Fast Acting Bronchodilators | Albuterol (aerosol & MDI)

**Category & Classification**
Beta2 adrenergic agonist

**Drug names (brand / generic)**
Proventil, AccuNeb, Ventolin / albuterol

**Dosages**
Ventolin is available as a MDI (2 puffs TID or QID), tablets (2mg TID or QID), extended-release tablets, and as a syrup (2mg per 5 ml TID or QID).
Proventil is a 0.5% solution for nebulization with 0.5 ml (in 3-5 ml NS) TID or QID.

**Onset, peak & duration**
Onset: 5-15 min after inhalation, 30 min PO
Peak: 30-60 min
Duration: 3-4 hr after inhalation, 4-6 hr PO

**Indications**
Relief of bronchospasm in patients with reversible obstructive airway disease.

**Side effects**
Shakiness in the legs, arms, hands or feet (most common)
Fast, irregular, pounding, or racing heartbeat or pulse

**Mode of action**
When Albuterol enters the body, it interacts with naturally occurring beta-receptors in the human body. Beta-receptors are found throughout the body but mostly found around the muscles of the lung and airways. When albuterol hits the beta-receptors in the muscles, the interaction stimulate the muscles, the muscles relax, and the airways expand to allow more air to get through lungs. Albuterol is usually combined in asthma medication with a variation of steroids, which bypass the muscles around the airways and go directly to the muscle of the lungs to attack the underlying inflammation.
Fast Acting Bronchodilators - Xopenex (aerosol & MDI)

**Category & Classification**
Beta2 adrenergic agonist

**Drug names (brand / generic)**
Xopenex / levalbuterol

**Dosages**
MDI: 2 puffs q4 or 6 hrs. In some patients, 1 puff q4hrs may be enough.
Nebulizer:
- Adults and children 12 years of age and older: At first, 0.63 mg TID or QID. Some patients may need to start at 1.25 mg TID.
- Children 6 to 11 years old: 0.31 mg TID and the dose is usually not more than 0.63 mg TID.

**Onset, peak & duration**
- Onset: the mean time to onset of a 15% increase in FEV1 over baseline was 10 to 17 minutes for 1.25 mg and 0.63 mg inhalation doses
- Peak: 1-5 hours
- Duration: 5-6 hours (up to 8 hrs in some patients)

**Indications**
Treatment or prevention of bronchospasm with reversible obstructive airway disease.

**Side effects**
Headache, tremors, feeling anxious or nervous, insomnia, cough, nausea, vomiting, dry mouth and throat, muscle pain, diarrhea.

**Mode of action**
Activation of beta-2 adrenergic receptors on airway smooth muscle leads to the activation of adenylate cyclase and to an increase in the intracellular concentration of cyclic-3', 5'-adenosine monophosphate (cyclic AMP). The increase in cyclic AMP is associated with the activation of protein kinase A, which in turn inhibits the phosphorylation of myosin and lowers intracellular ionic calcium concentrations, resulting in muscle relaxation. Levalbuterol relaxes the smooth muscles of all airways, from trachea to the terminal bronchioles. Increased cyclic AMP concentrations are also associated with the inhibition of release of mediators from mast cells in the airway irrespective of the spasmogen involves, thus protecting against all bronchoconstriction challenges. While it is recognized that beta-2 adrenergic receptors are the predominant receptors on bronchial smooth muscle, data indicate that there are beta-receptors in the human heart, 10 – 50% of which are beta-2 adrenergic receptors.
Fast Acting Bronchodilators  
Racemic Epinephrine (aerosol)

**Category & Classification**
Ultra Short-Acting Adrenergic bronchodilator, Sympathetic Agonist (Sympathomimetic)

**Drug names (brand / generic)**
MicroNefrin, Nephron, S2 / Racemic Epinephrine

**Dosages**
2.25% solution (5.63 – 11.25 mg) QID via SVN
Adult: 0.5 – 0.75 ml
Pediatric: 0.25 – 0.5 ml

**Onset, peak & duration**
Onset: within 5 minutes
Peak: 5 – 20 mins
Duration: 30 mins to 2 hrs

**Indications**
Treat croup (laryngotracheobronchitis). Patient signs include inspiratory and expiratory stridor and a seal barklike cough.

**Side effects**
- **Cardiovascular:** Tachycardia, pounding heartbeat/ palpitations, flushing, hypertension, and cardiac arrhythmias
- **CNS:** Nervousness, restlessness, headache, dizziness, lightheadedness, insomnia, and anxiety
- **GI:** Nausea, vomiting
- **Neuromuscular & skeletal:** weakness, trembling
- **Renal:** Decreased renal flow, acute urinary retention in patients with bladder outflow obstruction
- **Respiratory system:** increased myocardial oxygen consumption, wheezing.

**Mode of action**
Alpha-receptor stimulation causes vasoconstriction, which results in reduction of mucosal and submucosal edema. Beta-receptor stimulation causes bronchodilation and reduction in airway smooth muscle spasm.
Long Acting Bronchodilators **Serevent (DPI)**

**Category & Classification**
bronchodilator of beta-2 agonist

**Drug names (brand / generic)**
Serevent / Salmeterol

**Dosages**

**Asthma** (Serevent must only be administered in combination with anti-inflammatory therapy such as inhaled corticosteroid (ICS))
2 inhalations (2 x 25 mcg) twice daily

**COPD:** 2 inhalations (2 x 25 mcg) twice daily

**Onset, peak & duration**
Onset: 30 – 48 mins (asthma), 2 hrs (COPD)
Peak: 20 mins
Duration: 12 hr

**Indications**

**Asthma:** Serevent is indicated for long term regular of reversible airways obstruction in asthma (including nocturnal asthma and exercise-induced asthma) in adults and children who are receiving inhaled or oral corticosteroid

**COPD:** Serevent is indicated for long lasting bronchodilation in adults with reversible airways obstruction due to COPD

**Side effects**
Headache, shaking, dizziness, cough, stuffed nose, runny nose, ear pain, pale skin, muscle pain, sore throat, flu-like symptom, nausea, heartburn, wheezing, fast bounding heartbeat, chest pain, rash, hives.

**Mode of action**
Salmeterol is in part attributable to stimulation of intracellular adenyl cyclase, the enzymes that catalyzes the conversion of ATP to cyclic AMP. Increased cyclic AMP levels cause relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially from mast cells.
Long Acting Bronchodilators  Foradil (DPI)

**Category & Classification**
sympathomimetic; long acting, selective beta2-adrenergic receptor agonist; bronchodilator

**Drug names (brand / generic)**
Foradil Aerolizer / formoterol

**Dosages**
Asthma: 12 mcg q12hrs
Exercise-induced bronchospasm: 12 mcg inhaled PO 15 mins before exercise PRN
COPD: 12 mcg inhaled PO q12hrs

**Onset, peak & duration**
Onset: 15 mins
Peak: 30 – 60 mins
Duration: 12hrs

**Indications**
Treatment of asthma, prevention of exercise-induced bronchospasm, maintenance of COPD

**Side effects**
Tremor, dizziness, anxiety, headache, insomnia, and hoarseness.

**Mode of action**
LABA; acts as a bronchodilator, stimulates intracellular adenyl cyclase, and increases cAMP levels, causing relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially from mast cells.
**Long Acting Bronchodilators**  
**Brovana (aerosol)**

**Category & Classification**
Long acting beta-2 adrenergic agonists, Bronchodilator, sympathomimetic

**Drug names (brand / generic)**
Brovana / arformoterol tartate

**Dosages**

**Bronchoconstriction:**
**Usual:** 15 mcg bid (am and pm) by nebulization
**Max:** 30 mcg/day (15 mcg bid)

**Onset, peak & duration**
Onset: 15 mins
Peak: 30 – 60 mins
Duration: 12 hrs

**Indications**
Maintenance treatment of bronchoconstriction in patients with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema.

