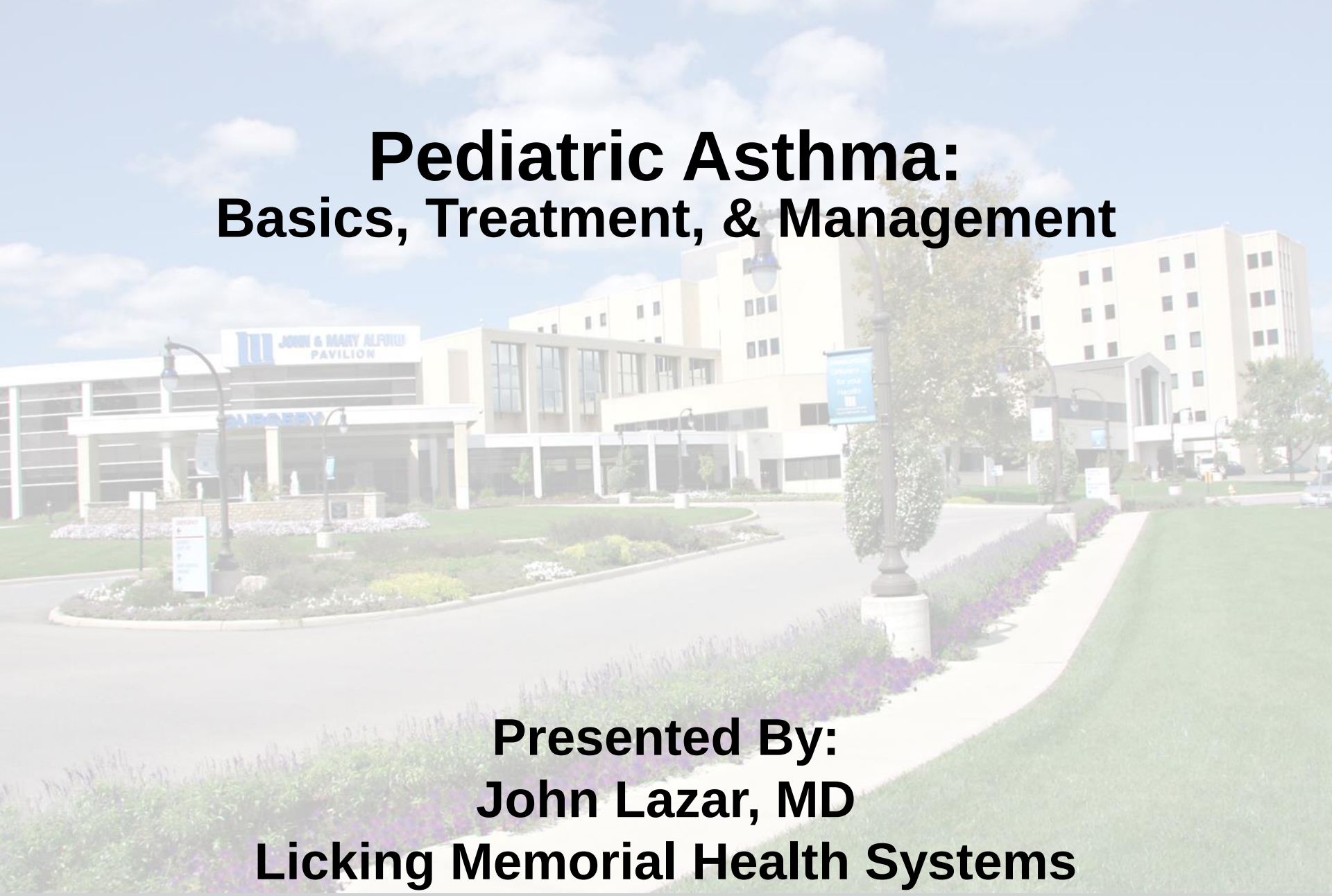


Pediatric Asthma:
Basics, Treatment, & Management

Presented By:
John Lazar, MD
Licking Memorial Health Systems

Disclosures

- Nothing to declare!

