THE OHIO STATE UNIVERSITY
WEXNER MEDICAL CENTER

Key Clinical Points for Outpatient Asthma Management

- Fully assess asthma control and document in medical record.
  - Recommendation: use validated questionnaire like ACT and document score.
- Obtain spirometry in all patients ≥ 5 years of age.
- Develop a written asthma action plan for all asthma patients.

Assessing Asthma Control and Adjusting Therapy in Youths > 4 Years of Age and Adults

Components of Control		Classification of Asthma Control (> 12 years of age)		
		Well Controlled	**Not Well Controlled**	**Very Poorly Controlled**
Impairment	Symptoms	≤ 2 days/week	> 2 days/week	Throughout the day
	Nighttime awakenings	≤ 2 times/month	1-3 times/week	≥ 4 times/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting $beta_2$- agonist use for symptoms control (not prevention of EIB)	≤ 2 days/week	> 2 days/week	Several times per day
	FEV1 or peak flow	> 80% predicted/personal best	60-80% predicted/personal best	< 60% predicted/personal best
	Validated questionnaires			
	ACT or c-ACT **(preferred)**	≥ 20	16-19	≤ 15
	ATAQ	0	1-2	3-4
	ACQ	≤ 0.75*	≥ 1.5	N/A
Risk	**Number of exacerbations requiring oral systemic corticosteroids**	**0-1/year**	**> 2/year**	
		Consider severity and interval since last exacerbation		
	Progressive loss of lung function	Evaluation requires long-term follow-up care.		
	Treatment-related adverse effects	Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.		
Recommenced Action for Treatment *(See "Stepwise Approach for Managing Asthma" on the next page for treatment steps.)*		• Maintain current step. • Regular follow-up at every 1-6 months to maintain control. • Consider step down if well controlled for at least 3 months.	• Step up 1 step. • Reevaluate in 2-6 weeks. • For side effects, consider alternative treatment options	• Consider short course of oral systematic corticosteroids. • Step up 1-2 steps. • Reevaluate in 2 weeks. • For side effects, consider alternative treatment options.

**ACQ values of 0.76-1.4 are indeterminate regarding well-controlled asthma.*

Key: EIB = exercise-induced bronchospasm; ICU = intensive care unit.

Notes:

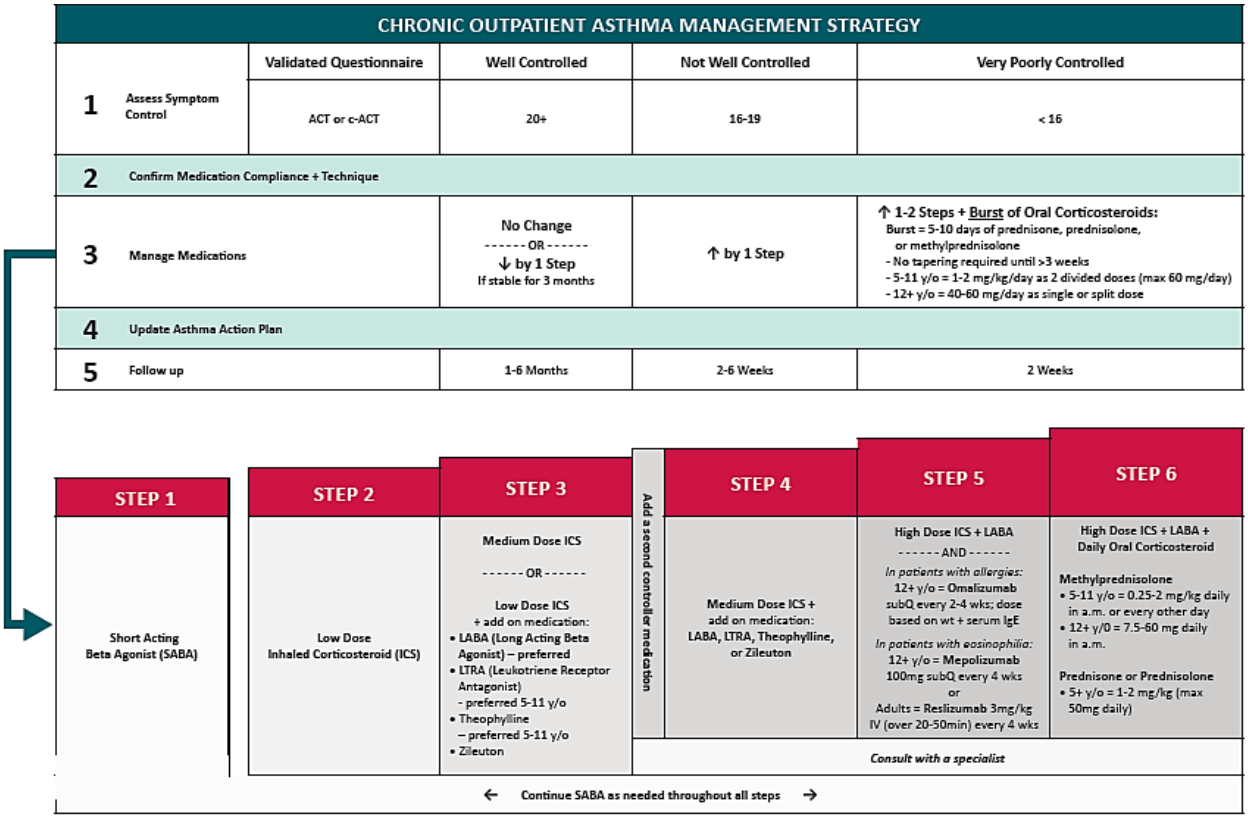
- Stepwise approach is meant to assist, not replace, clinical decision making required to meet individual patient needs.
- Level of control is based on the most severe impairment or risk category. Assess impairment domain by patient's recall of previous 2-4 weeks and by spirometry or peak flow measures. Symptom assessment for longer periods should reflect a global assessment, such as inquiring whether patient's asthma is better or worse since last visit.
- At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma control. In general, more frequent and intense exacerbations (e.g., requiring urgent, unscheduled care, hospitalization, or ICU admission) indicate poorer disease control. For treatment purposes, patients who had > 2 exacerbations requiring oral systemic corticosteroids in the past year may be considered the same as patients who have not-well controlled asthma, even in the absence of impairment levels consistent with not-well-controlled asthma.
  - ACT = Asthma Control Test™ c-ACT = Childhood Asthma Control Test™
    - **ACT is the preferred tool to use and the scores should be documented in IHIS (visit navigator → "screenings")**
  - ATAQ = Asthma Therapy Assessment Questionnaire©
  - ACQ = Asthma Control Questionnaire©

Before Step Up in Therapy:

- Review adherence to medication, inhaler technique, environmental control, and comorbid conditions.
- If an alternative treatment option was used in a step, discontinue and use the preferred treatment for that step.

Source: *U.S. Department of Health and Human Services, National Institute of Health, National heart, Lung, and Blood Institute. Guidelines for the Diagnosis and Management of Asthma, Summary Report 2007.*

Outpatient Management of Asthma



Quick-Relief Medication for All Patients:

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

Key: Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy.ICS = inhaled corticosteroid; LABA = long-acting inhaled beta2-agnoist; LTRA = leukotriene receptor antagonist; SABA =inhaled short-acting beta2-agonist.

Notes:

- The stepwise approach is meant to assist, not replace, the clinical decision making required to meet individual patient needs.
- If alternative treatment is used and response is inadequate, discontinue it and use the preferred treatment before stepping up.
- Zileuton is a less desirable alternative due to limited studies as adjunctive therapy and the need to monitor liver function. Theophylline requires monitoring of serum concentration levels.
- In step 6, before oral corticosteroids are introduced, a total of high-dose ICS + LABA + either LTRA, theophylline, or zileuton may be considered, although this approach has not been studied in clinical trials.
- Step 1, 2, and 3 preferred therapies are based on Evidence A; step 3 alternative therapy is based on Evidence A for LTRA, Evidence B for theophylline and Evidence D for zileuton. Step 4 preferred therapy is based on Evidence B, and alternative therapy is based on Evidence B for LTRA and theophylline and Evidence D zileuton. Step 5 preferred therapy is based on Evidence B. Step 6 preferred therapy is based on (Expert Panel Report-2 1997) and Evidence B for omalizumab. Immunotherapy for steps 2-4 is based on Evidence B for house-dust mites, animal danders, and pollens; evidence is weak or lacking for molds and cockroaches. Evidence is strongest for immunotherapy with single allergens. The role of allergy in asthma is greater in children than in adults.
- Clinicians who administer immunotherapy, omalizumab, or mepolizamab should be prepared and equipped to identify and treat anaphylaxis that may occur.