**Side effects**
Pain, chest/back pain, diarrhea, sinusitis, leg cramps, dyspnea, rash, flu syndrome, peripheral edema.

**Mode of action**
LABA; stimulates intracellular adenyl cyclase, the enzyme that catalyzes the conversion of adenosine triphosphate to cAMP. Increased cAMP levels cause relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially from mast cells.
**Long Acting Bronchodilators** Breo (DPI)

**Category & Classification**
Beta-2 agonist, corticosteroid

**Drug names (brand / generic)**
Breo Ellipta / fluticasone furoate, vilanterol

**Dosages**
COPD: long term maint Tx of airflow obstruction in patients w/ COPD (Chronic Bronchitis, Emphysema) 1 inh QD; do not use > 1 time Q24hrs

**Onset, peak & duration**
Onset: within 1 hr
Peak: 1-2 hrs
Duration: 24 hr

**Indications**
Maintain Tx of airflow obstruction in patients with COPD including chronic bronchitis and/or emphysema. To reduce exacerbations of COPD in patients with a history of exacerbations.

**Side effects**
Milk protein hypersensitivity, headache, asthma-related death, oral candidiasis, hyperglycemia, adrenal suppression, hypokalemia.

**Mode of action**
Fluticasone: Corticosteroid; has not been established. Shown to have a wide range of actions on multiple cell types (eg, mast cells, eosinophils, neutrophils, macrophages, lymphocytes) and mediators (eg, histamine, eicosanoids, leukotrienes, cytokines) involved in inflammation. Vilanterol: LABA; attributable to stimulation of intracellular adenyl cyclase, the enzyme that catalyzes the conversion of ATP to cAMP. Increased cAMP levels cause relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially from mast cells.
Anticholinergics  Atrovent (aerosol & MDI)

Category & Classification
Anticholinergic bronchodilator

Drug names (brand / generic)
Atrovent / ipratropium bromide

Dosages
2 actuation Q6hr, then additional actuations PRN, not to exceed 12 actuations/day; Nebulizer: 2.5 ml (500 mcg) Q6-8 hrs
Acute asthma: inhaler: 8 actuation Q20 min PRN for 3 doses; Nebulizer: 500 mcg Q20min for 3 doses, then PRN

Onset, peak & duration
Onset: 15 mins
Peak: 1-3 hr
Duration: 3 – 4 hrs

Indications
Maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema.

Side effects
Bronchitis, COPD exacerbation, sinusitis, UTI, influenza-like symptoms, dyspnea, back pain, dyspepsia, headache, dizziness, nausea, dry mouth.

Mode of action
Anticholinergic bronchodilator; appears to inhibit vagally-mediated reflexes by antagonizing the action of acetylcholine. Prevents the increases in intracellular concentration of Ca²⁺ that is caused by interaction of acetylcholine with the muscarinic receptors on bronchial smooth muscle.
Anticholinergics  **Spiriva (DPI)**

**Category & Classification**
Anticholinergic bronchodilator

**Drug names (brand / generic)**
Spiriva / tiotropium bromide

**Dosages**
COPD: Handihaler: 2 PO inhalations of 1 capsule (18mcg) Qday via HandiHaler inhalation device. Respimat: 5 mcg (2 actuation; 2.5 mcg/actuation) inhaled PO QDay

**Onset, peak & duration**
Onset: 30 mins  
Peak: 1-4 hr  
Duration: >24 hrs

**Indications**
Long-term qd maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema. Reduction of exacerbations in COPD patients.

**Side effects**
Dry mouth, sinusitis, constipation, abdominal pain, UTI, URTI, chest pain, edema, vomiting, myalgia, moniliasis, rash, dyspepsia, pharyngitis, rhinitis.

**Mode of action**
Anticholinergic bronchodilator; inhibits M₃-receptors on smooth muscle, leading to bronchodilation.
**Anticholinergics**  **Tudorza (DPI)**

**Category & Classification**
Anticholinergic, bronchodilator

**Drug names (brand / generic)**
Tudorza Pressair / aclidinium bromide

**Dosages**
1 puff twice a day (each puff contains 400 mcg)

**Onset, peak & duration**
Onset: within 1 hr  
Peak: 2-4 hrs  
Duration: 12 hrs

**Indications**
Long-term, maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema

**Side effects**
Fever, headache, muscle aches, sore throat, decrease in the frequency of urination, eye pain, blurred vision, painful urination.

**Mode of action**
Tudorza Pressair is an anticholinergic drug that exhibits bronchodilatory effect by blocking the neurotransmitter acetylcholine from binding to M₃ receptors in the airway smooth muscle.
Combination drugs **Combivent Respimat**

**Category & Classification**
Anticholinergic/beta₂-agonist

**Drug names (brand / generic)**
Combivent Respimat / (albuterol/ipratropium bromide)

**Dosages**
1 inh 4 times daily; max 6 inh/day

**Onset, peak & duration**
Onset: 15 min  
Peak: 1-2 hr  
Duration: 4-6 hrs

**Indications**
For use in patients with chronic obstructive pulmonary disease (COPD) on a regular aerosol bronchodilator that continue to have evidence of bronchospasm and who require a second bronchodilator.

**Side effects**
Wheezing, choking, chest pain, pounding heartbeats or fluttering

**Mode of action**
Ipratropium: Anticholinergic bronchodilator; appears to inhibit vagally mediated reflexes by antagonizing the action of acetylcholine. Prevents the increases in intracellular concentration of Ca^{2+}, which is caused by interaction of acetylcholine with the muscarinic receptors on bronchial smooth muscle.

