CHRONIC COUGH IN CHILDREN

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10-27-2021

CHOC Children's

Disclosures

- I have no disclosures

OBJECTIVE

- At the end of this activity participants will be able to:
  - Understand the pathophysiology of cough
  - Understand the differential diagnosis of chronic cough
  - Use chronic cough algorithm
  - Know when to refer to a pulmonologist

OBJECTIVE

Scheduling

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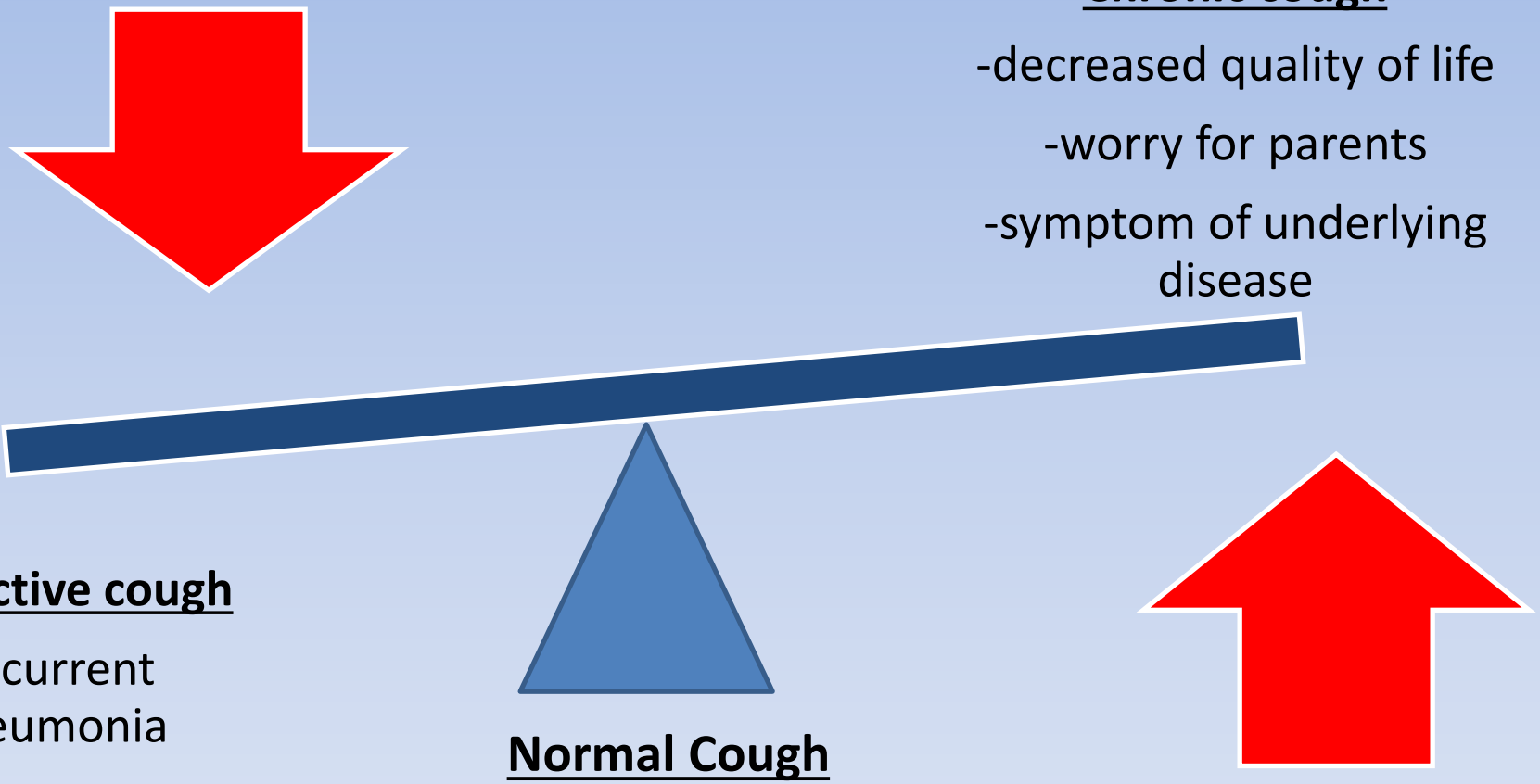
New pt: Chronic cough

Why is understanding cough important?

- Cough is the most common symptom seen by general pediatrician
  - Frustrating consultation for pediatrician and parents
- Cough is easily recognizable (unlike wheeze)
- ~$2 Billion - spent on abx, cough suppressants, and expectorants

Cough Balance



Chronic cough

-decreased quality of life

-worry for parents

-symptom of underlying disease

Ineffective cough

-recurrent pneumonia

Normal Cough

-defense mechanism in health and disease

Outline

- Definition of cough
- Mechanism of cough
- Specific diseases
- Evaluation and Workup

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DEFINITION OF COUGH

- An explosive expiration that provides a normal protective mechanism for clearing the tracheobronchial tree of secretions and foreign material

- Protective mechanism that ensures the removal of mucus, noxious substances, and infectious organisms from the larynx, trachea, and large bronchi → prevents pulmonary aspiration, promotes cilliary activity, and clears airway debris

NORMAL vs ABNORMAL

- Healthy children cough from 1-34x/day (mean 11)
- Cough may be the presenting symptom of pulmonary or extra pulmonary disease
- Chronic cough – cough of > 4 weeks

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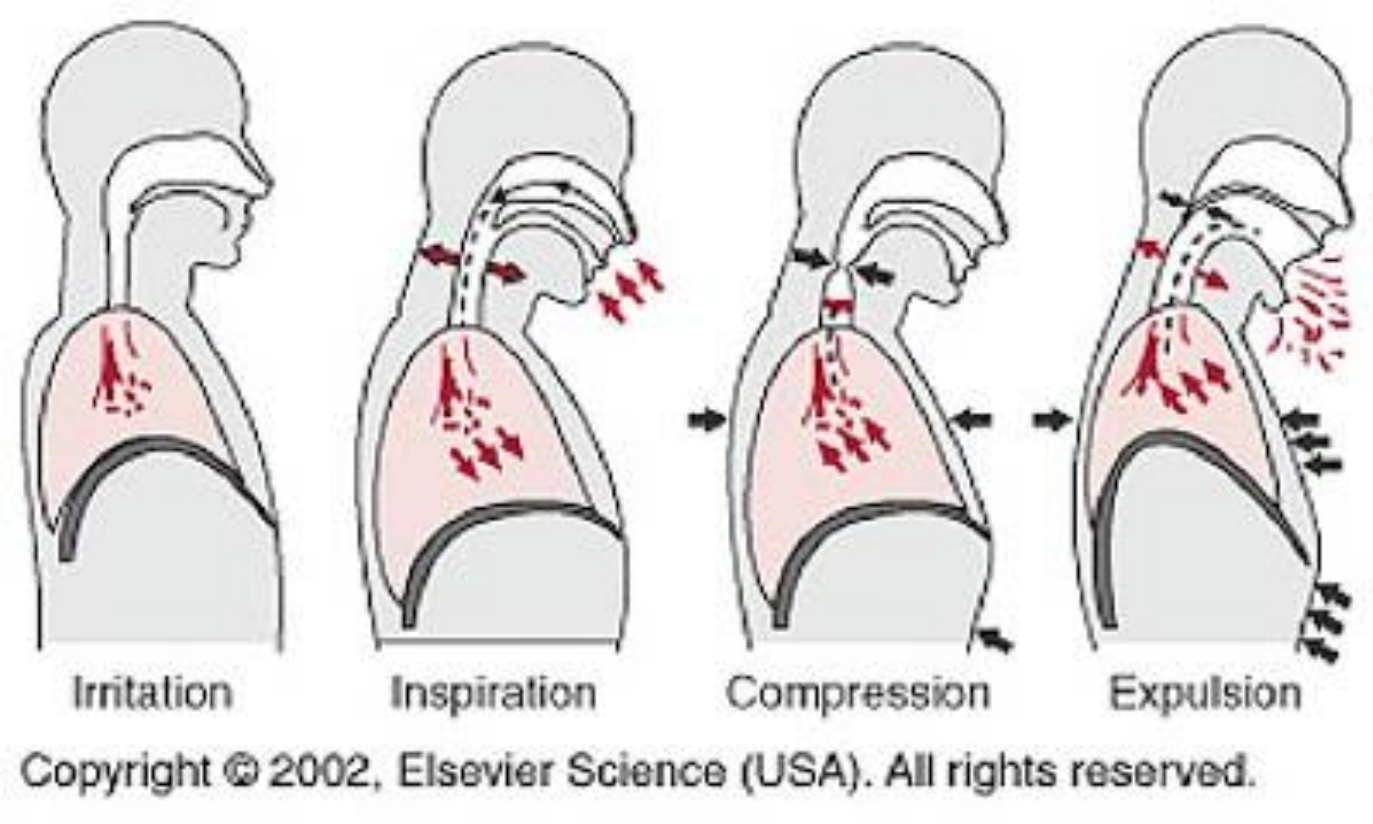