Note: *For an explanation of levels of evidence mentioned in the notes above, see NIH Asthma Guidelines.* ***Source:*** *U.S. Department of Health and Human Services, National Institute of Health, National heart, Lung, and Blood Institute. Guidelines for the Diagnosis and Management of Asthma, Summary Report*

Outpatient Management of Asthma

STEP 1	STEP 2	STEP 3	Add a second controller medication	STEP 4	STEP 5	STEP 6
Short Acting Beta Agonist (SABA)	Low Dose Inhaled Corticosteroid (ICS)	Medium Dose ICS ------ OR ------ Low Dose ICS + add on medication: • LABA (Long Acting Beta Agonist) – preferred • LTRA (Leukotriene Receptor Antagonist) - preferred 5-11 y/o • Theophylline – preferred 5-11 y/o • Zileuton		Medium Dose ICS + add on medication: LABA, LTRA, Theophylline, or Zileuton	High Dose ICS + LABA ------ AND ------ *In patients with allergies:* 12+ y/o = Omalizumab subQ every 2-4 wks; dose based on wt + serum IgE *In patients with eosinophilia:* 12+ y/o = Mepolizumab 100mg subQ every 4 wks or Adults = Reslizumab 3mg/kg IV (over 20-50min) every 4 wks	High Dose ICS + LABA + Daily Oral Corticosteroid Methylprednisolone • 5-11 y/o = 0.25-2 mg/kg daily in a.m. or every other day • 12+ y/0 = 7.5-60 mg daily in a.m. Prednisone or Prednisolone • 5+ y/o = 1-2 mg/kg (max 50mg daily)
					Consult with a specialist	

← Continue SABA as needed throughout all steps →

, **, * - Number of stars indicates how many extra inhalers a specific dose would require for a month.*

SABA	Low Dose ICS	Medium Dose ICS	High Dose ICS
Albuterol / Salbutamol (ProAir or Ventolin) **Aerosol** 4+ y/o = 90 mcg 2 puffs Q4 hr prn **Nebulizer** 2+ y/o (15 kg+) = 2.5 mg / 3 mL (0.083%) neb 3-4x a day prn 2+ y/o = 5 mg / 1 mL (0.5%) neb 3-4x a day prn (max 1.5 mg/kg/day) **Levalbuterol** (Xopenex) **Aerosol** 5+ y/o = 59 mcg 2 puffs Q4 hr prn **Nebulizer** 6-11 y/o = 0.63% (0.63 mg / 3 mL) up to 3x a day prn 12+ y/o = 1.25% (1.25 mg / 3 mL) up to 3x a day prn	**Beclomethasone** (QVAR)	**Beclomethasone** (QVAR)	**Beclomethasone** (QVAR)
	5+ y/o = 40 mcg 2 puffs BID	12+ y/o = 80 mcg 2-3* puffs BID	12+ y/o = 80 mcg 4** puffs BID
	Budesonide (Pulmicort)	**Budesonide** (Pulmicort)	**Budesonide** (Pulmicort)
	Powder 6+ y/o= 180 mcg 1 puff BID	Powder 6-11 y/o = 180 mcg 2 puffs BID 12+ y/o = 180 mcg 2-3* puffs BID	Powder 12+ y/o = 180 mcg 4* puffs BID
	Nebulizer 5-11 y/o = 0.5 mg 1 neb daily	Nebulizer 5-11 y/o = 1 mg 1 neb daily	Guidelines do not recommend high-dose ICS without a LABA, move on to combination medications below or equivalent regimen.
	Ciclesonide (Alvesco)	**Ciclesonide** (Alvesco)	
	12+ y/o = 80 mcg 2* puffs BID	12+ y/o = 160 mcg 2* puffs BID	
	Flunisolide (Aerospan)	**Flunisolide** (Aerospan)	
	6-11 y/o = 80 mcg 1 puff BID 12+ y/o = 80 mcg 2 puffs BID	6-11 y/o = 80 mcg 2 puffs BID 12+ y/o = 80 mcg 3-4* puffs BID	
	Fluticasone (Flovent)	**Fluticasone** (Flovent)	**Fluticasone** (Flovent)
	Flovent Aerosol 4+ y/o = 44 mcg 2 puffs BID	Flovent Aerosol 12+ y/o = 110 mcg 2 puffs BID	Flovent Aerosol 12+ y/o = 220 mcg 2, 3* or 4* puffs BID
	Flovent Powder 4+ y/o = 50 mcg 1 puff BID	Flovent Powder 12+ y/o = 250 mcg 1 puffs BID	Flovent Powder 12+ y/o = 250 mcg 2*, 3** or 4*** puffs BID
	Arnuity Ellipta Powder 12+ y/o = 100 mcg 1 puff daily	Arnuity Ellipta Powder 12+ y/o = 200 mcg 1 puff daily	
	Mometasone (Asmanex)	**Mometasone** (Asmanex)	**Mometasone** (Asmanex)
	Aerosol 12+ y/o = 100 mcg 1 puff BID	Aerosol 12+ y/o = 100 mcg 2 puffs BID	Aerosol 12+ y/o = 200 mcg 2 puffs BID
	Powder 4-11 y/o = 110 mcg 1 puff QPM 12+ y/o = 220 mcg 1 puff QPM	Powder 12+ y/o = 220 mcg 2 puffs QPM	Powder 12+ y/o = 220 mcg 2 puffs BID