Albuterol: Selective β₂-adrenergic bronchodilator; activates β₂-receptors on airway smooth muscle, resulting in activation of protein kinase, which inhibits phosphorylation of myosin and lowers intracellular ionic Ca^{2+} concentrations, resulting in relaxation.
Combination drugs  Advair (DPI)

Category & Classification
Beta₂-agonist/corticosteroid

Drug names (brand / generic)
Advair Diskus, Advair HFA / Fluticasone propionate and salmeterol

Dosages
Adult
Asthma:
Usual: 1 inh bid, approximately 12 hrs apart
Titrate: May replace current strength with a higher strength if response to initial dose after 2 weeks is inadequate
Max: 500/50 bid

COPD
Maint Treatment of Airflow Obstruction Associated with COPD, Including Chronic Bronchitis and Emphysema
Usual: 1 inh of 250/50 bid, approximately 12 hrs apart

Pediatric:
Asthma:
4-11 Years:
Usual: 1 inh of 100/50 bid, approximately 12 hrs apart
≥12 Years:
Usual: 1 inh bid, approximately 12 hrs apart
Titrate: May replace current strength with a higher strength if response to initial dose after 2 weeks is inadequate
Max: 500/50 bid

Onset, peak & duration
Onset: 15 mins
Peak: 30-60 mins
Duration: 5-8 hrs

Indications
Treatment of asthma in patients ≥4 yrs of age. (250/50) Maintenance treatment of airflow obstruction in patients with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and/or emphysema. To reduce exacerbations of COPD in patients with history of exacerbations.
Combination drugs  Advair (DPI)

**Side effects**
Upper respiratory tract infection/inflammation, pharyngitis, hoarseness/dysphonia, bronchitis, cough, headache, N/V, sinusitis, throat irritation, viral respiratory infection, musculoskeletal pain, fever, dizziness.

**Mode of action**
Fluticasone: Corticosteroid; effects in COPD treatment not established. Shown to have a wide range of actions on multiple cell types (eg, mast cells, eosinophils, neutrophils, macrophages, lymphocytes) and mediators (eg, histamine, eicosanoids, leukotrienes, cytokines) involved in inflammation. Salmeterol: Selective LABA; attributable to stimulation of intracellular adenyl cyclase, the enzyme that catalyzes the conversion of ATP to cAMP. Increased cAMP levels cause relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially from mast cells.
Combination drugs **Symbicort (MDI)**

**Category & Classification**
Beta2-agonist/corticosteroid

**Drug names (brand / generic)**
Symbicort; Generic name: budesonide/formoterol fumarate dehydrate

**Dosages**

**Asthma**

2 inh bid (am and pm, approx q12h)

**Initial:** Based on severity  
**Max:** 160mcg-4.5mcg/inh bid

**Not Responding After 1-2 Weeks of Therapy w/ 80mcg-4.5mcg/inh:**
Replace w/ 160mcg-4.5mcg/inh for better asthma control

**Chronic Obstructive Pulmonary Disease**

**Maint Treatment of Airflow Obstruction in Patients w/ COPD, Including Chronic Bronchitis and Emphysema:**

2 inh (160mcg-4.5mcg/inh) bid

**PEDIATRIC DOSAGE**

**Asthma**

≥12 Years:

2 inh bid (am and pm, approx q12h)

**Initial:** Based on severity  
**Max:** 160mcg-4.5mcg/inh bid

**Not Responding After 1-2 Weeks of Therapy w/ 80mcg-4.5mcg/inh:**
Replace w/ 160mcg-4.5mcg/inh for better asthma control

**Onset, peak & duration**

Onset: 1-3 min  
Peak: 15 mins  
Duration: >12 hrs

**Indications**

Treatment of asthma in patients ≥12 yrs of age. (160mcg-4.5mcg/inh) Maintenance treatment of airflow obstruction in patients with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema.

**Side effects**

Nasopharyngitis, headache, URTI, pharyngolaryngeal pain, sinusitis, influenza, back pain, nasal congestion, stomach discomfort, oral candidiasis, bronchitis, vomiting.
Combination drugs Symbicort (MDI)

Mode of action
Budesonide: Corticosteroid; shown to have inhibitory activities on multiple cell types and mediators involved in allergic and nonallergic mediated inflammation. Formoterol: LABA; attributable to stimulation of intracellular adenyl cyclase, that catalyzes the conversion of ATP to cAMP. Increased cAMP levels cause relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially mast cells.
Combination drugs  Dulera (MDI)

**Category & Classification**
Beta\(_2\)-agonist/corticosteroid

**Drug names (brand / generic)**
Dulera; Generic name: formoterol fumarate dihydrate/mometasone furoate

**Dosages**

**Asthma**

Previously on Inhaled Medium Dose Corticosteroids:
2 inh of 100mcg-5mcg bid (am and pm)
**Max:** 400mcg-20mcg daily

Previously on Inhaled High Dose Corticosteroids:
2 inh of 200mcg-5mcg bid (am and pm)
**Max:** 800mcg-20mcg daily

Do not use >2 inh bid of the prescribed strength. If inadequate response after 2 weeks of therapy, higher strength may provide additional asthma control

**PEDIATRIC DOSAGE**

**Asthma**

≥12 Years:

Previously on Inhaled Medium Dose Corticosteroids:
2 inh of 100mcg-5mcg bid (am and pm)
**Max:** 400mcg-20mcg daily

Previously on Inhaled High Dose Corticosteroids:
2 inh of 200mcg-5mcg bid (am and pm)
**Max:** 800mcg-20mcg daily

Do not use >2 inh bid of the prescribed strength. If inadequate response after 2 weeks of therapy, higher strength may provide additional asthma control

**Onset, peak & duration**

Onset: unknown
Peak: unknown
Duration: unknown

**Indications**

Treatment of asthma in patients ≥12 yrs of age.
Combination drugs **Dulera (MDI)**

**Side effects**
Nasopharyngitis, sinusitis, headache, dysphonia.

**Mode of action**
Mometasone: Corticosteroid; not established. Shown to have inhibitory effects on multiple cell types (eg, mast cells, eosinophils, neutrophils) and mediators (eg, histamine, eicosanoids, leukotrienes) involved in inflammation and asthmatic response.
Formoterol: LABA; stimulates intracellular adenyl cyclase, which catalyzes conversion of adenosine triphosphate to cAMP. Increased cAMP levels cause relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially from mast cells.
Inhaled Steroids  Flovent (DPI & MDI)

Category & Classification
Corticosteroid

Drug names (brand / generic)
Flovent Diskus, Flovent HFA / fluticasone propionate

Dosages

ADULT DOSAGE
Asthma
Maintenance Treatment

Previous Therapy:

Bronchodilators Alone:
Initial: 100mcg bid
Max: 500mcg bid

Inhaled Corticosteroids:
Initial: 100-250mcg bid
Max: 500mcg bid
May consider starting doses >100mcg bid with poorer asthma control or previous high-dose inhaled corticosteroid requirement

Oral Corticosteroids:
Initial: 500-1000mcg bid
Max: 1000mcg bid
Reduce oral prednisone no faster than 2.5-5mg/day on a weekly basis beginning after at least 1 week of fluticasone therapy

Titrates: Reduce to lowest effective dose once asthma stability is achieved. Higher dosages may provide additional asthma control if response to initial dose is inadequate after 2 weeks

PEDIATRIC DOSAGE
Asthma
Maintenance Treatment

4-11 Years:
Previous Therapy:
Oral Corticosteroids:
Initial: 50mcg bid
May consider starting doses >50mcg bid with poorer asthma control or previous high-dose inhaled corticosteroid requirement
Max: 100mcg bid
≥12 Years:

**Previous Therapy:**

**Bronchodilators Alone:**
- **Initial:** 100mcg bid
- **Max:** 500mcg bid

**Inhaled Corticosteroids:**
- **Initial:** 100-250mcg bid
  - May consider starting doses >100mcg bid with poorer asthma control or previous high-dose inhaled corticosteroid requirement
- **Max:** 500mcg bid

**Oral Corticosteroids:**
- **Initial:** 500-1000mcg bid
- **Max:** 1000mcg bid
  - Reduce oral prednisone no faster than 2.5-5mg/day on a weekly basis beginning after at least 1 week of fluticasone therapy

**Titrate:** Reduce to lowest effective dose once asthma stability is achieved. Higher dosages may provide additional asthma control if response to initial dose is inadequate after 2 weeks

**Onset, peak & duration**
- Onset: unknown
- Peak: unknown
- Duration: unknown

**Indications**
- Maintenance treatment of asthma as prophylactic therapy in patients ≥4 yrs of age and for patients requiring oral corticosteroid therapy for asthma.

