**
- Status asthmaticus
- Acute bronchospasm
- Warfarin anticoagulation therapy
- Hypersensitivity to zafirlukast
- Hypersensitivity to iodine
- Hypersensitivity to lactose
- Hypersensitivity to titanium dioxide
- Hypersensitivity to cellulose
- Cirrhosis
- Hepatitis
- Hepatic encephalopathy
- Corticosteroid withdrawal
**Adverse drug events:**
**Serious:** symptomatic hepatitis, hepatic failure, Churg-Strauss syndrome (rare)

**Drug interactions:**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coumarin Derivatives</td>
<td>Decreased metabolism of coumarin Increased serum concentration of coumarin Increased INR</td>
<td>Monitor INR and adjust coumarin dose accordingly</td>
</tr>
<tr>
<td>CYP 2C8/9 inhibitor (i.e. cimetidine)</td>
<td>Decreased metabolism of substrate Increased effect of substrate</td>
<td>Monitor therapeutic effects of substrate</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Decreased serum concentration of zafirlukast</td>
<td>Monitor therapeutic effects of zafirlukast</td>
</tr>
<tr>
<td>Theophylline derivatives</td>
<td>Increased serum concentration of zafirlukast</td>
<td>Monitor therapeutic effects of zafirlukast</td>
</tr>
<tr>
<td>CYP2C8/9 inducers (i.e. cimetidine, phenytoin)</td>
<td>Increased metabolism of zafirlukast Decreased serum concentration of zafirlukast</td>
<td>Choose a therapeutic alternative Monitor therapeutic effects of zafirlukast</td>
</tr>
<tr>
<td>Salicylates</td>
<td>Increased serum concentration of zafirlukast</td>
<td>No management required</td>
</tr>
</tbody>
</table>
Zaileuton

Zyflo®
Zyflo CR®

**Class:**
5-Lipoxygenase Inhibitor

**Use:**
Prophylaxis and chronic treatment of asthma.

**Mechanism:**
Inhibits 5-lipoxygnase inhibitor which therefore inhibits leukotrine formation

**Dose:**
IR: 600 mg by mouth 4 times per day (≥12 years old)
ER: 1,200 mg by mouth twice daily (≥12 years old)

**Administration:**
IR: Take with or without food
ER: Do not crush, cut, or chew. Take within 1 hour after morning or evening meals

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zyflo®</td>
<td>IR tablet</td>
<td>600 mg</td>
<td>120 tablets</td>
<td>$609.98</td>
</tr>
<tr>
<td>zyflo CR®</td>
<td>12-hour tablet</td>
<td>600 mg</td>
<td>120 tablets</td>
<td>$687.66</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**

**Hepatic Impairment:** contraindicated

**Pregnancy:** Risk factor category C.

**Lactation:** Unknown if excreted into breast milk.

**Children:** Only for use in children 12 years and older

**Precautions/Contraindications:**
- Hypersensitivity to zileuton
- Active liver disease
- Transaminase elevations ≥times ULN
- Neuropsychiatric events

**Adverse Drug Events:** Serious: hepatitis, liver failure, suicidal

**Drug Interactions:**

<table>
<thead>
<tr>
<th>Interacting Agent</th>
<th>Effect</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>Increase CNS depression and risk of hepatic toxicity</td>
<td>Avoid</td>
</tr>
</tbody>
</table>
Mast Cell Stabilizers

**Effects:**
Prevention of bronchoconstriction and inflammation.

**Mechanism of Action:**
Antagonize mast cell degranulation to prevent the release of histamine and other mediators of allergic reaction. Agents do not interfere with IgE. The anti-inflammatory mechanism is unknown.

