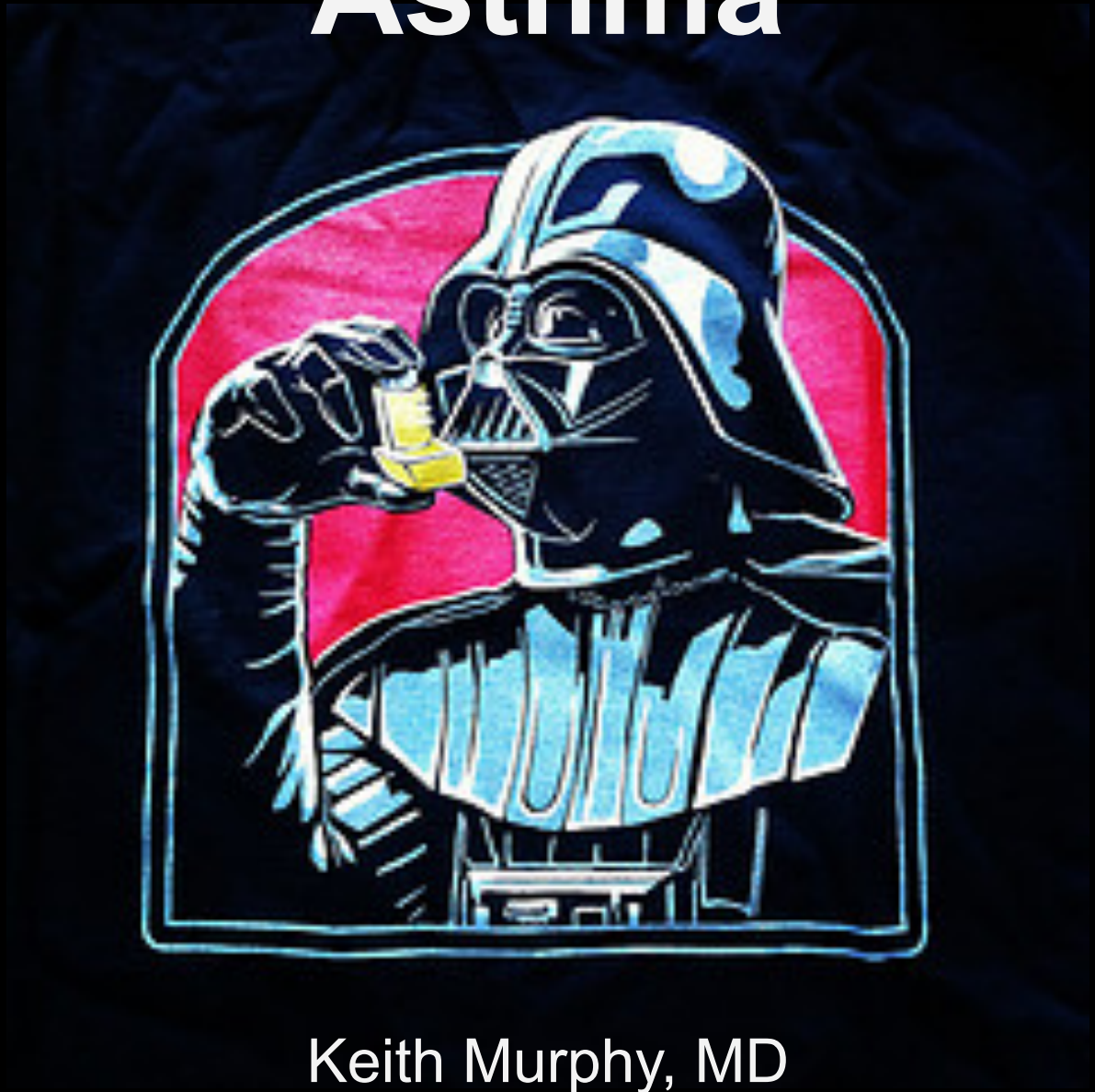
Asthma



Keith Murphy, MD
Med/Peds
Created Feb 2013

What is asthma?

Asthma is:

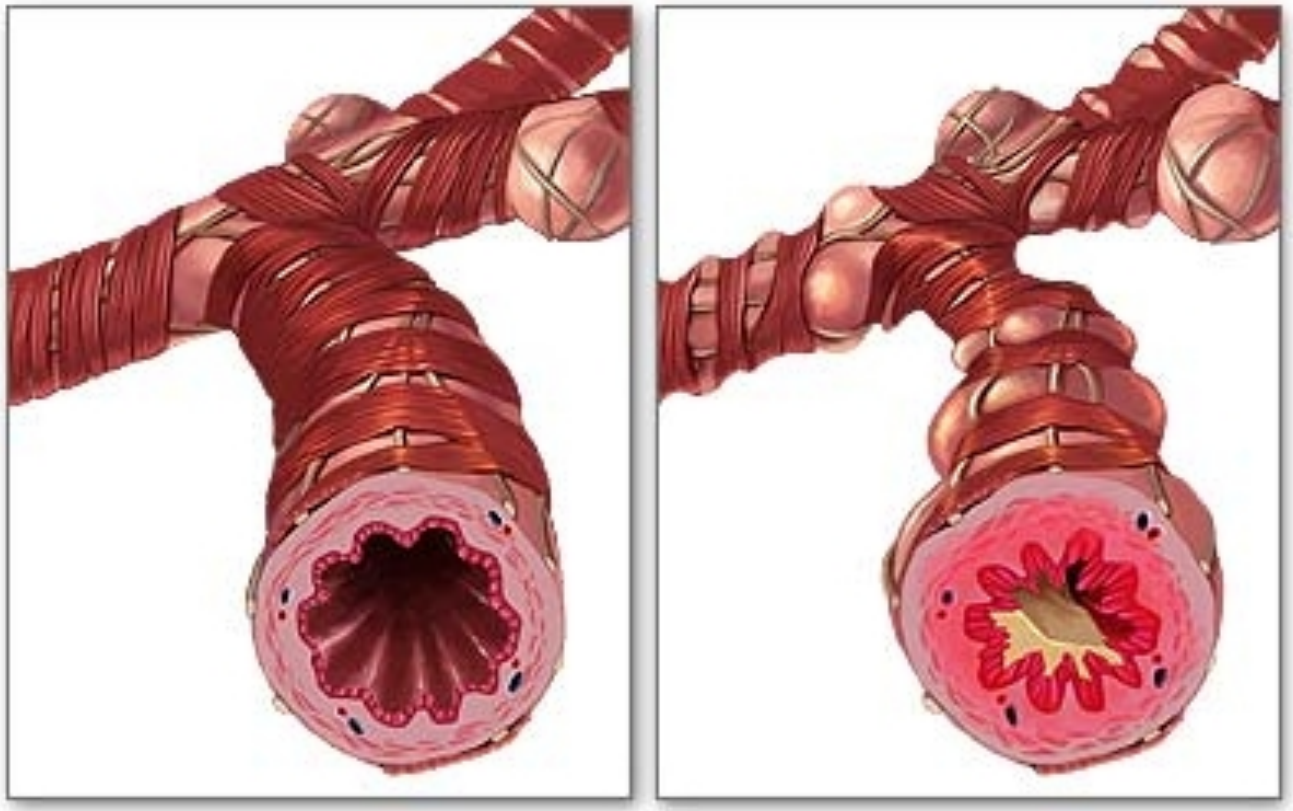
a chronic inflammatory condition of the airways associated with variable/recurring symptoms

1. *Reversible* airflow obstruction
2. Bronchial hyperresponsiveness
3. Underlying inflammation

Pathophysiology

Normal

Asthma



Muscle constriction

Bronchial thickening with airway edema

Mucus production

Epidemiology

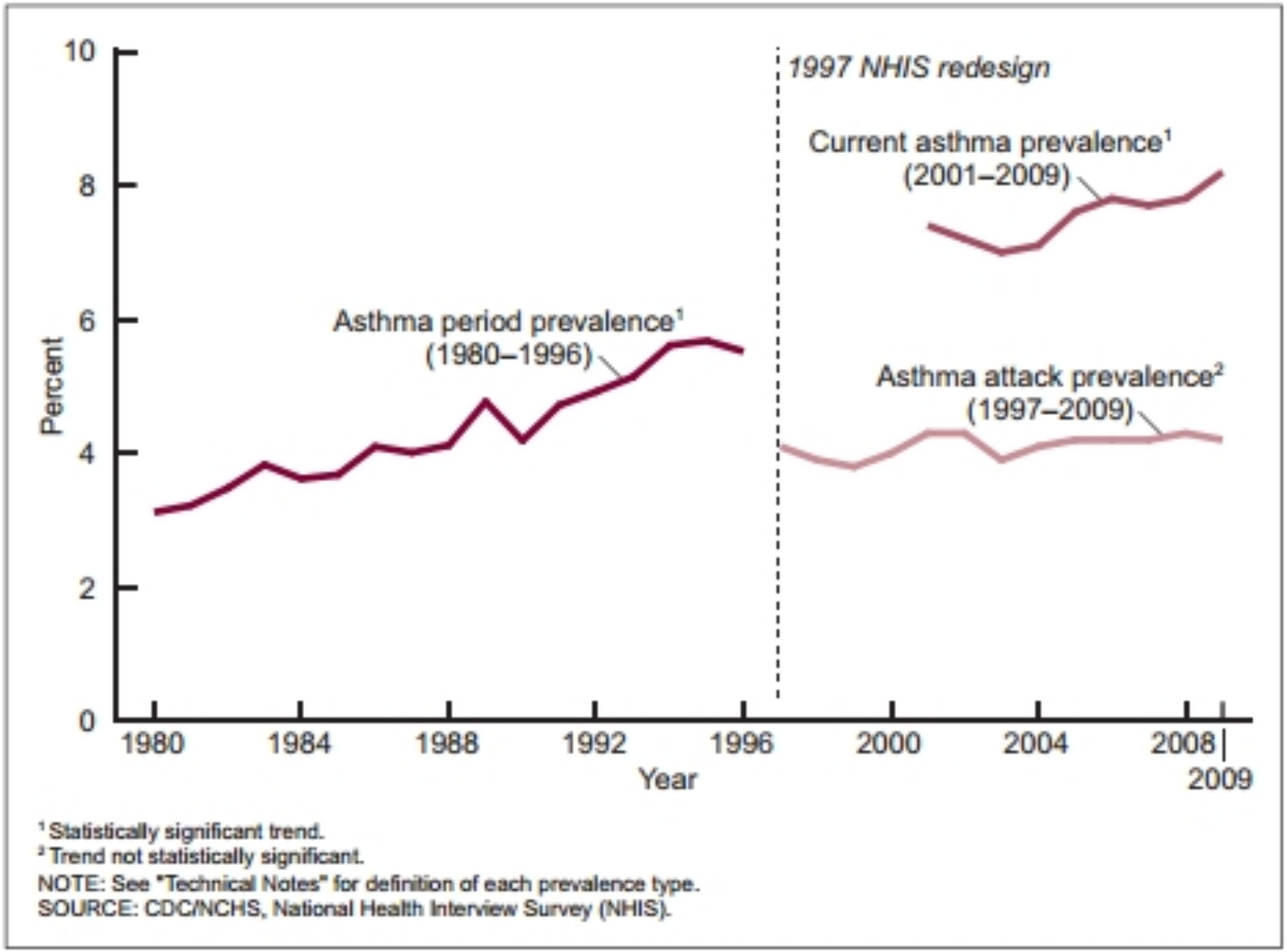


Figure 1. Asthma period prevalence, asthma attack prevalence, and current asthma prevalence for all ages: United States, 1980–2009

Who might have asthma?

- intermittent dyspnea
- cough (worse at night)
- wheezing
- family history of atopy

Reactive Airway Disease?

- Ambiguous term
- Usually used to mean:
  - Asthma in a kid that was unable to do spirometry
  - I Rx an inhaler and needed to code something
- Provides false sense of security
- I'd recommend not using it

1. Fahy and O'Byrne. "Reactive Airways Disease" A Lazy Term of Uncertain Meaning That Should Be Abandoned. *Am J Respir Crit Care Med*. 2001. 163;822-3.

