Cough-variant Asthma

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Disclosures

Speakers’ Bureau

• MERCK, Astra-Zeneca, TEVA, MEDA
Cough-variant asthma

- Cough is the sole symptom
- Positive methacholine challenge test
- Sputum eosinophilia
- Responds to asthma treatment
- Accounts for about 25%-30% cases of chronic cough
Eosinophilic bronchitis

- NAEB- Nonasthmatic eosinophilic bronchitis
- Cough is the sole symptom
- **Negative methacholine challenge test**
- > 3% nonsquamous sputum eosinophils (normal- 1.1%)
- Account for about 10-15% cases of chronic cough
- With or without atopy
Atopic cough

- Cough as the sole symptom
- Atopy
- Negative methacholine challenge test
- Possibly a sub-group of NAEB
- Described in Japanese population
Exhaled Nitric Oxide/eNO

- Levels increased in cough-variant asthma and NAEB
- Sensitivity and specificity very high (above 85%) for predicting response to steroids and presence of sputum eosinophilia
- High negative predictive value to rule out CVA and NAEB before the use of steroids
- Very good correlation between eNO and sputum eosinophilia in steroid-naïve patients
Natural history of cough-variant asthma

- Not entirely clear due to lack of sufficient data
- In one 4-year retrospective study of 42 patients, 7 went into remission, and 13 developed classical asthma

Natural history of NAEB

• In one study of 32 patients, one patient had complete resolution, 21 (66%) had persistent symptoms/inflammation, 3 (9%) developed asthma, 5 (16%) developed fixed airflow obstruction

• Causal association between NAEB and COPD- ??

*Berry MA, et al. Clin Exp Allergy*  
2005;35(5):598-601
Immunopathology

• Mast cells are localized and activated in more superficial airway epithelium in nonasthmatic eosinophilic bronchitis, whereas in asthma they lie deeper in close association with the airway smooth muscle
Recurrent Cough

- What is the likelihood of asthma in a child presenting with recurrent cough
- In a child with asthma, is cough severity a reflection of asthma severity
- Recurrent cough in the absence of wheeze is generally not from asthma
- Children with recurrent cough have an increased cough receptor sensitivity to capsaicin
Treatment of recurrent cough

- Usually self-limiting
- A short therapeutic trial with asthma meds can be considered (4 weeks)
- If a child doesn’t respond, then avoid escalating treatments but rather take a step back to reassess
- Is the child any worse without the treatment
Cough in an asthmatic child

- Cough in an asthmatic child is often due to increased cough receptor sensitivity
- Cough severity may not reflect asthma severity
- Cough should not be used as the major indicator for the level of asthma treatment especially in an acute episode
- Complete absence of cough may not be essential for asthma control. Avoid overtreatment
Cough-variant asthma

• Over-diagnosed or under-diagnosed??

• What do you think???
Pediatric Asthma Deaths: Patients With Mild Asthma Are Also at Risk

Findings from a cohort study reviewing all pediatric asthma-related deaths (n=51) in the Australian state of Victoria from 1986 to 1989.

FEV$_1$ Is Associated With Risk of Asthma Attacks

Proportion of Observations Reporting an Asthma Attack Over Subsequent Year

FEV$_1$ % Predicted Decile

Self-report
Parental report

Key New Concepts of Asthma Management

- Elements of assessment and monitoring
  - Severity
  - Control
  - Responsiveness to treatment
- Severity emphasized for initiating therapy
- Control emphasized for monitoring and adjusting therapy
- Severity and control defined in terms of 2 domains
  - Impairment
  - Risk

Asthma Severity and Control: Impairment Domain

Impairment = Current Frequency and Intensity of Symptoms and Functional Limitations

**Symptoms**
- Nighttime awakenings
- Need for short-acting $\beta_2$-agonists (SABAs) for quick relief of symptoms
- School days missed
- Exercise tolerance

**Lung Function**
- Spirometry
- Peak flow

Asthma Severity and Control: Risk Domain

• Future likelihood of asthma exacerbations, progressive decline in lung function over time, or risk of adverse effects from medications