**Products available:**

<table>
<thead>
<tr>
<th>Generic name</th>
<th>Dosage form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cromolyn</td>
<td>Nebulize solution</td>
</tr>
<tr>
<td></td>
<td>Nasal</td>
</tr>
<tr>
<td></td>
<td>Oral</td>
</tr>
</tbody>
</table>

**Special populations:**
- **Renal impairment:** Dose reduction may be necessary.
- **Hepatic impairment:** Dose reduction may be necessary.
- **Pregnancy:** Risk factor category B.
- **Lactation:** Some agents are excreted in breast milk.
- **Children:** Safety and efficacy data incomplete in young children.

**Precautions/Contraindications:**
- Status asthmaticus
- Acute bronchospasm
- Cardiac disease
- Contact lenses
- Hypersensitivity to the drug or its excipients

**Adverse Drug Reactions:**

- Bronchospasm
- Irritated/sore throat
- Cough
- Taste changes
- Nausea
- Vomiting
- Headache
- Anaphylaxis
- Photophobia
- Nasal irritation
- Nasal congestion
- Rhinitis
- Nausea
- Vomiting
- Ocular burning
- Ocular stinging
- Conjunctivitis
Cromolyn

**Class:**
Mast cell stabilizer

**Use:**
Prophylaxis for asthma, exercise induced bronchospasm, and allergic disorders.

**Dose:**

**Asthma:**
(Nebs) 20 mg 4 times daily, taper to lowest effective frequency (≥2 years old)

**Allergic rhinitis:**
(Nasal) 1 spray into each nostril 3-4 times daily, up to 6 times/day (≥2 years old)

**Administration:**
Not for treatment of acute bronchospasm.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10* (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cromolyn sodium</td>
<td>Nebulization</td>
<td>20 mg/2mL</td>
<td>120 vials</td>
<td>$94.99</td>
</tr>
<tr>
<td></td>
<td>Ophthalmic Solution</td>
<td>4%</td>
<td>10mL</td>
<td>$31.99</td>
</tr>
<tr>
<td>Gastrocom®</td>
<td>Oral solution</td>
<td>100 mg/5mL</td>
<td>480 mL</td>
<td>$376.46</td>
</tr>
<tr>
<td>NasalCrom®</td>
<td>Nasal Spray</td>
<td>40 mg/mL (5.2 mg/dose)</td>
<td>13 mL</td>
<td>$9.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26 mL</td>
<td>$16.29</td>
</tr>
<tr>
<td>Crolom®</td>
<td>Ophthalmic solution</td>
<td>4%</td>
<td>10 mL</td>
<td>$45.99</td>
</tr>
</tbody>
</table>

*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.
Special Populations:
Renal Impairment: Dosage reduction recommended.
Hepatic Impairment: Dosage reduction recommended.
Pregnancy: Risk factor category B.
Lactation: Cromolyn is excreted in human breast milk.
Children: No safety and efficacy data for children < 2 years old.

Precautions/Contraindications:
• Status asthmaticus
• Hypersensitivity to cromolyn
• Coronary artery disease
• Cardiac arrhythmias
• Contact lenses
• Lactose hypersensitivity

Adverse drug events:
Common: throat irritation, cough, bad taste
Serious: bronchospasm, anaphylaxis

Drug interactions:
No clinically significant interactions currently identified.
Methylxanthine Derivatives

**Effects:** Bronchodilation independent of mechanism of bronchoconstriction. Secondary effects include increased strength of diaphragm, decreased fatigue, CNS stimulation, improved response to hypoxemia, decreased lower esophageal sphincter tone, increased gastric acid secretion, and a short-term diuretic effect.

**Mechanism of Action:** The inhibition of phosphodiesterase stops the breakdown of 3',5'-cAMP at high doses. Proposed mechanisms of action include prostaglandin antagonism, stimulation of endogenous catecholamines, inhibition of calcium influx into smooth muscle (preventing muscle contraction), antagonism of adenosine receptors, and inhibition of release of mediators from leukocytes and mast cells.

