Pediatric Asthma
Christina Ferreri, DNP, APRN
DISCLOSURES

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SESSION OBJECTIVES

• Identify pathophysiology of pediatric asthma.
• Identify typical triggers for asthma.
• Discuss management of pediatric asthma.
Step Up Primary Care!

Pediatric Asthma Management in 2015:

“It’s All About That Base”
Background

1988 BSN
2002 MSN FNP
2011 DNP

Over 25 years in Pediatrics NICU/Primary Care
Pediatric Primary Care in Manchester, NH
Strong Interest in Asthma
2002 Study: Barriers to Acute Office Asthma Management
Various Asthma Committees/Initiatives
1. Clarify Problem and Introduce Phenotypes
   - Size of the Asthma Problem
   - The Guideline Dance
   - Research Evidence and How Far We’ve Come

2. Simplify Classification and Management

   Childhood Wheezing

3. Challenges and Obstacles
   - Insurance
   - Compliance

4. New Treatment Highlights
The Problem: Does asthma warrant your attention?

1 in 11 Children

1 in 5 Went to ED

30% Acute Visits

9 People Die Daily

25.5 M
18.7 Adults
7 Kids (9.3%)

1.9 M ER visits

8.9M Office Visits

14.2% of all OV

1 in 5 Went to ED

1.9 M ER visits

8.9M Office Visits

14.2% of all OV

3rd leading cause hospital < 15yrs

3rd leading cause hospital < 15yrs

30% of Acutes (Peters 2007)

3,388 Deaths

http://www.cdc.gov/nchs/fastats/asthma.htm# Health Interview Survey (CDC, 2012)

http://www.cdc.gov/VitalSigns/Asthma/index.html

http://www.progressive-charlestown.com/2011/07/are-these-stories-true.html

http://www.kairos2.com/children_inhaler.htm

https://openclipart.org/detail/170120/Grim%20Reaper

http://radiopaedia.org/cases/hydatid-cyst-in

Prevalence has grown by 15% in the last decade.
Among children aged 0-14, boys were more likely than girls to have asthma.
Boys and girls aged 15-17 years had asthma at the same rate.
Among adults women were more likely than men to have asthma.

http://www.cdc.gov/asthma/asthmadata.htm
Who Does all this Surveillance Anyway?
Who are we Missing in this Data?

Little Undiagnosed Wheezers

- 26% 2-3 yo viral wheezers (not all future asthmatics)
- 50-80% pedi asthma wheeze < 5yrs

How do we classify and capture these kids?

Seasonal wheezers: Intermittent or Persistent?

(Bloomberg, 2009), (Potter, 2009)
Purpose of guidelines:
  Reduce confusion
  Improve patient outcomes utilizing research
  Standardize care to achieve best practices across range of settings
  Decrease costs: less errors and malpractice

Staying current with raw evidence is overwhelming
Clinical Trials Show Guidelines Work

<table>
<thead>
<tr>
<th>Study by first author</th>
<th>Guideline-based asthma care</th>
<th>Adherence and associated with asthma control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keemink (2014)</td>
<td>104</td>
<td>85%</td>
</tr>
<tr>
<td>Klok (2014)</td>
<td>81</td>
<td>80%</td>
</tr>
<tr>
<td>Klok (2012)</td>
<td>93</td>
<td>92%</td>
</tr>
</tbody>
</table>
Controlled patients

- Have fewer exacerbations (Schatz et al, 2014)
- Are 5 times less likely to require an acute office visit
- Are 5 times less likely to require ED visit (Guilbert et al, 2011)
Are Your Patients in Control in Real Life?

<table>
<thead>
<tr>
<th>Study</th>
<th>Uncontrolled Asthma</th>
</tr>
</thead>
<tbody>
<tr>
<td>TENOR</td>
<td>83%</td>
</tr>
<tr>
<td>REACT</td>
<td>55%</td>
</tr>
<tr>
<td>Fuhlbrigge et al</td>
<td>41%</td>
</tr>
<tr>
<td>ACCESS/Stanford</td>
<td>58%/46%</td>
</tr>
<tr>
<td>ACCESS/Liu</td>
<td>54%R/35%</td>
</tr>
<tr>
<td>AIM</td>
<td>71%</td>
</tr>
<tr>
<td>CHOICE</td>
<td>85%</td>
</tr>
</tbody>
</table>

It’s the Adherence.......#@& !..... that Determines Control!