Road Map

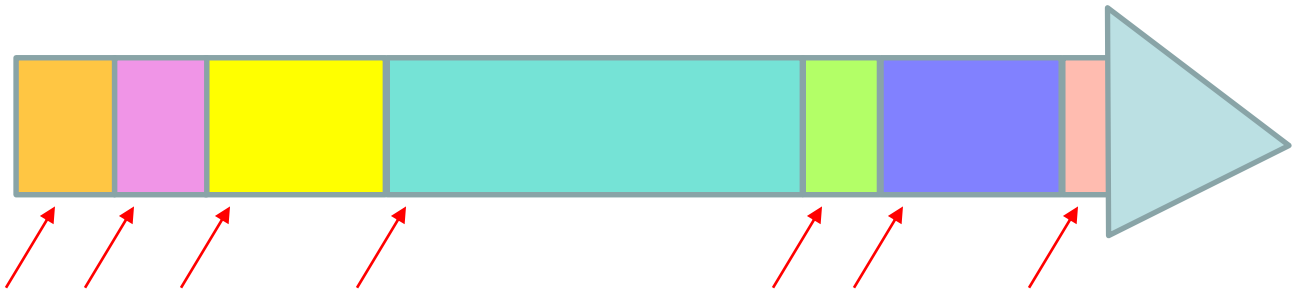
Can’t-Miss Pointers

Epidemiology

Pathophysiology/diagnosis

Mgmt

- General
- Med Techniques
- Outpatient Basics
- Exacerbations



Prognosis

Case study

Wrap-up

Can't Miss Pointers

- Mod/severe exacerbation: early, aggressive, and include albuterol/ipratropium
- Spacer with every inhaled med
- All Persistent asthma needs a controller
- Know how to:
  - Assess severity (determined by highest score in any category)
  - Initiate and step-up/step-down therapies
- Response to tx more important than nailing down dx

Why Should You Care?!

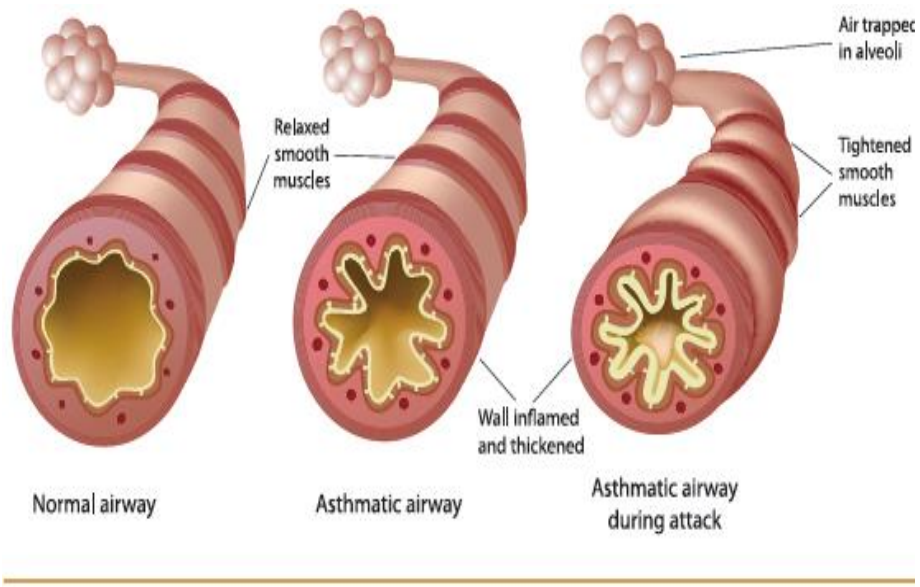
- Estimated to cost $2 billion/year
  - In < 5 y/o, ~50% was for inpt mgmt
- 1/3 of pt's do not have asthma action plan (AAP)
- 1/3 of pt's not counseled on early warning signs/mgmt
- 2004: 3% of pediatric hospitalizations and ED visits
- Outpatient control can prevent attacks, ED/UC visits, admissions

Epidemiology

- Differences exist related to SES, genetics, environment, in utero exposures, races (AA and Puerto Rican predilection)
- More attacks in cold/flu season
- Increased in atopic families

Pathophysiology

- Airway dz with inflammation, smooth muscle constriction, mucous production, edema leading to obstruction & air trapping
- Partially reversible
- Chronic symptoms → airway epithelium remodeling
- Triggers → exaggerated inflammatory response and bronchoconstriction (hyper-responsiveness):
  - URI, exercise, weather change, tobacco/smoke, air pollution, cold/hot air, strong perfumes, NSAIDs
- Hygiene hypothesis may decrease asthma