Patient with asthma vs. Asthmatic

That asthmatic guy

Patient with asthma vs. Asthmatic

Keith Murphy

(and also I happen to have asthma)

Diagnosis

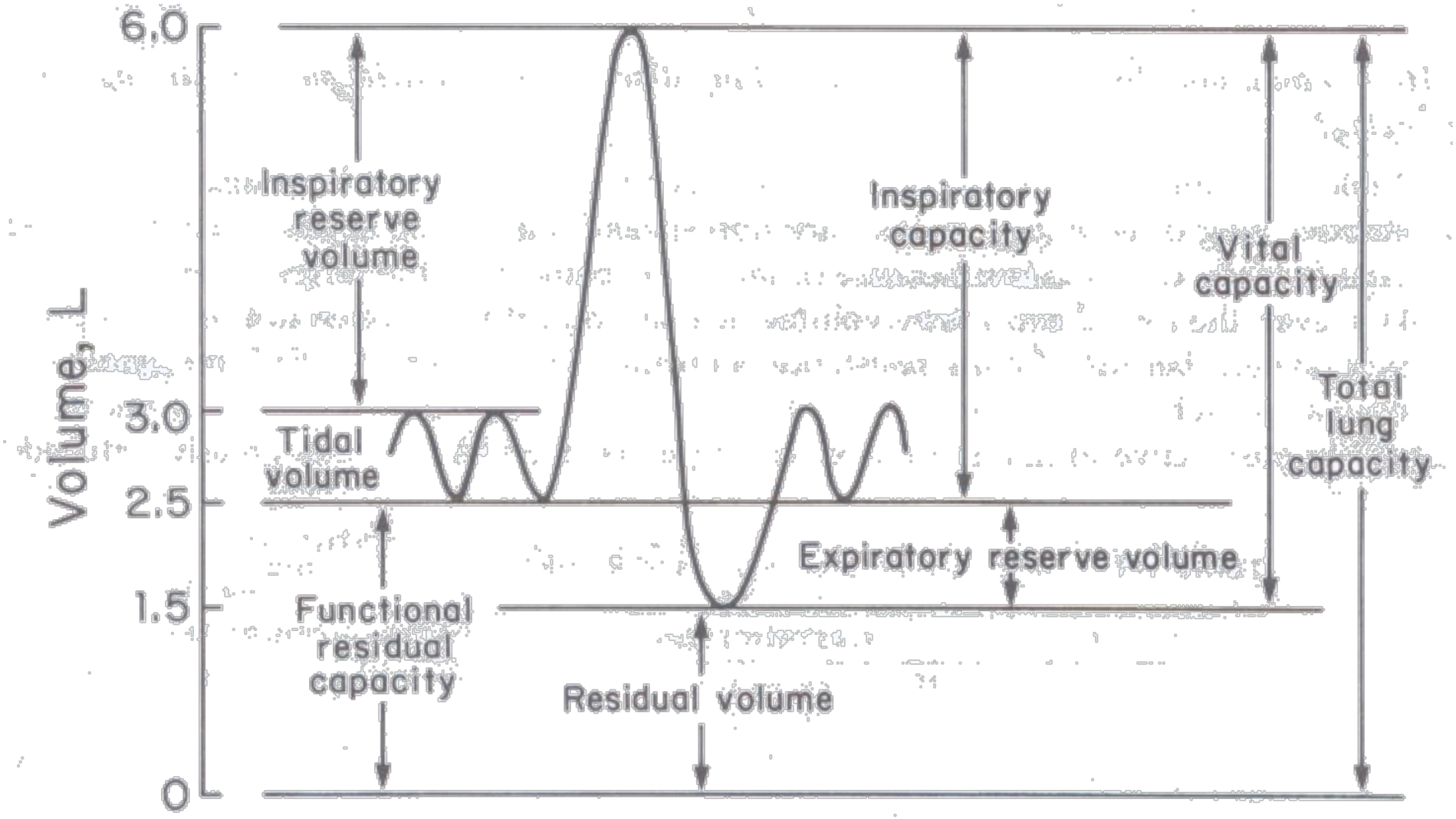
Asthma is a clinical diagnosis

1. Demonstrate variable expiratory airflow limitation
2. Exclusion of alternatives

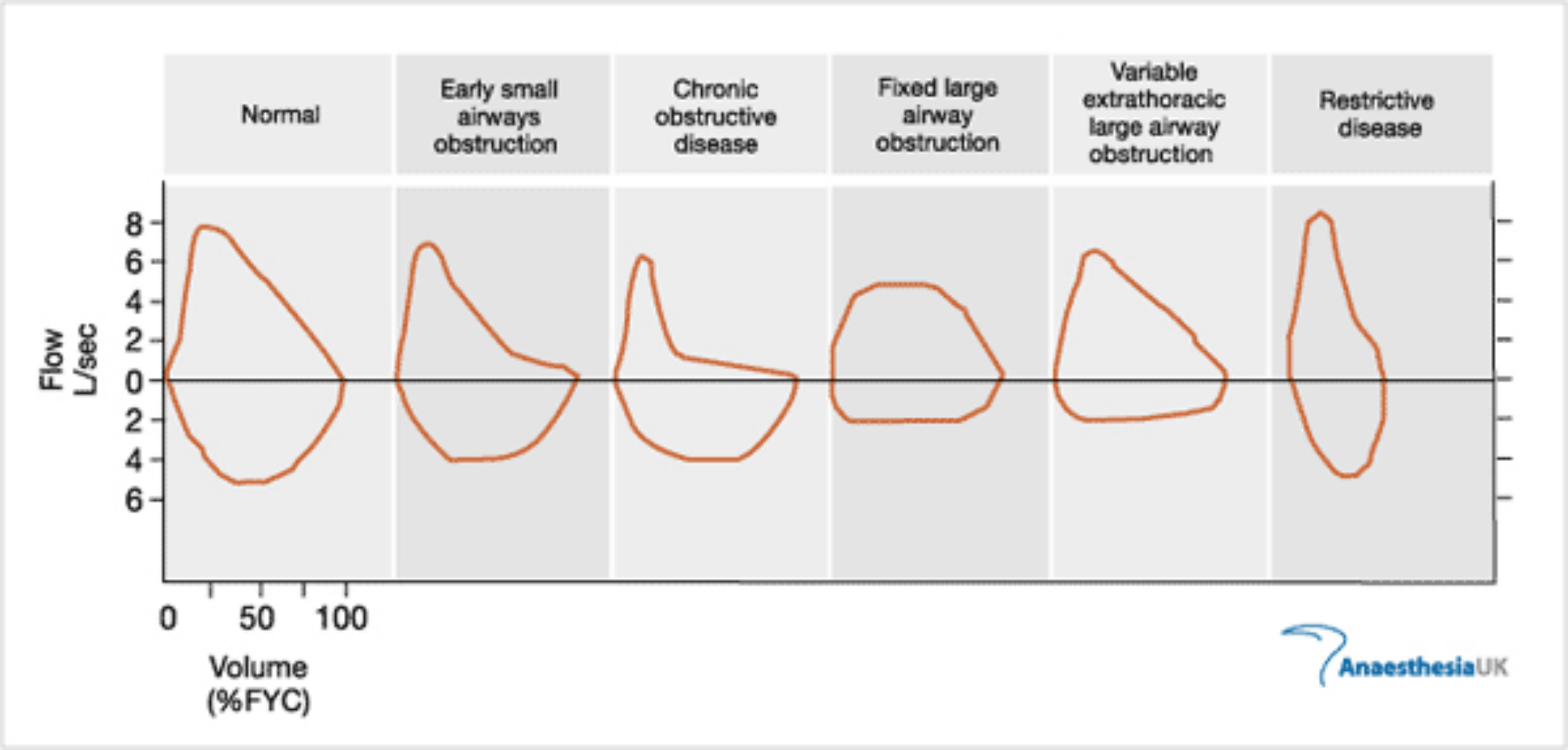
DDx

dysphagia/aspiration
foreign body aspiration
vocal cord dysfunction
vascular ring/sling
COPD
heart disease
endobronchial tumor
extrinsic airway
compression
drugs (eg ACE-i)
habit cough
cystic fibrosis
laryngotracheomalacia
chronic rhinosinusitis

Spirometry


6.0
3.0
2.5
1.5
0
Volume, L
Inspiratory reserve volume
Tidal volume
Functional residual capacity
Residual volume
Expiratory reserve volume
Inspiratory capacity
Vital capacity
Total lung capacity

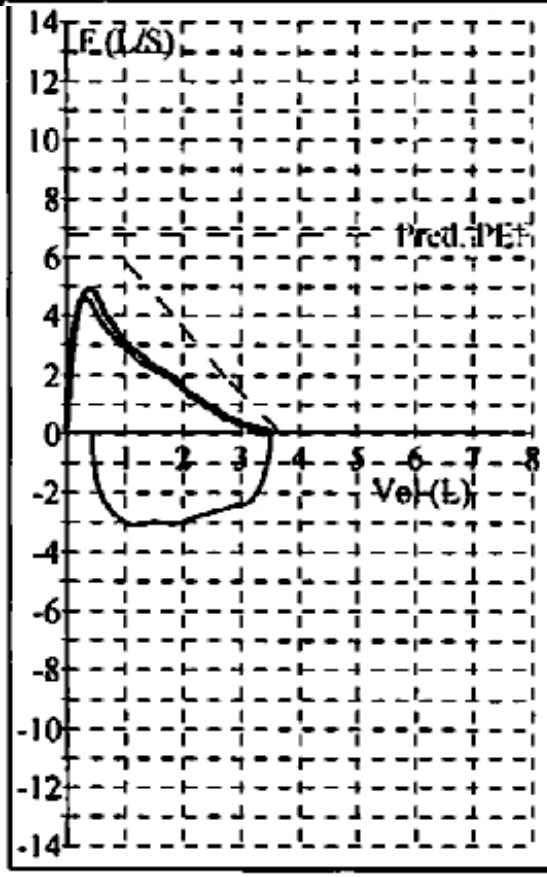
Spirometry

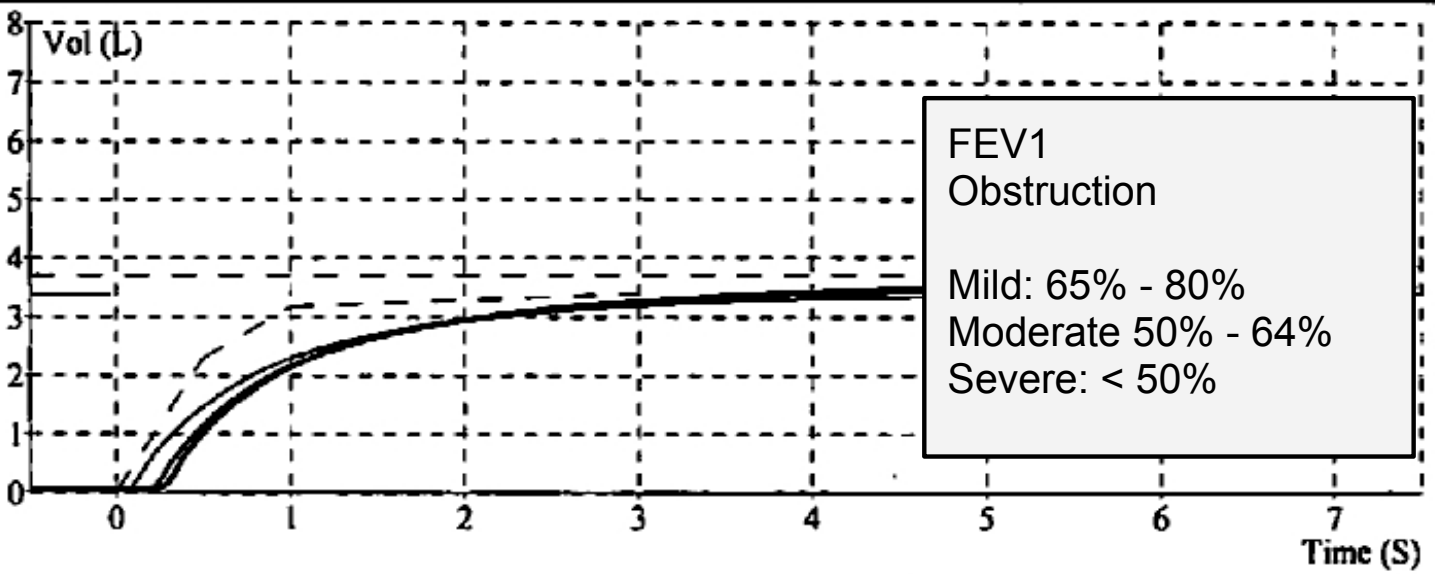

Normal
Early small airways obstruction
Chronic obstructive disease
Fixed large airway obstruction
Variable extrathoracic large airway obstruction
Restrictive disease
Flow L/sec
8
6
4
2
0
2
4
6
0
50
100
Volume (%FYC)
AnaesthesiaUK