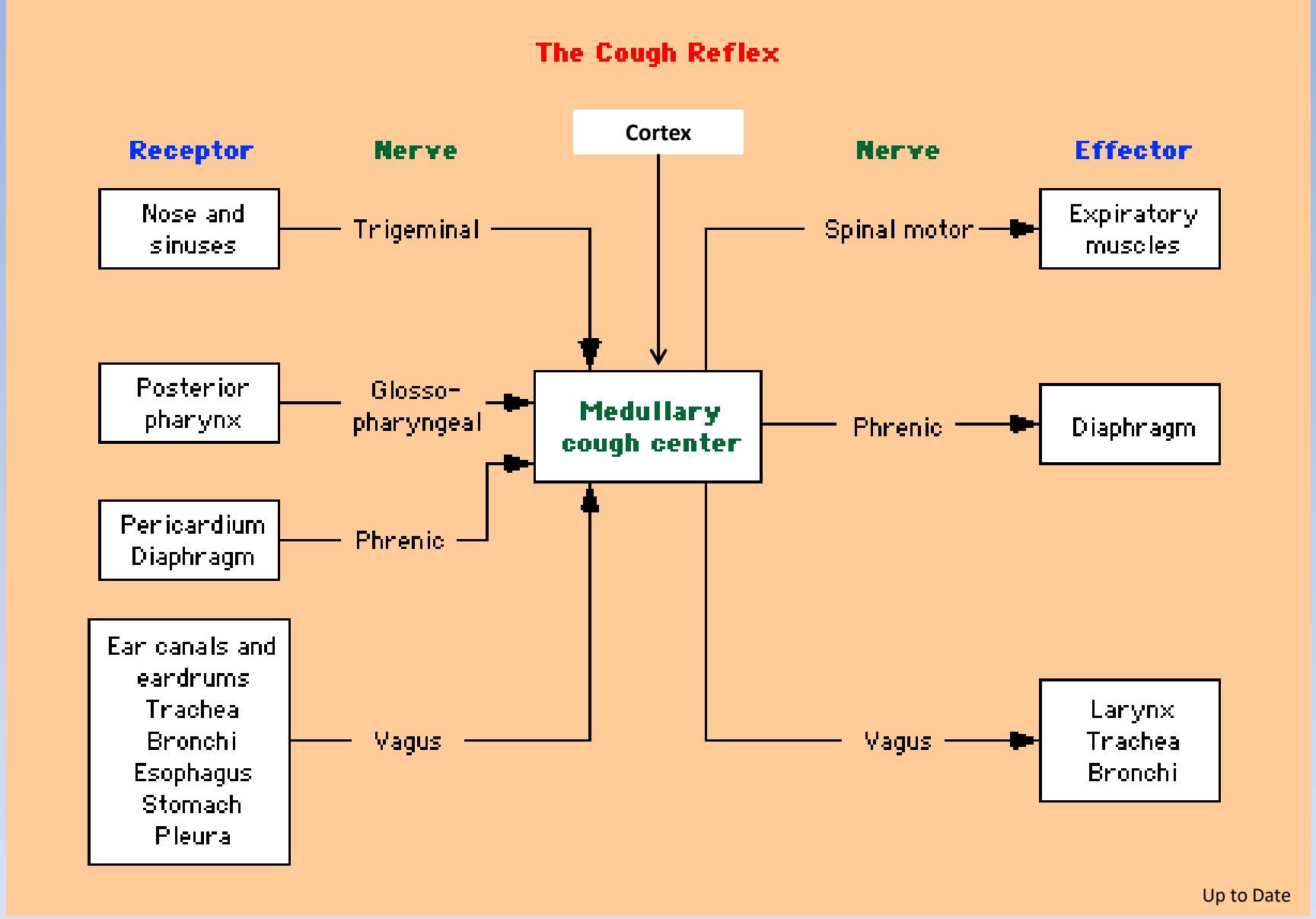
MECHANISM OF COUGH

MECHANISM

- Coughing may be initiated either voluntarily or reflexively
- As a defensive reflex it has both afferent and efferent pathways
- Starts with a deep inspiration followed by glottic closure and muscle contraction against a closed glottis

MECHANISM

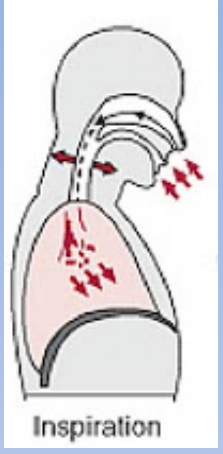
- Cough receptors are found along the surface of the pharynx, larynx, trachea, and major bronchi.
  - Also found: middle ear, sinuses, pericardium, and diaphragm
  - Not found: alveoli or lung parenchyma
- Afferent neural pathway
  - receptors via neural pathways →medulla of the brain
- Efferent neural pathway
  - cerebral cortex and medulla via neural pathways → glottis, external intercostals, diaphragm, and other major expiratory muscles

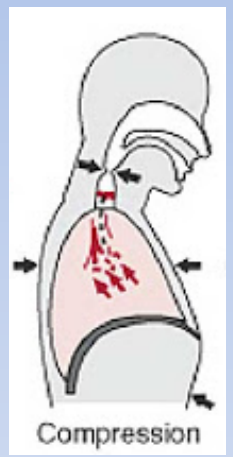


- Stimulation of cough receptors (mechanical or chemical)
  - central airways – mechanoreceptors >chemoreceptors
  - peripheral airways – chemoreceptors > mechanoreceptors

4 PHASES OF A COUGH

- Irritation
- Deep inspiration
  - Airways open and the lungs inflate
  - 1-2.5x tidal volume
- Compression
  - glottis closes + contraction of muscles (chest wall, diaphragm, and abdominal wall) → increased pressure in the lungs (~300cm H_20)
- Expulsion
  - Glottis opens → air rushes out of the lungs at high velocity → dislodgement and removal of mucus from the airways
- Relaxation
  - Chest wall and abdominal muscles relax