Diagnosis

- Usually needs observation over time
- Official: methacholine pulmonary function testing (PFT)
- Unofficial: If it looks like a duck, walks like a duck, quacks like a duck...
- Symptoms: cough, wheezing, chest tightness, SOB, prolonged expiration with trigger exposure
- Asthma Predictive Index (API)- predicts risk of asthma dx in children ≤ 3:
  - Major: 1 or more: eczema, parental asthma

    OR
  - Minor: 2 or more: allergic rhinitis, wheezing unrelated to colds, eosinophil count > 4%
  - ≥ 3 wheezing episodes/year: 95% specific
  - < 3 wheezing episodes/year: 80% specific
- Consider allergy testing for trigger avoidance

Wheezing Diagnosis: Just Wheezing or is it Asthma (and Does it Matter?)

Asthma is characterized by:

- Recurrent
- Persistent (usually past age 3)

Wheezing stats:

- 1st year of life: 32% of have LRTI-related wheezing
- 2nd year: 17%
- 3rd year: 12%
- ~50% have an episode of wheezing before 6 y/o (majority resolve)
- > 80% of infants with wheezing do NOT have wheezing after age 3

API to the rescue to predict risk!

Infants with RSV/rhinovirus bronchiolitis are at risk of wheezing.

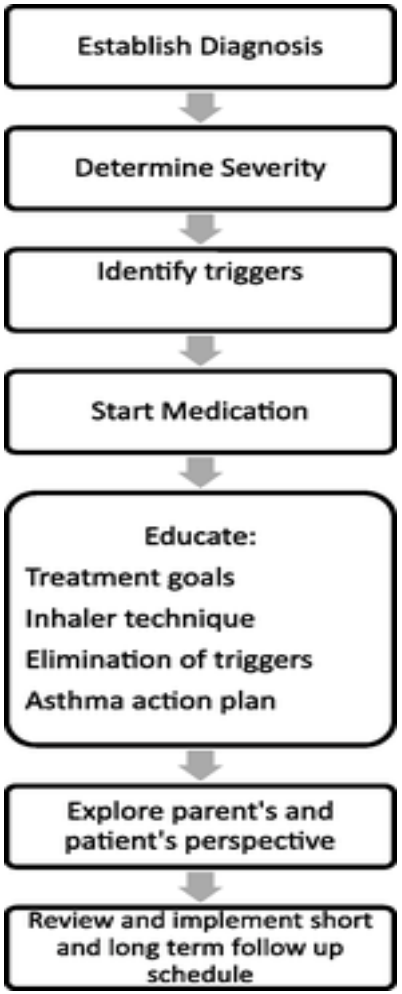
Sometimes too early to tell just-wheezing vs. asthma, but response to albuterol is key

- Can dx in as young as 6m
- Wheezing associated with respiratory infection (WARI) is safer term
- Highly suspicious:
  - Infant w 2nd time wheezing, atopic fam hx, previous h/o albuterol response
  - Nighttime cough responsive to inhaled corticosteroid (ICS)

Quick Detour: Exercise Induced Bronchospasm (EIB)

- Asthma symptoms only with exercise
- Duration: within a few minutes of starting through 20-90 minutes of stopping (when untreated)
- Official dx: PFT
- Tx:
  - 15 minutes slow warm-up
  - Short-acting beta-agonist (SABA) 15 minutes before exercise
  - Controller (inhaled steroid) if SABA is insufficient or pt needs more than 1 dose/day
  - NOT long-acting beta-agonist (LABA)

Mgmt: Outpatient Basics



Mgmt: Severity Assessment

Impairment:

- Frequency/severity of symptoms (daytime and nighttime)
- Interference w activity
- SABA frequency
- PFT results (if available)

Risk: history

- Frequency of PO steroids
- *Frequency/pace of attacks

Severity level determined by highest score in any category

Not included: Exercise induced bronchospasm (EIB) and ppx use of SABA

RF for asthma (age 0-4 range)

- Major (need 1)- atopic dermatitis, sensitization to aeroallergens, parent w asthma
- Minor (need 2)- sensitization to foods, > 4% eosinophils, wheezing apart from colds