### Products available:

<table>
<thead>
<tr>
<th>Generic name</th>
<th>Trade name</th>
<th>Dosage form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theophylline</td>
<td>Elixophyllin</td>
<td>Oral elixir</td>
</tr>
<tr>
<td></td>
<td>Theo-24</td>
<td>ER-capsule</td>
</tr>
<tr>
<td></td>
<td>Theochron</td>
<td>ER-tablet</td>
</tr>
<tr>
<td></td>
<td>Theophylline CR</td>
<td>12-hour capsule</td>
</tr>
<tr>
<td>Aminophylline</td>
<td>Various generics</td>
<td>Intravenous injection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oral solution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oral tablet</td>
</tr>
<tr>
<td></td>
<td>Truphylline</td>
<td>Suppository</td>
</tr>
<tr>
<td>Caffeine Citrate</td>
<td>Cafcit</td>
<td>Oral solution Intravenous injection</td>
</tr>
</tbody>
</table>

### Special Populations:

**Renal Impairment:** Dose reduction may be necessary.

**Hepatic Impairment:** Dose reduction may be necessary.

**Elderly:** Dose reduction recommended.

**Pregnancy:** Insufficient evidence to recommend use during pregnancy.

**Lactation:** Theophylline is excreted in human breast milk.

**Children:** Dose reduction recommended in neonates, especially if premature, or with kidney or liver impairment.
**Precautions/Contraindications:**
- Cardiac disease
- Coronary artery disease
- Cor pulmonale
- Cardiac arrhythmias
- Congestive heart failure
- Myocardial infarction
- Regular ethanol consumption
- Tobacco smoking
- Passive smoke exposure
- Gastritis
- Peptic ulcer disease
- Gastroesophageal reflux disease
- Hiatal hernia
- Seizure disorder
- Hypersensitivity to theophylline
- Cholestasis
- Hypothyroidism
- Acute pulmonary edema
- Sepsis with multiple organ failure
- Shock
- Hyperthyroidism
- Cystic fibrosis
- Acidemia
- Viral pulmonary infection
- Prolonged fever
- Influenza vaccine
- Respiratory tract infection
- Severe hypoxemia
- Urinary retention
- Benign prostatic hypertrophy
- Hypersensitivity to corn

**Adverse Drug Reactions:**

<table>
<thead>
<tr>
<th>Seizures</th>
<th>Tachycardia</th>
<th>Diarrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent neurologic deficits</td>
<td>Tachycardia</td>
<td>Death</td>
</tr>
<tr>
<td>CNS stimulation</td>
<td>Arrhythmias</td>
<td>Hyperglycemia</td>
</tr>
<tr>
<td>Restlessness</td>
<td>Tachypnea</td>
<td>Diuresis (tolerance develops quickly)</td>
</tr>
<tr>
<td>Irritability</td>
<td>Nausea</td>
<td>Urinary retention</td>
</tr>
<tr>
<td>Insomnia</td>
<td>Vomiting</td>
<td>Hypokalemia</td>
</tr>
<tr>
<td>Headache</td>
<td>Anorexia</td>
<td></td>
</tr>
</tbody>
</table>

**Methylxanthine Derivatives**

- health.utah.gov/asthma
Theophylline

Theo-24®
Theochron®
Elixophyllin

Class:
Methylxanthine derivative

Use:
Treatment of asthma, bronchitis, and COPD symptoms of reversible airway obstruction

Dose:

Asthma or COPD:

Oral, IR
Loading dose: 5 mg anhydrous theophylline/IBW, then
300 mg/day divided every 6-8 hours x 3 days, then
400 mg/day divided every 6-8 hours x 3 days, then
600 mg/day divided every 6-8 hours

Oral, ER-12 hr
300 mg/day divided every 12 hours x 3 days, then
400 mg/day divided every 12 hours x 3 days, then 600 mg/day divided every 12 hours

Oral, ER-24 hr
300-400 mg once daily x 3 days, then
400-600 mg once daily x 3 days, then titrate according to blood level

IV
Loading dose: 5 mg/kg over 20-30 minutes, then 0.4 mg/kg/hr continuous infusion

Asthma (children < 45 kg):