**Side effects**
- Upper respiratory tract infection, throat irritation, headache, sinusitis, N/V, rhinitis, cough, muscle pain, oral candidiasis, arthralgia, fatigue, fever, nasal congestion, bronchitis, GI discomfort.

**Mode of action**
- Corticosteroid; shown to have a wide range of actions on multiple cell types (eg, mast cells, eosinophils, neutrophils, macrophages, lymphocytes) and mediators (eg, histamine, eicosanoids, leukotrienes, cytokines) involved in inflammation.
**Inhaled Steroids**  
**Pulmicort (aerosol)**

**Category & Classification**  
Inhaled Corticosteroid

**Drug names (brand / generic)**  
Pulmicort Repsules, Pulmicort Flexhaler / budesonide

**Dosages**

**Adults** - Flexhaler: Maint:
Initial: 180-360 mcg bid  
Max: 720 mcg bid

**Pediatrics** - 1-8 Years:  
**Respules:**  
Maint/Prophylaxis:

- Previously on Bronchodilators Alone:
  Initial: 0.5mg qd or 0.25mg bid  
  Max: 0.5 mg/day

- Previously on Inhaled Corticosteroids:
  Initial: 0.5 mg qd or 0.25mg bid  
  Max: 1 mg/day

- Previously on Oral Corticosteroids:
  Initial: 1 mg qd or 0.5mg bid  
  Max: 1 mg/day

**Symptomatic Children Not Responding to Nonsteroidal Therapy:**  
Initial: 0.25mg qd  
≥ 6 Years:

**Flexhaler - Prophylaxis:**  
Initial: 180-360 mcg bid  
Max: 360 mcg bid

**Onset, peak & duration**

**Route:** PO  
Onset: rapid, improvement within 24 hours, up to 2 weeks  
Peak: 1-2 hours  
Duration: 12 weeks
Inhaled Steroids  **Pulmicort (aerosol)**

**Indications**
Flexhaler: Maintenance treatment of asthma as prophylactic therapy in patients ≥ 6 yrs of age
Repsules: Maintenance treatment of asthma and as prophylactic therapy in children 12 months to 8 yrs of age

**Side effects**
Flexhaler: Nasopharyngitis, headache, fever, sinusitis, pain, N/V, insomnia, dry mouth, weight gain.
Repsules: Rhinitis, otitis media, coughing, viral infection, ear infection, gastroenteritis

**Mode of action**
Potent anti-inflammatory actions that reduces inflammation and hyper-reactivity (spasm) of the airways caused by asthma. When used as an inhaler, the budesonide goes directly to the inner lining of the inflamed airways to exert its effects.
**Inhaled Steroids**  
**Asmanex (DPI)**

**Category & Classification**  
Corticosteroid

**Drug names (brand / generic)**  
Asmanex / mometasone furoate

**Dosages**  
4-11 Years - Initial/Max: 110 mcg qpm  
≥12 Years:  
Previous Therapy:  
Bronchodilators Alone or Inhaled Corticosteroids:  
Initial: 220 mcg qpm  
Max: 440 mcg qpm or 220 mcg bid

Oral Corticosteroids:  
Initial: 440 mcg bid  
Max: 880 mcg/day

**Onset, peak & duration**  
Route: inhalation  
Onset: 1-2 weeks  
Peak: 1-2.5 hours  
Duration: unknown

**Indications**  
Maintenance treatment of asthma as prophylactic therapy in patients ≥ 4 yrs of age

**Side effects**  
Headache, allergic rhinitis, pharyngitis, URTI, sinusitis, oral candidiasis, dysmenorrhea, musculoskeletal pain, back pain, dyspepsia, myalgia, abdominal pain, nausea

**Mode of action**  
Inhibits the release of leukotrienes from leukocytes of allergic patient
Inhaled Steroids  Qvar (MDI)

**Category & Classification**
Inhaled Corticosteroid

**Drug names (brand / generic)**
Qvar / beclomethasone dipropionate

**Dosages**
5-11 Years:
Previously on Bronchodilators Alone or Inhaled Corticosteroids:
Initial: 40 mcg bid
Max: 80 mcg bid

≥12 Years:
Previously on Bronchodilators Alone:
Initial: 40-80 mcg bid
Max: 320 mcg bid

Previously on Inhaled Corticosteroids:
Initial: 40-160 mcg bid
Max: 320 mcg bid

**Onset, peak & duration**
Route: PO (MDI)
Onset: 1-4 weeks
Peak: 10-30 minutes
Duration: unknown

**Indications**
Maintenance treatment of asthma as prophylactic therapy in patients ≥ 5 yrs of age. To reduce or eliminate the need for systemic corticosteroids in asthma patients requiring systemic corticosteroid administration.

**Side effects**
Nausea, cough, bronchospasms, nasal dryness/irritation

**Mode of action**
Decrease inflammation by decreasing number & activity of inflammatory cells, inhibiting bronchoconstrictor mechanisms producing direct smooth-muscle relaxation & decreasing airway hyperresponsiveness.
**Inhaled Steroids  Aerospan (MDI)**

**Category & Classification**
Corticosteroid

**Drug names (brand / generic)**
Aerospan / flunisolide

**Dosages**

6-11 Years:
Initial: 80 mcg bid  
Max: 160 mcg bid

≥ 12 Years:
Initial: 160 mcg bid  
Max: 320 mcg bid

**Onset, peak & duration**
Route: inhalation
Onset: 1-4 weeks  
Peak: unknown  
Duration: unknown

**Indications**
Maintenance treatment of asthma as prophylactic therapy in adult and pediatric patients ≥ 6 yrs of age. To reduce or eliminate the need for oral corticosteroids in asthma patients requiring oral corticosteroid therapy.