Pulmonary Function Testing

- Office spirometry
- Methacholine challenge
- Post-bronchodilator
- Exercise PFTs

Measurement	Units	Predicted	Pre-Bronchodilator Trial					
			1		2		[illegible]	
			Actual	% Pred.	Actual	% Pred.	Actual	% Pred.
FVC	L	3.66	3.39	92 %	3.52	96 %	3.54	97 %
FEV1	L	3.14	2.31	74 %	2.35	75 %	2.40	77 %
FEV1/FVC	%	85 %	68 %	[illegible]	67 %	[illegible]	68 %	[illegible]
FEF25%	L/S	6.07	3.35	55 %	3.33	55 %	3.66	60 %
FEF50%	L/S	4.05	2.04	50 %	2.01	50 %	2.04	50 %
FEF75%	L/S	1.92	0.71	37 %	0.71	37 %	0.73	38 %
FEF25-75%	L/S	3.49	1.66	48 %	1.58	45 %	1.65	47 %
PEF	L/S	6.81	4.61	68 %	4.58	67 %	4.94	73 %
Exp. Time	Sec.		6.57		6.48		5.58	
V ext.	L		0.03		0.05		0.07	





FEV1
Obstruction

Mild: 65% - 80%
Moderate 50% - 64%
Severe: < 50%

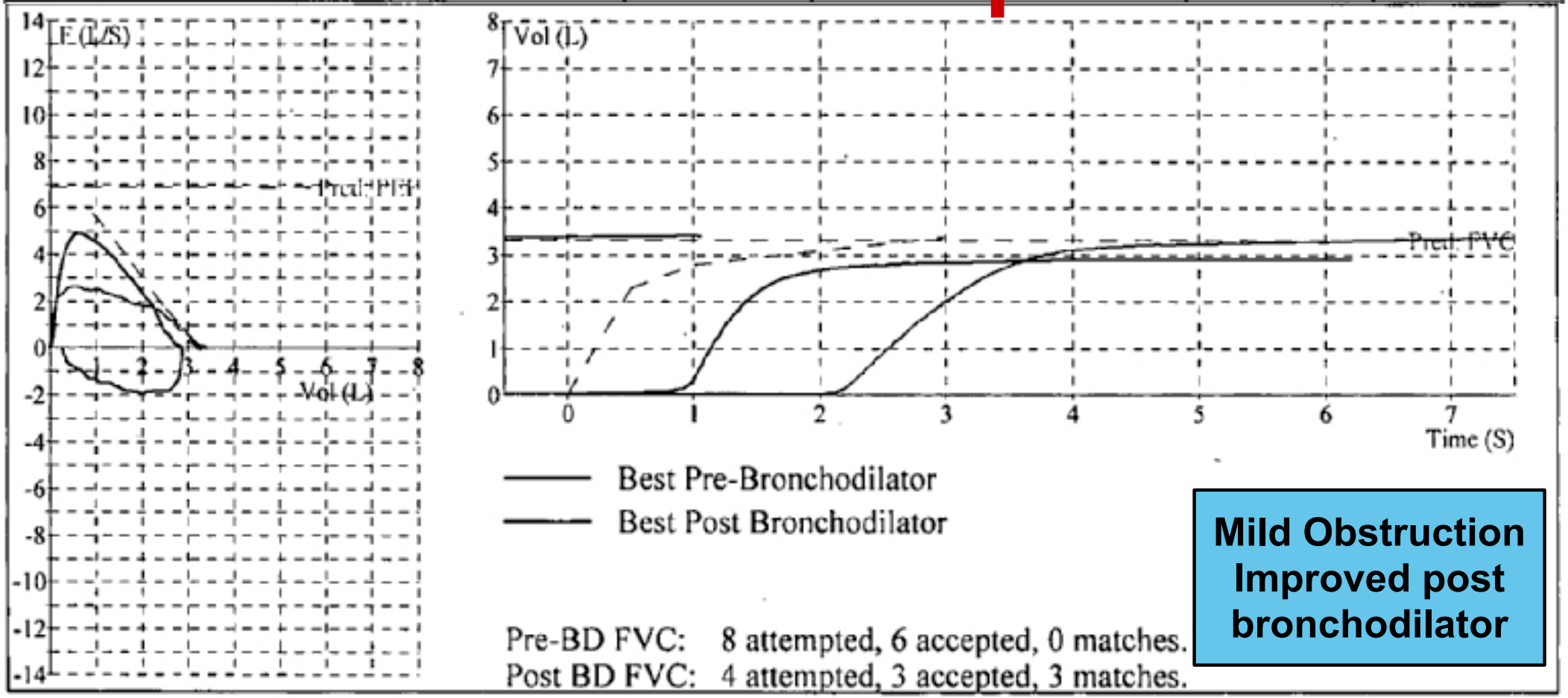
Test #1
Test #2
Test #4 (Best)

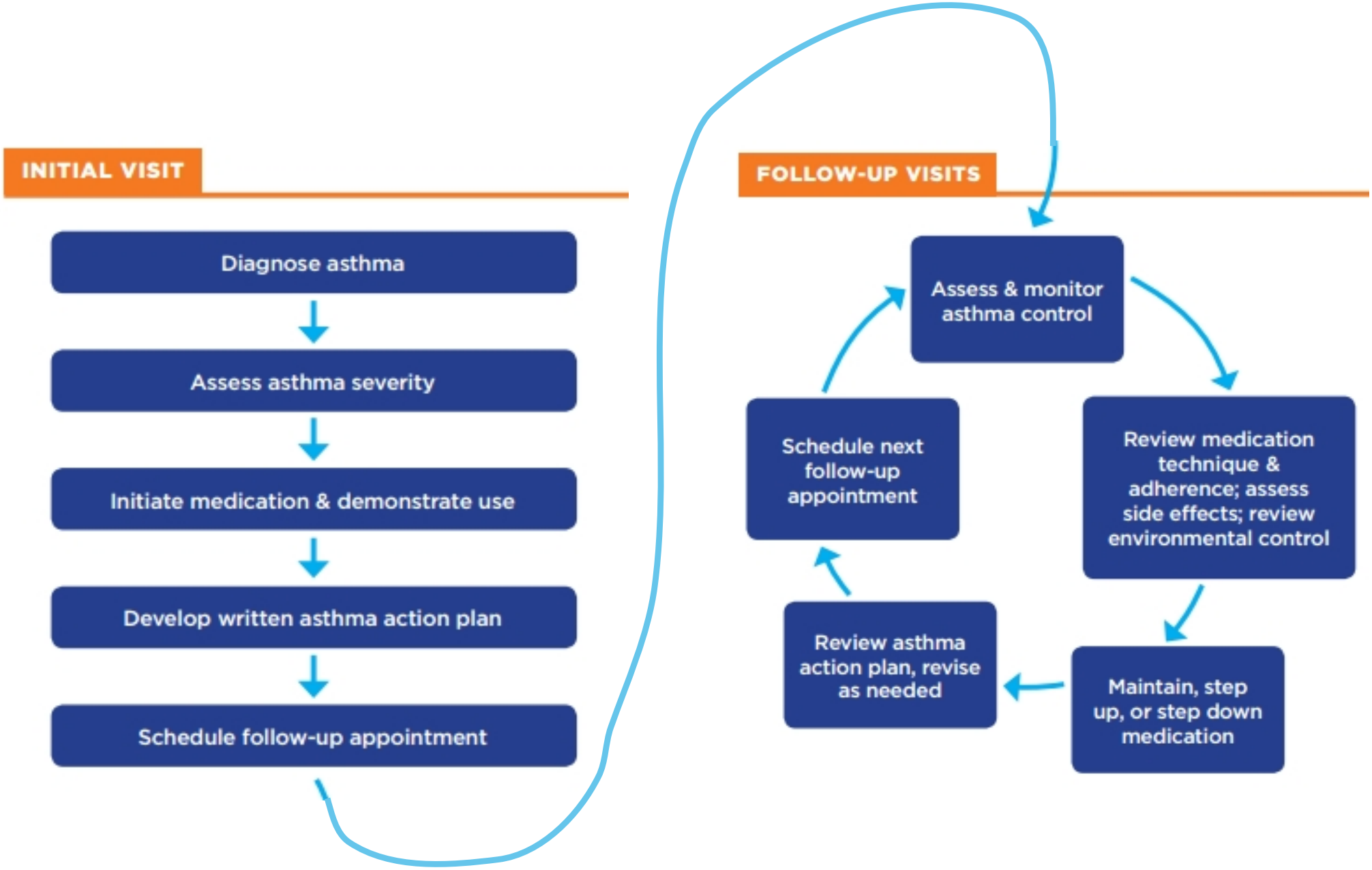
[illegible] = Best FVC test
* = Best Pre FEV1

Pre-BD FVC: 4 attempted, 4 accepted, 3 matches.

Mild Obstruction

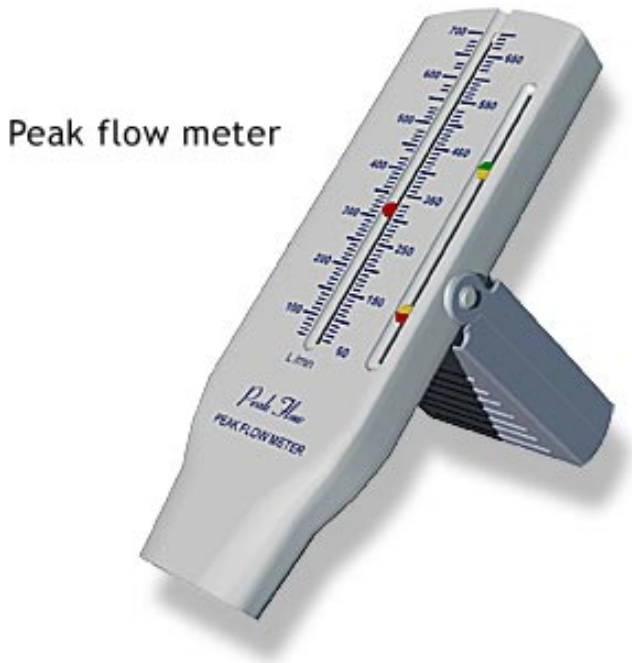
Measurement	Units	Predicted	Pre-Bronchodilator		Post-Bronchodilator		% Change
			Actual	% Pred.	Actual	% Pred.	
FVC	L	3.28	3.40	104%	2.87	88 %	-15 %
FEV1	L	2.75	2.24	81 %	2.60	94 %	16 %
FEV1/FVC	%	85 %	66 %	78 %	90 %	107 %	25 %
FEF25%	L/S	6.12	2.52	41 %	5.02	82 %	99 %
FEF50%	L/S	4.05	2.11	52 %	3.87	96 %	83 %
FEF75%	L/S	1.83	1.45	79 %	2.10	115%	45 %
FEF25-75%	L/S	3.13	2.00	64 %	3.47	111%	73 %
PEF	L/S	6.94	2.67	38 %	4.94	71 %	85 %
Exp. Time	Sec.		6.83		5.17		-24 %
V ext.	L		0.10		0.15		51 %




INITIAL VISIT
Diagnose asthma
Assess asthma severity
Initiate medication & demonstrate use
Develop written asthma action plan
Schedule follow-up appointment
FOLLOW-UP VISITS
Assess & monitor asthma control
Review medication technique & adherence; assess side effects; review environmental control
Maintain, step up, or step down medication
Review asthma action plan, revise as needed
Schedule next follow-up appointment

What about peak flows?