Combination ICS / LABA	Low Dose ICS / LABA	Medium Dose ICS / LABA	High Dose ICS / LABA
(NOT USED IN STEP 2)	**Budesonide / Formoterol** (Symbicort)		
	12+ y/o = 80/4.5 mcg 2 puffs BID	12+ y/o = 160/4.5 mcg 2 puffs BID	
	Fluticasone / Salmeterol (Advair)		**Fluticasone / Salmeterol** (Advair)
	Aerosol 4+ y/o = 45/21 mcg 1 puff BID	Aerosol 4+ y/o = 115/21 mcg 2 puffs BID	Aerosol 4+ y/o = 230/21 mcg 2 puffs BID
	Powder 4+ y/o = 100/50 mcg 1 puff BID	Powder 4+ y/o = 250/50 mcg 1 puff BID	Powder 4+ y/o = 500/50 mcg 1 puff BID
	Fluticasone / Vilanterol (Breo)		
	18+ y/o =100/25 mcg 1 puff daily	18+ y/o =200/25 mcg 1 puff daily	
		Mometasone / Formoterol (Dulera)	**Mometasone / Formoterol** (Dulera)
		12+ y/o = 100/5 mcg 2 puffs BID	12+ y/o = 200/5 mcg 2 puffs BID

ALTERNATIVES

Cromolyn	Other add ons w/ICS:	Alternative combinations w/ICS for 5-11 y/o:
LTRA • Montelukast (Singulair) • Zafirlukast (Accolate)	LTRA *preferred 5-11 y/o , alternative 12+ y/o* • Montelukast (Singulair) • Zafirlukast (Accolate)	LTRA • Montelukast (Singulair) • Zafirlukast (Accolate)
Theophylline	Theophylline *preferred 5-11 y/o , alternative 12+ y/o*	Theophylline
	Zileuton *alternative if 12+ y/o*	

Dosing is consistent across steps:

- **Cromolyn:** 5+ y/o = 20 mg 3-4x a day nebulizer
- **LTRA** **Montelukast** (Singulair): 6-14 y/o = 5 mg QPM; 15+ y/o = 10 mg QPM
  Zafirlukast (Accolate): 5-11 y/o = 10 mg BID; 12+ y/o = 20 mg BID
- **Theophylline:** Start at 300 mg/day then after 3 days (if tolerated), increase to 400 mg/day. After 3 more days (if tolerated and needed) increase to 600 mg/day. Dosing based on # of hrs divided over – IR (ever 6-8 hrs), ER over 12 or 24 hr
- **Zileuton:** 12 y/o + = IR (600 mg 4x/day); ER (1200 mg BID)

Please direct feedback or suggestions regarding this guideline resource to
Dr. Jeffrey (Jay) Lawrence | Associate Chief Quality Officer for Ambulatory Care | jeffrey.lawrence@osumc.edu

Before Step-Up in Therapy

- Review adherence to medication, inhaler technique, environmental control, and comorbid conditions.
- If an alternative treatment option was used in a step, discontinue and use the preferred treatment for that step

Related Tools

Order set

- OSU IP PUL: ADMISSION ASTHMA [2220]

IHIS Tip Sheet

- Ordering Patient Asthma Tracking in OSUMyChart
- Dot phrases for outpatient management and documentation

Assessment Tools

- Asthma Management Point of Care Decision Support Tool
- ACT Questionnaire
- c-ACT Questionnaire
- Asthma Action Plan

Inpatient Quality Measures

- All patients with asthma discharged with rescue inhaler
- All patients with persistent asthma discharged on controller therapy
- Follow-up will be arranged within 2-6 weeks of an asthma related hospitalization.