• Assessment
  – Frequency and severity of exacerbations
  – Prednisone use
  – ER visits
  – Lung function
  – Minimally invasive biomarkers may play an increased role in the future (NO)

### Asthma Severity in Children Aged 0 to 4 Years

#### Components of Severity

<table>
<thead>
<tr>
<th>Impairment</th>
<th>Classification of Asthma Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intermittent</td>
</tr>
<tr>
<td></td>
<td>Mild</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>≤2 days/week</td>
</tr>
<tr>
<td><strong>Nighttime awakenings</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Short-acting β₂-agonist use for symptom control (not prevention of EIB)</strong></td>
<td>≤2 days/week</td>
</tr>
<tr>
<td><strong>Interference with normal activity</strong></td>
<td>None</td>
</tr>
</tbody>
</table>
| **Risk** | Exacerbations (consider frequency and severity) | 0-1/year | ≥2 exacerbations in 6 months requiring oral steroids, or ≥4 wheezing episodes/year lasting >1 day AND risk factors for persistent asthma  
Frequency and severity may fluctuate over time  
Exacerbations of any severity may occur in patients in any severity category |

Currently not taking controller medication.

EIB = exercise-induced bronchospasm.  
## Asthma Severity: 5 to 11 Years*

<table>
<thead>
<tr>
<th>Components of Severity</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>Mild</td>
</tr>
<tr>
<td>Impairment</td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>≤2/month</td>
</tr>
<tr>
<td>Lung Function</td>
<td></td>
</tr>
<tr>
<td>• Normal FEV₁ between exacerbations</td>
<td></td>
</tr>
<tr>
<td>• FEV₁ &gt;80% predicted</td>
<td></td>
</tr>
<tr>
<td>• FEV₁/FVC &gt;80%</td>
<td></td>
</tr>
<tr>
<td>Exacerbations (consider frequency and severity)</td>
<td>0-2/year</td>
</tr>
<tr>
<td>Risk</td>
<td></td>
</tr>
<tr>
<td>Interference with normal activity</td>
<td>None</td>
</tr>
</tbody>
</table>

*Currently not taking controller medication.

FEV₁ = forced expiratory volume in 1 second; FVC = forced vital capacity.

Key Changes in Classifying Asthma Severity in Children

• Severity now classified in terms of the new domains of current impairment and future risk
• New measures of impairment
  – Lung function (FEV$_1$/FVC)
• New measures of risk
  – Frequent wheezing episodes and risk factors for persistent asthma
  – Frequency and severity of exacerbations
• “Intermittent” category has replaced “mild intermittent” to emphasize that exacerbations can be mild or severe
Assessing Asthma Control in Children Aged 0 to 4 Years

<table>
<thead>
<tr>
<th>Components of Control</th>
<th>Classification of Asthma Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Well Controlled</td>
</tr>
<tr>
<td><strong>Impairment</strong></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>1/month</td>
</tr>
<tr>
<td>Interference with</td>
<td>None</td>
</tr>
<tr>
<td>normal activity</td>
<td></td>
</tr>
<tr>
<td>Short-acting β2-agonist use for symptom control (not prevention of EIB)</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td></td>
</tr>
<tr>
<td>Exacerbations</td>
<td>0-1/year</td>
</tr>
<tr>
<td>Treatment-related</td>
<td></td>
</tr>
<tr>
<td>adverse effects</td>
<td></td>
</tr>
</tbody>
</table>

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.
# Asthma Control: 5 to 11 Years

