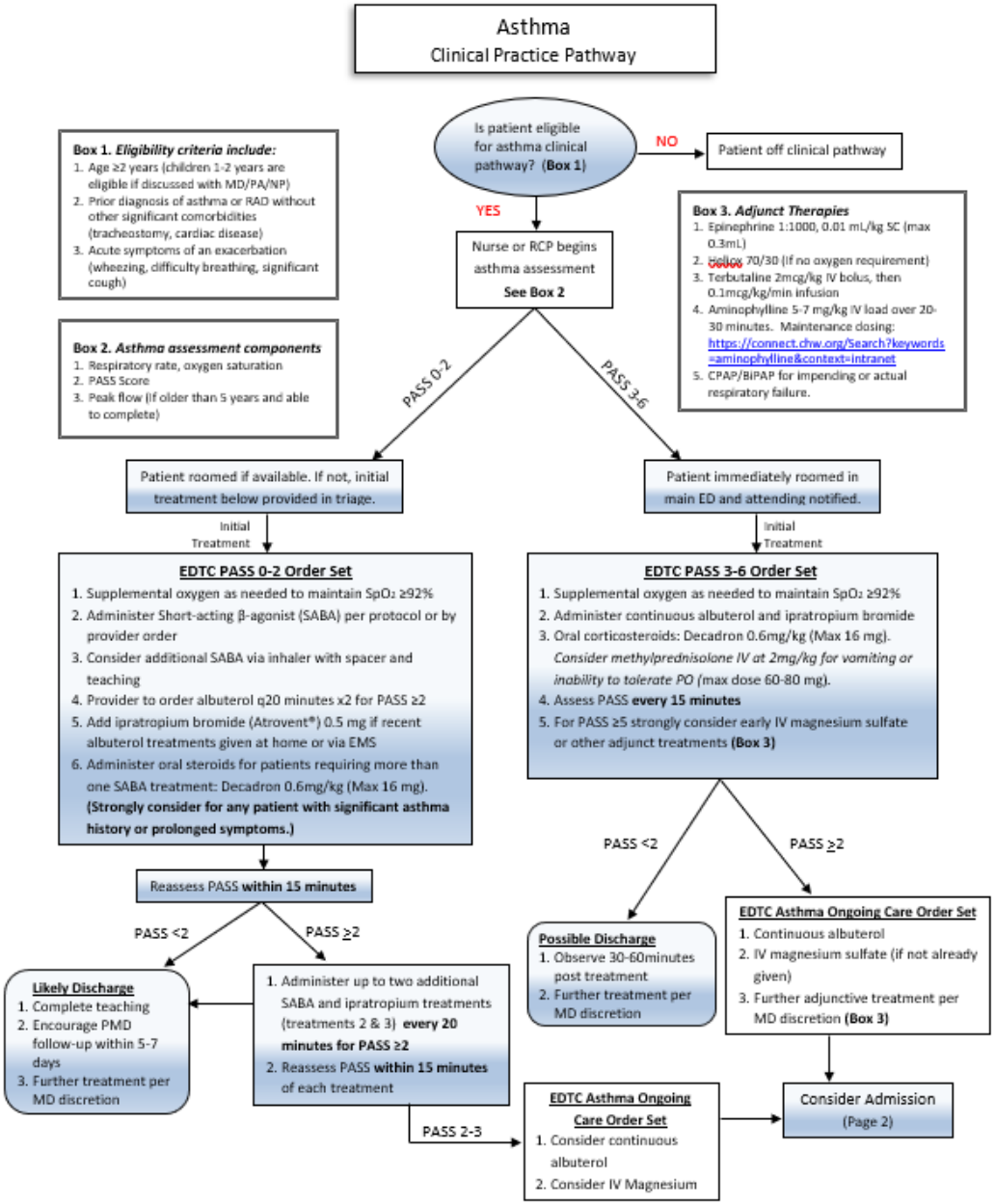
Emergency Department Asthma Management



Inclusion Criteria:

- Age 2-18 yrs of age
- History of asthma or reactive airway disease (RAD) or new presentation of asthma/RAD

Exclusion Criteria:

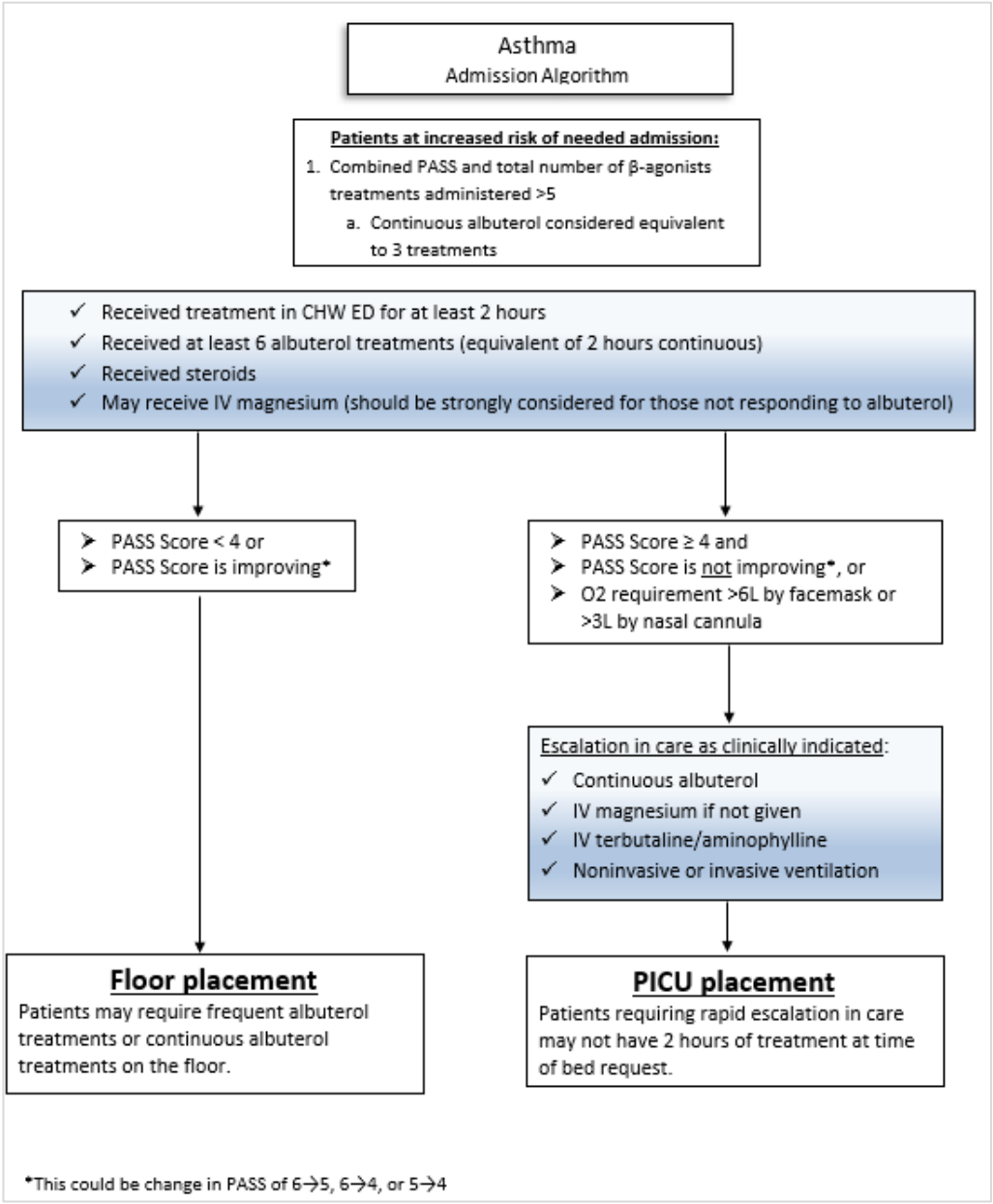
- Diagnosis of pneumonia
- Primary diagnosis of bronchiolitis
- History of sickle cell disease
- Medical complexity
- Trach-only use patients
- Chronic non-invasive ventilation use