Outpatient Quality Measures

- All patients with asthma assessed for control using validated questionnaire (ACT or c- ACT)
- All patients with asthma prescribed a rescue inhaler
- All patients with persistent asthma or ≥ 2 exacerbations requiring prednisone prescribed controller therapy

References

- U.S. Department of Health and Human Services, National Institute of Health, National Heart, Lung, and Blood Institute. (2007). National Asthma Education and Prevention Program Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma, Summary Report.
- Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention 2016.

Authors

- Jonathan Parsons, MD, MSc
- Bruce Doepker, PharmD, BCPS
- Jeffrey (Jay) Lawrence, MD

Guideline Approved

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Disclaimer: *Clinical practice guidelines and algorithms at The Ohio State University Wexner Medical Center (OSUWMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUWMC's guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.*

Glossary of Asthma Medications – CONTROLLERS

Key: **NF** = Not on the Formulary of Accepted Medications at The Ohio State University Medical Center;
RU = Restricted Use

Name	Usual Doses	Side Effects	Comments
Glucocorticosteroids **Inhalation (ICS):** • Budesonide • Fluticasone • Beclomethasone (NF) • Ciclesonide (NF) • Flunisolide (NF) • Mometasone (NF) • Triamcinolone (NF) **Tablet:** • Hydrocortisone • Methylprednisolone • Prednisolone • Prednisone **Syrup:** • Prednisone	**Inhalation:** Beginning dose dependent on asthma control then titrated down over 2-3 months to lowest effective dose once control is achieved. **Tablet or syrup:** For daily control use lowest effective dose 5-40 mg of prednisone or equivalent in a.m. or every other day. Methylprednisolone • 5-11 y/o = 0.25-2 mg/kg daily in a.m. or every other day • 12+ y/0 = 7.5-60 mg daily in a.m. Prednisone or Prednisolone • 5+ y/o = 1-2 mg/kg (max 50mg daily) For acute attacks • 5-11 y/o = 1-2 mg/kg/day as 2 divided doses x 3-10 days. • 12+ y/o = 40-60 mg/day as single or split dose x 3-10 days	**Inhalation:** **High daily doses**: may be associated with skin thinning and bruises, and rarely adrenal suppression. Local side effects are hoarseness and oropharyngeal candidiasis. **Low to medium doses:** have produced minor growth delay or suppression (avg. 1cm) in children. Attainment of predicted adult height does not appear to be affected. **Tablet or syrup:** Used long term, may lead to osteoporosis, hypertension, diabetes, cataracts, adrenal suppression, growth suppression, obesity, skin thinning or muscle weakness. Consider coexisting conditions that could be worsened by oral glucocorticosteroids, e.g., herpes virus infections, Varicella, tuberculosis, hypertension, diabetes and osteoporosis.	**Inhalation:** Potential but small risk of side effects is well balanced by efficacy. Valved holding chambers with MDIs and mouth washing with DPIs after inhalation decrease oral candidiasis. Preparations not equivalent on per inhalation or mcg basis. **Tablet or syrup:** • **Long-term use:** alternate day a.m. dosing produces less toxicity. •
Chromone • Cromolyn (NF)	**Nebulizer:** 20 mg 3-4 times daily.	Minimal side effects. Cough may occur upon inhalation.	May take 4-6 weeks to determine maximum effects. Frequent daily dosing required.
Combination ICS/LABA • Budesonide/ formoterol (Symbicort) • Fluticasone/ salmeterol (Advair HFA) (NF) • Fluticasone/ salmeterol (Advair Diskus) (NF) • Fluticasone/ vilanterol (Breo) • Mometasone/ formoterol (Dulera)	**Symbicort:** 2 inhalations every morning and evening. **Advair HFA:** 2 inhalations every morning and evening, 12 hrs apart **Advair Diskus:** 1 inhalation every morning and evening, 12 hrs apart. **Breo:** 1 inhalation daily. **Dulera:** 2 inhalations every morning and evening, 12 hrs apart.	Tachycardia, skeletal muscle tremor, hypokalemia, QTc prolongation in overdose. Have been associated with an increased risk of severe exacerbations and asthma deaths when added to usual therapy.	In moderate to severe persistent asthma, combination is more effective than doubling the ICS dose. Budesonide /formoterol has been approved for adjustable as needed dosing in addition to regular dosing. Dosing is dependent on level of control. Limited data in children 4-11 yrs. No data in children < 4 yrs.