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<tr>
<th>Components of Control</th>
<th>Classification of Asthma Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Well Controlled</td>
</tr>
<tr>
<td><strong>Impairment</strong></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2 days/week but not more than once on each day</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>≤1/month</td>
</tr>
<tr>
<td>Interference with normal activity</td>
<td>None</td>
</tr>
<tr>
<td>Short-acting $\beta_2$-agonist use for symptom control (not prevention of EIB)</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Lung function</td>
<td></td>
</tr>
<tr>
<td>- FEV$_1$ or peak flow</td>
<td>&gt;80% predicted/personal best</td>
</tr>
<tr>
<td>- FEV$_1$/FVC</td>
<td>&gt;80% predicted</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td></td>
</tr>
<tr>
<td>Exacerbations</td>
<td>0-1/year</td>
</tr>
<tr>
<td>Reduction in lung growth</td>
<td>Evaluation requires long-term follow-up</td>
</tr>
<tr>
<td>Treatment-related adverse effects</td>
<td>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 overall assessment.</td>
</tr>
</tbody>
</table>

Key Changes in Assessing Asthma Control

• Once treatment is established, emphasis should be on assessment of asthma control rather than on severity
• New measures of impairment
  – Lung function over time (FEV$_1$/FVC)
• New measures of risk
  – Frequency of exacerbations
  – Treatment-related side effects
Onset of Symptoms in Children With Asthma\textsuperscript{1,2}

\begin{itemize}
\item 30\% >3 Years
\item 20\% 2–3 Years
\item 20\% 1–2 Years
\item 30\% <1 Year
\end{itemize}

Wheezing Children: Asthma or Not?

• 50% of infants who experience a single episode of wheezing will present with one or more additional wheezing episodes within the next few months¹

• 40% of children who wheeze in the first 3 years of life will continue to wheeze at 6 years of age (“persistent wheezers”)²

• It is important to identify patterns of wheezing and other risk factors for developing asthma in children
  – Early wheezers should be considered for a diagnosis of asthma and may, therefore, be candidates for controller therapy
The Risk of Asthma in Wheezing Children: Modified Asthma Predictive Index\textsuperscript{1,2}

In the past 12 months, >3 exacerbations of wheezing with at least 1 physician-diagnosed exacerbation \textbf{PLUS}

\begin{itemize}
  \item \textbf{1 Major Criterion}
    \begin{itemize}
      \item Parental history of asthma
      \item Physician-diagnosed atopic dermatitis
      \item Allergic sensitization to \textgt;=1 aeroallergen*  
    \end{itemize}

  \item \textbf{OR}

  \item \textbf{2 Minor Criteria}
    \begin{itemize}
      \item Wheezing unrelated to colds
      \item Blood eosinophils \textgt;=4%
      \item Allergic sensitization to milk, eggs, or peanuts
    \end{itemize}
\end{itemize}

House dust mite, cockroach, dog, cat, mold, grass, tree, and weed.
Early Aeroallergen Sensitization in Children Aged 2 to 3 Years

Sensitization by Allergen Class

- Food 7%
- Neither 39%
- Both 26%
- Aeroallergen 28%

Study included 285 children, aged 2 to 3 years, with positive modified Asthma Predictive Index (mAPI). Adapted with permission from Guilbert TW et al. *J Allergy Clin Immunol.* 2004;114:1282-1287.
Epithelial Remodelling in Asthma

Normal

Asthmatic
Effect of Inhaled Budesonide on Inflammation

Pre- and post-3-month tx with budesonide (BUD) 600 mcg b.i.d.

Risk factors for developing asthma

• Family history of asthma/atopy
• Sensitization to indoor allergens: dust mites, animal dander, cockroaches
• Sensitization to outdoor allergens: e.g. Alternaria
• Early exposure to cigarette smoke
• Rhinitis
Many Patients Incorrectly Perceive Their Asthma as “Well/Completely” Controlled\textsuperscript{1,2}

- **Moderate (n=473)**
  - Daily daytime symptoms
  - Nighttime symptoms >1 night/week

- **Severe (n=480)**
  - Continual daytime symptoms
  - Frequent nighttime symptoms

\textsuperscript{1} Adapted with permission from Chipps BE, Spahn JD. \textit{J Asthma.} 2006;43:567-572.
## The Rule of “2”