It’s the adherence, stupid (that determines asthma control in preschool children)

Ted Klok1, Adrian A. Kaptein2, Eric J. Duiverman3,4 and Paul L. Brand1,5

Author Affiliations

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Abstract

Although guideline-based asthma care and adherence to inhaled corticosteroids are predictors of asthma control, the role of adherence in maintaining long-term asthma control is largely unknown. This study was designed to explore the relationship between adherence to inhaled corticosteroids and long-term asthma control in young children with asthma.

In this observational study, 81 2–6-year-old asthmatic children, using inhaled corticosteroids, closely followed-up in a programme with extensive self-management training, were enrolled. Adherence was measured daily for 12 months using Martinhalter® (Nexus Ltd, Auckland, New Zealand) devices. Long-term asthma control was assessed by parents and physicians and included clinical assessment, an asthma control questionnaire and lung function measurement. We examined the association of adherence to asthma control, adjusting for seasonal influences and clinical characteristics.

Median (interquartile range) adherence was 87% (70–94%), and 64/798 children had well-controlled asthma throughout follow-up. Adherence >80% was associated with better asthma control, and we found no important confounders of this association. Children with persistent mild symptoms had lower adherence rates (p=0.028).

Guideline-based asthma care was associated with good asthma control in most children. Adherence to inhaled corticosteroids was an independent strong predictor of long-term asthma control, with highest levels of asthma control found in children with adherence >80% of doses prescribed.

Adherence to ICS is an independent strong predictor of long-term asthma control

<table>
<thead>
<tr>
<th>Study</th>
<th>Main Factors for non adherence</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jentzsch 2012</td>
<td>Asthma related</td>
<td>44%</td>
</tr>
<tr>
<td>Schultz 2012</td>
<td>Pt related</td>
<td>60%</td>
</tr>
<tr>
<td>Vasbinder 2012</td>
<td>Pt related/med beliefs</td>
<td>49%</td>
</tr>
<tr>
<td>Klok (2014)</td>
<td>Provider prescribing</td>
<td>49%</td>
</tr>
</tbody>
</table>
Adherence to ICS is the Keystone

**Patient Barriers**
- Socioeconomic
- Ethnicity
- Family routines
- Pt/family Knowledge
- Parental views or perspectives
- Parental/patient Perception of episodic vs persistent
- Intrinsic Asthma control factors

**Provider Barriers**
- Lack of evidence knowledge of ICS research
- Persistent medication beliefs
- Busy schedules treating <4 respiratory illness individually each time.
Guideline Implementation

FOCUS FOCUS FOCUS

PROVIDER VARIABLES: learn it, use it, promote it.
Use current knowledge of clinical types with endotypes

PATIENT VARIABLES: Chronic Diseases are full of variables (endotypes)

Too Many Variables!

WE need a Research based Patient centered approach

Research Utilization without an individualized patient centered approach doesn’t work
How well are we managing this in Primary care?

Research shows providers:
1. Underestimate prevalence of symptoms
2. Overestimate patients' control
3. Underprescribe adequate controller medication

(Wechler, 2009; Holgate, Price, & Balovirta, 2006)

Nearly ¾ of patients in National Claims Study met criteria for uncontrolled disease

(Stempel, McLaughlin, Standaford & Fulbrigge, 2005; Wechsler, 2009)
Asthma Guidelines in US

The “Asthma Guidelines”

- National Heart, Lung, and Blood Institute
- National Asthma Education and Prevention Program (NAEPP) 1989

Periodic Updates: 2011
Needs Assessment/updates 2014

The “Other” Guidelines

- Asthma Guidelines Cincinnati Children’s Hospital
- VA guidelines for Asthma Ect.
Asthma Guidelines in US

**United States**

- Asthma Guidelines
  Cincinnati Children’s Hospital
- VA guidelines for Asthma Ect.