Pattern of cough

- Specific pattern of the cough depends on the site and type of stimulation

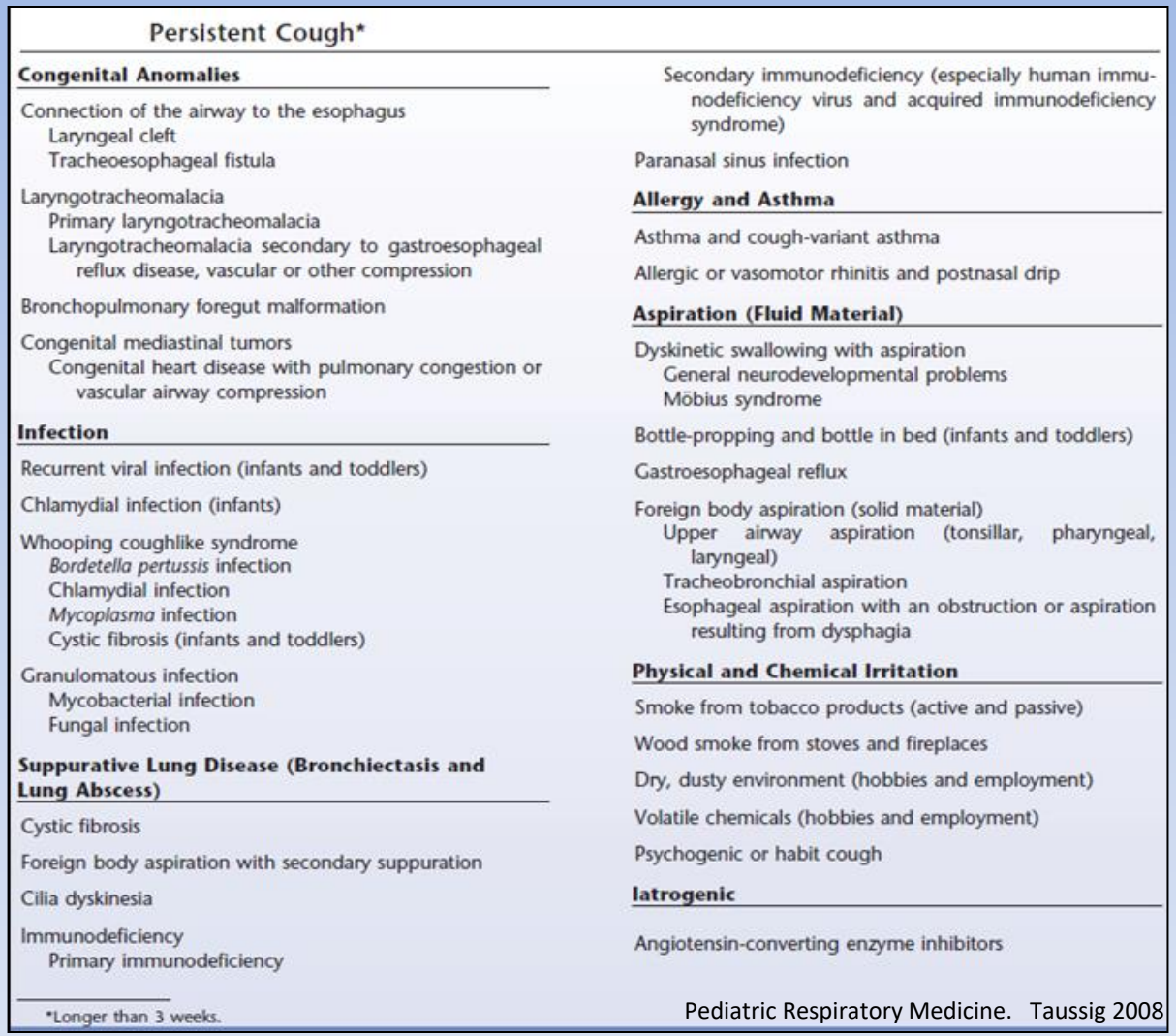
- Laryngeal cough→ immediate expiratory stimulation
  - protects the airway from aspiration

- Tracheobronchial cough (stimulation distal to the larynx) → 4 phases of cough
  - generate the airflow necessary to remove the stimulus

Outline

- Definition of cough
- Mechanism of cough
- Specific diseases
- Evaluation and Workup

Causes of chronic cough



Persistent Cough*

Congenital Anomalies

Connection of the airway to the esophagus
- Laryngeal cleft
- Tracheoesophageal fistula

Laryngotracheomalacia
- Primary laryngotracheomalacia
- Laryngotracheomalacia secondary to gastroesophageal reflux disease, vascular or other compression

Bronchopulmonary foregut malformation

Congenital mediastinal tumors
- Congenital heart disease with pulmonary congestion or vascular airway compression

Infection

Recurrent viral infection (infants and toddlers)

Chlamydial infection (infants)

Whooping coughlike syndrome
- *Bordetella pertussis* infection
- Chlamydial infection
- *Mycoplasma* infection
- Cystic fibrosis (infants and toddlers)

Granulomatous infection
- Mycobacterial infection
- Fungal infection

Suppurative Lung Disease (Bronchiectasis and Lung Abscess)

Cystic fibrosis

Foreign body aspiration with secondary suppuration

Cilia dyskinesia

Immunodeficiency
- Primary immunodeficiency
- Secondary immunodeficiency (especially human immunodeficiency virus and acquired immunodeficiency syndrome)

Paranasal sinus infection

Allergy and Asthma

Asthma and cough-variant asthma

Allergic or vasomotor rhinitis and postnasal drip

Aspiration (Fluid Material)

Dyskinetic swallowing with aspiration
- General neurodevelopmental problems
- Möbius syndrome

Bottle-propping and bottle in bed (infants and toddlers)

Gastroesophageal reflux

Foreign body aspiration (solid material)
- Upper airway aspiration (tonsillar, pharyngeal, laryngeal)
- Tracheobronchial aspiration
- Esophageal aspiration with an obstruction or aspiration resulting from dysphagia

Physical and Chemical Irritation

Smoke from tobacco products (active and passive)

Wood smoke from stoves and fireplaces

Dry, dusty environment (hobbies and employment)

Volatile chemicals (hobbies and employment)

Psychogenic or habit cough

Iatrogenic

Angiotensin-converting enzyme inhibitors

*Longer than 3 weeks.