Glossary of Asthma Medications – CONTROLLERS *(continued)*			
Name	**Usual Doses**	**Side Effects**	**Comments**

Methylxanthine
• Theophylline
  ○ IR oral liquid tablets (NF)
  ○ Extended Release 12hr or 24hr (NF)
	12+:10 mg/kg/day up to 300mg; (300 mg/day in divided doses over 6 to 8 hours; after 3 days (if tolerated), increase to 400 mg/day in divided doses over 6 to 8 hours; after 3 more days (if tolerated and needed), increase to 600 mg/day ORALLY in divided doses over 6 to 8 hours usual max up to 800 mg/day.	Dose related toxicity. Nausea and vomiting are most common.
		
		Serious effects occurring at higher serum concentrations include seizures, tachycardia, and arrhythmias.
			Recommend checking a serum concentration if patient exhibits side effects related to theophylline toxicity, develops acute hepatic insufficiency and/or renal failure, or is on higher than normal dose.
			
			Absorption and metabolism may be affected by many factors, including febrile illness.

Leukotriene modifiers or Leukotriene Receptor Antagonists (LTRAs) • Montelukast (M) • Zafirlukast (Z) (NF) **5-LipoxygenaseInhibitor** • Zileuton (Zi) (NF)	**Children:** • M 5 mg qhs (6-14 y) • M 4 mg qhs (2-5 y) • Z 10mg bid (7-11 y) **Adults:** • M 10mg qhs • Z 20mg bid • Zi IR 600mg 4x daily • Zi ER 1200mg bid	No specific adverse effects to date at recommended doses. Elevation of liver enzymes with Zafirlukast and Zileuton and limited case reports of reversible hepatitis and hyperbilirubinemia with Zileuton and hepatic failure with Zafirlukast.	Leukotriene modifiers are most effective for patients with mild persistent asthma. They provide additive benefit when added to ICSs though not as effective as inhaled long-acting β2-agonists.
Immunomodulator: **Anti-IgE** • Omalizumab (NF)	**Anti-IgE:** 6+ y/o Dose administered subcutaneously every 2-4 weeks dependent on weight and IgE concentration.	Anti-IgE: Pain and bruising at injection site (5-20%) and rare cases of anaphylaxis (0.2%).	Need to be stored under refrigeration 2-8°C and maximum of 150 mg administered per injection site.
Immunomodulators: Interleukin-5 (IL-5) Antagonist • Mepolizumab • Reslizumab	**Adults:** • M 100 mg dose administered subcutaneously every 4 weeks. • R 3 mg/kg IV infusion over 20-50 minutes every 4 weeks **Children:** 12+ y/o • M 100 mg dose administered subcutaneously every 4 weeks	Shingles (vaccine recommended before starting) M: Injection site reaction, antibody development, backache, fatigue & headache (most common 19%). Anaphylaxis R: antibody development, increased creatine kinase level (0.8 – 20%), myalgia, pain in throat, & rare cases of anaphylaxis (0.3%) & cancer (0.6%).	Intended as add on therapy in patients with eosinophilic phenotype. M: store below 77 °F, do not freeze R: Need to be stored under refrigeration 36-46°F (before dilution); below 77°F after s dilution, stable up to 16 hrs, protect from light.