Pediatric Asthma Severity Score (PASS)

Clinical Finding	0	1	2
Wheezing	None or mild	Moderate	Severe or absent due to poor air exchange
Work of breathing	None or mild	Moderate	Severe
Prolongation of expiration	Normal or mildly prolonged	Moderately prolonged	Severely prolonged

PASS: Clinical score ranging from 0-6 used to assess acute asthma severity[1]

Emergency Department Algorithm for Patient Placement



Hospital Medicine Asthma Clinical Practice Guideline

Children's Wisconsin | Medical College of Wisconsin

Acute Care Guideline

Key to Abbreviations

AMP: Asthma Management Plan
CW: Children's Wisconsin
CPG: Clinical Practice Guideline
CXR: Chest X-ray
ED: Emergency Department
ICU: Intensive Care Unit
ICS: Inhaled Corticosteroid
O2: Oxygen
PEF: Peak Expiratory Flow
PEP: Positive Expiratory Pressure
RAD: Reactive Airway Disease
RT: Respiratory Therapist
SABA: Short Acting Beta Agonist
UC: Urgent Care
AVS: After Visit Summary

Within History and Physical

- **Classify asthma severity** (see Tables 1,2,3): daytime/nighttime cough, interference with activity, exacerbations, prior hospitalizations/ICU admits/intubations/# ED/UC visits/steroid courses in past year, identify home asthma medications, frequency of albuterol use, check for compliance, assess for asthma triggers and for smoke exposure
- **Identify overall control** on current regimen
- **Assess for comorbidities** (chronic lung disease, gastroesophageal reflux, obstructive sleep apnea, allergic rhinitis) and/or coinfections (sinusitis, flu symptoms, pneumonia)
- **Use recommended H&P note template** "HOSP CW IP Hospitalist Asthma H&P" and document patient is admitted for status asthmaticus

Inclusion/Exclusion Criteria

See Page 1

Initial Management on Acute Care Unit

- Initiate Asthma Protocol (see A) – Orders placed by RT include those in *italics* below:
  - *Oxygen (O2 to keep saturations > 90%)*
  - *Continuous pulse oximetry until 4 hrs on room air*
  - *Inhaled SABA* (see B)
- Systemic steroids (see C)
- Start/continue/step-up home maintenance meds as indicated (see D)

Quick Link

RCS Asthma Protocol

Improving

- Improved respiratory distress and aeration
- Meeting oral intake goals
- Able to decrease dose and/or frequency of albuterol

- Continue protocol, wean off O2
- Pulse oximetry checks when off O2 > 4 hrs
- Communicate with RT when home asthma medication plan complete and RT will create and review AMP with family (see L)

Discharge Criteria

- Oxygen saturations > 90% on RA for approx. 8 hrs
- Tolerating 2 consecutive albuterol treatments spaced to 4 puffs every 4 hrs
- Peak flow > 60% predicted if > 5 yrs
- Meeting oral intake goals
- AMP and Asthma Teaching Complete
- Discharge considerations and resources (See I-M)

Not Improving

- Mild to moderate respiratory distress
- Poor to fair aeration
- Persistent hypoxia
- Not meeting oral intake goals

- Consider CXR
- Reassess scoring/management with RT
- Treat underlying comorbidities, if present
- Consider Asthma Consult (see H)

Risk factors for severe disease

- History of prematurity, chronic lung disease, poor baseline control, delayed symptom recognition, comorbid conditions such as obesity, allergic rhinitis, and/or food allergies

Worsening Clinical Status

- Moderate to severe respiratory distress
- Poor aeration
- Persistent hypoxia
- Change in mental status

- STAT CXR and capillary blood gas
- Start continuous albuterol
- Start intravenous systemic steroids
- Consider IV magnesium sulfate (see E)

- Consider **Critical Care consult** if > 5 hrs on continuous albuterol without improvement or other clinical concerns (see F)
- Call **Rapid Response** Team if acute deterioration
- If continued deterioration in clinical status, transfer to **ICU**
- Consider IM Epinephrine in collaboration with critical care (see G)

A. ASTHMA PROTOCOL[2]: CHW Protocol involves using asthma score based on exam findings and peak flow to determine SABA dosing. Routine repeat evaluations and SABA wean directed by RT asthma scoring. The current asthma protocol can be found on the Q: drive under P&P Patient Care Protocols; 2018 Active Protocols for R.M; Respiratory Care Services (RCS) Asthma Protocol, or via CW Intranet RCS Asthma Protocol.[2] The Asthma Protocol Total Scores, admission peak flows, peak flows pre- and post-bronchodilator therapy, time of treatments are entered in the "RT Assessment" Tab in the Doc Flowsheet.

B. SHORT ACTING BETA AGONIST DOSING FOR ACUTE EXACERBATIONS (RED ZONE) BY WEIGHT, PER CHW ASTHMA PROTOCOL: (See Table 6 for Albuterol Discharge Dosing)

Weight	< 5 kg	5-20 kg	21-29 kg	>30 kg
Albuterol MDI (preferred)	2 puffs	4 puffs	6 puffs	8 puffs
Inpatient Albuterol Aerosol (0.5% solution, 2.5 mg/0.5 mL)	1.25 mg/0.25 mL	2.5 mg/0.5 mL	3.75 mg/0.75 mL	5 mg/1 mL
Discharge Albuterol Aerosol (0.083% solution, 2.5 mg/3 mL)	2.5 mg/3 mL (1 nebule)	2.5 mg/3 mL	2.5 mg/3 mL	2.5 mg/3 mL

- CHW Inpatient Pharmacy stocks 0.5% albuterol solution, 2.5 mg/0.5 mL.
- Outpatient pharmacies use prediluted nebules with 0.083% albuterol solution, 2.5 mg/3 mL.