- Maximal amount patient can exhale after full inspiration
- Compare to age/sex/height controls
- Variability makes unreliable
- Easy to rig your results



Initial Visit

Components of Severity		Intermittent			Persistent								
					Mild			Moderate			Severe		
		Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years
Impairment	Symptoms	≤2 days/week			>2 days/week but not daily			Daily			Throughout the day		
	Nighttime awakenings	0	≤2x/month		1–2x/month	3–4x/month		3–4x/month	>1x/week but not nightly		>1x/week	Often 7x/week	
	SABA* use for symptom control (not to prevent EIB*)	≤2 days/week			>2 days/week but not daily	>2 days/week but not daily and not more than once on any day		Daily			Several times per day		
	Interference with normal activity	None			Minor limitation			Some limitation			Extremely limited		
	Lung function		Normal FEV_1 between exacerbations	Normal FEV_1 between exacerbations									
	→ FEV_1* (% predicted)	Not applicable	>80%	>80%	Not applicable	>80%	>80%	Not applicable	60–80%	60–80%	Not applicable	<60%	<60%
	→ FEV_1/FVC*		>85%	Normal†		>80%	Normal†		75–80%	Reduced 5%†		<75%	Reduced >5%†
Risk	Asthma exacerbations requiring oral systemic corticosteroids‡	0–1/year			≥2 exacerb. in 6 months, or wheezing ≥4x per year lasting >1 day AND risk factors for persistent asthma	≥2/year		*Generally, more frequent and intense events indicate greater severity.*			*Generally, more frequent and intense events indicate greater severity.*		
		*Consider severity and interval since last asthma exacerbation. Frequency and severity may fluctuate over time for patients in any severity category. Relative annual risk of exacerbations may be related to FEV_1.**											
Recommended Step for Initiating Therapy *(See "Stepwise Approach for Managing Asthma Long Term," page 7)* *The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.*		Step 1			Step 2			Step 3	Step 3 medium-dose ICS* option	Step 3	Step 3	Step 3 medium-dose ICS* option or Step 4	Step 4 or 5
								Consider short course of oral systemic corticosteroids.					
		In 2–6 weeks, depending on severity, assess level of asthma control achieved and adjust therapy as needed. For children 0–4 years old, if no clear benefit is observed in 4–6 weeks, consider adjusting therapy or alternate diagnoses.											

Follow-up Visits

Components of Control		Well Controlled			Not Well Controlled			Very Poorly Controlled		
		Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years
Impairment	Symptoms	≤2 days/week	≤2 days/week but not more than once on each day	≤2 days/week	>2 days/week	>2 days/week or multiple times on ≤2 days/week	>2 days/week	Throughout the day		
	Nighttime awakenings	≤1x/month		≤2x/month	>1x/month	≥2x/month	1–3x/week	>1x/week	≥2x/week	≥4x/week
	Interference with normal activity	None			Some limitation			Extremely limited		
	SABA* use for symptom control (not to prevent EIB*)	≤2 days/week			>2 days/week			Several times per day		
	Lung function									
	→ FEV_1* (% *predicted*) or peak flow (% *personal best*)	Not applicable	>80%	>80%	Not applicable	60–80%	60–80%	Not applicable	<60%	<60%
	→ FEV_1/FVC*		>80%	Not applicable		75–80%	Not applicable		<75%	Not applicable
	Validated questionnaires†									
	→ ATAQ*	Not applicable	Not applicable	0	Not applicable	Not applicable	1–2	Not applicable	Not applicable	3–4
	→ ACQ*			≤0.75‡			≥1.5			Not applicable
	→ ACT*			≥20			16–19			≤15
Risk	Asthma exacerbations requiring oral systemic corticosteroids§	0–1/year			2–3/year	≥2/year		>3/year	≥2/year	
		Consider severity and interval since last asthma exacerbation.								
	Reduction in lung growth/Progressive loss of lung function	Not applicable	Evaluation requires long-term follow-up care.		Not applicable	Evaluation requires long-term follow-up care.		Not applicable	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.*								
Recommended Action for Treatment *(See "Stepwise Approach for Managing Asthma Long Term," page 7)* *The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.*		*Maintain current step. Regular follow-up every 1–6 months. Consider step down if well controlled for at least 3 months.*			Step up 1 step	Step up at least 1 step	Step up 1 step	*Consider short course of oral systemic corticosteroids. Step up 1–2 steps. Reevaluate in 2 weeks to achieve control.*		
					Reevaluate in 2–6 weeks to achieve control. For children 0–4 years, if no clear benefit observed in 4–6 weeks, consider adjusting therapy or alternative diagnoses.					
					Before step up in treatment: Review adherence to medication, inhaler technique, and environmental control. If alternative treatment was used, discontinue and use preferred treatment for that step. For side effects, consider alternative treatment options.					

Steps age 0 to 4

ASSESS CONTROL:

STEP UP IF NEEDED (first, check medication adherence, inhaler technique, environmental control, and comorbidities)

STEP DOWN IF POSSIBLE (and asthma is well controlled for at least 3 months)

At each step: Patient education, environmental control, and management of comorbidities

0–4 years of age

	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
	Intermittent Asthma	**Persistent Asthma: Daily Medication** Consult with asthma specialist if step 3 care or higher is required. Consider consultation at step 2.				
Preferred Treatment†	SABA* as needed	low-dose ICS*	medium-dose ICS*	medium-dose ICS* + either LABA* or montelukast	high-dose ICS* + either LABA* or montelukast	high-dose ICS* + either LABA* or montelukast + oral corticosteroids
Alternative Treatment†,‡		cromolyn or montelukast				
If clear benefit is not observed in 4–6 weeks, and medication technique and adherence are satisfactory, consider adjusting therapy or alternate diagnoses.						
Quick-Relief Medication	▪ SABA* as needed for symptoms; intensity of treatment depends on severity of symptoms. ▪ With viral respiratory symptoms: SABA every 4–6 hours up to 24 hours (longer with physician consult). Consider short course of oral systemic corticosteroids if asthma exacerbation is severe or patient has history of severe exacerbations. ▪ Caution: Frequent use of SABA may indicate the need to step up treatment.					

Steps age 5 to 11

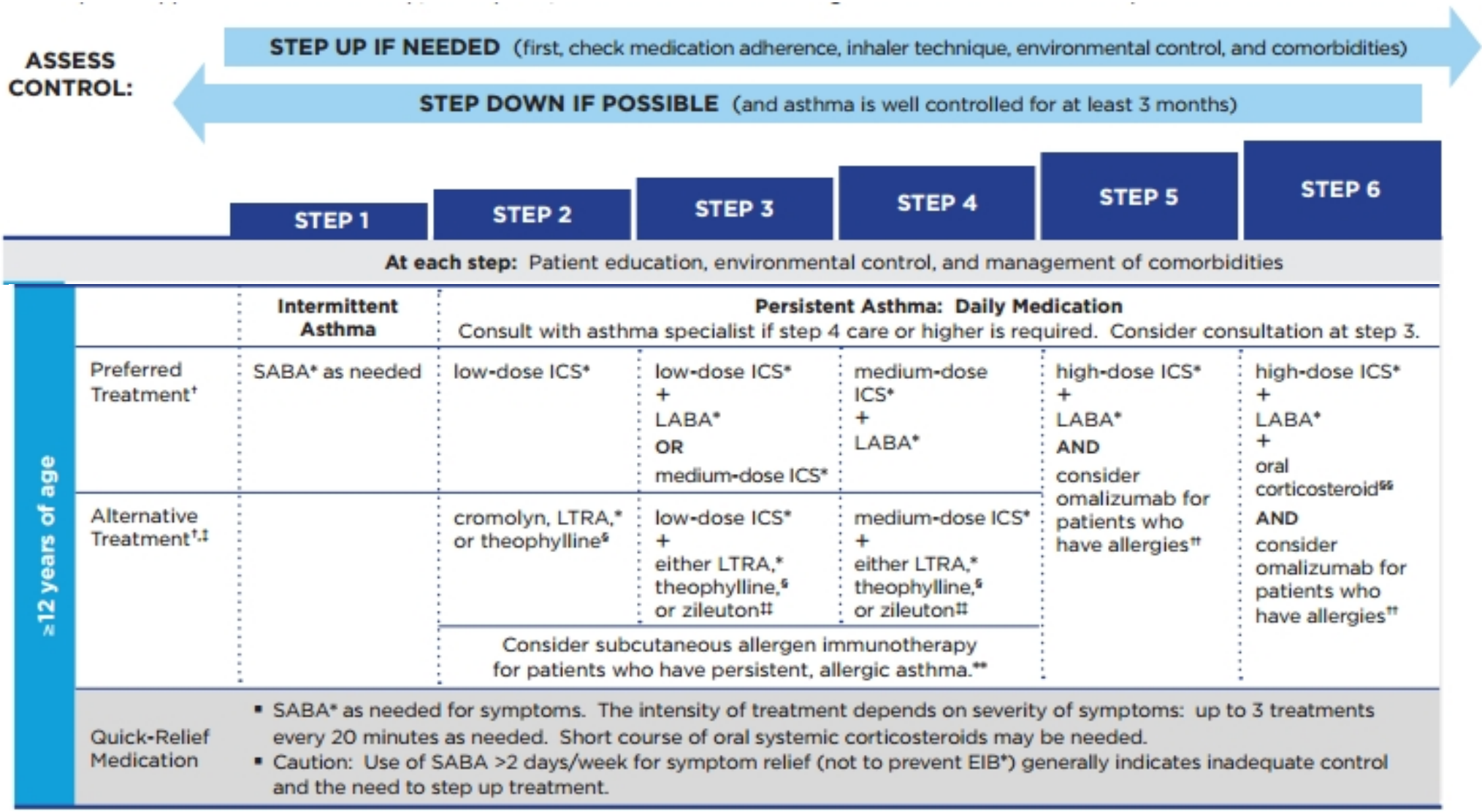
ASSESS CONTROL:

STEP UP IF NEEDED (first, check medication adherence, inhaler technique, environmental control, and comorbidities)

STEP DOWN IF POSSIBLE (and asthma is well controlled for at least 3 months)

	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
At each step: Patient education, environmental control, and management of comorbidities						
5–11 years of age	**Intermittent Asthma**	**Persistent Asthma: Daily Medication** Consult with asthma specialist if step 4 care or higher is required. Consider consultation at step 3.				
Preferred Treatment†	SABA* as needed	low-dose ICS*	low-dose ICS* + either LABA,* LTRA,* or theophylline[b] OR medium-dose ICS	medium-dose ICS* + LABA*	high-dose ICS* + LABA*	high-dose ICS* + LABA* + oral corticosteroids
Alternative Treatment†,‡		cromolyn, LTRA,* or theophylline[g]		medium-dose ICS* + either LTRA* or theophylline[g]	high-dose ICS* + either LTRA* or theophylline[g]	high-dose ICS* + either LTRA* or theophylline[g] + oral corticosteroids
		Consider subcutaneous allergen immunotherapy for patients who have persistent, allergic asthma.**				
Quick-Relief Medication	▪ SABA* as needed for symptoms. The intensity of treatment depends on severity of symptoms: up to 3 treatments every 20 minutes as needed. Short course of oral systemic corticosteroids may be needed. ▪ Caution: Increasing use of SABA or use >2 days/week for symptom relief (not to prevent EIB*) generally indicates inadequate control and the need to step up treatment.					

Steps age > 12


ASSESS CONTROL:
STEP UP IF NEEDED (first, check medication adherence, inhaler technique, environmental control, and comorbidities)
STEP DOWN IF POSSIBLE (and asthma is well controlled for at least 3 months)
STEP 1
STEP 2
STEP 3
STEP 4
STEP 5
STEP 6
At each step: Patient education, environmental control, and management of comorbidities
≥12 years of age
Intermittent Asthma
Persistent Asthma: Daily Medication
Consult with asthma specialist if step 4 care or higher is required. Consider consultation at step 3.
Preferred Treatment†
SABA* as needed
low-dose ICS*
low-dose ICS* + LABA* OR medium-dose ICS*
medium-dose ICS* + LABA*
high-dose ICS* + LABA* AND consider omalizumab for patients who have allergies††
high-dose ICS* + LABA* + oral corticosteroid§§ AND consider omalizumab for patients who have allergies††
Alternative Treatment†,‡
cromolyn, LTRA,* or theophylline§
low-dose ICS* + either LTRA,* theophylline,§ or zileuton‡‡
medium-dose ICS* + either LTRA,* theophylline,§ or zileuton‡‡
Consider subcutaneous allergen immunotherapy for patients who have persistent, allergic asthma.**
Quick-Relief Medication
▪ SABA* as needed for symptoms. The intensity of treatment depends on severity of symptoms: up to 3 treatments every 20 minutes as needed. Short course of oral systemic corticosteroids may be needed.
▪ Caution: Use of SABA >2 days/week for symptom relief (not to prevent EIB*) generally indicates inadequate control and the need to step up treatment.

Can we stop wheezers from developing asthma?

PEAK Trial

- n=285
- Double blind, randomized, placebo-controlled, parallel study

- 2-3 year-olds at high risk for developing asthma
- Question: Can we prevent asthma?
- Randomized to fluticasone vs placebo for 2 years, followed by 1 year without medication

No change in progression to asthma.