<table>
<thead>
<tr>
<th>Symptom/Use</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime asthma symptoms</td>
<td>&gt;2 days per week</td>
</tr>
<tr>
<td>Nighttime asthma symptoms</td>
<td>&gt;2 days per month</td>
</tr>
<tr>
<td>Rescue $\beta_2$-agonist canisters</td>
<td>&gt;2 per year</td>
</tr>
<tr>
<td>Rescue $\beta_2$-agonist use</td>
<td>&gt;2 times per week</td>
</tr>
</tbody>
</table>

Asthma Control Test™ (ACT)

1. In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home?

- All of the time 1
- Most of the time 2
- Some of the time 3
- A little of the time 4
- None of the time 5

2. During the past 4 weeks, how often have you had shortness of breath?

- More than once a day 1
- Once a day 2
- 3 to 6 times a week 3
- Once or twice a week 4
- Not at all 5

3. During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night, or earlier than usual in the morning?

- 4 or more nights a week 1
- 2 or 3 nights a week 2
- Once a week 3
- Once or twice 4
- Not at all 5

4. During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?

- 3 or more times per day 1
- 1 or 2 times per day 2
- 2 or 3 times per week 3
- Once a week or less 4
- Not at all 5

5. How would you rate your asthma control during the past 4 weeks?

- Not controlled at all 1
- Poorly controlled 2
- Somewhat controlled 3
- Well controlled 4
- Completely controlled 5

Copyright 2002, by QualityMetric Incorporated.
Exploring Reasons for Failure of Asthma Control$^1,2$

- “Under or Mis” diagnosis of asthma
- Inadequate therapy for disease severity
- Not addressing environmental allergies
- Poor compliance
- Repeated respiratory infection (daycare)
- Comorbid conditions: Sinus, GERD

Assessment of Asthma Control
Recommended (1- to 6-Month Intervals)

- Are goals of therapy being met? ✓
- Are adjustments in treatment necessary? ✓
- Measure
  - Signs and symptoms ✓
  - Pulmonary function ✓
  - Quality of life (QOL)/functional status ✓
  - History of exacerbations ✓
  - Pharmacotherapy ✓
  - Patient-provider communication and patient satisfaction ✓
Asthma Action Plan until ______________

Name  Date
Primary Care Provider Name:  Daytime Phone Number:                             Night/Weekend Phone Number:                             Pharmacy Name  Pharmacy Phone Number:

The colors of a traffic light will help you use your asthma medicines.
Green means Go Zone!
Use preventive medicine.
Yellow means Caution Zone!
Add quick-relief medicine.
Red means Stop Zone!
Get help from a doctor.
Personal Best Peak Flow: ________

GO
ACTION: Use these daily preventive anti-inflammatory medicines:

<table>
<thead>
<tr>
<th>Medicine</th>
<th>How Much</th>
<th>How Often</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You have all of these:
• Breathing is good
• No cough or wheeze
• Sleep through the night
• Got work and play
For asthma with exercise, take:

CAUTION
ACTION: Continue with your medicine, as above, and Add:

<table>
<thead>
<tr>
<th>Medicine</th>
<th>How Much</th>
<th>How Often</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You have any of these:
• First signs of a cold
• Cough
• Mild wheeze
• Tight chest

Call your primary care provider

DANGER
ACTION: Take these medicines until you talk to your doctor:

Get help from a doctor now! Do not be afraid of causing a fuss.
Your doctor will want to see you right away. It's important!

Your asthma is getting worse fast:
• Medicine is not helping
• Breathing is hard and fast
• Nose opens wide
• Ribs show
• Can't talk well

If you cannot contact your doctor, go directly to the emergency room. DO NOT WAIT.
Call an ambulance (911) if necessary.

Make an appointment with your primary care provider within two days of an ER visit or hospitalization.

Adapted from the NHLBI

Reprinted with permission from IMPACT DC.
Clinical Control of Asthma

- No (or minimal)* daytime symptoms
- No limitations of activity
- No nocturnal symptoms
- No (or minimal) need for rescue medication
- Normal lung function
- No exacerbations

*Minimal = twice or less per week
Key Questions

• Are Peak Flow Meters useful?
• When to give Asthma Action Plans?
• When and why to do allergy testing?
• Can starting early on inhaled steroids prevent airway remodeling?
• What is the role of allergy shots?
• Can allergy shots prevent asthma?
Primary Prevention of Asthma??