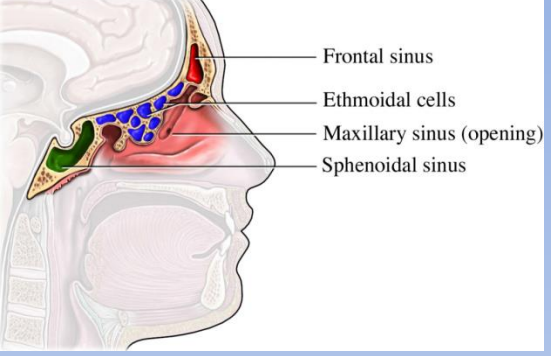
Pediatric Respiratory Medicine. Taussig 2008

- Most common causes of chronic cough in children: nonspecific cough that resolves spontaneously, asthma, and protracted bacterial bronchitis (PBB)

Causes of chronic cough

Upper Airway	Postnasal drip/nasal allergy
	Sinusitis
	Foreign body in external auditory canal
Lower Airway	Asthma
	Infectious (tuberculosis, mycoplasma, chlamydia, pertussis)
	Cystic fibrosis
	Primary ciliary dyskinesia
	Irritative (primary smoking, secondhand smoke, indoor pollution)
Other	Gastroesophageal reflux disease
	Psychogenic
	Aspiration

Pediatric Pulmonology. M Light. 2011

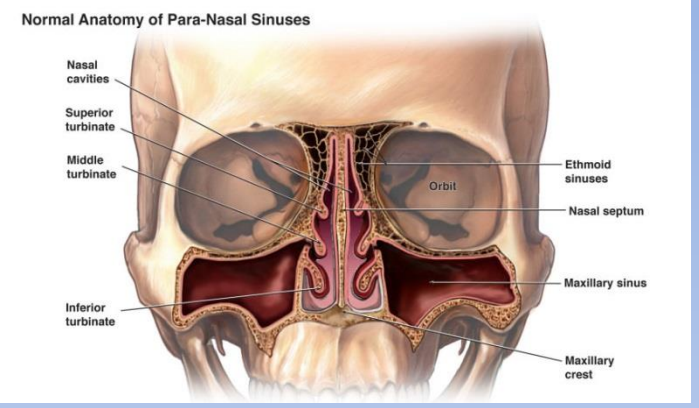


Sinusitis

- Cough that is accompanied by nasal discharge, headache, or malodorous breath

- Acute bacterial sinusitis - a child with an acute upper respiratory tract infection presents with:
  - 1)persistent illness (nasal discharge of any quality) or daytime cough or both, lasting more than 10 days without improvement
  - 2) a worsening course (worsening or new onset of nasal discharge, daytime cough or fever after initial improvement)
  - 3) severe onset (concurrent and purulent nasal discharge for at least 3 consecutive days

Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1 to 18 Years. E. Wald et al.



Sinusitis

- Clinicians should not obtain imaging studies to distinguish acute bacterial sinusitis from viral URI

- **Tx:** amoxicillin with or without clavulanate as first-line treatment

Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1 to 18 Years. E. Wald et al.

Foreign body in the external auditory canal

- Arnold's nerve reflex - mechanical stimulation of the external auditory meatus can activate the auricular branch of the vagus nerve (Arnold's nerve) and evoke reflex cough

http://www.drrahmatorlummc.com/foreignbody.htm

Postnasal drip
Upper airway cough syndrome (UACS)

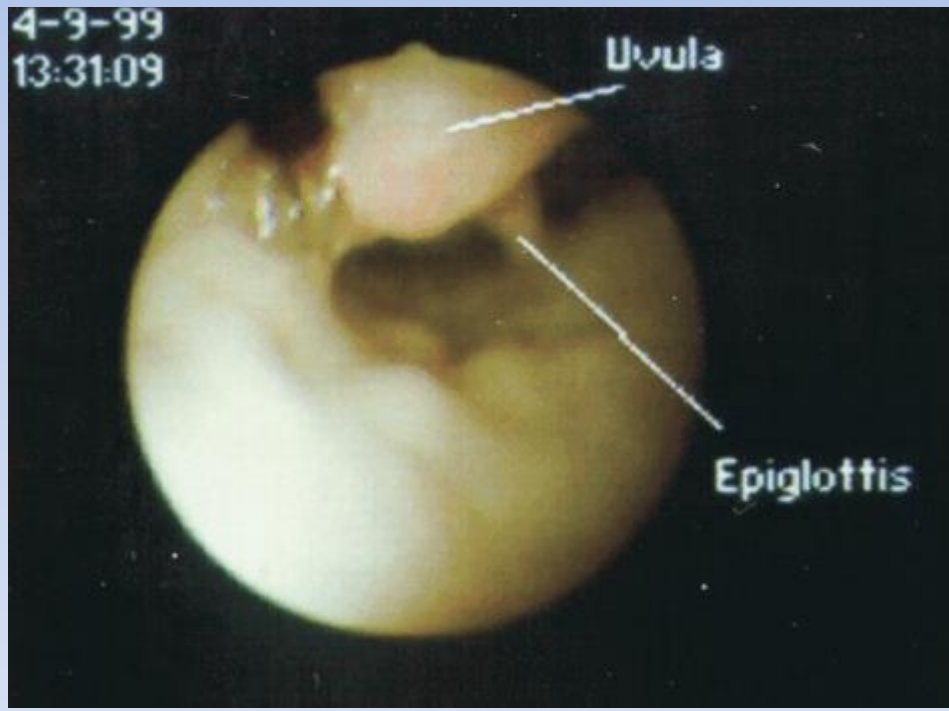
- Seasonal cough
- Occurs with specific triggers
- Worse when laying flat
- **Sx:** sensation of “something dripping into the throat,” frequent throat clearing, nasal congestion or discharge
- often due to Allergic Rhinitis, Non-Allergic Rhinitis, Vasomotor Rhinitis, and Chronic Bacterial Sinusitis.
- **Tx:** avoid trigger, saline nasal spray, nasal steroids, sinus rinse

Cobblestoning of posterior pharyngeal wall

- Lymphoid hyperplasia secondary to chronic stimulation by postnasal drip

Uvula

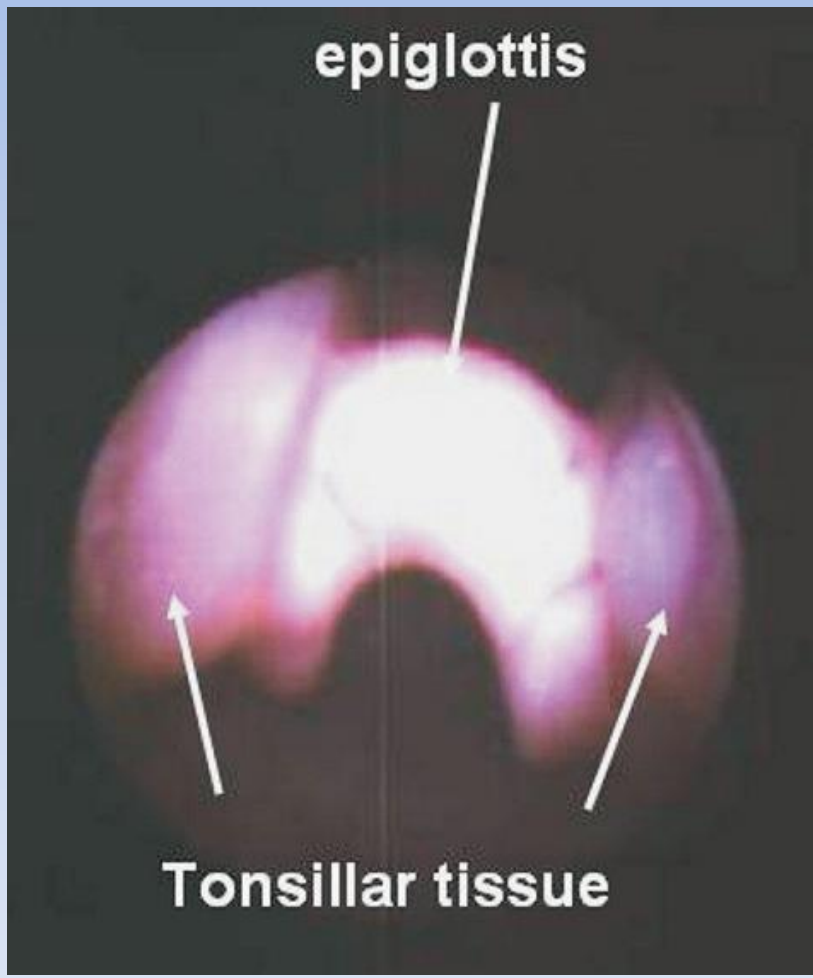
- 4 yo boy with cough
- “Felt like something was in the back of his throat”
- Unsuccessful treatment for asthma
- Cured with uvulectomy



Cough misdiagnosed as asthma. M. Weinberger.

