Maintenance Treatment in Pediatric Asthma

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Asthma treatment

- “Reliever" medications,
  - which are taken as needed during sudden flare-ups
- "Maintenance" treatment
- Refers to the long-term, regular (daily) use of medications aimed at
  - controlling symptoms,
  - preventing asthma attacks,
  - and maintaining stable lung function.,

maintenance treatments are taken consistently—even when a person feels well—to keep inflammation in the airways under control.

Relievers vs Maintenance

- Reliever (Rescue) meds: Short-acting bronchodilators (like albuterol) taken only when symptoms appear.

- Maintenance meds: Taken daily to prevent those symptoms from arising in the first place.

Key Goals

- Reduce airway inflammation
- Prevent asthma symptoms (cough, wheeze, shortness of breath)
- Minimize the need for rescue inhalers
- Reduce the risk of severe asthma exacerbations and hospitalizations
- Improve quality of life and lung function

Main Types of Maintenance Medications

Inhaled Corticosteroids (ICS)

- First-line treatment for most people with persistent asthma.
- Reduce airway inflammation and hyperreactivity.
- Examples: budesonide, fluticasone, beclomethasone.

Long-Acting Beta-Agonists (LABAs) – usually combined with ICS

- Provide long-term relaxation of airway muscles.
- Used only in combination with corticosteroids, not alone.
- Examples: formoterol, salmeterol.

Combination Inhalers (ICS + LABA)

- Simplify treatment and improve adherence.
- Examples: budesonide-formoterol, fluticasone-salmeterol.

Leukotriene Receptor Antagonists (LTRAs)

- Oral medications that reduce airway inflammation.
- Examples: montelukast, zafirlukast.

Biologic Therapies (for severe asthma)

- Target specific immune pathways in people with poorly controlled asthma.

- Examples: omalizumab (anti-IgE), mepolizumab (anti-IL-5).

Other Add-on Options

- Long-acting muscarinic antagonists (LAMAs) like tiotropium (in some patients).

- Theophylline (rarely used now due to side effects).

Stepwise Approach (Children 6–11 yrs)

Stepwise Treatment – NAEPP 2020 (Children 5–11 yrs)

Step	Preferred Treatment
1	PRN SABA
2	Daily low-dose ICS + PRN SABA
3	Daily low-dose ICS–LABA OR medium-dose ICS + PRN SABA
4	Medium-dose ICS–LABA + PRN SABA
5	High-dose ICS–LABA + PRN SABA
6	High-dose ICS–LABA + oral corticosteroid

Stepwise Treatment – GINA 2024 (Children 6–11 yrs)

Step	Preferred Treatment
1–2	Low-dose ICS daily, or ICS with SABA; Montelukast less effective
3	Low-dose ICS–LABA OR medium-dose ICS; MART with ICS–formoterol preferred
4	Medium-dose ICS–LABA; add tiotropium ≥6 yrs
5	High-dose ICS–LABA; consider biologics (omalizumab, mepolizumab, dupilumab)

GINA vs NAEPP – Comparison

GINA (Global Initiative for Asthma)	NAEPP (National Asthma Education and Prevention Program)
Global guideline (founded 1993, WHO collaboration)	U.S. national guideline (led by NIH/NHLBI)
Updated annually, worldwide applicability	Last major update in 2020
Uses MART terminology; emphasizes ICS–formoterol as reliever from Step 1	Uses SMART terminology; more conservative for mild asthma

MART vs SMART – Comparison

MART (Maintenance and Reliever Therapy)	SMART (Single Maintenance and Reliever Therapy)
Term used mainly in GINA guidelines (international)	Term used mainly in NAEPP guidelines (USA)
Same concept: ICS–Formoterol as both maintenance and reliever	Same concept: ICS–Formoterol as both maintenance and reliever

Case Vignette – Step 1–2

- 8-year-old, symptoms only with viral infections
- Symptoms <2x/month, no nocturnal symptoms
- Management: Low-dose ICS daily or with SABA