• Hygiene hypothesis- early exposure to endotoxins, microbial products
• Exposure to farm livestock, farm milk
• Breast feeding
• Early pet exposure
• Allergy immunotherapy/allergy shots
Can you outgrow asthma?

- 10-39% remission rate in children with non-atopic asthma
Inhaled steroids and Growth

- Relatively safe at low doses but have the potential to cause growth effects
- Use lowest dose possible
- Monitor growth charts
- Individualize the treatment
- Avoid steroid phobia and don’t be too casual either!
Don’t forget to address

- Environmental allergies
- Pet exposures
- Reflux
- Sinusitis
- Obesity
- Parental smoking
- Compliance on meds
Stepwise Approach for Managing Asthma in Children Aged 0 to 4 Years

ICS = inhaled corticosteroid; LABA = long-acting β₂-agonist; SABA = short-acting β₂-agonist.

Stepwise Approach for Managing Asthma in Children Aged 5 to 11 Years

### Persistent Asthma: Daily Medication

**Interruption Asthma**

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

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**Step 1**

*Preferred:*
- Low-dose ICS

*Alternative:*
- Cromolyn, Nedocromil, LTRA, or Theophylline

**Step 2**

*Preferred:*
- Medium-dose ICS OR
- Low-dose ICS + LABA

*Alternative:*
- Medium-dose ICS + either LTRA, Theophylline, or Zileuton

**Step 3**

*Preferred:*
- Medium-dose ICS + LABA

*Alternative:*
- High-dose ICS + either LTRA, Theophylline, or Zileuton

**Step 4**

*Preferred:*
- High-dose ICS + LABA AND Consider Omalizumab for patients who have allergies

**Step 5**

*Preferred:*
- High-dose ICS + LABA + oral corticosteroid AND Consider Omalizumab for patients who have allergies

**Step 6**

*Preferred:*
- High-dose ICS + LABA + oral corticosteroid AND Consider Omalizumab for patients who have allergies

---

### Patient Education and Environmental Control at Each Step

**Quick-Relief Medication for All Patients**

- SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-minute intervals as needed. Short course of systemic oral corticosteroids may be needed.
- Use of beta₂-agonist >2 days a week for symptom control (not prevention of EIB) indicates inadequate control and the need to step up treatment.

---

**Step up if needed**
- (first, check adherence, environmental control, and comorbid conditions)

**Assess control**

**Step down if possible**
- (and asthma is well controlled at least 3 months)
Inhaled Steroids Target Multiple Inflammatory Mediators

Inflammatory Signal Transduction Molecules
- NOS
- COX
- PLA

Leukotrienes?

Prostaglandins

Cytokines

Adhesion Molecules

Corticosteroids

COX = cyclooxygenase; NOS = nitric oxide synthase; PLA = phospholipase A.

Key Recommendations
Managing asthma in children 0-4 years

• Diagnosis is often difficult.
• Treatment has not been adequately studied.
• Criteria for initiation of long-term-control therapy:
  – 3 wheezing episodes in past year and positive asthma risk profile.
  – those who require symptomatic treatment > 2 days per week
  – two or more severe exacerbations within 6 months

DRAFT NHLBI 2007
The Risk of Asthma in Wheezing Children: Modified Asthma Predictive Index$^{1,2}$

In the past 12 months, >3 exacerbations of wheezing with at least 1 physician-diagnosed exacerbation **PLUS**

1 **Major Criterion**
- Parental history of asthma
- Physician-diagnosed atopic dermatitis
- Allergic sensitization to $\geq$1 aeroallergen*

OR

2 **Minor Criteria**
- Wheezing unrelated to colds
- Blood eosinophils $\geq$4%
- Allergic sensitization to milk, eggs, or peanuts