Age 1-15 years:
12-14 mg/kg/day every 4 to 6 hours for 3 days (MAX of 300 mg/day) then,
16 mg/kg/day every 4 to 6 hours for 3 days (MAX of 400 mg/day) then,
20 mg/kg/day every 4 to 6 hours (MAX of 600 mg/day)

MAX daily dose: (full term, 26-52 weeks old)

{[0.2 x (age in weeks) +5] x body weight in kg}/day divided every 6 hours

MAX daily dose: (full term, 6-26 weeks old)

{[0.2 x (age in weeks) +5] x body weight in kg}/day divided every 8 hours

MAX daily dose: (premature, >24 days old) 1.5 mg/kg every 12 hours

MAX daily dose: (premature, <24 days old) 1 mg/kg every 12 hours

Oral, ER-12 hr
6-12 mg/kg every 12 hours, (MAX 300 mg/d) x 3 days, then
8 mg/kg every 12 hours, (MAX 400 mg/d) x 3 days, then
10 mg/kg every 12 hours, (MAX 600 mg/d)

Oral, ER-24 hr
12-24 mg/kg once daily, (MAX 300 mg/d) x 3 days, then
16 mg/kg once daily, (MAX 400 mg/d) x 3 days, then
20 mg/kg once daily, (MAX 600 mg/d)
(IV) Loading dose: 5 mg/kg, then
0.7 mg/kg/hr, (9-16 years old), or
0.8 mg/kg/hr, (1-9 years old), or
\[0.008 \times \text{(age in weeks)} + 0.021\] mg/kg/hr, (full term, ≤1 year old)

**Administration:**
(Oral): Take long acting preparations with a full glass of water, do not chew or crush dosage form. Extended release capsules may be opened and sprinkled on soft food. Scored tablets can be cut in half. Absorption of some dosage forms may be altered by food. Take with water one hour before or two hours after meals.

**How supplied:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage form</th>
<th>Dose</th>
<th>Package size</th>
<th>Pricing as of 09/16/10 (<a href="http://www.drugstore.com">www.drugstore.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theophylline CR</td>
<td>12-hour capsule</td>
<td>100 mg</td>
<td>60 tablets</td>
<td>$17.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125 mg</td>
<td>60 tablets</td>
<td>$43.57</td>
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<td>200 mg</td>
<td>60 tablets</td>
<td>$23.74</td>
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<td>300 mg</td>
<td>60 tablets</td>
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<td>300 mg</td>
<td>60 tablets</td>
<td>$29.99</td>
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<tr>
<td></td>
<td></td>
<td>450 mg</td>
<td>60 tablets</td>
<td>$47.24</td>
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<tr>
<td>Elixophyllin</td>
<td>Oral elixir</td>
<td>80 mg/15mL</td>
<td>480 mL</td>
<td>$96.99</td>
</tr>
<tr>
<td>Theophylline</td>
<td>24-hour tablet</td>
<td>400 mg</td>
<td>100 tablets</td>
<td>$99.99</td>
</tr>
<tr>
<td>Theo-24®</td>
<td>24-hour tablet</td>
<td>100 mg</td>
<td>60 capsules</td>
<td>$49.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200 mg</td>
<td>60 capsules</td>
<td>$75.99</td>
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<td></td>
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<td>300 mg</td>
<td>60 capsules</td>
<td>$89.99</td>
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<tr>
<td></td>
<td></td>
<td>400 mg</td>
<td>60 capsules</td>
<td>$119.99</td>
</tr>
</tbody>
</table>
*Prices vary by pharmacy and insurance coverage. These prices are intended only as an estimate of cash cost.

**Special Populations:**
- **Elderly:** Dose reduction recommended.
- **Pregnancy:** Risk factor category C.
- **Lactation:** Theophylline is excreted in human breast milk.
- **Children:** Dose reduction recommended in neonates, especially if premature, or with kidney or liver impairment.