C. SYSTEMIC CORTICOSTEROID DOSING: Corticosteroid options include oral prednisolone, oral prednisone, or intravenous methylprednisolone. Recommended corticosteroid dosing range per 2007 Asthma Guidelines is 1 mg/kg to 2 mg/kg/day (max 60 mg per day) in single or divided doses.[3,4,5] Local consensus supports 2 mg/kg/day given once daily. If the patient received a dose of dexamethasone in the ED, this initial dose is considered the first dose of steroids. IV methylprednisolone dosing is 0.5 mg/kg every 6 hours (max of 60 mg day or 15 mg per dose if > 30 kg). Can give 2 mg/kg loading dose if they have not yet received any steroids, otherwise no loading dose needed. Start an H2 blocker such as ranitidine if initiating IV steroids. As there is limited data for the inpatient use of dexamethasone for acute asthma exacerbations[5,6], the MCW Hospitalist group consensus is to continue a 5-day course of corticosteroids for those patients with severe persistent asthma and/or needing ICU level care or treatment. However, in certain situations (i.e. concern about ability to pick-up medications or medication compliance/tolerance, lower severity of illness) the use of dexamethasone can be considered. Dexamethasone has been shown to be equally as effective as an oral corticosteroid 3-5 day burst in patients discharged from the ED.[7]

D. INHALED CORTICOSTEROID DOSING: Utilize age-based severity classification for initiating (Table 1, 2, 3) and step wise (Table 4) asthma management. Changing the home ICS regimen OR starting a new ICS warrants discussion with attending physician before ordering. Fluticasone (Flovent) is the preferred ICS and is covered by Medicaid. Fluticasone dosing below:[3,8]

Fluticasone/Flovent Dosing	Children <12 years:	Children ≥12 years:
Low Dose	88-176 mcg/day (44 mcg/puff: 2-4 puffs/day)	88-264 mcg/day (44 mcg/puff: 2-6 puffs/day) or (110 mcg/puff: 2 puffs/day)
Medium Dose	>176-352 mcg/day (44 mcg/puff: 4-8 puffs/day) or (110 mcg/puff: 2-3 puffs/day)	> 264-440 mcg/day (110 mcg/puff: 2-4 puffs/day)
High Dose	>352 mcg/day (110 mcg/puff: >3 puffs/day) or (220 mcg/puff: >1 puff/day)	>440 mcg/day (110 mcg/puff: >4 puffs/day) or (220 mcg/puff: >2 puffs/day)

E. IV MAGNESIUM SULFATE: Dosing IV Magnesium Sulfate: 25-75 mg/kg/dose (max 2 grams) as a single dose given over 20 minutes.[8,9] Indication: Consider in patients who have life threatening exacerbations and in those whose exacerbations remain in the severe category or FEV_1/PEF < 40% after 1 hour of intensive conventional therapy.[3] There is a lack of evidence for repeat magnesium dosing. Attending physician should be included if you are considering re-dosing magnesium sulfate on the acute care unit. Adverse effects reported: hypotension, facial or epigastric warmth, flushing, pain/numbness at infusion site, dry mouth, malaise. Contraindicated in renal failure, cardiovascular and GI disease, or allergy to magnesium[8]. Give 20 mL/kg NS bolus with IV Magnesium Sulfate as hypotension is a side effect.

F. CONSULTING CRITICAL CARE: Consider a critical care consult if the patient requires multiple interventions and frequent monitoring, clinical status worsening and is at risk for progression to respiratory failure, or is worsening or has not shown improvement after 5 hours of continuous albuterol (Misty Finity Medium Volume High flow nebulizer used to deliver continuous albuterol at CHW and allows for 5 hours of continuous albuterol before redosing).[10,11,12]

G. IM EPINEPHRINE: Only consider with co-management with critical care in patient that has already received IV magnesium sulfate and is not improving and will be transferring to PICU. IM administration is in the anterolateral aspect of the middle third of the thigh. IM dosing is 1:1000 solution, 15-29 kg: 0.15 mg (EpiPen Jr®), ≥30 kg: 0.3 mg (EpiPen®).[8]

H. CONSULTING ALLERGY/IMMUNOLOGY OR PULMONARY: At CHW, both Allergy/Immunology and Pulmonary Medicine perform inpatient consults for asthma. To contact the designated Asthma Consultant, go to the CHW Intranet → On Call Schedules → Asthma. Consider consulting if you have a high risk patient with a previous severe exacerbation, two or more hospitalizations or three or more ED visits for asthma in the past year, a hospitalization in the past month, using >1 canisters of SABA per month, difficulty perceiving asthma symptoms, not improving on protocol, comorbidities including cardiovascular disease, other chronic lung disease, or psychiatric disease.[13] Other considerations in the social history putting patients at high risk: concern for access to healthcare, illicit drug use, major psychosocial problems. Within the 2020 updates to the NHLBI guidelines there is a recommendation for Single Maintenance and Reliever Therapy (SMART) for children ≥ 4 years at Step 3 of Management.[16] (See Appendix J for additional information and for age-based tables from the updated 2020 NHLBI guidelines). Of note, inhaled corticosteroid/salmeterol combinations (e.g. Dulera or Symbicort) are the preferred agents for SMART therapy. If your patient's AMP includes SMART or you believe they would be a candidate for SMART, place an Asthma consult for recommendations. The consult team will determine the appropriate follow-up specialty (ie. If a patient has environmental or allergic triggers, they may follow-up in Allergy/Immunology Clinic, and if the child has underlying lung disease, Pulmonary Medicine may be the most ideal follow-up clinic).

I. DISCHARGE CONSIDERATIONS: Arrange follow-up with the PCP 1-3 days after discharge, and if applicable, arrange asthma/allergy or pulmonary appointment if not already scheduled. Ensure that all medications are sent to the pharmacy, and check with parents for what refills may be needed. Consider Skywalk Pharmacy bedside medication delivery service or Hayat Pharmacy home medication delivery service. Designate who is responsible for medication compliance (ie. Patient, parent, or patient AND parent) and that patient (if age-appropriate) and parents are able to demonstrate MDI, spacer, and mask technique.

J. DISCHARGE – RESOURCES FOR HOME: Speak with Inpatient Case Manager (ICM) if home nebulizer machine and/or a home asthma evaluation is warranted. Consider home asthma evaluation for children with any of the following: 1. ≥ 1 hospitalization(s) for asthma 2. Multiple ED visits for asthma 3. Persistent asthma requiring controller 4. ACT score < 19. A home asthma evaluation is a service for home asthma assessment, education and remediation. Options for home asthma include CHW Asthma Home Referral to Dorian James RT, Ascension Wheaton Home Nursing and Aurora VNA. Parents must consent. ICM can assist with arranging home asthma evaluation. Smoking cessation resources: CW Teaching Sheets: "Quit Smoking" or "Secondhand Smoke." You can also provide parents the Wisconsin Tobacco Quit Line phone number: 1-800-784-8669.

K. DISCHARGE SYSTEMIC CORTICOSTEROID DOSING: Prednisone/prednisolone should be continued at 2 mg/kg/day for a total 5-day course of systemic steroids. If treating only with dexamethasone (Decadron), two-doses of Decadron (0.6 mg/kg) should be given ~36 hours apart to complete the systemic steroid course.[4,5,6] If ordering while the patient is still in the hospital and liquid formulation is preferred, order the "injection for PO" formulation rather than the oral liquid due to large volumes needed of the oral liquid. If ordering upon discharge, order the tablet formulation of Decadron. Of note, Skywalk Pharmacy will dispense Decadron tablets; many outside pharmacies do not.