**Side effects**
Headache, allergic reactions, bacterial infection, vomiting, dyspepsia, pharyngitis, rhinitis, increased cough, sinusitis, epistaxis, urinary tract infection

**Mode of action**
Decreases inflammation of asthma by inhibiting macrophages, T cells, eosinophils, and mediators, reducing mast cells in airway
Systemic Steroids  Prednisone

Category & Classification
Glucocorticoid

Drug names (brand / generic)
Prednisone Intensol / prednisone

Dosages
Steroid-Responsive Disorders
Initial: 5-60 mg/day

Multiple Sclerosis
Acute Exacerbations:
200 mg/day for 1 week, followed by 80 mg qod for 1 month

Onset, peak & duration
Route: PO
Onset: variable
Peak: 1-2 hours/variable
Duration: 1.25-1.5 days/variable

Indications
Steroid-responsive disorders

Side effects
Anaphylactoid reactions, HTN, osteoporosis, muscle weakness, menstrual irregularities, insomnia, impaired wound healing, ulcerative esophagitis, increased sweating, decreased carbohydrate tolerance, glaucoma, weight gain, nausea, malaise, anemia

Mode of action
Decreases inflammation by stabilizing leukocyte lysosomal membranes; suppresses immune response; stimulates bone marrow; and influences protein, fat, and carbohydrate metabolism.
Systemic Steroids  Solumedrol

Category & Classification
Glucocorticoid

Drug names (brand / generic)
Solu-medrol / methylprednisolone sodium succinate

Dosages
Adults:
10 to 40 mg administered over 1 to several min.
In severe conditions, 30 mg/kg infused over 30 min;
may repeat every 4 to 6 h for 48 to 72 h.

Infants and Children:
not less than 0.5 mg/kg per 24 h

Onset, peak & duration
Route: IV or IM
Onset: 6-48 hours
Peak: 4-8 days (IM), 1-2 hours (oral)
Duration: 1.25-1.5 days (oral), 1-4 weeks (IM)

Indications
Treat conditions such as arthritis, blood disorders, severe allergic reactions, certain
cancers, eye conditions, skin/kidney/intestinal/lung diseases, and immune system
disorders.

Side effects
Nausea, vomiting, heartburn, headache, dizziness, trouble sleeping, appetite changes,
increased sweating, acne, or pain/redness/swelling

Mode of action
Potent anti-inflammatory steroid with greater anti-inflammatory potency than
prednisolone and even less tendency than prednisolone to induce sodium and water
retention.
**Systemic Steroids**  **Decadron**

**Category & Classification**
Glucocorticosteroid

**Drug names (brand / generic)**
Decadron, Maxidex, Hexadrol, Diodex / dexamethasone

**Dosages**
Adults: 0.75 to 9 mg P.O. daily divided b.i.d., t.i.d., or q.i.d.
Children: 0.024 to 0.34 mg/kg P.O. daily in four divided doses

**Onset, peak & duration**
Route: PO
Onset: 1-2 hours
Peak: 1-2 hours
Duration: 2.5 days

**Indications**
Berylliosis, fulminating or disseminated pulmonary tuberculosis when used concurrently with appropriate antituberculous chemotherapy, idiopathic eosinophilic pneumonias, symptomatic sarcoidosis.

**Side effects**
Increased appetite, irritability, insomnia, pedal edema, heartburn, muscle weakness, impaired wound healing, Increased blood sugar levels.

**Mode of action**
Dexamethasone stimulates the synthesis of enzymes needed to decrease the inflammatory response. It causes suppression of the immune system by reducing activity and volume of the lymphatic system, producing lymphocytopenia (primarily T-lymphocytes), decreasing passage of immune complexes through basement membranes, and possibly by depressing reactivity of tissue to antigen-antibody interactions.
Systemic Steroids  Singulair

Category & Classification
Leukotriene receptor antagonist

Drug names (brand / generic)
Singulair, Montelukast / montelukast sodium

Dosages
Seasonal allergic rhinitis:
15+ years of age: ONE 10-mg tablet
6-14 years of age: ONE 5-mg chewable tablet
2-5 years of age: ONE 4-mg chewable tablet or one packet of 4-mg oral granules

Perennial allergic rhinitis:
15+ years of age: ONE 10-mg tablet.
6-14 years of age: ONE 5-mg chewable tablet.
2-5 years of age: ONE 4-mg chewable tablet/ONE packet of 4-mg oral granules.
6-23 months of age: ONE packet of 4-mg oral granules

Onset, peak & duration
Route: PO
Onset: 24 hours
Peak: 3-4 hours
Duration: 12 weeks

Indications
Prophylaxis and chronic treatment of asthma in adults and pediatric patients ≥ 12 months of age. Relief of symptoms of seasonal allergic rhinitis in patients ≥ 2 yrs of age and perennial allergic rhinitis in patients ≥ 6 months of age. Prevention of exercise-induced bronchoconstriction (EIB) in patients ≥ 6 yrs of age

Side effects
Abdominal or stomach pain, bloody nose, flu-like symptoms, general feeling of discomfort or illness, headache, joint pain, pain or tenderness around the eyes and cheekbones, shortness of breath or troubled breathing, sweating, tightness of the chest, trouble with swallowing, unusual tiredness or weakness

Mode of action
Montelukast causes inhibition of airway cysteinyl leukotriene receptors as demonstrated by the ability to inhibit bronchoconstriction due to inhaled LTD₄ in asthmatics. Doses as low as 5 mg cause substantial blockage of LTD₄-induced bronchoconstriction.
Systemic Steroids  **Xolair**

**Category & Classification**
Monoclonal antibody / IgE-blocker / Immunomodulators

**Drug names (brand / generic)**
Xolair / omalizumab

**Dosages**
150 to 375 mg by subcutaneous injection every 2 or 4 weeks

**Onset, peak & duration**
Route: subcutaneous injection
Onset: 1-5 days
Peak: 6-8 days
Duration: unknown

**Indications**
To decrease the incidence of asthma exacerbations in patients ≥12 yrs of age with moderate to severe persistent asthma with a (+) skin test or in vitro reactivity to a perennial aeroallergen and whose symptoms are inadequately controlled with inhaled corticosteroids. Treatment of chronic idiopathic urticaria (CIU) in patients ≥12 yrs of age who remain symptomatic despite H1 antihistamine treatment.

**Side effects**
Hives, rash, anxiety or fear, feeling like you might pass out, flushing (warmth, redness, or tingly feeling), chest tightness, wheezing, feeling short of breath, difficulty breathing; fast or weak heartbeats; or swelling of your face, lips, tongue, or throat.

**Mode of action**
Omalizumab inhibits the binding of IgE to the high-affinity IgE receptor (FceRI) on the surface of mast cells and basophils. Reduction in surface-bound IgE on FceRI-bearing cells limits the degree of release of mediators of the allergic response.
**Systemic Steroids**  
**Accolate**

**Category & Classification**
Leukotriene receptor antagonist

**Drug names (brand / generic)**
Accolate / zafirlukast

**Dosages**

**ADULT DOSAGE**

**Asthma**

Prophylaxis and Chronic Treatment:
20mg bid

**PEDIATRIC DOSAGE**

**Asthma**

Prophylaxis and Chronic Treatment:

- **5-11 Years:**
  10mg bid
- **≥12 Years:**
  20mg bid

**Onset, peak & duration**

Unknown

**Indications**

Prophylaxis and chronic treatment of asthma in adults and children ≥5 yrs of age.

**Side effects**

Headache, infection, nausea.