Enlarged tonsils

- 3 yo girl with chronic cough
- Unsuccessful treatment for asthma
- Cured with tonsillectomy



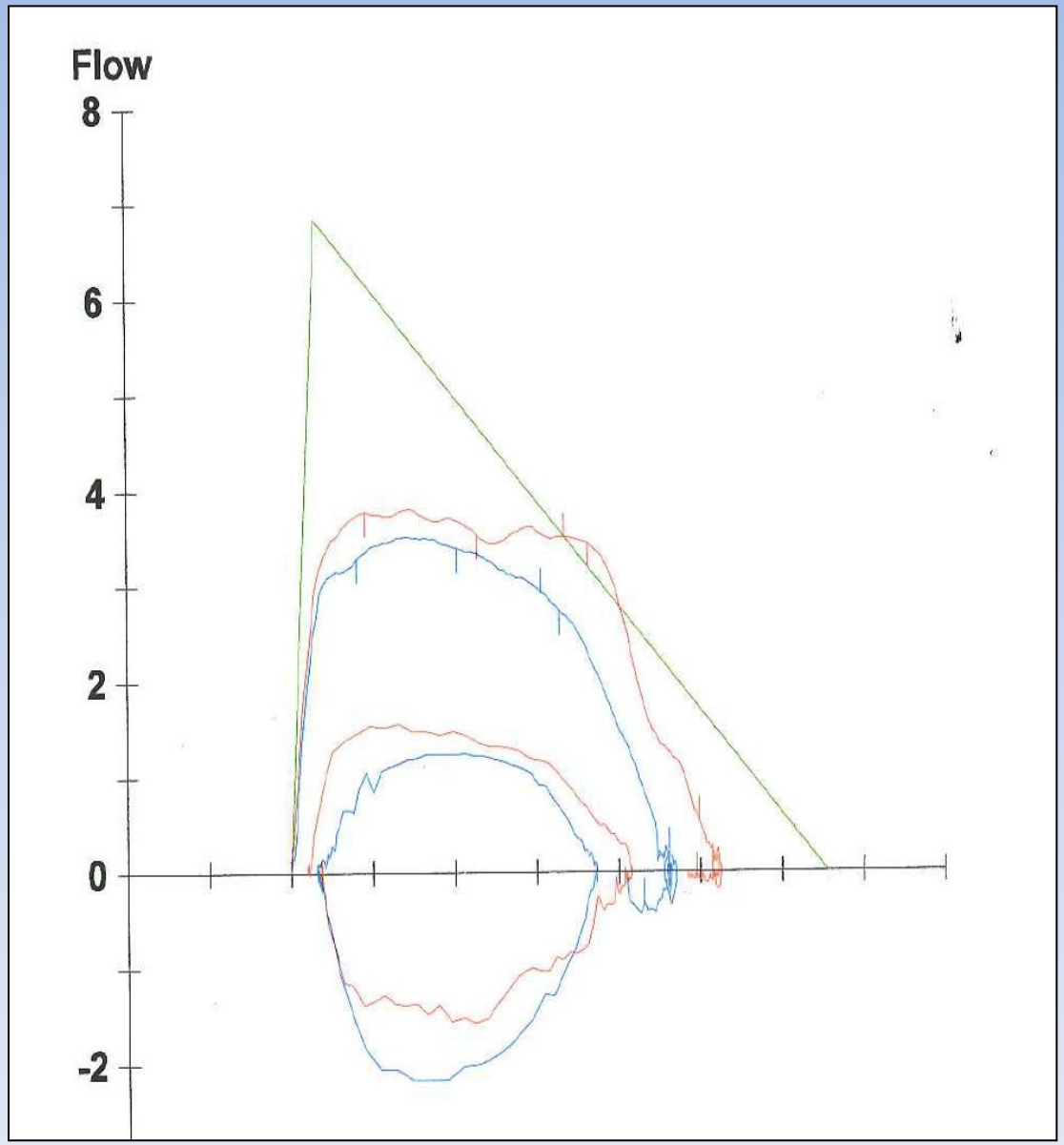
Cough misdiagnosed as asthma. M. Weinberger.

Tracheomalacia and bronchomalacia

- Due to inadequate rigidity of the tracheal or mainstem bronchial cartilage

- **Sx:** Barking or brassy cough

PFT in Tracheomalacia



Tracheomalacia

TRACHEOMALACIA

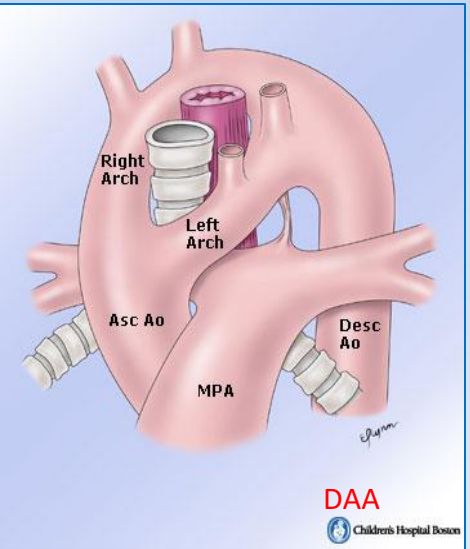
- Primary tracheomalacia
  - Congenital absence of tracheal-supporting cartilages
- Secondary tracheomalacia
  - Esophageal atresia/tracheo-esophageal fistula
  - Vascular rings (e.g. double aortic arch)
  - Tracheal compression from an aberrant innominate artery
  - Tracheal compression from mediastinal masses
  - Prolonged mechanical ventilation/chronic lung disease
  - Abnormally soft tracheal cartilages associated with connective tissue disorders(Ehlers Danlos, cutis laxa, marfan's, etc.)

EXPIRATORY STRIDOR - VASCULAR RINGS AND SLINGS

- Abnormal vasculature which compresses the trachea +/- esophagus

- **Sx:** Stridor, wheezing, feeding difficulties, chronic cough

- Variety of lesions:
  - Double aortic arch (~50%)
  - Right sided aortic arch with left ligamentum arteriosum (20%)
  - PA sling (rare)



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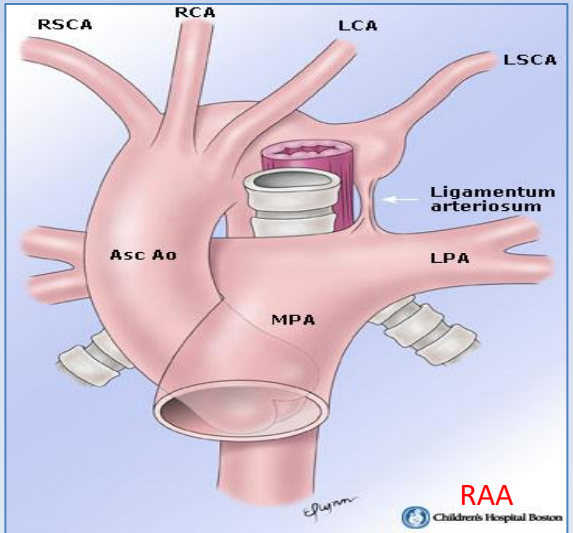