L. ASTHMA MANAGEMENT PLAN: If applicable, you can find previous completed versions of the AMP by clicking "Chart Review" tab → "Letters" → "Asthma Management Plan" (see Appendix G, Figure 1). The respiratory therapists complete the Asthma Management Plan (AMP), with the draft form found in Epic by clicking on the "Asthma Management Plan" workspace tab (or you can search "Asthma Management Plan" (see Appendix H, Figure 2). You may add an Epic column called "AMP Progress" to your custom patient list, which is a colored dot system for communication between resident teams and RTs for AMP readiness. The Asthma Management Plan includes: controller meds (or note "no controller needed at this time"), rescue medications for yellow and red zones, peak flow ranges if patient >5 years and able to perform PEF (see Appendix E, Table 5), and triggers list. The medications, dosages, and prescriptions must match the medications listed on the After Visit Summary. If your patient is of school-age, ask the respiratory therapist to print out an extra AMP for the child to have at school. There should also be copies in the home of every caretaker.

M. ASTHMA AFTER VISIT SUMMARY: There is a template for basic asthma discharge instructions to be included in the AVS , which can be found using "GEN DC ASTHMA" (see Appendix I, Figure 3). All elements of the AVS must be completed before discharge. The discharge medications must be listed on the AVS and must match the medications, dosages, and frequencies on the AMP.

N. INFLUENZA VACCINE: The American Academy of Pediatrics recommends annual seasonal influenza immunization for all people 6 months and older, with a special effort to vaccinate people that have conditions that increase complications from influenza, such as asthma.[13] See www.cdc.gov/flu/ for specific dosing recommendations. Children with asthma should be given the inactivated form of the vaccine, not the live-attenuated form.[13]

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Current Revision Authors/Contributors:
Hospital Medicine (Sarah Vepraskas MD, Danita Hahn MD, Erica Chou MD, Paula Soung MD), pediatric residents (Grace Muganda MD and Stason Vandegrift MD), Emergency Medicine (Matt Gray MD), Pulmonary (Juan Ruiz MD), Allergy/Immunology (Asriani Chiu MD), and Respiratory Therapy (Joe Gregoriou RCP). *With appreciation to historical authors.*

Please contact pedshospitalistsadminteam@mcw.edu for more information or to make comments.

Table 1. Classifying Severity and Initiating Treatment: Children 0 to 4 years

Severity Category	Days and Nights with Symptoms	Interference with Normal Activity	Exacerbations	Preferred Treatment
Severe Persistent	Throughout every day >1 night/wk	Extremely limited	2 or more exacerbations in 6 months or > 4 episodes of wheezing/yr with risk factors for asthma	Step 3: Medium-dose ICS and consider short-course OCS
Moderate Persistent	Daily 3-4 nights/mo	Some limitation	2 or more exacerbations in 6 months or > 4 episodes of wheezing/yr with risk factors for asthma	Step 3: Medium-dose ICS and consider short-course OCS
Mild Persistent	3-6 days/wk 1-2 nights/mo	Minor limitation	2 or more exacerbations in 6 months or > 4 episodes of wheezing/yr with risk factors for asthma	Step 2: Low-dose ICS
Intermittent	<2 days/wk 0 nights/mo	None	0-1 per year	Step 1: SABA PRN

ICS=inhaled corticosteroids, LABA=long-acting $beta_2$ agonist, OCS=oral corticosteroids, SABA=short acting $beta_2$ agonist

Risk factors for asthma: parental history of asthma, concurrent eczema, patient sensitized to aeroallergens, or two of the following: patient sensitized to foods, eosinophilia, wheezing apart from colds

Note: Asthma classification should be based on symptoms present 4 weeks prior to exacerbation (at healthy baseline)

Table adapted from NHLBI 2007 guidelines [3] and tables in Wood PR and Hill VL "Practical Management of Asthma"[14]

Table 2. Classifying Severity and Initiating Treatment: Children 5 to 11 years

Severity Category	Days and Nights with Symptoms	Interference with Normal Activity	Pulmonary Function	Exacerbations	Preferred Treatment
Severe Persistent	Throughout every day Often at night	Extremely limited	Peak flows (or FEV_1) <60% personal best	>2 per year	Step 4: Medium-dose ICS, LABA and consider short-course OCS Step 3: Medium-dose ICS and consider short-course OCS
Moderate Persistent	Daily >1 night/wk	Some limitation	Peak flows (or FEV_1) 60-80% personal best	>2 per year	Step 3: Medium-dose ICS and consider short-course OCS
Mild Persistent	3-6 days/wk 3-4 nights/mo	Minor limitation	Peak flows (or FEV_1) >80% personal best	>2 per year	Step 2: Low-dose ICS
Intermittent	<2 days/wk <2 nights/mo	None	Peak flows (or FEV_1) >80% personal best	0-1 per year	Step 1: SABA PRN

FEV_1=forced expiratory volume in 1 second, ICS=inhaled corticosteroids, LABA=long-acting $beta_2$ agonist, OCS=oral corticosteroids, SABA=short acting $beta_2$ agonist

Note: Asthma classification should be based on symptoms present 4 weeks prior to exacerbation (at healthy baseline)

Table adapted from NHLBI 2007 guidelines [3] and tables in Wood PR and Hill VL "Practical Management of Asthma"[14]

Table 3. Classifying Severity and Initiating Treatment: Youth > 12 Years of Age

Severity Category	Days and Nights with Symptoms	Interference with Normal Activity	Pulmonary Function	Exacerbations	Preferred Treatment
Severe Persistent	Throughout every day Often at night	Extremely limited	Peak flows (or FEV_1) <60% personal best	>2 per year	Step 5: High-dose ICS + LABA and consider short-course OCS Step 4: Medium-dose ICS + LABA and consider short-course OCS
Moderate Persistent	Daily 2-6 nights/wk	Some limitation	Peak flows (or FEV_1) 60-80% personal best	>2 per year	Step 3: Low-dose ICS + LABA OR Medium dose ICS and consider short-course OCS
Mild Persistent	3-6 days/wk 3-4 nights/mo	Minor limitation	Peak flows (or FEV_1) >80% personal best	>2 per year	Step 2: Low-dose ICS
Intermittent	<2 days/wk <2 nights/mo	None	Peak flows (or FEV_1) >80% personal best	0-1 per year	Step 1: SABA PRN

FEV_1=forced expiratory volume in 1 second, ICS=inhaled corticosteroids, LABA=long-acting $beta_2$ agonist, OCS=oral corticosteroids, SABA=short acting $beta_2$ agonist

Note: Asthma classification should be based on symptoms present 4 weeks prior to exacerbation (at healthy baseline)

Table adapted from NHLBI 2007 guidelines [3] and tables in Wood PR and Hill VL "Practical Management of Asthma"[14]

Table 4. Stepwise Approach for Managing Asthma: Preferred Therapy by Age Group

Age	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
0 to 4 yrs	SABA PRN	Low-dose ICS	Medium-dose ICS	Medium-dose ICS + either LABA or montelukast	High-dose ICS + either LABA or montelukast	High-dose ICS + OCS + either LABA or montelukast
5 to 11 yrs	SABA PRN	Low-dose ICS	Low-dose ICS + either LABA, LTRA, or theophylline OR Medium-dose ICS	Medium-dose ICS + LABA	High-dose ICS + LABA	High-dose ICS + LABA + OCS
> 12 yrs	SABA PRN	Low-dose ICS	Low-dose ICS + LABA OR Medium-dose ICS	Medium-dose ICS + LABA	High-dose ICS + LABA*	High-dose ICS + LABA + OCS*

ICS=inhaled corticosteroid, LABA=long-acting beta agonist, LTRA=leukotriene receptor antagonist, OCS=oral corticosteroids, SABA=short-acting beta$_2$ agonist.