**Mode of action**

Leukotriene receptor antagonist; selective and competitive receptor antagonist of leukotriene D₄ and E₄, components of slow-reacting substance of anaphylaxis. Inhibits bronchoconstriction caused by several kinds of inhalational challenges.
Mucolytics  **Mucomyst**

**Category & Classification**
Acetaminophen antidote / mucolytic

**Drug names (brand / generic)**
Mucomyst / acetylcysteine

**Dosages**
Nebulization: 2-20 ml of 10% solution q2-q6
Instillation: 1-2 ml of 10% solution q1-q4
Catheter with direct visualization 2-5 ml

**Onset, peak & duration**
Onset: unknown
Peak: unknown
Duration: unknown

**Indications**
Mucomyst is indicated as adjuvant therapy for patients with abnormal, viscid, or inspissated mucous secretions in such conditions as:

- Chronic bronchopulmonary disease (chronic emphysema, emphysema with bronchitis, chronic asthmatic bronchitis, tuberculosis, bronchiectasis and primary amyloidosis of the lung)
- Acute bronchopulmonary disease (pneumonia, bronchitis, tracheobronchitis)
- Pulmonary complications of cystic fibrosis
- Tracheostomy care
- Pulmonary complications associated with surgery
- Use during anesthesia
- Post-traumatic chest conditions
- Atelectasis due to mucous obstruction
- Diagnostic bronchial studies (bronchograms, bronchospirometry, and bronchial wedge catheterization).

**Side effects**
Oral administration of acetylcysteine, especially in the large doses needed to treat acetaminophen overdose, may result in nausea, vomiting and other gastrointestinal symptoms. Rash with or without mild fever has been observed rarely.

**Mode of action**
Antidote: Protects liver by maintaining or restoring glutathione levels, or by acting as alternate substrate for conjugation with, and thus detoxification of reactive metabolites, reducing extent of liver injury. Mucolytic: Opens disulfide linkages in mucous, thereby lowering viscosity.
Mucolytics  Sodium Bicarbonate

Category & Classification
Antacids, urinary pH modifiers

Drug names (brand / generic)
Alka-Seltzer Heartburn Relief / sodium bicarbonate

Dosages
Oral antacid: 325 mg to 2 g 1-4 times per day.

Onset, peak & duration
Onset: 30 min  
Peak: unknown  
Duration: 1-2 hr

Indications
Treating metabolic acidosis (a condition in which there is too much acid in the body) and certain drug intoxications, and replacing bicarbonate lost due to severe diarrhea.

Side effects
Belching, flatulence (gas), stomach pain, and edema (water retention).

Mode of action
Sodium bicarbonate is an electrolyte. It works by neutralizing excess acid in the blood. It may also replace bicarbonate when there are excess losses from the body.
Mucolytics  **Pulmozyme**

**Category & Classification**
Pulmonary Enzyme

**Drug names (brand / generic)**
Pumozyme / dornase alfa

**Dosages**

**ADULT DOSAGE**
Cystic Fibrosis
Improves pulmonary function in conjunction with standard therapies

2.5mg qd via nebulizer/compressor system (may benefit with bid dosing)

**PEDIATRIC DOSAGE**
Cystic Fibrosis
Improves pulmonary function in conjunction with standard therapies

≥ 5 Years:
2.5mg qd via nebulizer/compressor system (may benefit with bid dosing)

**Onset, peak & duration**
Route: Inhalation
Onset: within 15 min
Peak: 3 days - 1 week
Duration: 48 hr

**Indications**
Management of cystic fibrosis (CF) to improve pulmonary function in conjunction with standard therapies.

**Side effects**
Voice alteration, pharyngitis, rash, laryngitis, chest pain, conjunctivitis, rhinitis, fever, dyspnea, dyspepsia, antibodies development.

**Mode of action**
Enzyme; hydrolyzes the deoxyribonucleic acid in sputum of CF patients and reduces sputum viscoelasticity.
Mucolytics  Mucinex

**Category & Classification**
Expectorant

**Drug names (brand / generic)**
Mucinex / guaifenesin

**Dosages**

600mg Tab, Extended-Release (ER):
1 or 2 tabs q12h  
**Max:** 4 tabs/24 hrs

1200mg Tab, ER:
1 tab q12h  
**Max:** 2 tabs/24 hrs

**Onset, peak & duration**
Onset: unknown  
Peak: 8-12 hr  
Duration: 24 hr

**Indications**
Helps loosen phlegm and thin bronchial secretions to rid the bronchial passageways of bothersome mucus and make coughs more productive.

**Side effects**
Diarrhea, dizziness, headache, nausea or vomiting, skin rash, stomach pain, urticaria

**Mode of action**
Guaifenesin is thought to act as an expectorant by increasing the volume and reducing the viscosity of secretions in the trachea and bronchi. Thus, it may increase the efficiency of the cough reflex and facilitate removal of the secretions; however, objective evidence for this is limited and conflicting.
Anti-infective  Ribavirin

Category & Classification
Nucleoside analogue

Drug names (brand / generic)
Copegus, Moderiba, Rebetol, Ribasphere, virazole / ribavirin

Dosages

Combination with Peginterferon Alfa-2a:
Not Previously Treated with Interferon Alfa:
Monoinfection:
Genotypes 1, 4:
<75kg: 1000mg/day in 2 divided doses
≥75kg: 1200mg/day in 2 divided doses
Duration: 48 weeks

Genotypes 2, 3:
800mg/day in 2 divided doses
Duration: 24 weeks

HIV Coinfection:
800mg/day in 2 divided doses
Duration: 48 weeks (regardless of genotype)

Onset, peak & duration
Onset: unknown
Peak: unknown
Duration: Varies

Indications
In combination with Pegasys (peginterferon alfa-2a) for the treatment of patients ≥5 yrs of age with CHC virus infection who have compensated liver disease and have not been previously treated with interferon alfa.

Side effects
Hemolytic anemia, fatigue, asthenia, neutropenia, headache, pyrexia, myalgia, irritability, anxiety, nervousness, insomnia, alopecia, rigors, N/V.

Mode of action
Nucleoside analogue; not established. Has direct antiviral activity in tissue culture against many RNA viruses; increases mutation frequency in the genomes of several RNA viruses and ribavirin triphosphate inhibits HCV polymerase in a biochemical reaction.
Anti-infective Relenza

Category & Classification
Neuraminidase inhibitor

Drug names (brand / generic)
Relenza / zanamivir

Dosages
Treatment:
10mg (2 inh) q12h x 5 days
Day 1: Take 2 doses if possible at least 2 hrs apart
Subsequent Days: Take doses 12 hrs apart

Prophylaxis:
Household Setting:
10mg (2 inh) qd x 10 days

Community Outbreaks:
10mg (2 inh) qd x 28 days

Onset, peak & duration
unknown

Indications
Treatment of uncomplicated acute illness due to influenza A and B virus in adults and pediatric patients ≥7 yrs of age who have been symptomatic for no more than 2 days. Prophylaxis of influenza in adults and pediatric patients ≥ 5 yrs of age.

Side effects
Diarrhea, nausea, sinusitis, ear/nose/throat infections, viral respiratory infections, cough, headaches, nasal signs/symptoms, throat/tonsil discomfort and pain.