**International**

- PRACTALL 2008
- Global Initiative (GINA) New < 5 yo guidelines 2009
- European Academy of Asthma and Allergy 2008
Guidelines for the Diagnosis and Management of Asthma (EPR-3)

The Guidelines

- Full Report -- Prepublication copy
- Summary Report
- Press Release

Status

- Publication Date: July 2007
- Version History
  - EPR-2 Update on Selected Topic in 2002
  - EPR-2 published in 1997
  - EPR-1 published in 1991

Writing and Review Groups

- Expert Panel Members
- Conflicts of Interest

Methodology

- Description
- Search Strategies

Supporting Materials and Tools

- Asthma Care Quick Reference: Diagnosing and Managing Asthma
- Evidence Tables
- Guidelines Implementation Panel (GIP) Report
- National Asthma Control Initiative (NACI) Web Site
- Physician Asthma Care Education (PACE) Web Site
- Information for Health Professionals
- Information for Patients and the Public
1. Classify **Severity** by Presentation of **Impairment**

- **Stable or Uncontrolled?**
  - < 2 days/wk
  - < 2 noc/month
  - < 2 OS flareups/yr

1. Stable: Uncontrolled
2. Flare-up: Uncontrolled
3. Acute Distress: Uncontrolled
2. Choose your Therapy Based on Risk

4 Main Clinical Types

- **Severe/High**: *Step 5 or 6
  - ICS consider OS if flare up
  - Likely LABA or OS or LTI
  - Albuterol

- **Moderate/Medium**: *Step 3 or 4
  - ICS consider OS if flare up
  - Possible LTBA or LTI
  - Albuterol

- **Mild/Low**: *Step 2
  - Inhaled Steroids
  - Albuterol
  - Consider OS if flare up

- **Intermittent**: *Step 1
  - Albuterol only
  - Consider OS if flare up

**Follow Up Visit:**
- Manage triggers
- CT every visit
- Annual spirometry
- Follow every 3-6 months
Behind the Research

For Surveillance and for care Guidelines
Explosion in Asthma Research

1970’s

1980’s

1990’s

2000’s

Personalized Asthma Therapy
Biomarkers + Clinical Type

Present

Image courtesy of Sura Nualpradid at FreeDigitalPhotos.net
Image Open Access from Priyanka Pundir, Xiaofeng Wang and Marianna, 2012
Image Open Access from Shifren, Witt, Christie, Castro, 2012
Clinical Type + Cellular Biomarkers

Phenotype x
Phenotype y
Ect, ect, ect.....
Target therapy options in guidelines based on Phenotype and Endotype

9 Phenotypes!

- Severe non allergic persistent non ics responder asthma
  - Step 3 or 4

- Aspirin induced asthma
  - *Step 5 or 6

- Late onset non allergic asthma
  - *Step 3 or 4

- Obesity associated asthma
  - *Step 3 or 4

- Late onset Atopic wheezer
  - *Step 2

- Early onset Atopic Wheezer
  - *Step 5 or 6

- Exacerbation prone asthma
  - *Step 3 or 4

- Episodic vs multitrigger Wheezer
  - *Step 2
It’s All About That Base

Diagram showing interactions involving APC, TCR, Th0, Th1, Th17, Th2, Eosinophil, IL-4, IL-5, IgE, B cell, mast cell, FcεR, IL-17, IFN-γ, TNF, IL-4, IL-9, IgE, and IgE isotype switch. The interaction results in Smooth Muscle Cell Hyperplasia, Mucus Hypersecretion, and Eosinophil Infiltration.
You already know the clinical Types that you seen in your office.

Combine biomarkers and clinical type to determine phenotype and endotypes and target individualized asthma management:

- Risk
- Treatment
- Prognosis etc.
New Paradigm of Asthma
## Asthma Phenotypes 2000’s

### Transient Wheezing in Childhood
- Tucson Study (N=1246)
- Never Wheezed (51%)
- Transient Wheezers < 3 (20%)
- Persistent Wheezers (14%)
  - Non Atopic uncontrolled
  - Atopic IGE associated persistent wheeze
- Late onset Wheezers (15%)
  - Non Atopic
  - Atopic

### Asthma Predictive Index
- Asthma Predictive Index
- Isle of Write score
- Leicestershire tool PIAMA risk score
- Environment and Childhood asthma score
- Persistent Asthma Score
- Clinical Asthma Prediction Score
Development of definitions of asthma phenotypes that will enhance interpretation of studies
Phenotypes: 3 categories