1. Guilbert, *et al.* Long-Term Inhaled Corticosteroids in Preschool Children at High Risk for Asthma. *N Engl J Med.* May 11, 2006. 354;19.

PEAK Trial

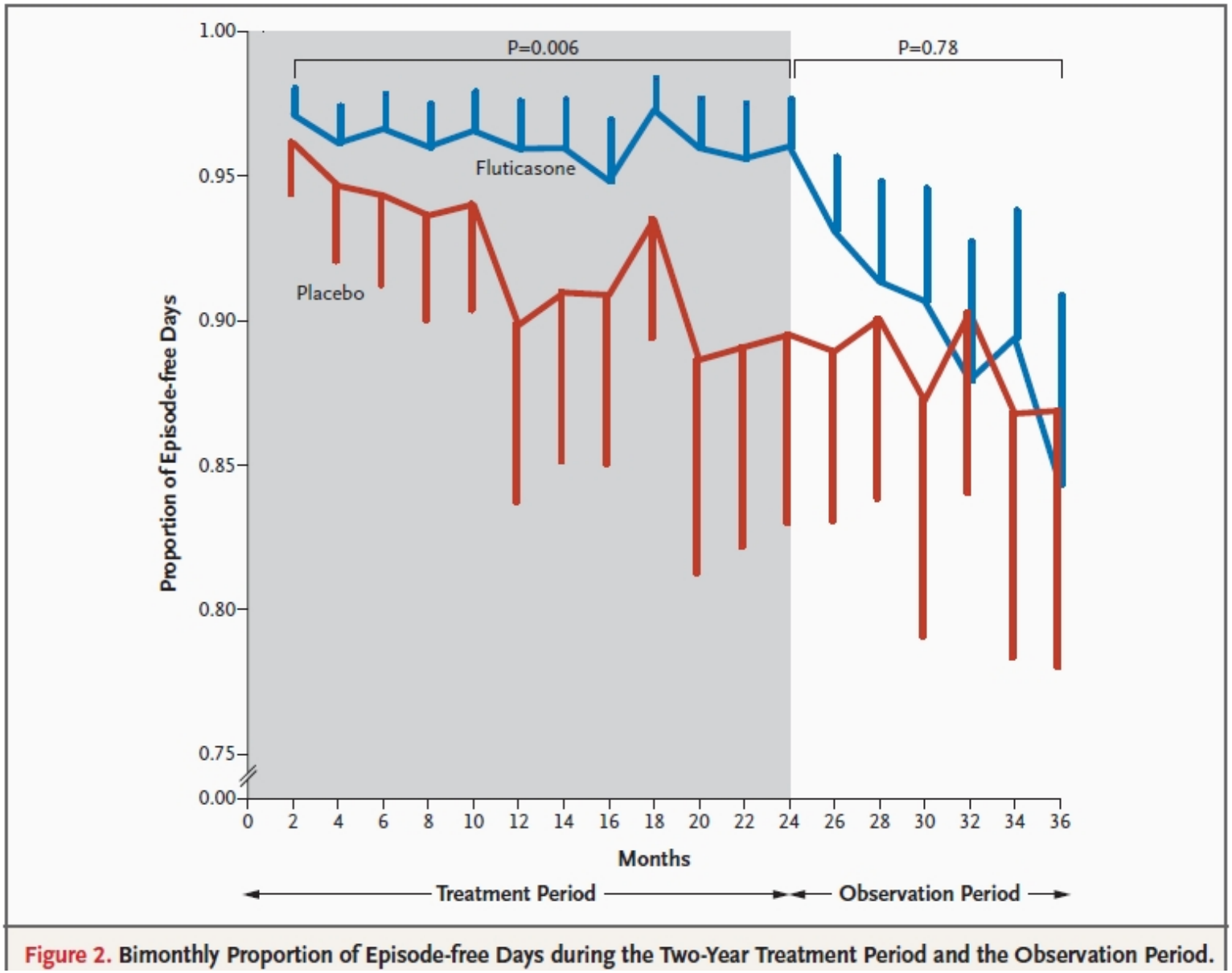


Figure 2. Bimonthly Proportion of Episode-free Days during the Two-Year Treatment Period and the Observation Period.

Nope

1. Guilbert, *et al.* Long-Term Inhaled Corticosteroids in Preschool Children at High Risk for Asthma. *N Engl J Med.* May 11, 2006. 354;19.

Are there side-effects for asthma treatment?

CAMP Trial

- n=1041
- Double blind, randomized, placebo-controlled

- 5-12 year-olds with mild to moderate asthma
- Followed for 4-6 years
- Question: Worried about side effects, previously limited data.
- Randomized to:
  - budesonide
  - nedocromil
  - or placebo

1. Long-Term Effects of Budesonide or Nedocromil in Children with Asthma. *N Engl J Med*. Oct 12, 2000. 343;15.

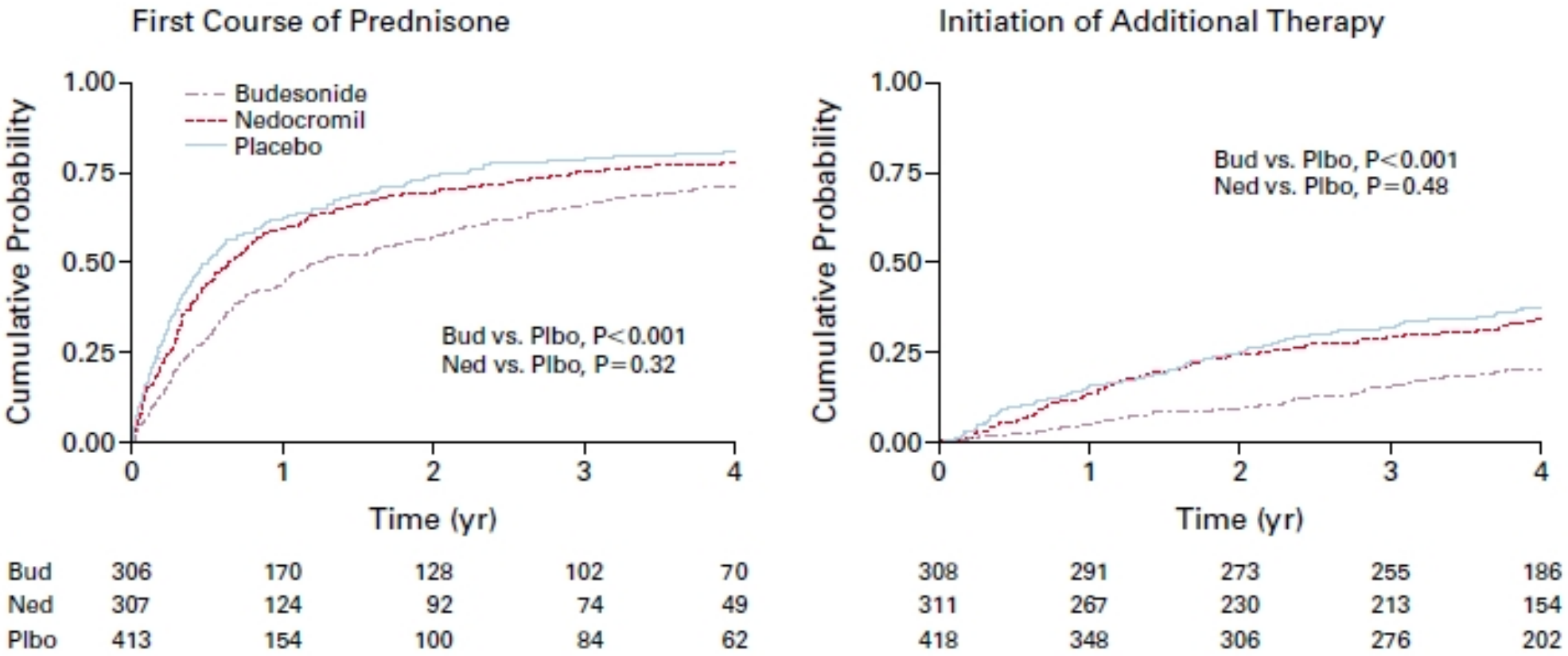
Are there side-effects for asthma treatment?

CAMP Trial

- Results:
  - Neither budesonide, nor nedocromil improve lung function
  - Budesonide
    - Improves airway hyperresponsiveness
    - Provides better asthma control
    - Small, transient growth velocity reduction

1. Long-Term Effects of Budesonide or Nedocromil in Children with Asthma. *N Engl J Med*. Oct 12, 2000. 343;15.

CAMP Trial



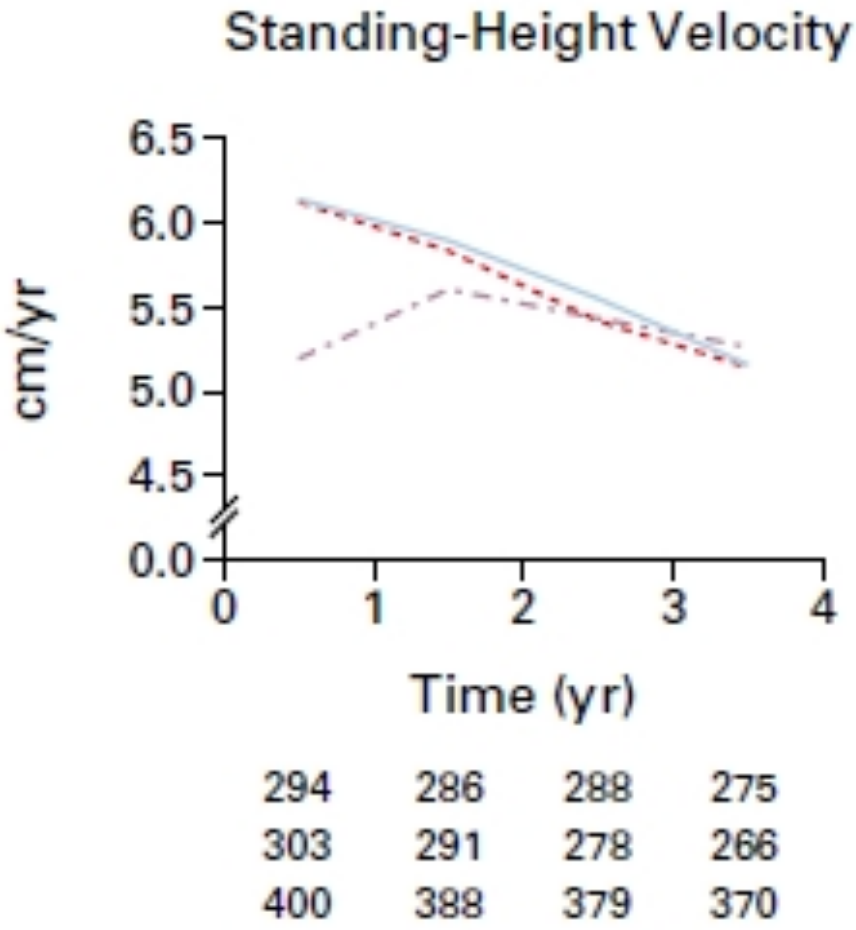
Bud	306	170	128	102	70	308	291	273	255	186
Ned	307	124	92	74	49	311	267	230	213	154
Plbo	413	154	100	84	62	418	348	306	276	202

Figure 2. Kaplan–Meier Estimates of the Cumulative Probability of a First Course of Prednisone and Initiation of Additional Therapy (Beclomethasone or Other Nonassigned Asthma Medications) during Four Years of Follow-up in the Budesonide (Bud), Nedocromil (Ned), and Placebo (Plbo) Groups.

The numbers of children at risk at annual intervals are shown below each graph.

1. Long-Term Effects of Budesonide or Nedocromil in Children with Asthma. *N Engl J Med*. Oct 12, 2000. 343;15.

CAMP Trial



1. Long-Term Effects of Budesonide or Nedocromil in Children with Asthma. *N Engl J Med*. Oct 12, 2000. 343;15.

So, what about that height thing?

CAMP Trial - Update

- n=943 (90.6% of inital study)
- Measured adult height
- Calculated differences across initial study groups

  (budesonide, nedocromil, placebo)

Mean adult height was

1.2 cm lower in budesonide group

and 0.2 cm lower in nedrocomil group

compared to placebo

1. H. William Kelly, *et al.* Effect of Inhaled Glucocorticoids in Childhood on Adult Height. *N Engl J Med*. Sept 3, 2012. 367;904-12.