TABLE 2. Assessment of Asthma Severity and Initial Therapy

VARIABLE	INTERMITTENT	MILD	MODERATE	SEVERE
Impairment				
Symptom frequency	≤2 days per week	>2 days per week but not daily	Daily	Throughout day
Nighttime awakenings	Age 0-4 years: 0 Age 5 years to adult: ≤2 times per month	Age 0-4 years: 1-2 times per month Age 5 years to adult: 3-4 times per month	Age 0-4 years: 3-4 times per month Age 5 years to adult: >1 times per week but not nightly	Age 0-4 years: >1 time per week Age 5 years to adult: >7 times per week
Interference with activity	None	Minor limitation	Some limitation	Extremely limited
SABA use (except for EIB)	≤2 days per week	Age 0-4 years: >2 days per week, not daily Age 5 years to adult: >2 days per week, not daily and not more than once per day	Daily	Several times per day
FEV_1, % predicted	>80%	>80%	60-80%	<60%
Risk				
Asthma exacerbations that require oral steroids	0-1 per year	Age 0-4 years: ≥2 in 6 months or wheezing >4 times per year lasting >1 day and risk factors for persistent asthma Age 5 years to adult: ≥2 per year	More frequent and intense events indicate greater severity	More frequent and intense events indicate greater severity
Treatment				
Initial treatment steps[a]	Step 1	Step 2	Age 0-4 years and ≥12 years: step 3 Age 5-11 years: medium-dose inhaled corticosteroid option	Age 0-4 years: step 3 Age 5-11 years: medium-dose inhaled corticosteroid option or step 4 Age ≥12 years: step 4 or 5

Mgmt: Med Basics

Trigger exposure reduction- next slide

Main medication categories:

- Quick relief: SABA, anticholinergics
- QD Controller: ICS, leukotriene antagonist, ICS/LABA combo
  - Mast-cell stabilizers: not preferred
- Systemic steroids (for attacks)

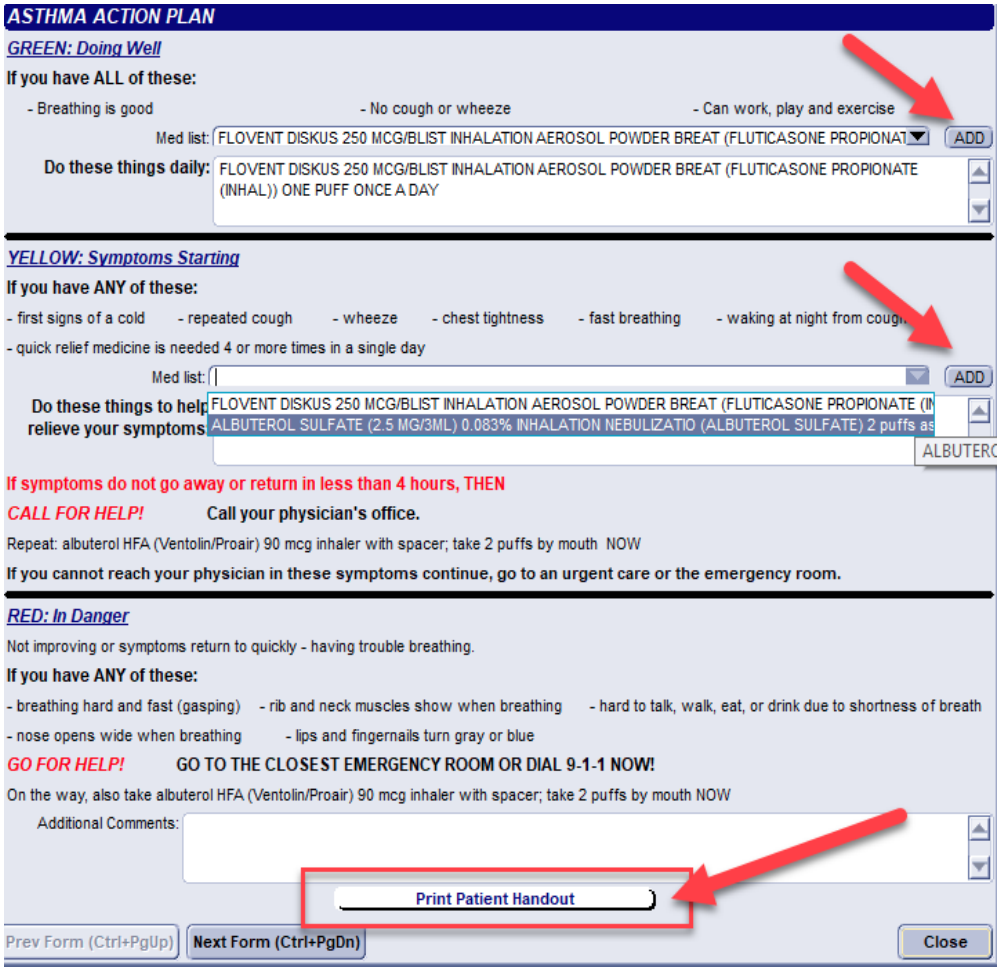
Every persistent patient needs controller