Mode of action
Neuraminidase inhibitor; inhibits influenza virus neuraminidase, affecting release of viral particles.
Anti-infective **Tobi**

**Category & Classification**
Aminoglycoside

**Drug names (brand / generic)**
Tobi / tobramycin

**Dosages**

**Sol:**
300mg bid (as close to 12 hrs apart as possible; not <6 hrs apart) for 28 days by inhalation over approx. 15 min, using a nebulizer

**Cap:**
Inh of four 28mg caps bid (as close to 12 hrs apart as possible; not <6 hrs apart) for 28 days using the Podhaler device

After 28 days of therapy, stop for the next 28 days, then resume for the next 28 day on and 28 day off cycle

**Onset, peak & duration**
Onset: about 10 min
Peak: unknown
Duration: up to 8 hr following an IM dose

**Indications**
Management of cystic fibrosis patients with *Pseudomonas aeruginosa*.

**Side effects**
Cough, lung disorder, dyspnea, hemoptysis, N/V, pulmonary function test decreased, headache, fever, chest pain, diarrhea, dysgeusia.

**Mode of action**
Aminoglycoside; acts primarily by disrupting protein synthesis, leading to altered cell membrane permeability, progressive disruption of the cell envelope, and eventual cell death.
Anti-infective  Nebupent

**Category & Classification**
Antifungal agent

**Drug names (brand / generic)**
Nebupent / pentamidine isethionate

**Dosages**

### Pneumocystis Pneumonia
Prevention of *Pneumocystis jiroveci* pneumonia (PJP) in high-risk, HIV-infected patients that have history of ≥1 episode of PJP and/or have peripheral CD4+ (T4 helper/inducer) lymphocyte count ≤ 200/mm³.

**Usual:** 300mg once every 4 weeks via Respirgard II nebulizer

**Onset, peak & duration**
Unknown

**Indications**
Prevention of *Pneumocystis jiroveci* pneumonia (PJP) in high-risk, HIV-infected patients that have history of ≥1 episode of PJP and/or have peripheral CD4+ (T4 helper/inducer) lymphocyte count ≤200/mm³.

**Side effects**
Fatigue, cough, fever, decreased appetite, shortness of breath, dizziness/light-headedness, wheezing, nonspecific serious infection, bronchospasm, night sweats, diarrhea, nausea, anemia, pharyngitis.

**Mode of action**
Antifungal agent; mechanism not fully understood. Proposed to interfere with microbial nuclear metabolism by inhibition of DNA, RNA, phospholipid and protein synthesis.
**Surfactants**  Curosurf

**Category & Classification**
Lung surfactant

**Drug names (brand / generic)**
Curosurf / Poractant Alfa

**Dosages**
Initial recommended dose is 2.5 mL/kg birth weight
Up to two repeat doses of 1.25 mL/kg birth weight may be administered at approximately 12-hour intervals
Maximum total dose (initial plus repeat doses) is 5 mL/kg

**Onset, peak & duration**
Onset: within 5 min
Peak: unknown
Duration: unknown

**Indications**
CUROSURF® (poractant alfa) Intratracheal Suspension is indicated for the treatment (rescue) of Respiratory Distress Syndrome (RDS) in premature infants. CUROSURF reduces mortality and pneumothoraces associated with RDS.

**Side effects**
Bradycardia, hypotension, endotracheal tube blockage, and oxygen desaturation.

**Mode of action**
Endogenous pulmonary surfactant reduces surface tension at the air-liquid interface of the alveoli during ventilation and stabilizes the alveoli against collapse at resting transpulmonary pressures. A deficiency of pulmonary surfactant in preterm infants results in Respiratory Distress Syndrome (RDS) characterized by poor lung expansion, inadequate gas exchange, and a gradual collapse of the lungs (atelectasis).

CUROSURF compensates for the deficiency of surfactant and restores surface activity to the lungs of these infants.
Surfactants Survanta

Category & Classification
Lung surfactant

Drug names (brand / generic)
Survanta / Beractant

Dosages
Each dose of SURVANTA is 100 mg of phospholipids/kg birth weight (4 mL/kg). The SURVANTA Dosing Chart below shows the total dosage for a range of birth weights. Use of SURVANTA in infants less than 600 grams birth weight or greater than 1750 grams birth weight has not been evaluated in controlled trials.

Onset, peak & duration
Route: Intratracheal
Onset: within minutes of administration
Peak: unknown
Duration: unknown

Indications
SURVANTA is indicated for prevention and treatment (“rescue”) of respiratory distress syndrome (RDS) (hyaline membrane disease) in premature infants. SURVANTA significantly reduces the incidence of RDS, mortality due to RDS and air leak complications.

Prevention: In premature infants less than 1250 g birth weight or with evidence of surfactant deficiency, give SURVANTA as soon as possible, preferably within 15 minutes of birth.

Rescue: To treat infants with RDS confirmed by x-ray and requiring mechanical ventilation, give SURVANTA as soon as possible, preferably by 8 hours of age.

Side effects
Transient bradycardia and oxygen desaturation; both were associated with the dosing procedure. Endotracheal tube reflux, pallor, vasoconstriction, hypotension, endotracheal tube blockage, hypertension, hypocarbia, hypercarbia, and apnea.
**Mode of action**

Beractant is a natural bovine lung extract containing phospholipids, neutral lipids, fatty acids, and the two hydrophobic, low-molecular-weight surfactant-associated proteins, SP-B and SP-C (beractant does not contain the hydrophilic, large-molecular-weight protein, SP-A). Colfosceril palmitate, palmitic acid, and tripalmitin are added to standardize the composition of beractant and make it similar to natural lung surfactant by optimizing surface tension–lowering properties. When beractant is used as a replacement for deficient endogenous lung surfactant, it is effective in lowering surface tension on alveolar surfaces during respiration and stabilizing the alveoli against collapse at resting transpulmonary pressures. Therefore, beractant reduces the incidence of RDS, mortality due to RDS, and air-leak complications.

Neonatal RDS develops primarily in premature infants because of pulmonary immaturity, including a deficiency of endogenous lung surfactant that results in higher alveolar surface tension and lower compliance properties. Without sufficient endogenous lung surfactant, progressive alveolar collapse occurs and both oxygen and carbon dioxide exchange are impaired. Also, RDS appears to be characterized by high pulmonary vascular permeability and increased lung tissue water. Fluid and protein that leak into alveoli inactivate both endogenous and exogenous surfactant, worsening lung function.

Natural lung surfactant is a mixture of lipids and apoproteins secreted by the alveolar cells into the alveoli and respiratory air passages. Surfactant reduces the surface tension of pulmonary fluids and thereby increases lung compliance. It exhibits not only surface tension–reducing properties (contributed by the lipids) but also rapid spreading and adsorption (contributed by the apoproteins). The major fraction of the lipid component of natural lung surfactant is dipalmitoylphosphatidylcholine (DPPC, colfosceril palmitate); this comprises up to 70% of the natural surfactant by weight.
Surfactants  Surfaxin

Category & Classification
Lung surfactant

Drug names (brand / generic)
Surfaxin / Lucinactant

Dosages
Usual: 5.8mL/kg birth weight
Up to 4 doses can be administered in the first 48 hrs of life; give doses no more frequently than q6h

Onset, peak & duration
Route: Intratracheal
Onset: Unknown
Peak: Unknown
Duration: up to 6 hr

Indications
Prevention of respiratory distress syndrome (RDS) in premature infants at high risk for RDS. Reduces the incidence of RDS at 24 hrs and mortality due to RDS.