CAMP Trial - Update

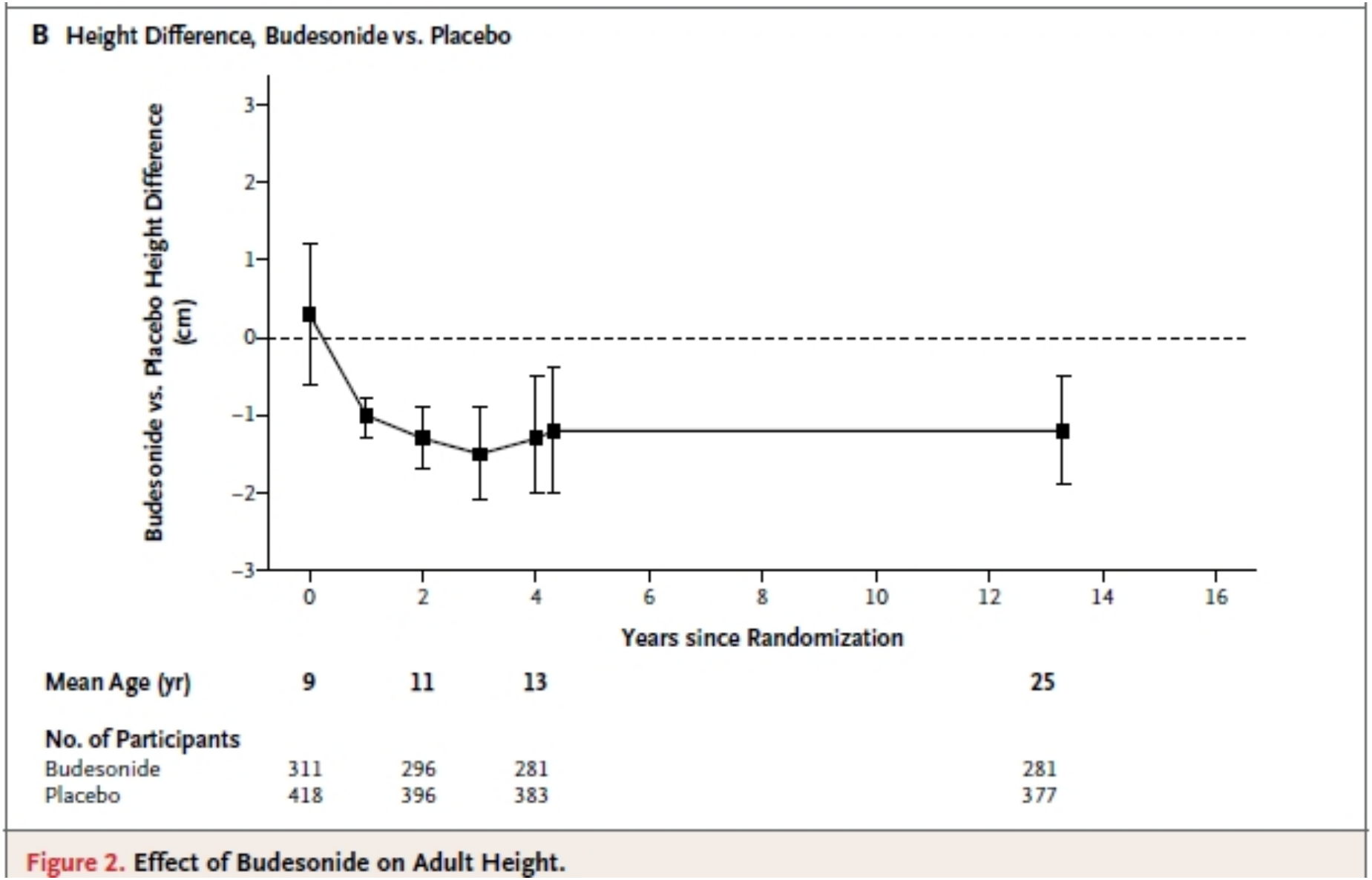


Figure 2. Effect of Budesonide on Adult Height.

1. H. William Kelly, *et al.* Effect of Inhaled Glucocorticoids in Childhood on Adult Height. *N Engl J Med*. Sept 3, 2012. 367;904-12.

Can we just use ICS for flares?

MIST Trial

- n=278 kids
- Ages 12 to 53 months
- Positive API, recurrent wheezing, at least one flare
- Randomized to:

Run-in: 2 Weeks	Treatment Phase: 52 Weeks		
	Randomized Treatment Group	**Nightly Except during Respiratory Tract Illnesses**	**During Respiratory Tract Illnesses Only for 7 Days**
Placebo once nightly and albuterol as needed	Daily	Budesonide (0.5 mg)	Placebo in a.m. Budesonide (0.5 mg) in p.m.
	Intermittent	Placebo	Budesonide (1.0 mg) in a.m. Budesonide (1.0 mg) in p.m.

Daily low-dose **was not superior** to intermittent high-dose budesonde in reducing asthma exacerbations

1. H. William Kelly, *et al.* Effect of Inhaled Glucocorticoids in Childhood on Adult Height. *N Engl J Med*. Sept 3, 2012. 367;904-12.

MIST Trial

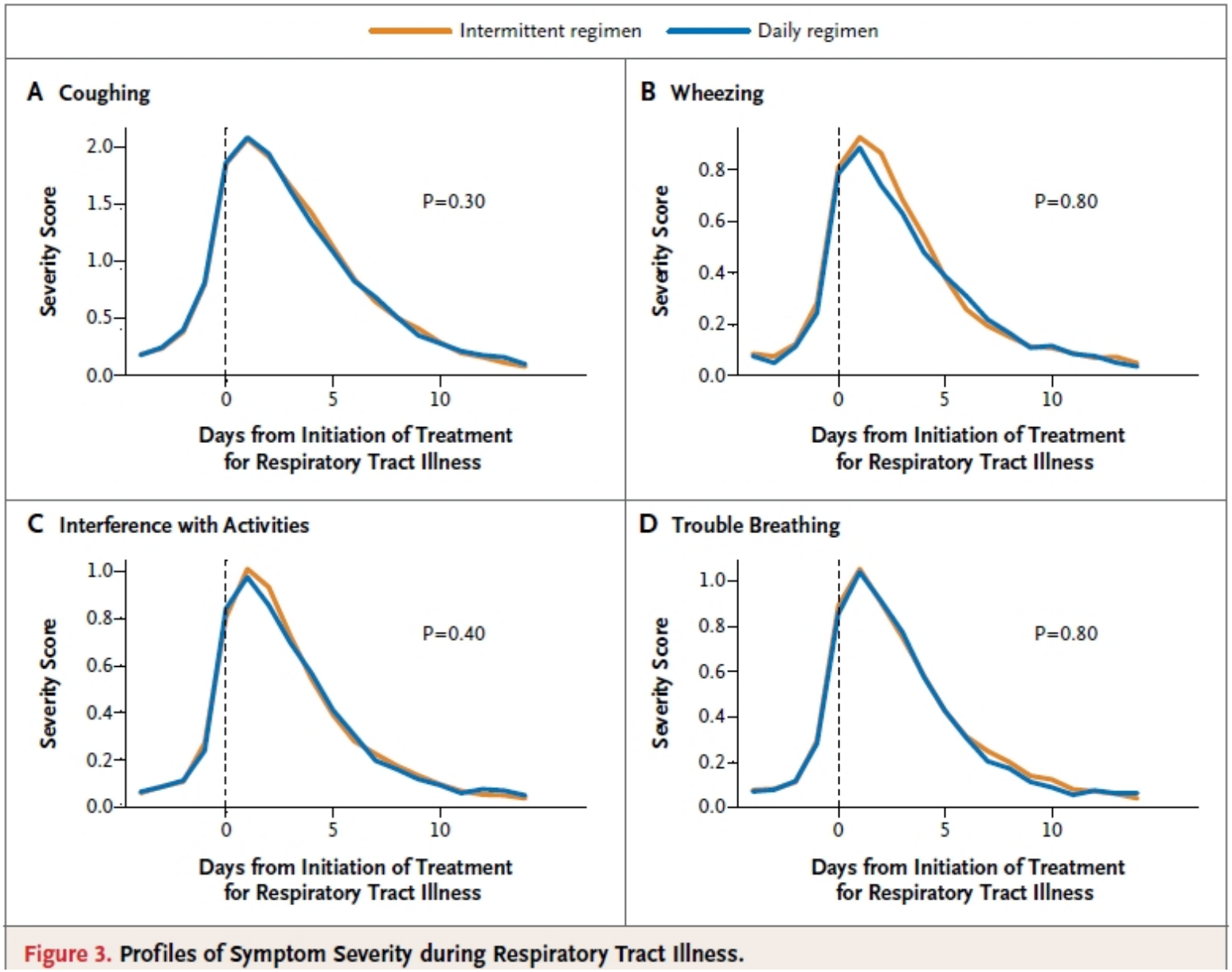


Figure 3. Profiles of Symptom Severity during Respiratory Tract Illness.

1. H. William Kelly, *et al.* Effect of Inhaled Glucocorticoids in Childhood on Adult Height. *N Engl J Med*. Sept 3, 2012. 367;904-12.

Is daily better than intermittent?

Cochrane Review (2012)

- Looked at 6 trials: 4 pediatric, 2 adult
- n=1211

Daily ICS had a slightly better

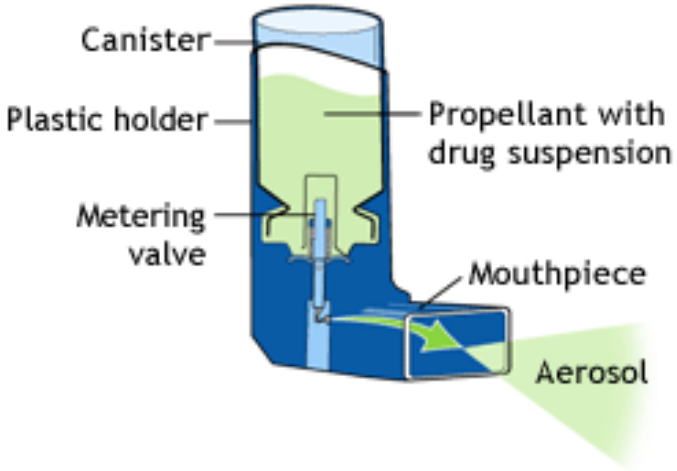
- peak flow (2.5%)
- symptom-free days (0.15 days)
- more beta agonist use (0.12 puffs per day)

No difference in:

- Quality of life, FEV1, hospitalizations, ER visits

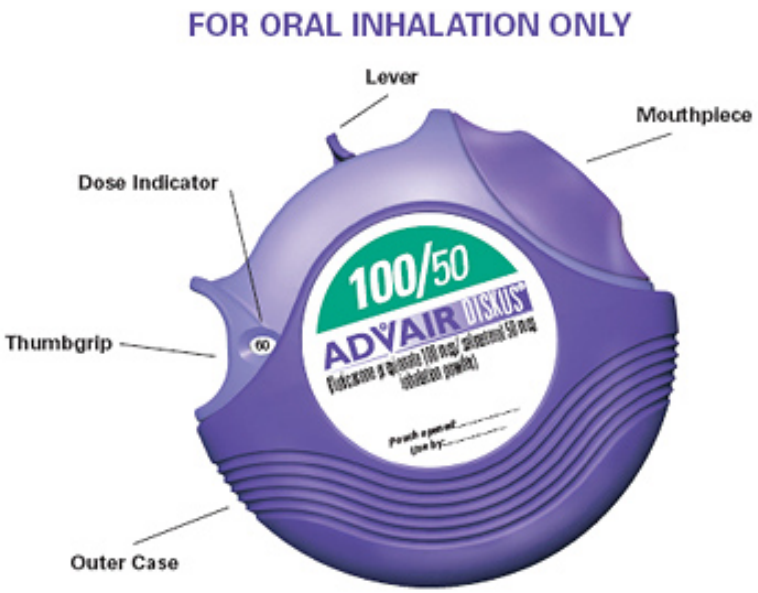
1. Chauhan, *et al.* intermittent vs daily inhaled corticosteroid for persistent asthma in adults and children. *Cochrane review.* 2012.