Regular f/u visits including risk/impairment/control assessment. Questionnaires can help

Consider immunotherapy for mod persistent asthma

Education is key:

- Signs/symptoms
- Asthma action plan (AAP)
- Trigger avoidance
- Importance of compliance & rationale of tx
- Medication technique
- Knowing when to seek medical help
- Fire analogy



Detour: What Have We Learned?

- Response to tx more important than nailing down dx
- Severity: score determined by highest score in any category
- All persistent asthma needs a controller

Mgmt: Trigger Avoidance

Allergens:

- Dust Mite
  - Reduce indoor humidity
  - Launder bedding in hot water
  - Mite-impenetrable covers on pillows/mattresses
  - Reduce "dust catchers" in bedroom (stuffed animals, curtains, carpet
  - HEPA filter does NOT help (not aerosolized)
- Cockroach
  - Hygiene: garbage cans, water leaks, clean environment
- Pet dander
  - No such thing as hypoallergenic pet
  - HEPA filter helps (dander is aerosolized)
  - Consider removing pet, keeping outside, or have 100% pet-free room with HEPA filter

Smoking Cessation

URI/colds

- Hand hygiene
- Annual flu vaccine

Exercise/EIB

- Exercise avoidance (JUST KIDDING!)
- SABA; consider ICS

Mgmt: Short-Acting: SABA and Anticholinergics

- SABA:
  - smooth muscle relaxation
  - Fast effect, short duration: 5-15 min through 3-4 hours
  - TOC for:
    - Acute attacks
    - IEB
- Anticholinergics:
  - Bronchodilate via cholinergic/vagal systems
  - Adjunct to SABA for mod/severe attacks
  - Pediatric literature:
    - Decreases ED time until discharge
    - Decreases amount of tx in ED
  - Adult literature:
    - Decreases hospital admissions

Mgmt: Controller Meds

ICS:

- Block late-phase (inflammation) response, not short-phase (bronchospasm)
- Effects: decrease attack frequency, decrease death, decrease airway inflammation, decrease bronchial hyper-responsiveness, improve lung function
- Concerns:
  - Thrush and hoarseness
  - NOT demonstrated: decreased BMD, cataracts
  - Growth slowing
    - no change in final height in low/medium doses
    - High doses: small effect on final growth (~1 cm) & risk of adrenal suppression
  - Strategies: spacer, wash mouth (mouthpiece) and/or perioral skin (mask), avoid triggers, use ICS/LABA to decrease ICS dose

LABA:

- Duration: up to 12 hours
- NEVER use as monotherapy
- Combination ICS/LABA
  - Adult data: improves asthma control and lung function
  - Pediatric recommendations:
    - ≤ 4: increase ICS dose
    - ≥ 5: add LABA to ICS
  - LABA should only be used in conjunction with ICS
  - Helps reduce ICS dose & SE's
  - LABA NOT recommended for IEB ppx
- Leukotriene antagonists
  - Decrease inflammation
  - Oral (not inhaled)
  - Often add-on to ICS-based controller therapy or alternative
- Theophylline and omalizumab (monoclonal anti-IgE)- beyond scope of this talk