- All patients need quick-relief medication (SABA)
- Each Step: Patient education, environmental control, and management of comorbidities
- Steps 2–4 (5 yr to adult): Consider subcutaneous allergen immunotherapy for patients who have persistent, allergic asthma
- *Steps 5–6 (12 yr to adult): Consider omalizumab for patients who have allergies

Table adapted from NHLBI 2007 guidelines [3] and tables in Wood PR and Hill VL "Practical Management of Asthma"[14]

Table 5. Peak Flow Prediction by Measured Height

Height (in)	Height (cm)	Predicted PF	Green Zone	Yellow Zone	Red Zone
43	109	147	>118	118 - 74	<74
44	112	160	>128	128 - 80	<80
45	114	173	>138	138 - 87	<87
46	117	187	>150	150 - 94	<94
47	119	200	>160	160 - 100	<100
48	122	214	>171	171 - 107	<107
49	124	227	>182	182 - 114	<114
50	127	240	>192	192 - 120	<120
51	130	254	>203	203 - 127	<127
52	132	267	>214	214 - 134	<134
53	135	280	>224	224 - 140	<140
54	137	293	>234	234 - 147	<147
55	140	307	>246	246 - 154	<154
56	142	320	>256	256 - 160	<160
57	145	334	>267	267 - 167	<167
58	147	347	>278	278 - 174	<174
59	150	360	>288	288 - 180	<180
60	152	373	>298	298 - 187	<187
61	155	387	>310	310 - 194	<194
62	157	400	>320	320 - 200	<200
63	160	413	>330	330 - 207	<207
64	163	427	>342	342 - 214	<214
65	165	440	>352	352 - 220	<220
66	168	454	>363	363 - 227	<227
67	170	467	>374	374 - 234	<234
68	173	476	>381	381 - 238	<238
70	178	503	>402	402 - 252	<252
72	183	529	>423	423 - 265	<265

Using Peak Flow Table

- Peak flows can be found for patients ≥ 5 yrs in Epic by reviewing "View-only Doc Flowsheet" → RT Assessment tab → Peak Flow subheading. You should use this table as a reference for disease progression.
- Peak flows for each respective zone will be entered on the AMP by the respiratory therapist.
- NOTE: All tables are averages and are based on tests with a large number of people. The peak flow rate of an individual can vary widely.

The predicted values on this table used by CHW RT are based on the regression equations of the following publication: Polgar G, Promadhat V; Pulmonary Function Testing in Children: Techniques and Standards. Philadelphia, W.B. Saunders Company, 1971.

Table 6. Albuterol Dosing Guide for Discharge After Status Asthmaticus

Weight	0-10 kg	11-20 kg	21-29 kg	>30 kg
Albuterol prediluted nebules **(Must specify concentration on prescription for pharmacist)** **In Epic order is "Albuterol nebulizer solution 0.083%"**	2.5 mg/3 mL (0.083%) Yellow zone: 1 nebule every 4 hours as needed, may give up to 1 nebule every 20 minutes x 3 as needed, call physician Red zone: 1 nebule every 20 min and go to ED	2.5 mg/3 mL (0.083%) Yellow zone: 1 nebule every 4 hours as needed, may give up to 1 nebule every 20 minutes x 3 as needed, call physician Red zone: 1 nebule every 20 min and go to ED	2.5 mg/3 mL (0.083%) Yellow zone: 1 nebule every 4 hours as needed, may give up to 1.5 nebules every 20 minutes x 3 as needed, call physician Red zone: 1 nebule every 20 min and go to ED	2.5 mg/3 mL (0.083%) Yellow zone: 1-2 nebules every 4 hours as needed, may give up to 2 nebules every 20 minutes x 3 as needed, call physician Red zone: 1 nebule every 20 min and go to ED
Albuterol HFA MDI (90 micrograms per acuation) **(Trade names: Proair©, Proventil©, Ventolin©)** **To be prescribed with a valved holding chamber (and a mask if < 5 yrs)**	4 puffs Yellow zone: Every 4 hours as needed, may give up to 4 puffs every 20 minutes x 3 as needed, call physician Red zone: 7-8 puffs every 20 minutes on the way to the ED	4 puffs Yellow zone: Every 4 hours as needed, may give up to 4-8 puffs every 20 minutes x 3 as needed, call physician Red zone: 7-8 puffs every 20 minutes on the way to the ED	4 puffs Yellow zone: Every 4 hours as needed, may give up to 4-8 puffs every 20 minutes x 3 as needed, call physician Red zone: 7-8 puffs every 20 minutes on the way to the ED	4 puffs Yellow zone: Every 4 hours as needed, may give up to 4-8 puffs every 20 minutes x 3 as needed, call physician Red zone: 7-8 puffs every 20 minutes on the way to the ED

Note: Dosing from this table is appropriate upon discharge. Inpatient dosing may be more frequent, as per protocol.

Table 7. Albuterol Dosing for an Acute Asthma Exacerbation per Lexicomp/NAEP 2007 Guidelines

Albuterol Nebulization:	**Children:** 0.15 mg/kg (minimum dose: 2.5 mg) every 20 minutes for 3 doses then 0.15-0.3 mg/kg (not to exceed 10 mg) every 1-4 hours as needed or 0.5 mg/kg/hour by continuous nebulization. **Adults:** 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 by continuous nebulization.
Albuterol Inhalation:	**Children:** 4-8 puffs every 20 minutes for 3 doses then every 1-4 hours. **Adults:** 4-8 puffs every 20 minutes for up to 4 hours then every 1-4 hours as needed.

Figure 1. Example Asthma Management Plan*

Children's Hospital of Wisconsin

Deanna Miniwheats
Asthma Management Plan
Date of Birth: 12/31/2009
Today's Date: 7/3/2018

Green Zone **Breathing should be good. No cough or wheeze. Can do normal activities.**

Always use a spacer with your inhalers as directed.

Controller Medicine(s)
Flovent 110 mcg inhaler 2 puffs every morning and evening

Exercise and Trigger Medicine(s) to be used before all activities
Albuterol (ProAir, Proventil, Ventolin) 90 mcg inhaler 4 puffs 15 minutes before activity

Yellow Zone **Cough. Cold symptoms. Wheeze. Tight chest. Cough at night.**

Start your Quick Relief Medicine(s)
Albuterol (ProAir, Proventil, Ventolin) 90 mcg inhaler 4 puffs every 4 hours as needed

Keep taking your Green Zone controller medicine(s) as prescribed.

If you are in the **YELLOW** zone more than **24** hours or are getting worse, follow RED ZONE and call your doctor right away!

Red Zone **Get Help Now!! Medicine is not working!!**
Breathing is hard and fast. Nose opens wider. Ribs sticking out. Trouble walking, talking, or sleeping.

Take your quick relief medicine(s) NOW and call your doctor or nurse NOW!
Albuterol (ProAir, Proventil, Ventolin) 90 mcg inhaler 8 puffs every 2 hours as needed

If you are not able to contact your doctor or nurse, go to the emergency room or call 911 right away!