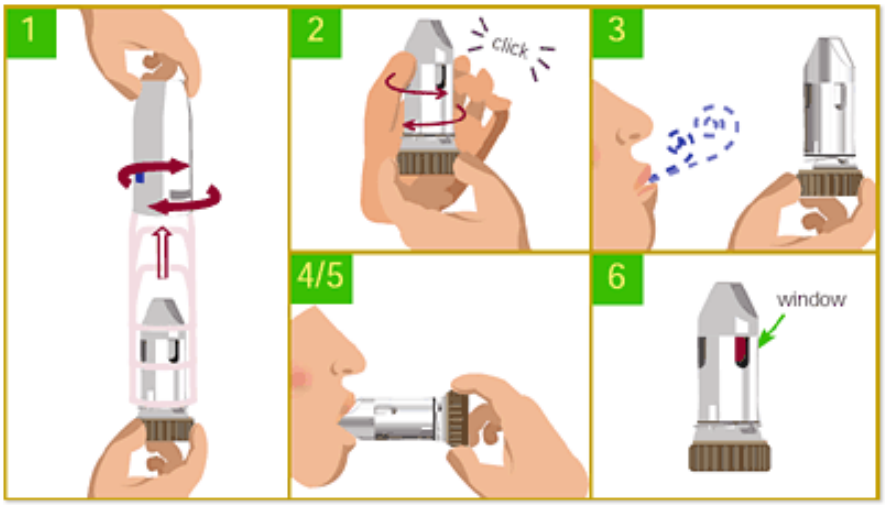
MDI (metered dose inhalers)



Drug runs out before propellant !

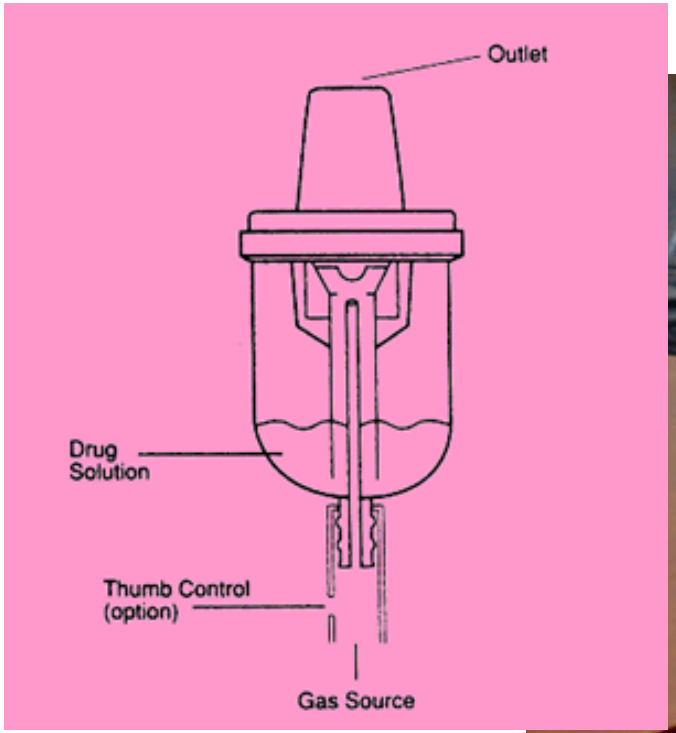
DPI (dry powder inhalers)





Nebulizers


DoggyNeb


Outlet
Drug Solution
Thumb Control (option)
Gas Source

My asthma medication isn't working.

- Doesn't feel sick in between flares
- Secondary gain
- Too expensive
- Doesn't understand when to use medications
- Using inhaler/nebulizer incorrectly
- Concerned about side-effects
- Can't feel the medication working
- Doesn't have asthma (not everything that wheezes is asthma)
- Needs a higher dose

1. ,Rubin, *et al.* What Does It Mean When A Patient Says, "My Asthma Medication is Not Working?" *Chest* 2004: 126;9742-81.

Nebulizers are better than inhalers, right?

- n=123
- Ages 1 to 24 months old
- Large hospital in Santiago, Chile
- Presenting to ED with mild to moderate wheezing
- Randomized trial
  - MDI-S (metered dose inhaler + spacer + mask)
  - Nebulizer
- Both groups received salbumatol
- Compared admissions, asthma scores

The children responded **faster to MDI-S**

1. Rubilar, *et al.* Randomized Trial of Salbutamol via Metered-Dose Inhaler with Spacer Versus Nebulizer for Acute Wheezing in Children Less Than 2 Years of Age. *Pediatric Pulmonary.* 2000. 29:264-9.

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VORTEX
Non Electrostatic Valved Holding Chamber

Nebulizers are better than inhalers, right?

TABLE 3—Comparison of Treatments

	NEB (n = 61)	MDI-S (n = 62)	*P*
Respiratory rate (min^{-1})			
On admission	55.3 ± 7.8[1]	56.2 ± 7.1	NS
After first hour	45.1 ± 6.9	38.8 ± 6.0	0.0001
After second hour	43.8 ± 3.8	37.3 ± 6.8	0.01
Clinical score: On admission			
Score from 6 to 7	37/61 (61%)	43/62 (69%)	NS
Score from 8 to 10	24/61 (39%)	19/62 (31%)	NS
Mean score ± SD	7.4 ± 0.9	7.1 ± 1.0	NS
After first hour			
Score ≤5 (success)	43/61 (71%)	56/62 (90%)	0.01
Mean score ± SD	4.4 ± 1.5	3.3 ± 1.4	0.01
After second hour			
Score ≤5 (success)	17/18 (94%)	6/6 (100%)	NS
Mean score ± SD	4.2 ± 1.0	3.5 ± 0.8	NS

[1]Mean ± SD. NS, no significance.

1. Rubilar, *et al.* Randomized Trial of Salbutamol via Metered-Dose Inhaler with Spacer Versus Nebulizer for Acute Wheezing in Children Less Than 2 Years of Age. *Pediatric Pulmonary.* 2000. 29:264-9.

Well that's just one small trial...

- Meta-analysis
- 6 trials, n=433
- Includes Rubilar trial
- All looked at MDI+VHC vs nebulizer

1. Castro-Rodriguez, *et al.* Beta-agonists through metered-dose inhaler with valved holding chamber vs nebulizer for acute exacerbatin of wheezing or asthma in children under 5 years of age: a systematic review with meta-analysis. *J Pediatr.* 2004;145:172-7.

Well that's just one small trial...

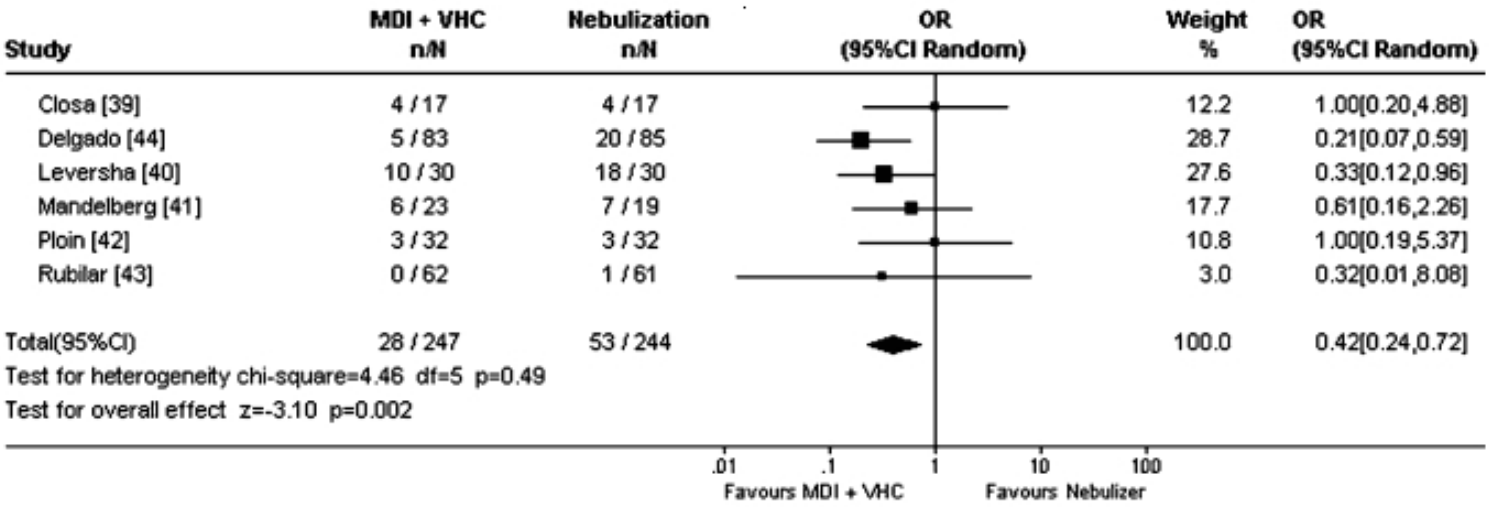


Fig 1. Pooled odds ratios of hospital admissions comparing treatment with β-agonists by MDI+VHC or nebulizer. Logarithmic scale was used for plotting odds ratios. Width of horizontal line represents 95% CI around point estimate (*black square*). Size of point estimate represents relative weight (percentage of weight) of each trial in the pooled summary estimate (*diamond*). *Vertical line* is line of no effect (OR, 1.0).

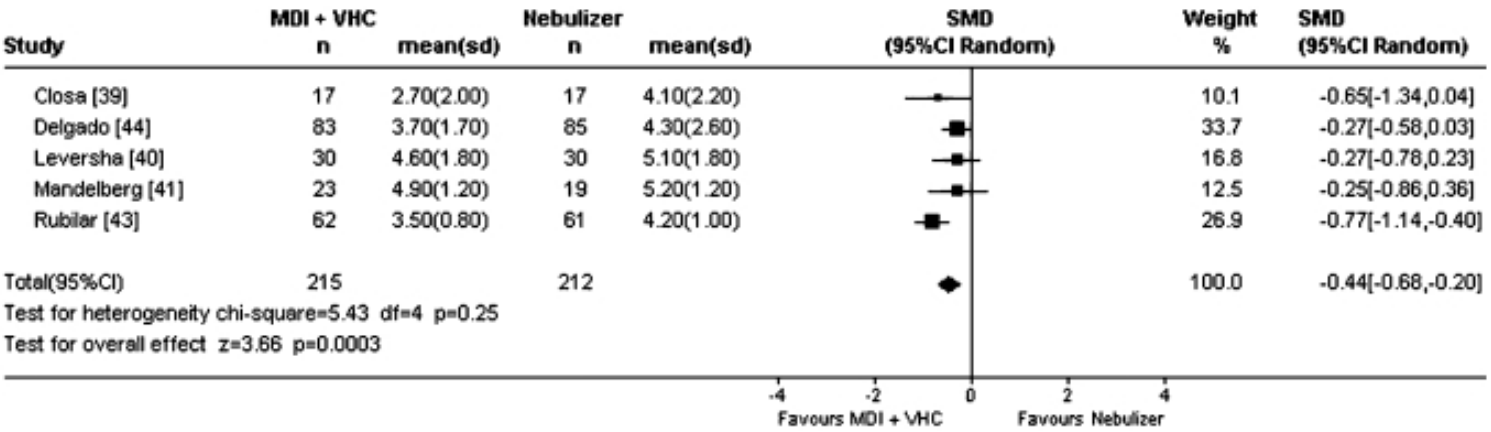


Fig 2. Pooled SMD in clinical score after treatment with β-agonists by MDI+VHC or nebulizer. SMD represents difference in means between groups displayed on SD units. Width of horizontal line represents 95% CI around point estimate (*black square*). Size of point estimate represents relative weight (percentage of weight) of each trial in the pooled summary estimate (*diamond*).

1. Castro-Rodriguez, *et al.* Beta-agonists through metered-dose inhaler with valved holding chamber vs nebulizer for acute exacerbatin of wheezing or asthma in children under 5 years of age: a systematic review with meta-analysis. *J Pediatr.* 2004;145:172-7.

Well that's just one small trial...