Mgmt: Controller Meds Dosing

Table 4. **Estimated Comparative Daily Dosages for Inhaled Corticosteroids**

	Low Dose			Medium Dose			High Dose		
Inhaled Steroid	0 to 4 yr	5 to 11 yr	12 yr to adult	0 to 4 yr	5 to 11 yr	12 yr to adult	0 to 4 yr	5 to 11 yr	12 yr to adult
Beclomethasone HFA (QVAR®)[1] 40 or 80 mcg/puff	NA	80 to 160 mcg	80 to 240 mcg	NA	>160 to 320 mcg	>240 to 480 mcg	NA	>320 mcg	>480 mcg
Budesonide DPI* (Pulmicort Flexhaler™)[2] 90 or 180 mcg	NA	180 to 400 mcg	180 to 600 mcg	NA	>400 to 800 mcg	>600 to 1,200 mcg	NA	>800 mcg	>1,200 mcg
Budesonide nebulizer* (Pulmicort Respules®)[2] 0.25 mg; 0.5 mg/respule	0.25 to 0.5 mg	0.5 mg	NA	>0.5 to 1 mg	1 mg	NA	>1 mg	2 mg	NA
Flunisolide HFA (Aerospan HFA™)[3] 80 mcg/puff	NA	160 mcg	320 mcg	NA	320 mcg	>320 to 640 mcg	NA	≥640 mcg	>640 mcg
Fluticasone (Flovent HFA®)[4] MDI: 44, 110, 220 mcg/puff	176 mcg	88 to 176 mcg	88 to 264 mcg	>176 to 352 mcg	>176 to 352 mcg	>264 to 440 mcg	>352 mcg	>352 mcg	>440 mcg
Fluticasone (Flovent Diskus®)[4] DPI: 50 mcg/puff	NA	100 to 200 mcg	100 to 300 mcg	NA	>200 to 400 mcg	>300 to 500 mcg	NA	>400 mcg	>500 mcg
Mometasone DPI* (Asmanex Twisthaler®)[5] 110 or 220 mcg/inhalation	NA		200 mcg	NA		400 mcg	NA		>400 mcg

DPI = dry powder inhaler, HFA = hydrofluoroalkane, MDI = metered dose inhaler, NA = not available (either not approved, no data available, or safety/efficacy not established for this age group)
*Approved for once/day dosing

Mgmt: Outpatient- Assessing Control

- Visits q1-6m depending on severity
- If not well-controlled:
  - Address these first: technique/adherence & triggers
  - Then consider adjusting therapy (step-up)
    - Reassess in 2-6 weeks
- Good control for >3m:
  - Consider step-down and reassess in 4-6 weeks

Table 6. **Asthma Control**

	Well-controlled	Not Well-controlled	Very Poor Control
Child 0 to 11 Years			
Day symptoms	≤2 days/wk	>2 days/wk	Throughout
Night symptoms	0 to 1/month	≥2/mo	≥2/wk
FEV_1, percent predicted	>80%	60% to 80%	<60%
FEV_1/FVC ratio	>80%	75% to 80%	<75%
Exacerbations	0 to 1/yr	≥2/yr	≥2/yr (>3/yr for 0 to 4 yr)
Action	Maintain; consider step down (if well-controlled for 3 months) Recheck in 1 to 6 months	Review ICE Step up Recheck in 2 to 6 weeks	Review ICE Step up 1 to 2 steps Consider OCS Recheck in 2 to 6 weeks
12 years to Adult			
Day symptoms	≤2 days/wk	>2 days/wk	Throughout
Night symptoms	0 to 2/month	1 to 3/wk	≥4/wk
FEV_1, percent predicted	>80%	60% to 80%	<60%
Exacerbations	0 to 1/yr	≥2/yr	≥2/yr
Action	Maintain; consider step down (if well-controlled for 3 months) Recheck in 1 to 6 months	Review ICE Step up 1 step Recheck in 2 to 6 weeks	Review ICE Step up 1 to 2 steps Consider OCS Recheck in 2 weeks

ICE=inhaler technique, compliance, environmental control and comorbidities, FEV_1=forced expiratory volume in 1 second, FVC=forced vital capacity, OCS=oral corticosteroids

Adapted from the National Asthma Education and Prevention Program. *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma, 2007.* NIH Publication No. 07-4051. Bethesda, Md: National Heart, Lung, and Blood Institute; 2007.