Your Asthma Triggers	Animal Dander, Colds and Viruses, Exercise, Tobacco Smoke.
Follow Up Information	Please refer to your most recent After Visit Summary (AVS) for detailed follow up information.

Form Completed by: Sarah H Vepraskas, MD 7/3/2018

* If your patient is of school-age, ask the respiratory therapist to print out extra AMPs for the child to have at school. There should also be copies in the home of every caretaker.

Figure 2. Example Asthma Management Plan in Draft Form

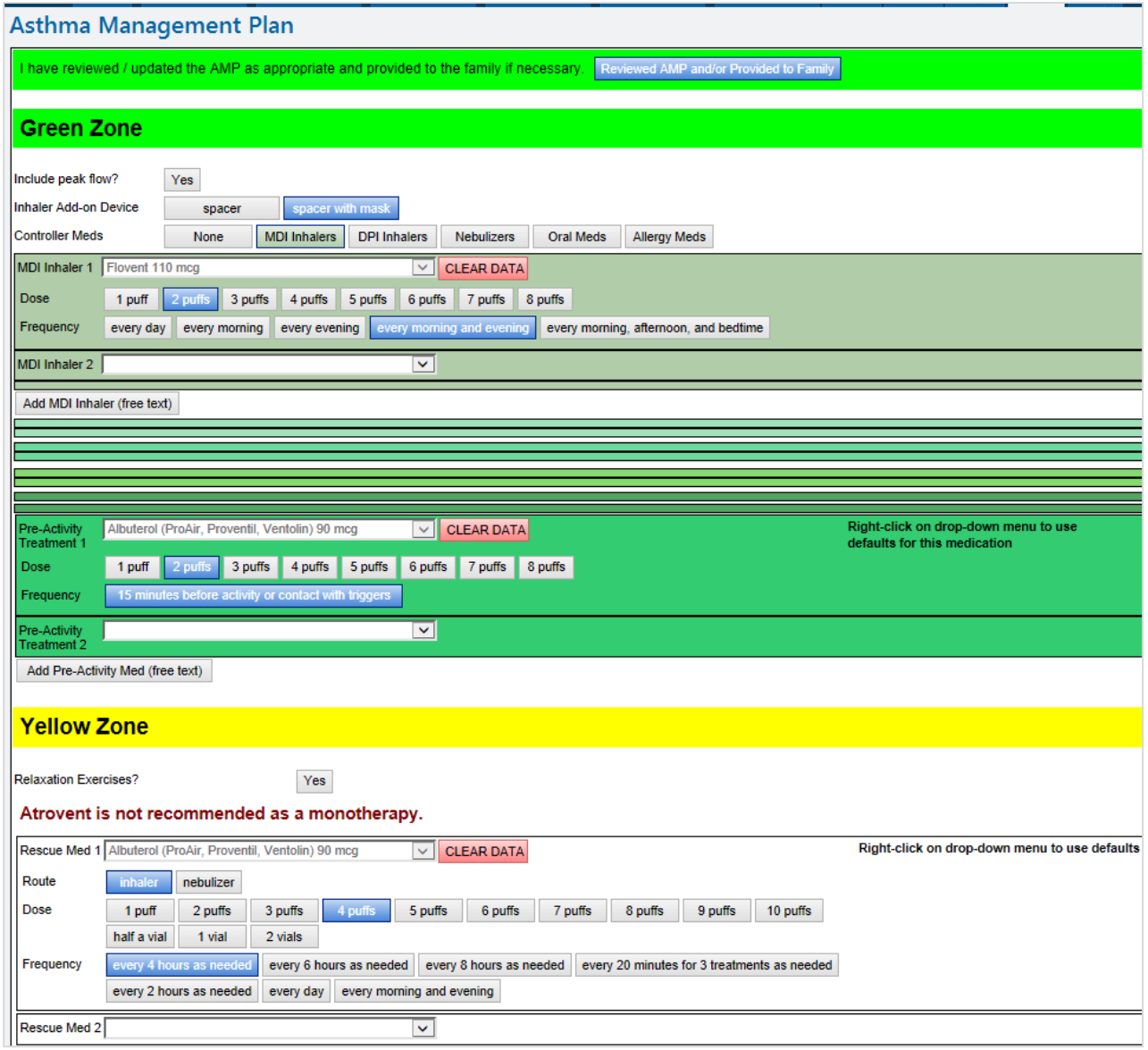

Figure 3. Example Asthma After Visit Summary

AFTER VISIT SUMMARY

Children's Hospital of Wisconsin

Anton Bat Date of birth: 8/12/2009 MRN: 2005921 CSN: 67073411

12/28/2018 WEST 10 Moderate persistent asthma with status asthmaticus

Hospital #414.266.2000 Central Scheduling #414.607.5280 Toll Free #877.607.5280

Reasons to Call

Call Primary Care Provider
King, Drew, MD
None
Call if:
- Has breathing that gets worse or does not get better over the next several days
- Does not feel better after breathing treatments
- Has no interest in eating, drinking or playing
- Is vomiting and cannot keep down medicine or fluids
- Has a new fever

Has signs of dehydration such as:
- No tears when crying
- Dry mouth
- No urine for 8-10 hours
- Has poor activity

Continue giving Albuterol treatments every 4 to 6 hours until your follow up appointment, Call if you need to give Albuterol more often than this.

Go to the Emergency Room or Call 911 if the Patient

Has a blue or gray color to lips or nail beds

Care at Home - What to Expect

Breathing should get better each day

Cough may last up to a week or longer. Cough should get better each day.

Care at Home - What to Do

Do not give cough or cold medicines without discussing with your primary care provider. These medications can be dangerous for small children.

Follow the Asthma Management Plan for when and how to use medicines, further care at home, and what to do if medicines are not helping and breathing is getting worse.

Limit smoke exposure
For free assistance to quit smoking, call the toll-free Wisconsin Tobacco Quit Line at 1-800-784-8669. You can also find more information online at https:www.quitnow.net/wisconsin.

Activity

Other Activity
Anton shouldn't play outside in the cold weather until cleared by his pediatrician.

Diet

May eat foods normally eaten.

Offer plenty of fluids

Immunizations

Yearly flu shot recommended

Medication List and Appointments Not Shown

Orderset Name: GEN DC ASTHMA

Single Maintenance and Reliever Therapy (SMART) Clinician's Summary from 2020 Focused Updates to the Asthma Management Guidelines

Clinician's Summary:

In individuals ages 4 years and older, the preferred Step 3 (low-dose ICS) and Step 4 (medium-dose ICS) therapy is single-inhaler ICS-formoterol both daily and as needed. In the literature, inhaled ICS-formoterol is referred to as "single maintenance and reliever therapy (SMART)." This form of therapy has only been used with formoterol as the LABA. Formoterol has a rapid onset and a maximum total daily dose that allows it to be used more than twice daily.[147] The maximum total daily dose of formoterol should not exceed eight puffs (36 mcg) for ages 4–11 years and 12 puffs (54 mcg) for ages 12 years and older. SMART is administered with a single inhaler containing both formoterol and an ICS (primarily budesonide in the reviewed studies, but one study used beclomethasone). The regimens compared to address this key question required two inhalers: the controller (ICS or ICS-LABA) and the reliever (SABA). The recommended alternate therapy of maintenance ICS-LABA with SABA as quick-relief therapy does not need to be changed if it is providing adequate control. However, patients whose asthma is uncontrolled on such therapy should receive the preferred SMART if possible before moving to a higher step of therapy.