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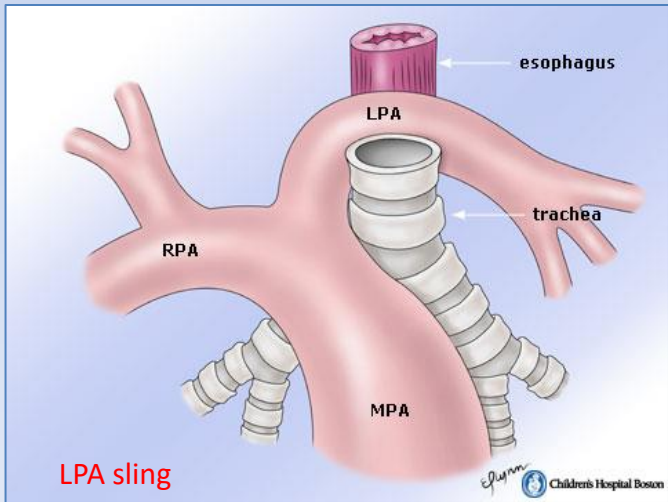
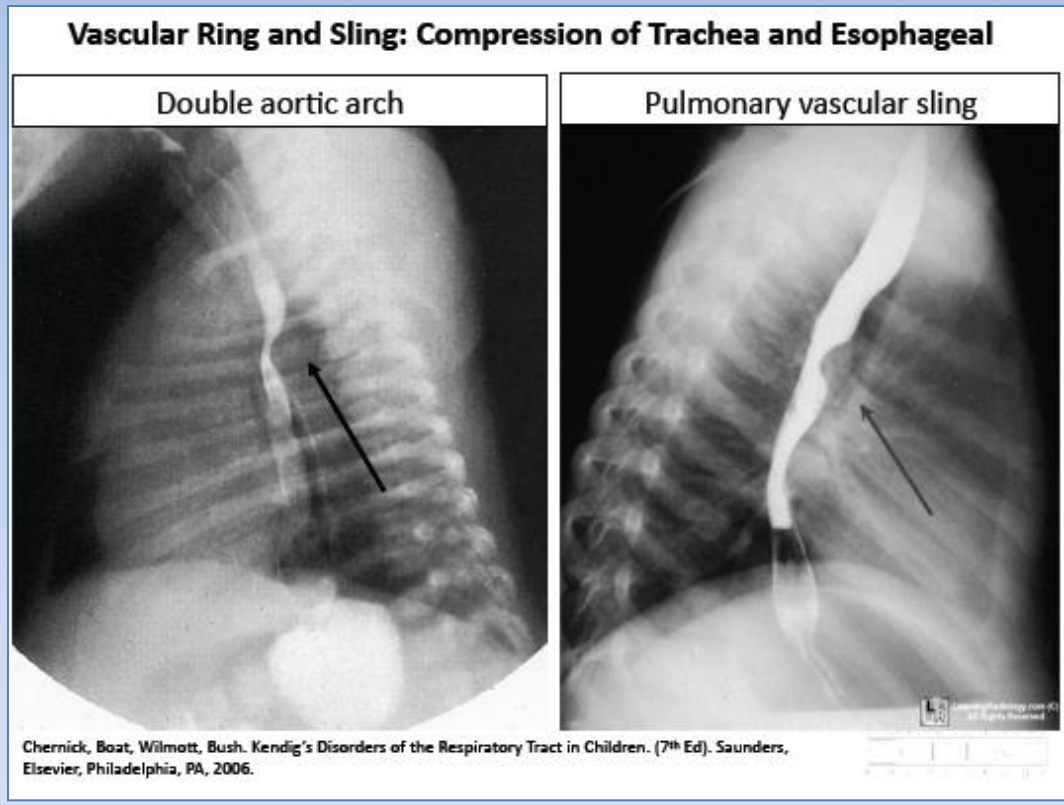