- Meta-analysis
- Looked at 59 RCTs
- Adults and kids
- Clinic and acute care/emergency care

1. Dolovich, *et al.* Device Selection and Outcomes of Aerosol Therapy: Evidence-based Guidelines. *Chest*. Jan 2005.

Symptom scores

Nebulizer better Holding chamber better

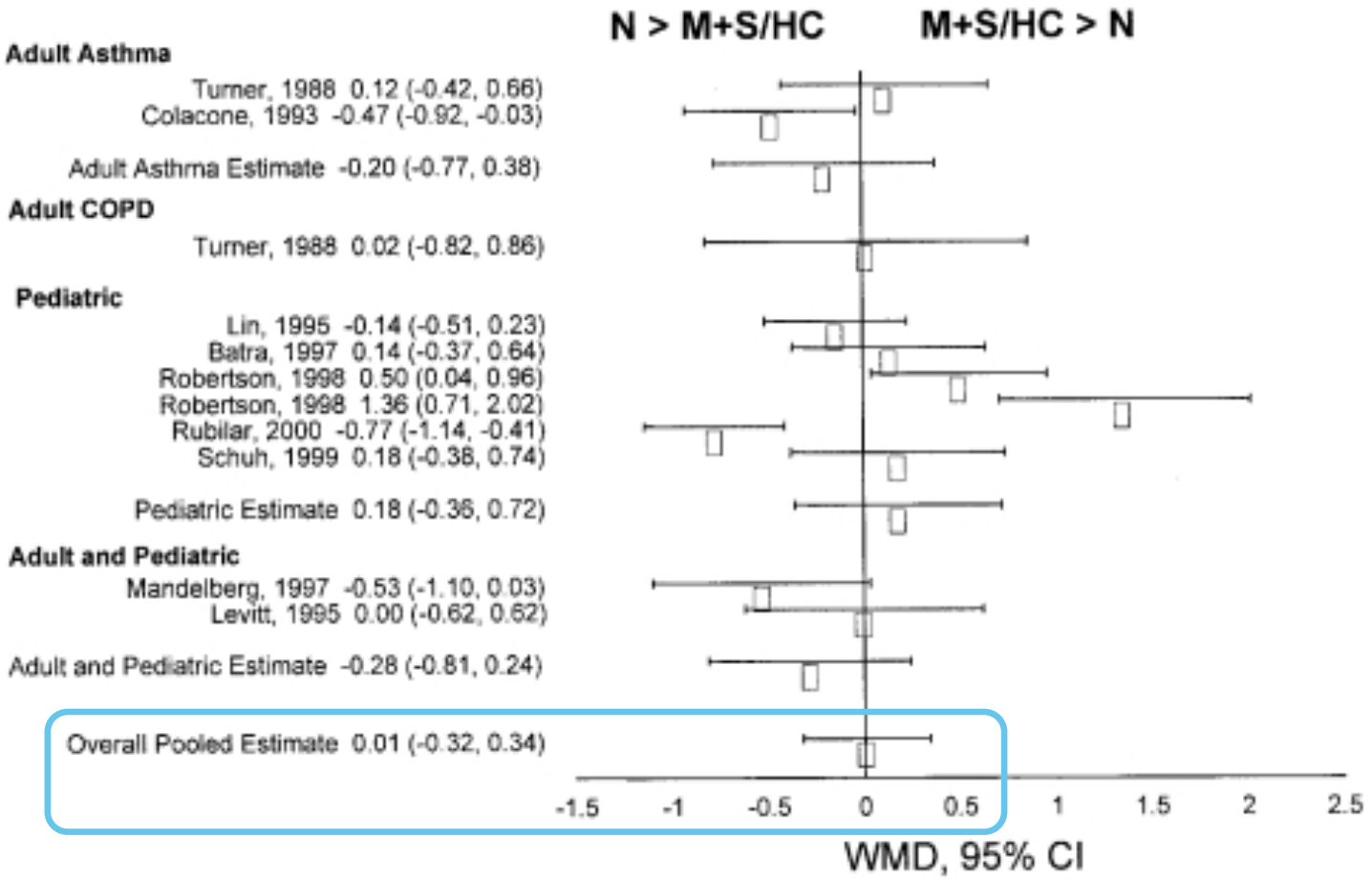


FIGURE 2. Weighted standardized mean difference (WMD) for symptom scores in ED/ICU trials using β_2-agonists comparing nebulizer (N) vs MDI + spacer/holding chamber (M + S/HC).

1. Dolovich, *et al.* Device Selection and Outcomes of Aerosol Therapy: Evidence-based Guidelines. *Chest*. Jan 2005.

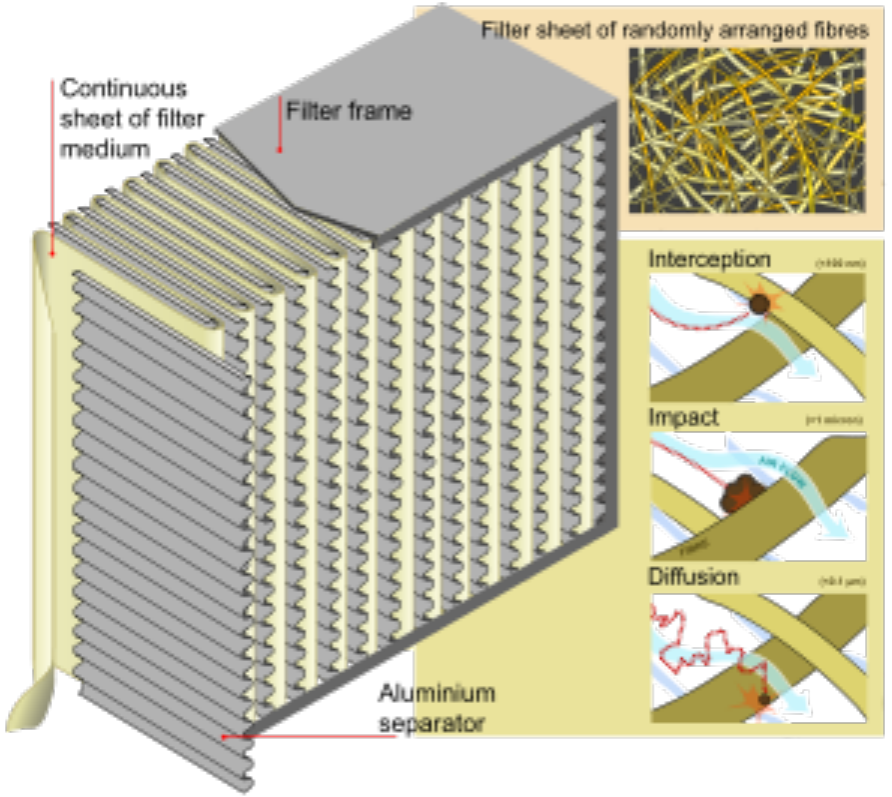
Cigarette Smoking

- Second hand smoke exposure is associated with worse asthma outcomes (increases risk for hospital admission)
- Oral steroids don't work as well when you smoke
- In utero exposure to a mom who smokes causes decreased lung function in children (particularly small airways)

1. Eisner, *et al.* Directly measured second hand smoke exposure and asthma health outcomes. *Thorax* 2005. 60:814-21.
2. Chaudhuryi, et al. Cigarette smoking impairs the therapeutic response to oral corticosteroids in chronic asthma. Am J Resp Crit Care Med. 2003. 168: 1308-11
3. Gilliland, *et al.* Maternal smoking during pregnancy, environmental tobacco smoke exposure and childhood lung function. *Thorax*. 2000. 55:271-6.

HEPA filter in bedroom

- Reduces burdeon of particles in the air
- eg cat dander
- Multiple studies have shown no effect on asthma symptoms (eg no change in FEV1)



HEPA filter in bedroom

- RCT
- n=100, ages 6-12
- Control
  - nothing x1 year, then same as intervention group
- Intervention:
  - Home education
  - Cockroach and rodent extermination
  - Mattress and pillow encasings
  - HEPA filter

1. Eggleston, *et al*. Home environmental intervention in inner-city asthma: a randomized controlled clinical trial. *Ann Allergy Asthma Immunol.* 2005;95:518-24.

HEPA filter in bedroom

Fewer particles

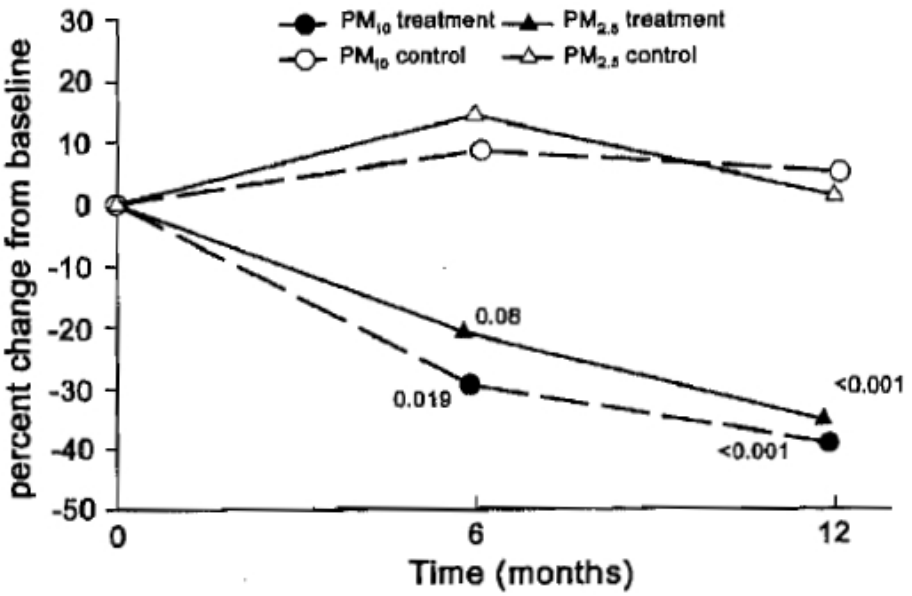


Figure 2. Median change in levels of particulate matter 10 μm or smaller (PM_{10}) and 2.5 μm or smaller ($PM_{2.5}$) measured in the child's bedroom.

Improved symptoms

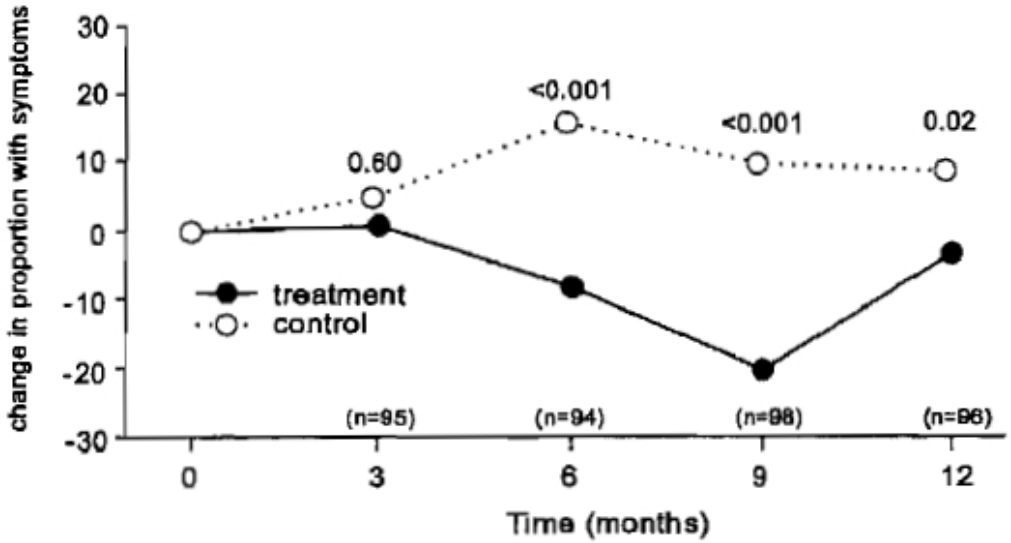


Figure 3. Change in the proportion of children with daytime asthma symptoms. The proportion was significantly lower at 6, 9, and 12 months in the treatment group (*t* test), and the average difference was significant during the first 9 months (generalized estimating equation).

1. Eggleston, *et al*. Home environmental intervention in inner-city asthma: a randomized controlled clinical trial. *Ann Allergy Asthma Immunol.* 2005;95:518-24.

Goals of Treatment

- Keep kids active (can do everything other kids can)
- Minimize missed school/work days
- Improve persistent symptoms
- Reduce frequency of exacerbations

Access this talk again at:

http://keithmurphy.org/talks

Other References

1. NHLBI 2007 Asthma Guidelines. http://www.nhlbi.nih.gov/guidelines/asthma/
2. Fanta, *et al*. Diagnosis of Asthma in Adolescents and Adults. *Up To Date.* http://UpToDate.com
3. Bailey, *et al.* Use of Inhalers in Adults. *Up To Date*. http://UpToDate.com