**Precautions/Contraindications:**
- Cardiac disease
- Coronary artery disease
- Cor pulmonale
- Cardiac arrhythmias
- Congestive heart failure
- Myocardial infarction
- Regular ethanol consumption
- Tobacco smoking
- Passive smoke exposure
- Gastritis
- Peptic ulcer disease
- Gastroesophageal reflux disease
- Hiatal hernia
- Seizure disorder
- Hypersensitivity to theophylline
- Cholestasis
- Hypothyroidism
- Acute pulmonary edema
- Sepsis with multiple organ failure
- Shock
- Hyperthyroidism
- Cystic fibrosis
- Acidemia
- Viral pulmonary infection
- Prolonged fever
- Influenza vaccine
- Respiratory tract infection
- Severe hypoxemia
- Urinary retention
- Benign prostatic hypertrophy
- Hypersensitivity to corn

**Adverse drug events:**
- **Common:** tachycardia, restlessness, insomnia, headache, tremor, nausea, vomiting
- **Serious:** convulsions, ventricular arrhythmias, severe vomiting, bradycardia
Drug interactions:
Agents that increase the risk of theophylline toxicity:

<table>
<thead>
<tr>
<th>Activated charcoal</th>
<th>Ephedrine</th>
<th>Oral contraceptives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyclovir</td>
<td>Famotidine</td>
<td>Propafenone</td>
</tr>
<tr>
<td>Allopurinol</td>
<td>Fluvoxamine</td>
<td>Quinolones</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>Food</td>
<td>Ranitidine</td>
</tr>
<tr>
<td>Beta agonists</td>
<td>Influenza vaccine</td>
<td>Tacrine</td>
</tr>
<tr>
<td>Beta blockers, nonselective</td>
<td>Interferon</td>
<td>Terbinafine</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Iodine 131 (hypothyroidism)</td>
<td>Tetracyclines</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>Isoniazid</td>
<td>Thiabendazole</td>
</tr>
<tr>
<td>Cimetidine</td>
<td>Loop diuretics</td>
<td>Thyroid (hypothyroidism)</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>Macrolides</td>
<td>Ticlopidine</td>
</tr>
<tr>
<td>Diltiazem</td>
<td>Mexiletine</td>
<td>Verapamil</td>
</tr>
<tr>
<td>Disulfiram</td>
<td>Nifedipine</td>
<td>Zafirlukast</td>
</tr>
<tr>
<td></td>
<td>Omeprazole</td>
<td></td>
</tr>
</tbody>
</table>

Agents that may reduce the therapeutic efficacy of theophylline:

<table>
<thead>
<tr>
<th>Aminoglutethimide</th>
<th>Ketoconazole</th>
<th>St. John’s Wort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbiturates</td>
<td>Carbamazepine</td>
<td>Thioamines (hyperthyroidism)</td>
</tr>
<tr>
<td>Felodipine</td>
<td>Lansoprazole</td>
<td>Food</td>
</tr>
<tr>
<td>Hydantoins</td>
<td>Rifamycins</td>
<td>Isoniazid</td>
</tr>
<tr>
<td>Beta agonists</td>
<td>Sulfinpyrazone</td>
<td>Loop diuretics</td>
</tr>
<tr>
<td>Beta blockers, nonselective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other interacting agents (effects):

- Adenosine (effects antagonized)
- Benzodiazepines (sedative effect antagonized)
- Halothane (arrhythmias)
- Hydantoins (decreased effect)
- Ketamine (seizures)
- Beta blockers, nonselective (decreased effects of both agents)
- Lithium (decreased serum concentration)
- Carbamazepine (decreased serum concentration)
- Non-depolarizing muscle relaxants (reversal of relaxation)
- Corticosteroids (increased prednisone activity)
- Tacrolimus (increased serum creatinine, increased serum tacrolimus concentrations)
- Macrolides (decreased serum concentration of erythromycin)
- Zafirlukast (serum concentration decreased)
- Food
References


UpToDate® Online 13.2: UpToDate®. Waltham, MA. September 2005.