LPA sling

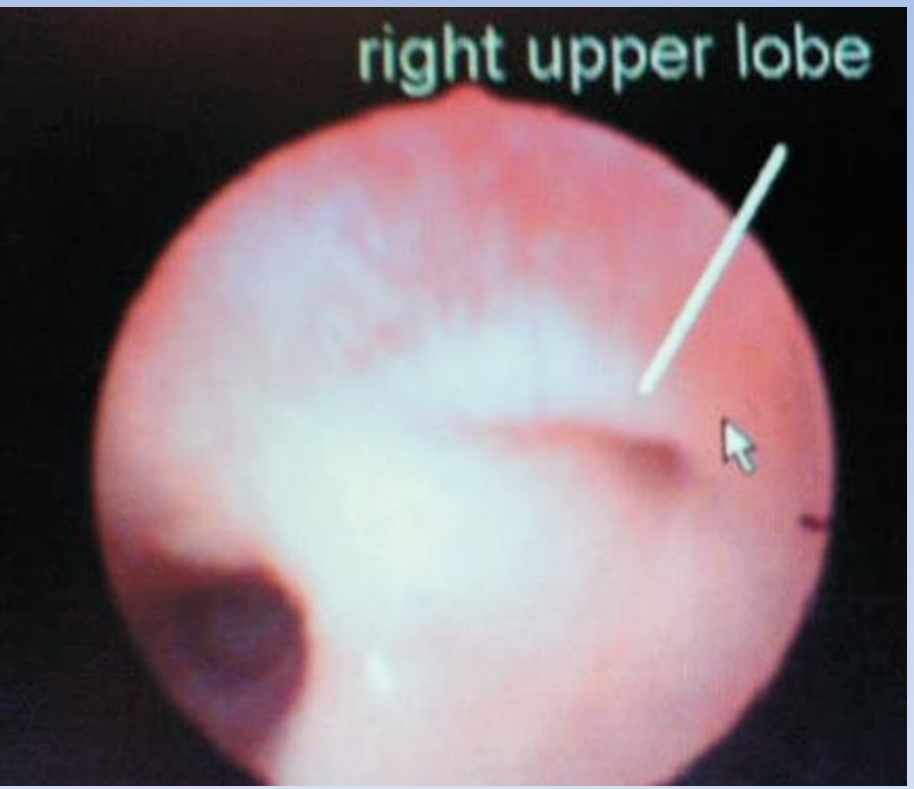
EXPIRATORY STRIDOR - VASCULAR RINGS AND SLINGS

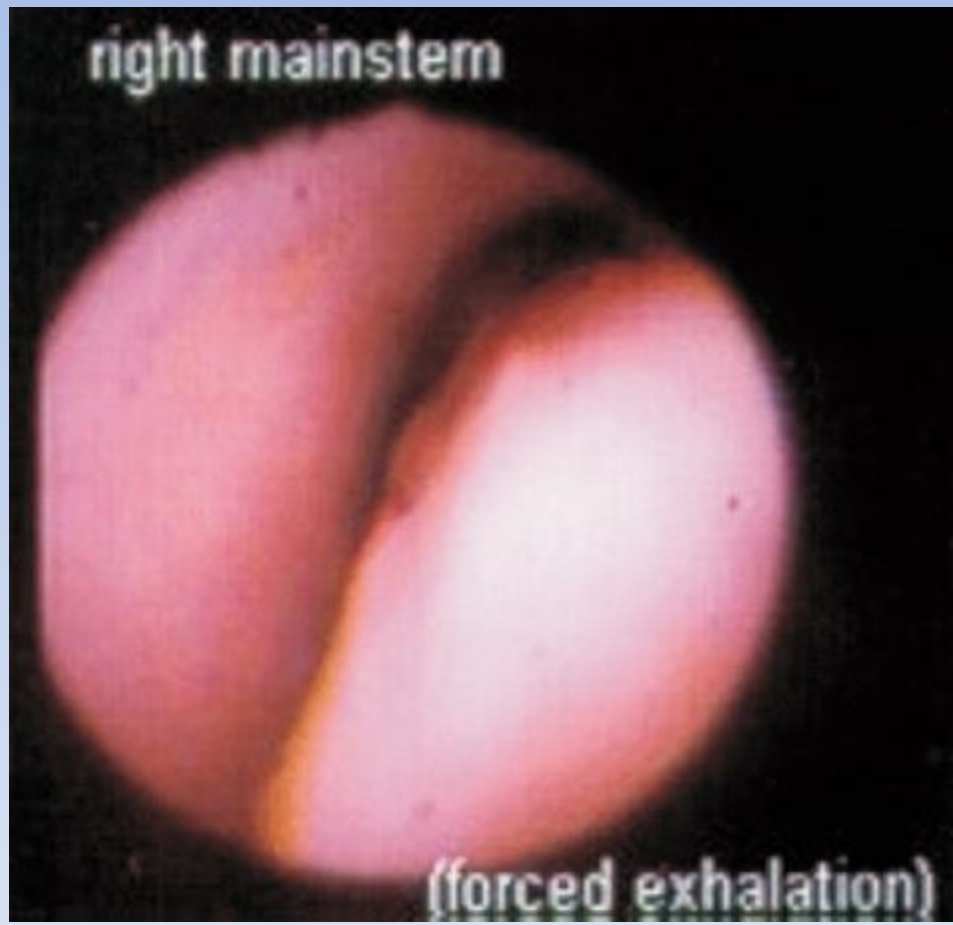
- Double aortic arch - bilateral and posterior compressions of the esophagus

- Left pulmonary artery sling - defect in the anterior wall of the esophagus . No posterior compression is present with this anomaly.



Bronchomalacia

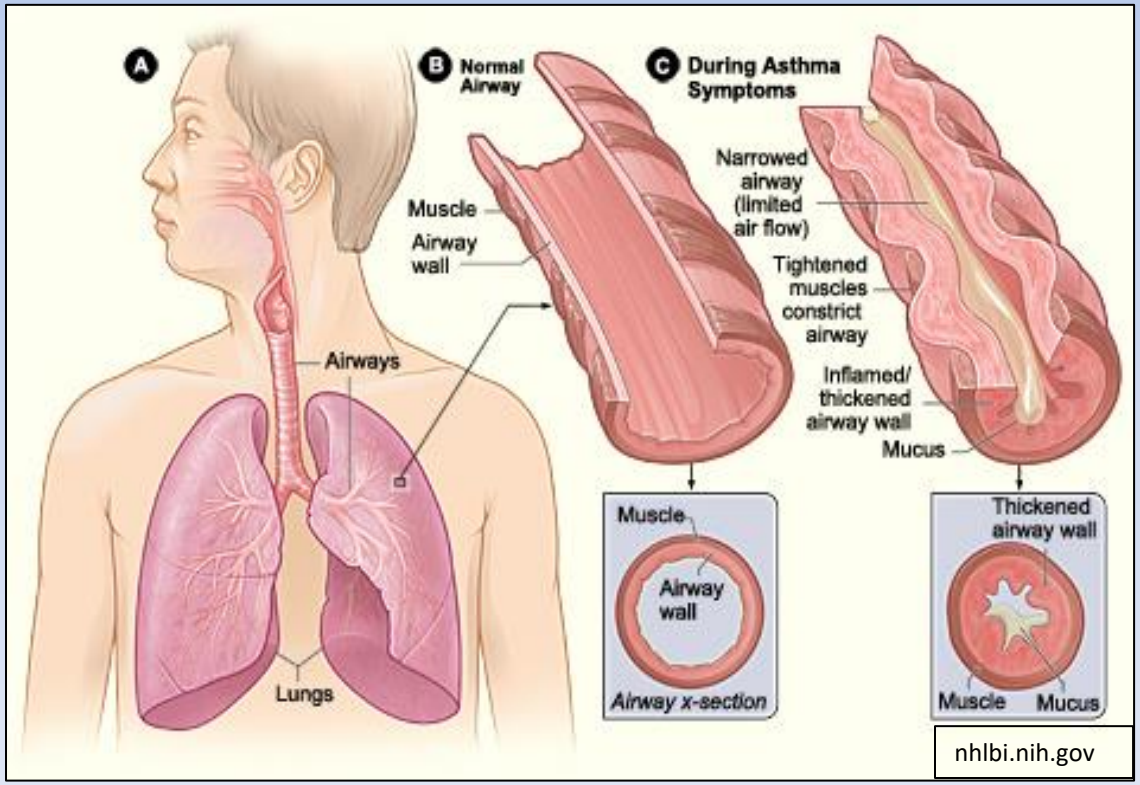




Cough misdiagnosed as asthma. M. Weinberger.

Asthma

- Asthma is a chronic inflammatory disease of airways characterized by increased responsiveness of the tracheo-bronchial tree to many stimuli