Management of Persistent Asthma for Ages 0-4 Years

(Table from 2020 Focused Updates to the Asthma Management Guidelines)

	Intermittent Asthma	Management of Persistent Asthma in Individuals Ages 0–4 Years				
Treatment	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
Preferred	PRN SABA and At the start of RTI: Add short course daily ICS▲	Daily low-dose ICS and PRN SABA	Daily low-dose ICS-LABA and PRN SABA▲ or Daily low-dose ICS + montelukast,* or daily medium-dose ICS, and PRN SABA	Daily medium-dose ICS-LABA and PRN SABA	Daily high-dose ICS-LABA and PRN SABA	Daily high-dose ICS-LABA + oral systemic corticosteroid and PRN SABA
Alternative		Daily montelukast* or Cromolyn,* and PRN SABA		Daily medium-dose ICS + montelukast* and PRN SABA	Daily high-dose ICS + montelukast* and PRN SABA	Daily high-dose ICS + montelukast*+ oral systemic corticosteroid and PRN SABA
			For children age 4 years only, see Step 3 and Step 4 on Management of Persistent Asthma in Individuals Ages 5–11 Years diagram.			

Assess Control

- First check adherence, inhaler technique, environmental factors,▲ and comorbid conditions.
- **Step up** if needed; reassess in 4–6 weeks
- **Step down** if possible (if asthma is well controlled for at least 3 consecutive months)

Consult with asthma specialist if Step 3 or higher is required. Consider consultation at Step 2.

Control assessment is a key element of asthma care. This involves both impairment and risk. Use of objective measures, self-reported control, and health care utilization are complementary and should be employed on an ongoing basis, depending on the individual's clinical situation.

Abbreviations: ICS, inhaled corticosteroid; LABA, long-acting beta$_2$-agonist; SABA, inhaled short-acting beta$_2$-agonist; RTI, respiratory tract infection; PRN, as needed

▲ Updated based on the 2020 guidelines.

* Cromolyn and montelukast were not considered for this update and/or have limited availability for use in the United States. The FDA issued a Boxed Warning for montelukast in March 2020.

NOTES FOR INDIVIDUALS AGES 0–4 YEARS DIAGRAM

Quick-relief medications	• Use SABA as needed for symptoms. The intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-minute intervals as needed. • **Caution:** Increasing use of SABA or use >2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and may require a step up in treatment. • Consider short course of oral systemic corticosteroid if exacerbation is severe or individual has history of previous severe exacerbations.
Each step: Assess environmental factors, provide patient education, and manage comorbidities▲	• In individuals with sensitization (or symptoms) related to exposure to pests‡: conditionally recommend integrated pest management as a single or multicomponent allergen-specific mitigation intervention.▲ • In individuals with sensitization (or symptoms) related to exposure to identified indoor allergens, conditionally recommend a multi-component allergen-specific mitigation strategy.▲ • In individuals with sensitization (or symptoms) related to exposure to dust mites, conditionally recommend impermeable pillow/mattress covers only as part of a multicomponent allergen-specific mitigation intervention, but not as a single component intervention.▲
Notes	• If clear benefit is not observed within 4–6 weeks and the medication technique and adherence are satisfactory, the clinician should consider adjusting therapy or alternative diagnoses.
Abbreviations	EIB, exercise-induced bronchoconstriction; SABA, inhaled short-acting $beta_2$-agonist. ▲Updated based on the 2020 guidelines. ‡ Refers to mice and cockroaches, which were specifically examined in the Agency for Healthcare Research and Quality systematic review.

Management of Persistent Asthma for Ages 5-11 Years

(Table from 2020 Focused Updates to the Asthma Management Guidelines)

SMART

	Intermittent Asthma	Management of Persistent Asthma in Individuals Ages 5–11 Years				
Treatment	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
Preferred	PRN SABA	Daily low-dose ICS and PRN SABA	Daily and PRN combination low-dose ICS-formoterol▲	Daily and PRN combination medium-dose ICS-formoterol▲	Daily high-dose ICS-LABA and PRN SABA	Daily high-dose ICS-LABA + oral systemic corticosteroid and PRN SABA
Alternative		Daily LTRA,* or Cromolyn,* or Nedocromil,* or Theophylline,* and PRN SABA	Daily medium-dose ICS and PRN SABA or Daily low-dose ICS-LABA, or daily low-dose ICS + LTRA,* or daily low-dose ICS +Theophylline,* and PRN SABA	Daily medium-dose ICS-LABA and PRN SABA or Daily medium-dose ICS + LTRA* or daily medium-dose ICS + Theophylline,* and PRN SABA	Daily high-dose ICS + LTRA* or daily high-dose ICS + Theophylline,* and PRN SABA	Daily high-dose ICS + LTRA* + oral systemic corticosteroid or daily high-dose ICS + Theophylline* + oral systemic corticosteroid, and PRN SABA
		Steps 2–4: Conditionally recommend the use of subcutaneous immunotherapy as an adjunct treatment to standard pharmacotherapy in individuals ≥ 5 years of age whose asthma is controlled at the initiation, build up, and maintenance phases of immunotherapy▲			Consider Omalizumab**▲	

Assess Control

- First check adherence, inhaler technique, environmental factors,▲ and comorbid conditions.
- **Step up** if needed; reassess in 2–6 weeks
- **Step down** if possible (if asthma is well controlled for at least 3 consecutive months)

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

Control assessment is a key element of asthma care. This involves both impairment and risk. Use of objective measures, self-reported control, and health care utilization are complementary and should be employed on an ongoing basis, depending on the individual's clinical situation.

Abbreviations: ICS, inhaled corticosteroid; LABA, long-acting beta$_2$-agonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short-acting beta$_2$-agonist

▲ Updated based on the 2020 guidelines.
* Cromolyn, Nedocromil, LTRAs including montelukast, and Theophylline were not considered in this update and/or have limited availability for use in the United States, and/or have an increased risk of adverse consequences and need for monitoring that make their use less desirable. The FDA issued a Boxed Warning for montelukast in March 2020.
** Omalizumab is the only asthma biologic currently FDA-approved for this age range.

NOTES FOR INDIVIDUALS AGES 5–11 YEARS DIAGRAM

Quick-relief medications	• Use SABA as needed for symptoms. The intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-minute intervals as needed. • In Steps 3 and 4, the preferred option includes the use of ICS-formoterol 1 to 2 puffs as needed up to a maximum total daily maintenance and rescue dose of 8 puffs (36 mcg).▲ • **Caution:** Increasing use of SABA or use >2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and may require a step up in treatment.
Each step: Assess environmental factors, provide patient education, and manage comorbidities▲	• In individuals with sensitization (or symptoms) related to exposure to pests‡: conditionally recommend integrated pest management as a single or multicomponent allergen-specific mitigation intervention.▲ • In individuals with sensitization (or symptoms) related to exposure to identified indoor allergens, conditionally recommend a multi-component allergen-specific mitigation strategy.▲ • In individuals with sensitization (or symptoms) related to exposure to dust mites, conditionally recommend impermeable pillow/mattress covers only as part of a multicomponent allergen-specific mitigation intervention, but not as a single component intervention.▲
Notes	• The terms ICS-LABA and ICS-formoterol indicate combination therapy with both an ICS and a LABA, usually and preferably in a single inhaler. • Where formoterol is specified in the steps, it is because the evidence is based on studies specific to formoterol. • In individuals ages 5–11 years with persistent allergic asthma in which there is uncertainty in choosing, monitoring, or adjusting anti-inflammatory therapies based on history, clinical findings, and spirometry, FeNO measurement is conditionally recommended as part of an ongoing asthma monitoring and management strategy that includes frequent assessment.
Abbreviations	EIB (exercise-induced bronchoconstriction); FeNO (fractional exhaled nitric oxide); ICS (inhaled corticosteroid); LABA (long-acting $beta_2$-agonist); SABA (inhaled short-acting $beta_2$-agonist). ▲Updated based on the 2020 guidelines. ‡ Refers to mice and cockroaches, which were specifically examined in the Agency for Healthcare Research and Quality systematic review.