GINA Criteria (Mild Asthma):
- Symptoms <2/week
- No night waking
- Normal activity
- FEV1 >80% predicted
- Controlled with Step 1–2 therapy

Severity: Mild Asthma

- Low-dose ICS:
  - Budesonide DPI: 100–200 mcg/day
  - Beclomethasone HFA: 100–200 mcg/day
  - Fluticasone propionate: 100 mcg/day

Case Vignette – Step 3

- 6-year-old, daily cough, SABA 4x/week, waking 2 nights/week
- On low-dose ICS for 3 months
- Management: Step up to low-dose ICS–LABA or MART

GINA Criteria (Moderate Asthma):

- Symptoms most days or waking ≥1/week
- Some activity limitation
- FEV1 60–80% predicted
- Controlled with Step 3 therapy

Severity: Moderate Asthma

Drug Dosing:

Low-dose ICS–LABA (preferred):

- Budesonide–Formoterol DPI 80/4.5 mcg: 1 puff BID

Medium-dose ICS (alternative):

- Budesonide DPI: 200–400 mcg/day
- Beclomethasone HFA: 200–400 mcg/day

Case Vignette – Step 4

- 10-year-old, persistent symptoms despite low-dose ICS–LABA
- Uses reliever daily, spirometry FEV1 72%
- Management: Medium-dose ICS–LABA, consider tiotropium

GINA Criteria (Moderate to Severe Asthma):

- Symptoms daily, frequent night waking
- Limitation of normal activity
- FEV1 often <70–80%
- Requires Step 4 treatment

Drug Dosing:

Medium-dose ICS–LABA:

- Budesonide–Formoterol DPI 80/4.5 mcg: 2 puffs BID

Add-on LAMA:

- Tiotropium Respimat (≥6 yrs): 1.25 mcg, 2 puffs once daily

Severity: Moderate to Severe Asthma

Case Vignette – Step 5

- 11-year-old, frequent hospitalizations despite high-dose ICS–LABA
- Atopic, blood eosinophils 600/µL
- Management: Add biologic (omalizumab, mepolizumab, dupilumab)

GINA Criteria (Severe Asthma):
- Poor control despite Step 4
- Frequent exacerbations/hospitalizations
- FEV1 <70% predicted
- Requires Step 5 (high-dose ICS–LABA ± biologics)

Severity: Severe Asthma

Drug Dosing:

High-dose ICS–LABA:
- Budesonide–Formoterol DPI 160/4.5 mcg: 2 puffs BID

Add-on Biologics:
- Omalizumab: 75–600 mg SC q2–4 weeks
- Mepolizumab: 40 mg SC q4 weeks (age 6–11)
- Dupilumab: 100 mg SC q2 weeks (age 6–11, weight-based)

Drug Doses – Pediatric Asthma (6–11 yrs)

Class	Drug	Dose (6–11 yrs)	Notes
ICS	Budesonide DPI	Low: 100–200 mcg/day Med: 200–400 mcg/day High: >400 mcg/day	
ICS	Beclomethasone HFA	Low: 100–200 mcg/day Med: 200–400 mcg/day High: >400 mcg/day	
ICS	Fluticasone propionate	Low: 100 mcg/day Med: 200 mcg/day High: >250 mcg/day	
ICS–LABA	Budesonide–Formoterol DPI (80/4.5)	Step 3: 1 puff BID Step 4: 2 puffs BID	SMART/MART option
ICS–LABA	Fluticasone–Salmeterol	100/50 mcg BID	Formulation dependent
LAMA	Tiotropium Respimat	1.25 mcg, 2 puffs OD	Add-on ≥6 yrs
Biologic	Omalizumab	75–600 mg SC q2–4 weeks	Based on weight & IgE (≥6 yrs)

Drug Doses – Pediatric Asthma (6–11 yrs)

Class	Drug	Dose (6–11 yrs)	Notes
Biologic	Omalizumab	75–600 mg SC q2–4 weeks	Based on weight & IgE (≥6 yrs)
Biologic	Mepolizumab	40 mg SC q4 weeks	Age 6–11 yrs
Biologic	Dupilumab	100 mg SC q2 weeks	Age 6–11 yrs, weight-based
Biologic	Benralizumab	SC dosing varies	≥12 yrs only

HFA = Hydrofluoroalkane

- یک گاز پروپلانت (است که در اسپری‌های استنشاقی (MDI: Metered Dose Inhaler)استفاده می‌شود.