Glossary of Asthma Medications – RELIEVERS

Key: **NF** = Not on the Formulary of Accepted Medications at The Ohio State University Medical Center; **RU** = Restricted Use

Name	Usual Doses	Side Effects	Comments
Short-acting β2- agonists (SABAs) • Albuterol (MDI, nebulization) salbutamol • Levalbuterol (NF) (MDI, nebulization) • Proair Respiclick	2 inhalations 15 min before exercise 2 inhalations every 4 hrs as needed for symptoms. Differences in potency exist but all products are essentially comparable on a per inhlation basis. For as needed symptomatic use and pretreatment before exercise 2 inhalations. For asthma attacks 4-8 inhalations q2-4h, may administer every 20min x 3 with medical supervision or the equivalent of 5 mg salbutamol by nebulizer. ED: <12 y/o – (A) 0.15 mg/kg (minimum dose 2.5 mg) every 20 minutes for 3 doses then 0.15–0.3 mg/kg up to 10 mg every 1–4 hours as needed, or 0.5 mg/kg/hour by continuous nebulization. (L) 0.075 mg/kg (minimum dose 1.25 mg) every 20 minutes for 3 doses, then 0.075–0.15 mg/kg up to 5 mg every 1–4 hours as needed. ED: >12 y/o – (A) 2.5–5 mg every 20 minutes for 3 doses, then 2.5–10 mg every 1–4 hours as needed, or 10–15 mg/hour continuously. (L) 1.25–2.5 mg every 20 minutes for 3 doses, then 1.25–5 mg every 1–4 hours as needed.	Tachycardia, skeletal muscle tremor, headache, and irritability. At very high dose hyperglycemia, hypokalemia.	Drug of choice for acute bronchospasm. Inhaled route has faster onset and is more effective than tablet or syrup. Increasing use, lack of expected effect, or use of > 1 canister a month indicate poor asthma control; adjust long- term therapy accordingly. Use of ≥ 2 canisters per month is associated with an increased risk of a severe, life- threatening asthma attack.
Short-acting Anticholinergics • Ipratropium bromide (Atrovent, nebulization) (Atrovent HFA, MDI)	**Atrovent HFA:** 2-3 inhalations every 6 hrs when used with SABA. (Max 12 inhlations in 24 hrs) **Ipratropium nebulization (**mix with SABA in same neb)**:** 0.25mg-0.5mg every 6 hrs . ED: <12 y/o - 0.25–0.5 mg every 20 minutes for 3 doses, then as needed ED >12 y/o - 0.5 mg every 20 minutes for 3 doses then as needed	Minimal mouth dryness or bad taste in the mouth.	Treatment of choice for bronchospasm due to beta-blocker medication. May provide additive effects to β2-agonist but has slower onset of action. Is an alternative for patients with intolerance for β2-agonists. ED: May be used for up to 3 hours in the initial management of severe exacerbations. The addition of ipratropium to albuterol has not been shown to provide further benefit once the patient is hospitalized.
Short-acting theophylline • Aminophylline	7 mg/kg loading dose over 20 min followed by 0.4 mg/kg/hr continuous infusion.	Nausea, vomiting, headache. **At higher serum concentrations:** seizures, tachycardia, and arrhythmias.	Aminophylline should only be used as salvage therapy in patients not responding to traditional treatments due to poor efficacy and safety profile. Aminophylline did not improve outcomes compared to using SABAs alone in severe asthma exacerbations. Serum concentration monitoring is required. Obtain serum levels 12 and 24 hrs into infusion. Maintain between 5-15 µg/mL.

Glossary of Asthma Medications – RELIEVERS *(continued)*			
Name	**Usual Doses**	**Side Effects**	**Comments**
Systemic Corticosteroids **Oral** • Methlyprednisolone • Prednisolone • Prednisone **IM** • Methylprednisolone	Dosage applies to three corticosteroids **Short course "burst":** 40-60 mg/day as single or 2 divided doses for 3-10 days 240 mg IM once	**Short-term use:** reversible abnormalities in glucose metabolism, increased appetite, fluid retention, weight gain, facial flushing, mood alternation, hypertension, peptic ulcer, and rarely aseptic necrosis. Consider coexisting conditions that could be worsened by systemic corticosteroids, e.g., herpes virus infections, varicella, tuberculosis, hypertension, diabetes, and osteoporosis.	Short courses or "bursts" are effective for establishing control when initiating therapy or during a period of gradual deterioration. Action may begin within an hr. May be used in place of a short burst of oral steroids in patients who are vomiting or if adherence is a problem.
Epinephrine/adrenaline injection	1:1000 solution (1mg/mL) 0.01mg/kg up to 0.3-0.5 mg can give q20min x 3.	Similar, but more significant effects than selective β2-agonist. In addition: hypertension, fever, vomiting in children and hallucinations.	In general, not recommended for treating asthma attacks if selective β2-agonists are available.