Management of Persistent Asthma for Ages 12+ Years

(Table from 2020 Focused Updates to the Asthma Management Guidelines)

SMART

	Intermittent Asthma	Management of Persistent Asthma in Individuals Ages 12+ Years				
Treatment	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6■
Preferred	PRN SABA	Daily low-dose ICS and PRN SABA or PRN concomitant ICS and SABA▲	Daily and PRN combination low-dose ICS-formoterol▲	Daily and PRN combination medium-dose ICS-formoterol▲	Daily medium-high dose ICS-LABA + LAMA and PRN SABA▲	Daily high-dose ICS-LABA + oral systemic corticosteroids + PRN SABA
Alternative		Daily LTRA* and PRN SABA or Cromolyn,* or Nedocromil,* or Zileuton,* or Theophylline,* and PRN SABA	Daily medium-dose ICS and PRN SABA or Daily low-dose ICS-LABA, or daily low-dose ICS + LAMA,▲ or daily low-dose ICS + LTRA,* and PRN SABA or Daily low-dose ICS + Theophylline* or Zileuton,* and PRN SABA	Daily medium-dose ICS-LABA or daily medium-dose ICS + LAMA, and PRN SABA▲ or Daily medium-dose ICS + LTRA,* or daily medium-dose ICS + Theophylline,* or daily medium-dose ICS + Zileuton,* and PRN SABA	Daily medium-high dose ICS-LABA or daily high-dose ICS + LTRA,* and PRN SABA	
		Steps 2–4: Conditionally recommend the use of subcutaneous immunotherapy as an adjunct treatment to standard pharmacotherapy in individuals ≥ 5 years of age whose asthma is controlled at the initiation, build up, and maintenance phases of immunotherapy▲			Consider adding Asthma Biologics (e.g., anti-IgE, anti-IL5, anti-IL5R, anti-IL4/IL13)**	

Assess Control

- First check adherence, inhaler technique, environmental factors,▲ and comorbid conditions.
- **Step up** if needed; reassess in 2–6 weeks
- **Step down** if possible (if asthma is well controlled for at least 3 consecutive months)

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

Control assessment is a key element of asthma care. This involves both impairment and risk. Use of objective measures, self-reported control, and health care utilization are complementary and should be employed on an ongoing basis, depending on the individual's clinical situation.

Abbreviations: ICS, inhaled corticosteroid; LABA, long-acting beta$_2$-agonist; LAMA, long-acting muscarinic antagonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short-acting beta$_2$-agonist

▲ Updated based on the 2020 guidelines.

* Cromolyn, Nedocromil, LTRAs including Zileuton and montelukast, and Theophylline were not considered for this update, and/or have limited availability for use in the United States, and/or have an increased risk of adverse consequences and need for monitoring that make their use less desirable. The FDA issued a Boxed Warning for montelukast in March 2020.

** The AHRQ systematic reviews that informed this report did not include studies that examined the role of asthma biologics (e.g. anti-IgE, anti-IL5, anti-IL5R, anti-IL4/IL13). Thus, this report does not contain specific recommendations for the use of biologics in asthma in Steps 5 and 6.

■ Data on the use of LAMA therapy in individuals with severe persistent asthma (Step 6) were not included in the AHRQ systematic review and thus no recommendation is made.

NOTES FOR INDIVIDUALS AGES 12+ YEARS DIAGRAM

Quick-relief medications	• Use SABA as needed for symptoms. The intensity of treatment depends on the severity of symptoms: up to 3 treatments at 20-minute intervals as needed. • In steps 3 and 4, the preferred option includes the use of ICS-formoterol 1 to 2 puffs as needed up to a maximum total daily maintenance and rescue dose of 12 puffs (54 mcg).▲ • **Caution:** Increasing use of SABA or use >2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and may require a step up in treatment.
Each step: Assess environmental factors, provide patient education, and manage comorbidities▲	• In individuals with sensitization (or symptoms) related to exposure to pests‡: conditionally recommend integrated pest management as a single or multicomponent allergen-specific mitigation intervention.▲ • In individuals with sensitization (or symptoms) related to exposure to identified indoor allergens, conditionally recommend a multi-component allergen-specific mitigation strategy.▲ • In individuals with sensitization (or symptoms) related to exposure to dust mites, conditionally recommend impermeable pillow/mattress covers only as part of a multicomponent allergen-specific mitigation intervention, but not as a single component intervention.▲
Notes	• The terms ICS-LABA and ICS-formoterol indicate combination therapy with both an ICS and a LABA, usually and preferably in a single inhaler. • Where formoterol is specified in the steps, it is because the evidence is based on studies specific to formoterol. • In individuals ages 12 years and older with persistent allergic asthma in which there is uncertainty in choosing, monitoring, or adjusting anti-inflammatory therapies based on history, clinical findings, and spirometry, FeNO measurement is conditionally recommended as part of an ongoing asthma monitoring and management strategy that includes frequent assessment. • Bronchial thermoplasty was evaluated in Step 6. The outcome was a conditional recommendation against the therapy.
Abbreviations	EIB, exercise-induced bronchoconstriction; FeNO, fractional exhaled nitric oxide; ICS, inhaled corticosteroid; LABA, long-acting beta$_2$-agonist; SABA, inhaled short-acting beta$_2$-agonist. ▲Updated based on the 2020 guidelines. ‡ Refers to mice and cockroaches, which were specifically examined in the Agency for Healthcare Research and Quality systematic review.

Medical Disclaimer

This CPG is designed to provide a framework for evaluation and treatment of *asthma*. It is not intended to establish a protocol for all patients with this condition, nor is it intended to replace a clinician's judgement. Adherence to this CPG is voluntary. Decisions to adopt recommendations from this CPG must be made by the clinician in light of available resources and the individual circumstances of the patient.

Medicine is a dynamic science; as research and clinical experience enhance and inform the practice of medicine, changes in treatment protocols and drug therapies are required. The authors have checked with sources believed to be reliable in their effort to provide information that is complete and generally in accord with standards accepted at the time of publication. However, because of the possibility of human error and changes in medical science, neither the authors nor Children's Hospital and Health System, Inc., nor any other party involved in the preparation of this work warrant that the information contained in this work is in every respect accurate or complete, and they are not responsible for any errors in, omissions from, or results obtained from the use of this information. Readers are encouraged to confirm the information contained in this work with other sources.