Mgmt: Stepwise Approach to Step-Up

AGE, Y	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
0-4	SABA as needed	Low-dose ICS	Medium-dose ICS	Medium-dose ICS and LABA or montelukast	High-dose ICS and LABA or montelukast	High-dose ICS and LABA or montelukast and oral corticosteroids
5-11	SABA as needed	Low-dose ICS	Low-dose ICS and LABA, LTRA, or theophylline or medium-dose ICS	Medium dose ICS and LABA	High-dose ICS and LABA	High-dose ICS and LABA and oral corticosteroids
≥12	SABA as needed	Low-dose ICS	Low-dose ICS and LABA or medium-dose ICS	Medium-dose ICS and LABA	High-dose ICS and LABA Consider omalizumab for allergic patients	High-dose ICS and LABA and oral corticosteroids Consider omalizumab for allergic patients

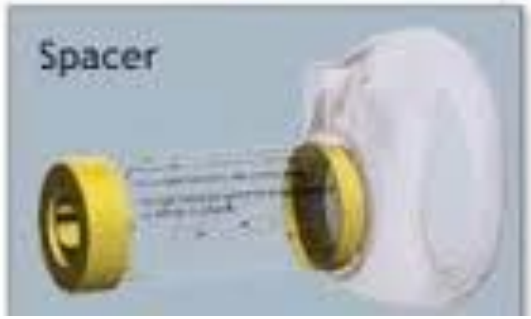
ICS=inhaled corticosteroid; LABA=long-acting inhaled β_2-agonist; LTRA=leukotriene antagonist; SABA=short-acting β_2-agonist.
Adapted from the National Asthma Education and Prevention Program. Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma, 2007. *Bethesda, MD: National Heart, Lung, and Blood Institute; 2007. NIH publication 07-4051.*

Mgmt: Newer Outpatient Practices: Think EARLY

- For risky pt:
  - Albuterol q4h for 48h at first sign may prevent steroids
  - PO steroids on hand may prevent hospitalizations
- GINA- consider adding ICS for even intermittent asthma

Mgmt: Inhaler vs. Nebulizer?

- MDI/spacer are as good as nebulizer
  - May even reduce ED LOS
- 2.5 mg neb dose = ~4-6 puffs
  - Green zone: 2 puffs probably OK
  - Yellow: consider increase to 4
  - Red: 4-6 en route to ED
- **Need spacer with every inhaled medication**
- Inhaler/spacer OK even in infants



Mgmt: Technique- Spacer, Nebulizer, Dry Powder Inhaler (DPI)

Spacer with Mouthpiece:

- Technique:
  - Completely exhale
  - Lips around spacer: press button & inhale *slowly*
  - Remove spacer and hold breath 10 seconds
  - Exhale
- OK for school-age child
- https://www.youtube.com/watch?v=8SXkuuv6p6w

Spacer with Mask:

- For anyone unable to do the above
- Technique:
  - Completely exhale
  - Press mask to face & press button
  - Take 6 *slow* in/out breaths
- https://www.youtube.com/watch?v=von7cyXcj2c

Nebulizer:

- Either use mask or mouthpiece
- Blow-by method not recommended

DPI

- No need for spacer
- Requires:
  - Ability to generate inspiratory flow (so mostly appropriate for school-age)
- Technique:
  - Load the chamber
  - Exhale away from DPI
  - Seal lips around mouthpiece
  - Inhale *quickly*/deep for 2-3 seconds
  - Hold breath for 10 seconds
- https://www.youtube.com/watch?v=bxC48vQEfZI

Mgmt: Acute Exacerbation

- Not so bad attack:
  - SABA 1-3x
  - Consider systemic steroid
- Bad (may need hospitalization or RF's for life-threatening attack):
  - Exam findings: hypoxia, increase WOB, lethargy, inability to speak, poor air movement, cyanosis, AMS
  - RF's: h/o ICU and/or intubation, poor adherence, daily symptoms, frequent systemic steroid need
  - CXR not routinely needed. Consider if:
    - Asymmetric exam
    - Atypical presentation/severe symptoms
    - Concern for foreign body
    - Concern for PTX