**Trigger Induced Asthma**
- Allergic
- Non-allergic
- Aspirin-sensitive
- Infection
- Exercise-induced

**Clinical Presentation**
- Pre-asthma wheezing in infants
  - Episodic (viral) wheeze
  - Multi-trigger wheezing
- Exacerbation-prone asthma
- Asthma associated with apparent irreversible airflow limitation

**Inflammatory markers of asthma**
- Eosinophilic
- Neutrophilic asthma
Phenotypes of Childhood Wheezing

1. Viral induced wheezing
2. Severe intermittent wheezing
3. Exercise bronchospasm/asthma
4. Persistent asthma
5. Severe asthma
When to Start Controllers on Transient Wheezers

- Is there a positive Asthma predictive Index?
- How many episodes in the past 6 months?
Rhino vs Respiratory Syncytial Viral infections and the Development of Asthma
Maintenance versus Intermittent Inhaled Steroids

Predict Future Atopic status until obvious allergic pattern emerges.

Infants
Wheezing Toddlers
Preschooler
School-age
The Asthma Visit Decision Points

Was he ....... uncontrolled the past month?
Will he ....... have risks for more symptoms?
Is he ........... in distress now?

- How Uncontrolled was his asthma
- How Risky will his asthma be
- How Bad is he today

http://animals.phillipmartin.info/index_bear.htm
Severity Scores:

PRAM: Pediatric Respiratory Assessment Measure (Chalut, 2000)

PIS: Pulmonary Index Score 93-2000 (Scarfone, 1993-2000)

PASS: Pediatric Asthma Severity Score (Gorelick, 2004)

RAD: Resp rate, Accessory muscles, Decreased BS (Horeczko, 2011)
Symptomatic Asthma: “Uncontrolled”
Classify Severity by current Impairment and future risk
The Asthma Control Test

The patient is asked, in the past 4 weeks:

- How much has asthma interfered with your day-to-day activity?
- How often have you had shortness of breath?
- How often have asthma symptoms woken you up at night or earlier than usual in the morning?
- How often have you had to use a rescue inhaler or nebulizer medication?

The patient is also asked:

- How well controlled do you think your asthma is?

NHLBI website. [9]
Definition of Asthma Control
Assessing Asthma Control

National Asthma Education and Prevention Program (NAEPP)
3rd Expert Panel Report

0-4
5-11
12-adult
Step-up Therapy
Step-Down Therapy
Pediatric patients with moderate-to-severe persistent asthma who discontinue LABA therapy:
37% chance of losing asthma control

Recent recommendations of discontinuing LABA therapy as soon as control is achieved should be evaluated in a prospective long-term study.
(O’Hagan, Morton, Eid, 2012)
Asthma Home Instructions for Flareup

This is home management of exacerbation-use guidelines and don’t under prescribe

1. Bronchodilator: albuterol

Explicit instructions below the name of each drug.

1 nebulizer OR _____ puffs via spacer.
Call if no improvement after treatment or if pt worsens
Call if symptoms of distress develop. (_______________________)
this should work within 5-10 minutes but wears off less than 4hrs

2. Anti-Swelling/Anti Inflammatory: steroids

Explicit instructions below the name of each drug

oral steroids______________________________
This may take ____ days to work

inhaled steroids______________________________
This may take ____ days to notice an improvement

Call if no improvement in ______ days
Call anytime symptoms persist > _______ days
Call sooner if symptoms worsen or new ones develop.

3. Other Therapy or Medications for underlying Trigger:__________________

4. Revisit in
What is Wheezing?

Wheezing is Tube Constriction and Swelling
Wheezing is common in uncontrolled Asthma

1. Tube (broncho) Constriction / spasm
   - Take tube Cross-section
   - 2 things occur when a patient wheezes
   - Triggered by:
     1. 
     2. 
     3. etc.