*House dust mite, cockroach, dog, cat, mold, grass, tree, and weed.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Low Daily Dose (µg)</th>
<th>Medium Daily Dose (µg)</th>
<th>High Daily Dose (µg)</th>
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</thead>
<tbody>
<tr>
<td>Beclomethasone</td>
<td>200-500</td>
<td>&gt;500-1000</td>
<td>&gt;1000</td>
</tr>
<tr>
<td></td>
<td>100-200</td>
<td>&gt;200-400</td>
<td>&gt;400</td>
</tr>
<tr>
<td>Budesonide</td>
<td>200-600</td>
<td>600-1000</td>
<td>&gt;1000</td>
</tr>
<tr>
<td></td>
<td>100-200</td>
<td>&gt;200-400</td>
<td>&gt;400</td>
</tr>
<tr>
<td>Budesonide-Neb Inhalation Suspension</td>
<td>250-500</td>
<td>&gt;500-1000</td>
<td>&gt;1000</td>
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<tr>
<td>Ciclesonide</td>
<td>80 – 160</td>
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<tr>
<td>Flunisolide</td>
<td>500-1000</td>
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<tr>
<td></td>
<td>500-750</td>
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<tr>
<td>Fluticasone</td>
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<td></td>
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<td>&gt;200-500</td>
<td>&gt;500</td>
</tr>
<tr>
<td>Mometasone furoate</td>
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<td>&gt;800-1200</td>
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<tr>
<td></td>
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<tr>
<td>Triamcinolone acetonide</td>
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<tr>
<td></td>
<td>400-800</td>
<td>&gt;800-1200</td>
<td>&gt;1200</td>
</tr>
</tbody>
</table>
Follow-Up

• Visits every 2-6 weeks until control achieved
• When control achieved, contact every 3-6 months
• Step-down in therapy
  – Consider with well-controlled asthma for at least 3 months
  – Decrease inhaled steroids by 25-50 % every 3 months to lowest effective dose
  – Patients may relapse with total discontinuation of inhaled corticosteroids
Peak Flow Meter is optional!

- Maximum expiratory flow rate
- Helps in monitoring (Not diagnosis)
- Very effort dependent
- Poor at detecting early/mild obstruction
- Can not distinguish between obstruction and restriction

*De-emphasize!*
What can lead to “difficult-to-control” asthma?

- Wrong diagnosis (VCD, FB, CF, others)
- Missed/untreated co-morbidities (Allergies)
- Heterogeneity of asthma
- Wrong medicine:
  - Technique
  - Choice
  - Dose
- Patient factors: compliance, anxiety, obesity
Pharmacotherapy for Asthma

- Short-acting beta agonists: albuterol, Maxair autohaler, Xopenex
- Long-acting beta agonists (LABA): Serevent, Foradil
- Inhaled steroids: fluticasone (Flovent), budesonide (Pulmicort), Asmanex (mometasone), Q-Var, Azmacort, Ciclesonide
- Inhaled steroid/LABA combination: Advair, Symbicort, Dulera
- Leukotriene modifiers: Singulair, Accolate
- Leukotriene inhibitor: Zileuton (zyflo)
- Anti-IgE: Xolair
- Miscellaneous: Theophylline, lidocaine via nebulizer
- Oral steroids: prednisone
- Allergy Immunotherapy/Injections
Can diet affect respiratory system???

- Fruit-based (apples, pears, etc.) dietary fiber intake reduced cough with phlegm (?)
- Omega-3 fatty acid play a role in leukotrienes and inflammation (?)
- Vitamin C for exercise-induced asthma (?)
- Whole grains and fish lower asthma risk (?)


**Tabak C, et al.** Diet and asthma in Dutch school children. Thorax. 2006;61:1048-1053
My vision for a futuristic asthma care model

Collaboration

- Patient
- Nurse
- Respiratory therapist
- Pharmacist
- Dietician and Exercise Therapist, Counselling
- Primary Care Provider and Specialist
- AAAAI, ACAAI: Web-based educational support, CME, CE
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Thank you!

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