- Mod/severe treatment keys:
  - Quick
  - SABA AND anticholinergic (ipratropium)
  - Big doses are good:
    - 1st hour burst- <15kg: 3 Duoneb, 1 alb, 2 saline; > 15kg: 3 Duoneb & 3 albuterol
    - 2nd hour burst- < 15 kg: 4 albuterol and 2 saline; > 15kg: 6 albuterol
  - Systemic steroids
  - Consider:
    - Mg bolus (50 mg/kg MAX 2g over 20 min); follow with saline bolus
    - saline bolus- 20 ml/kg
    - BiPap
- Wheezer but no asthma dx? Try albuterol, esp if h/o wheezing or albuterol responsiveness

Prognosis

- 60% of childhood asthma pt's are symptom-free as adults
- Less likely to outgrow if:
  - Early onset (dx before age 3)
  - Parental h/o asthma
  - Atopic dermatitis
  - Sensitization to aeroallergens
  - Severe disease

Case Study: Sheila

16 y/o Caucasian female with asthma: 2 day h/o worsening cough, SOB, URI symptoms

- On low-dose ICS and PRN albuterol
- Baseline:
  - Daytime sx: 2/week
  - Nighttime sx: 2/week
  - Exacerbations needing PO steroid in past year: 2
- Well-controlled?
  - NO!
- Exam in the ED:
  - P 130, RR 45, BP 120/80, T 98.4, Pulse ox 91-93% on RA
  - Cannot speak in full sentences, some suprasternal retractions
  - Lungs: poor aeration, faint wheezing, no focality
- Anything else you want to know?

Case Study: Continued

- Initial mgmt.:
  - Mild?
    - NO!
  - 1st hour burst: 3 albuterol/ipratropium & 3 albuterol
  - PO steroid (dexamethasone vs. prednisolone)
  - Consider:
    - IV?
      - Yes
    - CXR?
      - No
  - Assessment after 1st burst: improved aeration, louder wheezes, 95-96% on RA, no increased WOB
- Next steps:
  - Ensure she can make it to q4h albuterol dose
  - If symptoms progress, consider:
    - 2nd-hour burst vs. individual albuterol doses
    - Mg bolus
    - BiPap

Case Study: Discharge and Step-up

Controlled?

- No

Next moves:

- Assess compliance/technique
- Reduce triggers
- Step-up therapy
- Recheck 2-6w

Table 6. **Asthma Control**

	Well-controlled	Not Well-controlled	Very Poor Control
Child 0 to 11 Years			
Day symptoms	≤2 days/wk	>2 days/wk	Throughout
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≥12	SABA as needed	Low-dose ICS	Low-dose ICS and LABA or medium-dose ICS	Medium-dose ICS and LABA	High-dose ICS and LABA Consider omalizumab for allergic patients	High-dose ICS and LABA and oral corticosteroids Consider omalizumab for allergic patients

Wrap-Up: Main Pointers

- Mod/severe exacerbation: early, aggressive, and include albuterol/ipratropium
- Need spacer with every inhaled med dose
- All Persistent asthma needs a controller
- Assess severity (determined by highest score in any category)
- Know how to initiate tx & step-up/step-down
- Response to tx more important than nailing down dx

Works Cited

- Cates, et. Al. 2013. Holding chambers (spacers) versus nebulisers for beta-agonist treatment of acute asthma. Cochrane Database Syst Rev. 2013 Sep 13;(9)CD000052.
- Hill, VL, Wood, RW. 2009. Asthma Epidemiology, Pathophysiology, and Initial Evaluation. Pediatrics in Review. Vol30, No9.
- Hill, VL, Wood, RW. 2009. Practical Management of Asthma. Pediatrics in Review. Vol30, No10.
- Kirkland SW, et. Al. 2017. Combined inhaled beta-agonist and anticholinergic agents for emergency management in adults with asthma. Cochrane Database Syst Rev Vol 1.
- Link HW. 2014. Pediatric Asthma in a Nutshell. Pediatrics in Review. Vol35, No7.
- Schuh et. Al. 1999. Comparison of albuterol delivered by a metered dose inhaler with spacer versus a nebulizer in children with mild acute asthma. J Pediatr. 135(1):22-7.
- https://www.youtube.com/watch?v=8SXkuuv6p6w
- https://www.youtube.com/watch?v=von7cyXcj2c
- https://www.youtube.com/watch?v=bxC48vQEfZI
- Zorc JJ et. Al. 1999. Ipratropium Bromide Added to Asthma Treatment in the Pediatric Emergency Department. *Pediatrics* 103;748.

My Loved Ones At Home