   - Albuterol
     - 1. Quick < 20min
     - Medications in this category are designed for a quick reversal of Tube constriction

2. Tube (broncho) Swelling / Inflammation
   - Natural Steroids
     - May take up to 2 weeks or never get there.

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Medication in this category is for Control or Prevention of tube Swelling

Anti-inflammatory route is based on how quickly needed:
1. Inhaled - takes a few days to begin - 2 weeks to benefit
2. Oral
3. Shot or other
Treatment points

- Target Inflammation in Asthma
- Inhaled Corticosteroids
- Leukotriene Modifiers
- Trends in Asthma therapy
ACUTE Presentation

**Exacerbation**: Stable Flareup or Acute Distress

- Stabilize ED, Office, or Home
  - Severity (Guidelines for Home or office exacerbations)

  **Triage**: Brief History
  
  Onset
  
  Potential causes

  #1 **Initial Quick Assessment**: Classify!

  VS, pulse oximetry
  Level of alertness
  Hydration status
ACUTE Presentation

Exacerbation: Stable Flareup or Acute Distress

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Triage: Brief History
- Onset
- Potential causes

#1 Initial Quick Assessment: Classify!
- VS, pulse oximetry
- Level of alertness
- Hydration status
Kids have highest number of attacks

Asthma Attack Prevalence among Persons with Current Asthma by Age Group, Sex, Race and Ethnicity, Poverty Status, and Geographic Region: United States, Average Annual 2008-2010

From 2008 to 2010 asthma attacks occurred more often in children and women, among families whose income was below 100% of the federal poverty threshold, and in the South and West. Race or asthma did not significantly affect asthma attack prevalence.
Attacks in kids are more prevalent than in adults

Asthma Attack Prevalence among Children and Adults with Current Asthma: United States, 2001-2010

http://www.cdc.gov/asthma/asthmadata.htm
Classify Acute Severity

# 1. Assess or Classify the severity of the exacerbation

Severity Screening Tools:

- PRAM: Pediatric Respiratory Assessment Measure
- PIS: Pulmonary Index Score
- PASS: Pediatric Asthma Severity Score
- RAD: Resp rate, Accessory muscles, Decreased BS
SEND OR STAY IN OFFICE PASS SCORING

Pediatric Asthma Severity Score (none, mild, moderate) total possible points 6
1. Wheezing
2. work of breathing,
3. prolongation of expiration

Mild
No or mild wheeze
No or mild retractions
No or mild I:E prolongation

PASS to STAY

Score of O-3
Wheeze w/Good aeration
SOB when active
Lusty cry/full sentences
Alert
Oxim >94
PEF > 70%

Score of 4-6

PASS to ED

Wheeze with Wide spread aeration decrease/none
SOB at rest, stops feeding
Minimal cry between breaths
Agitated
O2sats < 91
LF < 40

Severe or Imminent failure
Severe wheeze or absent
Suprasternal retractions
Severe I:E Prolongation

Vitals:
Oximetry: > 90%

Lung Function: Not always feasible during exacerbation
Imminent Failure:

- Patient with PASS score nearing or at 6
- Severe tachypnea
- Bradypnea or apnea
- Severe retractions, nasal flaring, grunting
- Fatigue or lethargy from respiratory effort despite nebulizer treatments in the office
- Pulse oximetry < 90% with evidence of increased work of breathing or poor aeration

At any point a Score of 4-6

- Absent aeration
- Crying soft b/w breaths/Talks in words only
- Oximetry < 91
- PEF < 40%
PASS to Stay in Office
Score < 3

- Mild to Mod Wheeze
- Minimal to full intercostal retractions
- Mild to moderate prologation of I:E
- Oximetry >91%
How Much Albuterol do you Give in a Flareup?  
Flare Up versus Standard Asthma Dosing

< 5 years

- 1 (2.5mg) neb or
- 4-8 puffs MDI up to every 20 min for 1 hr (yep that’s 12 puffs!)

then every 4 hours as needed

> 5 years old

- 1 neb or 4-8 puffs (It is the same)

Non-Flareup Asthma Dosing Home
Post 1\textsuperscript{st} albuterol

- **Consider Further Diagnostic Testing** if the patient has any of the following:
  - Persistent Distress despite Albuterol
  - Significant hypoxemia
  - Asymmetry on lung exam

- **Chest X-ray**
  - Routine chest imaging is **NOT** recommended

- **Viral Testing**
  - Routine viral testing is **NOT** recommended
  - Consider if:
    - Suspected H1N1 or influenza infection if patient meets criteria for treatment