Side effects
Oxygen desaturation, bradycardia, ETT reflux/obstruction, pallor, apnea, intraventricular hemorrhage, periventricular leukomalacia, acquired sepsis, patent ductus arteriosus, retinopathy of prematurity, necrotizing enterocolitis, pulmonary interstitial emphysema, pneumothorax, pulmonary hemorrhage.

Mode of action
Lung surfactant; lowers surface tension at the air-liquid interface of the alveolar surfaces during respiration and stabilizes the alveoli against collapse at resting transpulmonary pressures. Compensates for the deficiency of surfactant and restores surface activity to the lungs of infants.
**Xanthines**  
**Theophylline**

### Category & Classification
Bronchodilators

### Drug names (brand / generic)
- Slo-phyllin
- Theolair
- Quibron-T
- Dividose
- Bronkodyl
- Elixophyllin
- Theo-Dur
- Uni-Dur
- Uniphyl / Theophylline

### Dosages
- **Acute therapy:** Oral loading dose of 5 mg/kg
- **Chronic therapy:** 16 mg/kg/24 hr or 400 mg/24 hr which ever is less
  
**Dosages may need to be adjusted for age, heart disease and liver disease**

### Onset, peak & duration
- **Route: PO**
  - Onset (rapid), Peak 1-2 hr, Duration 6 hr
- **Route: PO-ER**
  - Onset (delayed), Peak 4-8 hr, Duration 8-24 hr
- **Route: IV**
  - Onset (rapid), Peak (end of infusion), Duration 6-8 hr

### Indications

#### I. Use in Asthma
- a. Sustained-release theophylline is indicated as a long term controller drug, for maintenance therapy of mild, persistent (Step2) asthma or greater
- b. Sustained-release theophylline is considered as a less-preferred alternative to low dose inhaled corticosteroids or cromolyn-like agents as second-line maintenance drug therapy in stable asthma

#### II. Use in Chronic Obstructive Pulmonary Disease
- a. Xanthines would be considered for moderate (Stage II) and severe (Stage III) COPD
- b. Recommended as an alternative to β2 agonists or anticholinergic agents
- c. Intravenous theophylline may be used in severe exacerbations of COPD when aggressive inhaled bronchodilator therapy is inadequate

#### III. Use in Apnea of Prematurity
- a. Xanthines are first-line agents of choice to stimulate breathing in apnea of prematurity
Xanthines Theophylline

Side effects
Most common: gastric upset, headache, anxiety, nervousness, tachypnea

Mode of action
Theories of Activity

a. Previously known as phosphodiesterase inhibitors
   It was thought that xanthines caused smooth muscle relaxation by inhibiting phosphodiesterase, leading to an increased level of cyclic AMP
   ***this theory has been questioned

b. Other theories
   Antagonism of Adenosine - may block smooth muscle constriction and mast cell degranulation
   Catecholamine Release (epinephrine) - xanthines may cause the production and release of endogenous catecholamines leading to bronchial relaxation
Xanthines  Caffeine

Category & Classification
CNS Stimulants

Drug names (brand / generic)
Vivarin, NoDoz, Stay Awake, Alert / caffeine

Dosages
5-200mg

Onset, peak & duration
Onset: 5-10 min
Peak: 15-45 min
Duration: 2-4 hr after onset

Indications
Used in bronchopulmonary dysplasia in premature infants for both prevention and treatment. Apnea of prematurity as a primary treatment, but not prevention. Orthostatic hypotension treatment. Also used to treat asthma, and hypersomnia.

Side effects
Anxiety, increases urine output acutely but not chronically.

Mode of action
Caffeine is a receptor antagonist at all adenosine receptor subtypes (A1, A2A, A2B, and A3 receptors). Antagonism at these receptors stimulates the medullary vagal, vasomotor, and respiratory centers, which increases respiratory rate, reduces heart rate, and constricts blood vessels. Adenosine receptor antagonism also promotes neurotransmitter release (e.g., monoamines and acetylcholine), which endows caffeine with its stimulant effects; adenosine acts as an inhibitory neurotransmitter that suppresses activity in the central nervous system.
Pulmonary Hypertension  Nitric Oxide

**Category & Classification**
Vasodilator

**Drug names (brand / generic)**
INOmax / nitric oxide

**Dosages**
**Adult:** Gas, Inhalation: 100ppm, 800ppm [353L, 1963L]
**Pediatric:** **Usual:** 20ppm
Maintain treatment for up to 14 days or until underlying oxygen desaturation has resolved and the neonate is ready to be weaned from therapy
**Max:** 20ppm

**Onset, peak & duration**
Onset: 1-3 min

**Indications**
Treatment of term and near-term (>34 weeks) neonates w/ hypoxic respiratory failure associated w/ pulmonary HTN in conjunction w/ ventilatory support and other appropriate agents

**Side effects**
Hypotension

**Mode of action**
Pulmonary vasodilator; relaxes vascular smooth muscle by binding to the heme moiety of cytosolic guanylate cyclase, activating guanylate cyclase and increasing intracellular levels of cyclic guanosine 3', 5'-monophosphate, which leads to vasodilation. Selectively dilates the pulmonary vasculature when inhaled. Appears to increase partial pressure of arterial oxygen (PaO₂) by dilating pulmonary vessels in better ventilated areas of the lung, redistributing pulmonary blood flow away from lung regions with low ventilation/perfusion (V/Q) ratios toward regions with normal ratios.
Pulmonary Hypertension  Flolan

Category & Classification  Vasodilators

Drug names (brand / generic)  Flolan, Veletri / epoprostenol sodium

Dosages  
Initiate chronic infusion of FLOLAN at 2 ng/kg/min and increase in increments of 2 ng/kg/min every 15 minutes or longer until dose-limiting pharmacologic effects are elicited or until a tolerance limit to the drug is established or further increases in the infusion rate are not clinically warranted (see Dosage Adjustments). If dose-limiting pharmacologic effects occur, then decrease the infusion rate until FLOLAN is tolerated.

Onset, peak & duration  
Route: IV  
Onset: rapid (within minute)  
Peak: unknown  
Duration: 2-3 min

Indications  
Treat high blood pressure in the lungs

Side effects (serious)  
- fever, flu symptoms, mouth and throat ulcers, rapid heart rate, rapid and shallow breathing, fainting;  
- chest pain, trouble breathing;  
- fast, slow, or uneven heart rate;  
- pale skin, easy bruising, unusual bleeding (nose, mouth, vagina, or rectum), purple or red pinpoint spots under your skin;  
- blood in your urine or stools;  
- coughing up blood;  
- feeling like you might pass out; or  
- numbness or increased sensitivity anywhere in your body.

Side effects (less serious)  
- flushing (warmth, redness, or tingly feeling);  
- nausea, vomiting, diarrhea, stomach pain;  
- headache or jaw pain;  
- joint or muscle pain;  
- dizziness, sweating;
- feeling anxious, nervous, or agitated.

**Mode of action**
Works by relaxing and widening the blood vessels (arteries) in the lungs and other parts of the body so that blood can flow more easily, increasing the supply of blood to the lungs, reducing the workload of the heart.