- در واقع HFAجایگزین گازهای CFC (Chlorofluorocarbons)قدیمی شده است که به لایه اوزون آسیب می‌رساندند.
- بکلومتازون HFA
- همان بکلومتازون دی‌پروپیونات است که در یک دستگاه MDIبا پروپلانت HFAفرمول‌بندی شده.

مزایا نسبت به فرمولاسیون‌های قدیمی:

- ذرات ریزتر : رسوب بیشتر در ریه‌ها و اثربخشی بهتر

- ایمنی بیشتر برای محیط زیست (بدون آسیب به اوزون)

- امکان استفاده از دوز پایین‌تر برای رسیدن به همان اثر درمانی

Age Restrictions of Asthma Medications

Class	Medication	Age Restriction
ICS	Budesonide DPI	≥6 yrs (nebules ≥1 yr)
ICS	Beclomethasone HFA	≥5 yrs
ICS	Fluticasone propionate	≥4 yrs
ICS–LABA	Budesonide–Formoterol DPI	≥6 yrs
ICS–LABA	Beclomethasone–Formoterol HFA	≥12 yrs
ICS–LABA	Fluticasone–Salmeterol	≥4 yrs
LAMA	Tiotropium Respimat	≥6 yrs
Biologics	Omalizumab	≥6 yrs
Biologics	Mepolizumab	≥6 yrs
Biologics	Dupilumab	≥6 yrs
Biologics	Benralizumab	≥12 yrs

Step-Up / Step-Down

- Principles:
- Step up if uncontrolled after 2–3 months of good adherence.
- Check adherence, inhaler technique, triggers before stepping up.
- Step down after 3–6 months of good control to minimize side effects.
- Always aim for the lowest effective dose.

Special Age Groups

- Preschool (<5 yrs): daily low-dose ICS mainstay; intermittent high-dose ICS for viral wheeze.
- Adolescents: adherence challenges, once-daily combos useful, psychosocial support critical.

Stepwise Therapy – <5 years

Step	Preferred Treatment (<5 yrs)
1	SABA as needed; if severe viral-induced wheeze → short course of daily ICS
2	Low-dose ICS daily (e.g., Budesonide nebules, Fluticasone HFA) Alternative: Montelukast
3	Double low-dose ICS OR Low-dose ICS + Montelukast (LABA generally not recommended <5 yrs)
4	Specialist referral; consider higher-dose ICS or Montelukast add-on Evaluate other diagnoses

Practical Pearls

- Growth suppression risk with ICS is dose-related but benefits outweigh risks.
- Montelukast popular but less effective; discuss neuropsychiatric risks.
- Phenotyping (allergic, eosinophilic) useful in uncontrolled cases.
- Teach inhaler technique at every visit.
- Address caregiver beliefs & adherence barriers.

Interpretation of Spirometry and FeNO in Pediatric Asthma

Test	Parameter	Interpretation
Spirometry	FEV1 ≥80% predicted	Normal lung function
Spirometry	FEV1 60–80% predicted	Moderate impairment
Spirometry	FEV1 <60% predicted	Severe impairment
Feno(Fractional exhaled Nitric Oxide)	<20 ppb	Unlikely eosinophilic inflammation
FeNO	20–35 ppb	Borderline / consider clinical context
FeNO	>35 ppb	Likely eosinophilic inflammation; good ICS response