**Ipratropium bromide/albuterol (duoneb)**
Stable enough for Home?

Is patient a candidate for home management

Assess Home Risk:

• Exacerbation was not in Severe Category

• Good Response to appropriate albuterol dosing (disposition clearly improved)

• O2sats > 92% preferably > 95%

• No significant co-morbidity

• If PEFR done then now > 70% predicted

• No “Fatal” risk factor
  • PEF < 40
  • Multiple prior hospitalizations or ED visits for asthma
  • Acute deterioration
  • Complicating psychosocial issues
  • New onset asthma (?)

• Home and family appropriate for discharge
Prescribe oral steroids for 5 days if indicated (1mg/kg BID X 5 days, max 30 mg/dose)

Review Asthma Action Plan:
- Bronchodilator dosing for flare
- Inhaled steroid dosing
- Oral steroid dosing (if prescribed)

Review signs that would require callback or visit to ED

Follow up with primary provider within 5 days to 2 weeks
Acute Asthma Followup Plan

Visit
Stabilize with Albuterol — May take 1-2 hrs.
Re-assess appropriateness of home.
Prescribe and Teach Control Plan

4 hour Call
Recheck Stabilization via Call; Review 24-48 hour plan

24 hour Call
Recheck 24-48 hrs via Call or Visit.

Visit 1 Week
Make plan to step down from acute dosing to chronic dosing
(Make Asthma Action Plan)

Visit 1-3 week
Re-Classify severity and decrease more or increase therapy.
(Asthma Action Plan)
Plan for Flu/pneum shot, spirometry, allergy assessment etc.
Asthma Plan Made at Followup
3. Challenges and Obstacles

Insurance
Compliance
New Treatment Highlights
  o For comparison among population subgroups, percentages were adjusted by age using the 2000 U.S. Census standard population.

• Current Asthma Prevalence: United States, 2001-2010. See Figure 1 in National Surveillance of Asthma: United States, 2001-2010.
  o For comparison among population subgroups, percentages were adjusted by age using the 2000 U.S. Census standard population. See Table 1 for underlying data.

• Current Asthma Prevalence by Race and Ethnicity: United States, 2001-2010. See Table 1 for underlying data in National Surveillance of Asthma: United States, 2001-2010.
  o For comparison among population subgroups, percentages were adjusted by age using the 2000 U.S. Census standard population.
  o Race categories ‘White’ and ‘Black’ include only those with a single race. Persons of Hispanic origin may be of any race.

• Current Asthma Prevalence by Age Group, Sex, Race and Ethnicity, Poverty Status, Geographic Region, and Urbanicity: United States, Average Annual 2008-2010. See Figure 2 in National Surveillance of Asthma: United States, 2001-2010.
  o Represents 95% confidence interval.
  o Crude (unadjusted) percentages are presented. See Table 2 for underlying data.
  o The categories ‘Puerto Rican’ and ‘Mexican’ are subcategories of Hispanic.
Sources (continued)

CDC National Center for Health Statistics, National Health Interview Survey (NHIS)

  - Crude (unadjusted) percentages are presented.

- Asthma Attack Prevalence among Children and Adults with Current Asthma (Risk-based): United States, 2001-2010. See Figure 5 in National Surveillance of Asthma: United States, 2001-2010.
  - Crude (unadjusted) percentages are presented. See Table 5 for underlying data.

- Asthma Attack Prevalence among Persons with Current Asthma (Risk-based) by Age Group, Sex, Race and Ethnicity, Poverty Status, and Geographic Region: United States, Average Annual 2008-2010. See Figure 6 in National Surveillance of Asthma: United States, 2001-2010.
  - Represents 95% confidence interval.
  - Crude (unadjusted) percentages are presented. See Table 6 for underlying data.
  - The categories ‘Puerto Rican’ and ‘Mexican’ are subcategories of ‘Hispanic’.

CDC Behavioral Risk Factor Surveillance System (BRFSS)

- Adult Current Asthma Prevalence by State or US Territory, 2010. See Table C1 for underlying data in 2010 Adult Asthma Data: Prevalence Tables and Maps.