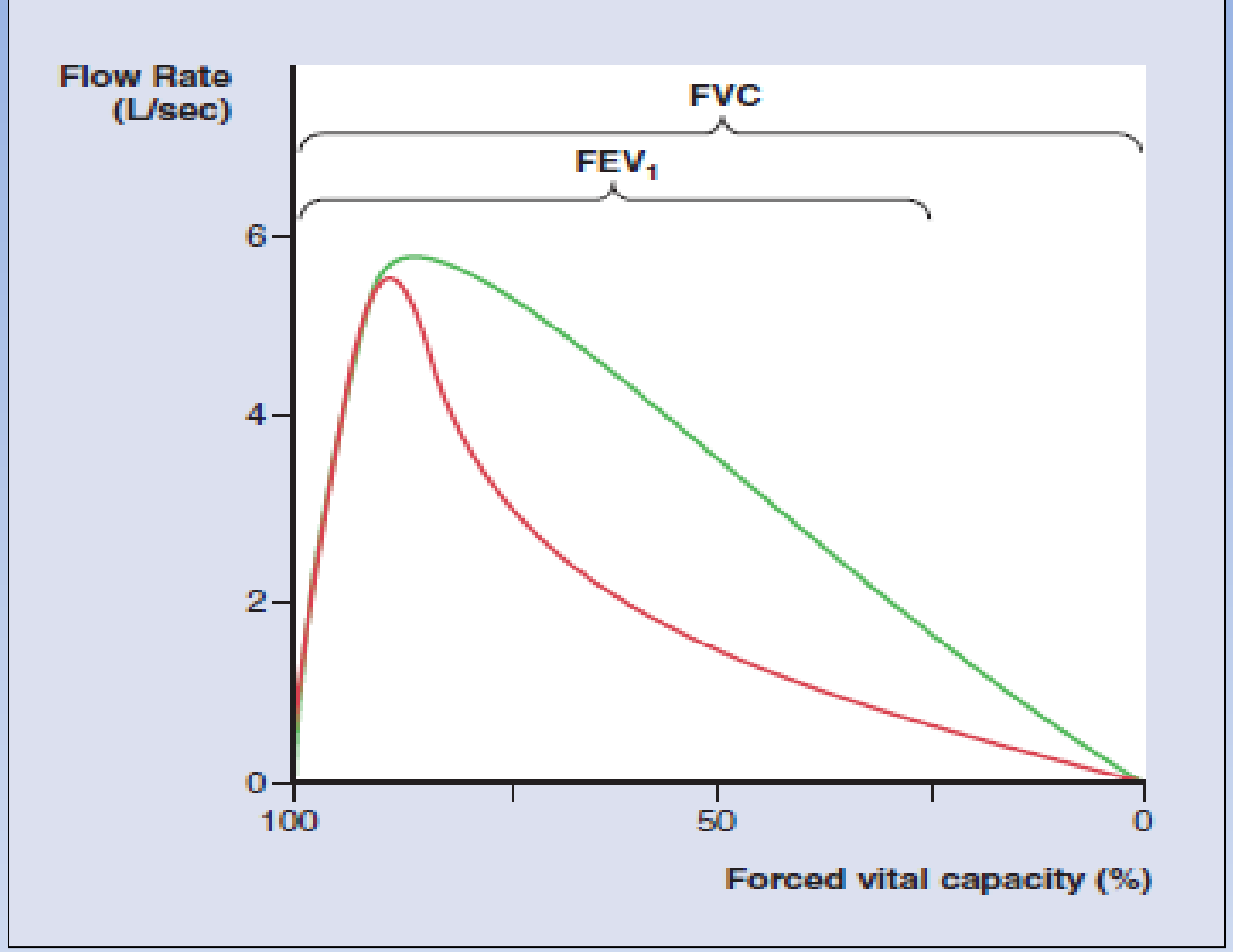


Asthma

- Asthma is the most common cause of chronic cough in pediatric patients
- Most common chronic childhood disease
  - Affecting more than 1 child in 20
- 3rd-ranking cause of hospitalization for children
- #1 cause of school absenteeism among children

Asthma

- **Sx:**
  - wheeze, cough, shortness of breath, chest tightness
- **Triggers:**
  - URI, cold air, exercise, irritants, animals, allergens
- **PE:**
  - Shiners
  - Swollen nasal turbinates
  - Allergic nasal crease
  - Pharyngeal cobblestoning
  - Cough
  - Wheezing
  - Dyspnea



Pediatric Respiratory Medicine. Taussig 2008

- Response to bronchodilators

- Reversibility: ≥ 10% ↑ in FEV_1 or ≥ 15% ↑ in $FEF_{25-75\%}$ after two puffs of a β2-adrenergic agonist

Asthma Treatment

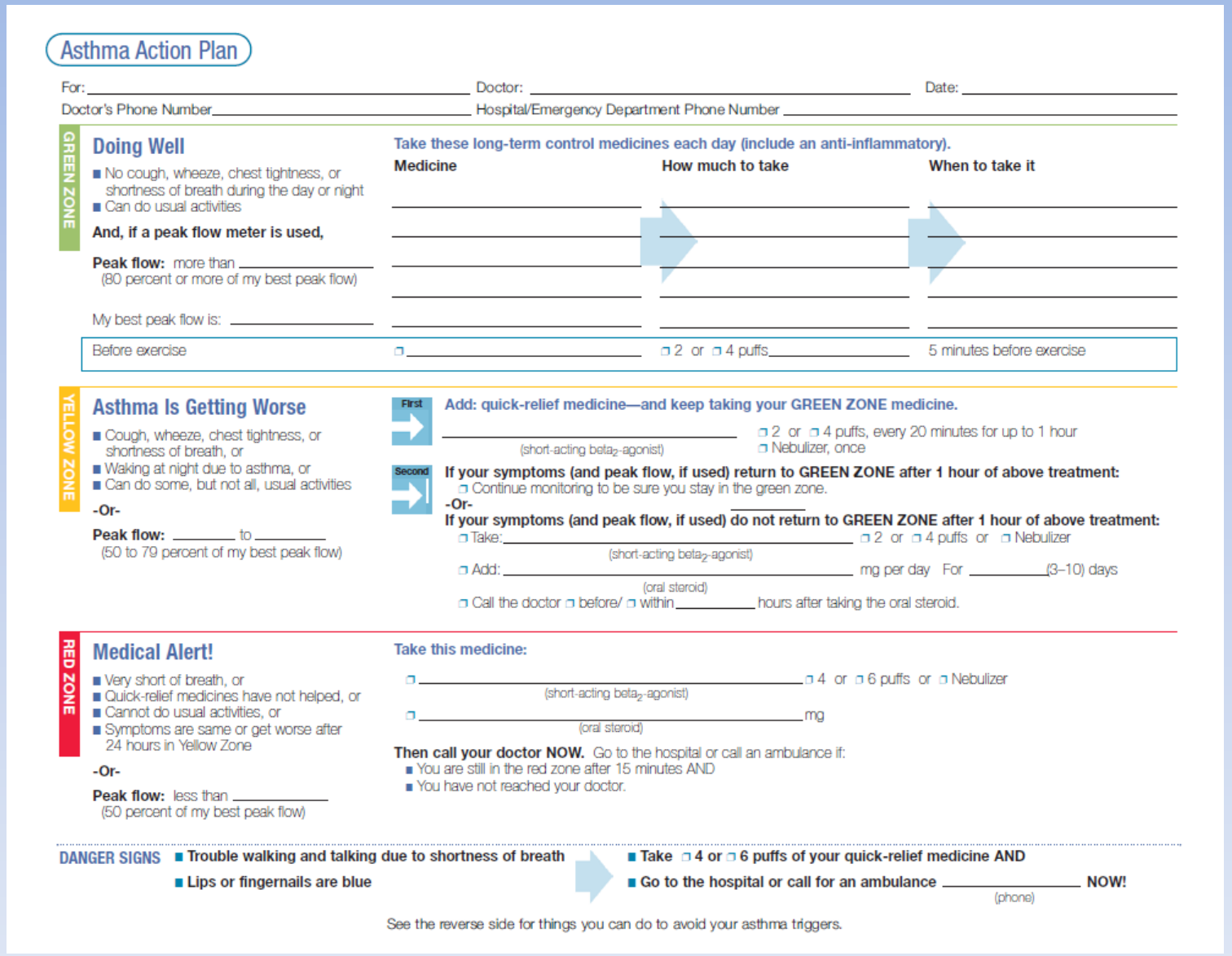
- Goals of therapy:
  - Control inflammation in lungs
  - Prevention and treatment of bronchospasm
  - Prevent recurrent exacerbations
  - Lessen need for emergency care and oral steroids
  - Maintain normal or near-normal lung function
  - Maintain normal activity levels

- All patients should have asthma action plan

- Peak flow training for patients > age 5 years

- Asthma education for all families regarding pathogenesis, triggers, and medications used for asthma therapy

Asthma Action Plan



Asthma Action Plan

For: _____ Doctor: _____ Date: _____

Doctor's Phone Number _____ Hospital/Emergency Department Phone Number _____

GREEN ZONE

Doing Well

- No cough, wheeze, chest tightness, or shortness of breath during the day or night
- Can do usual activities

And, if a peak flow meter is used,

Peak flow: more than _____
(80 percent or more of my best peak flow)

My best peak flow is: _____

Take these long-term control medicines each day (include an anti-inflammatory).

Medicine	How much to take	When to take it
Before exercise ❒ _____	❒ 2 or ❒ 4 puffs _____	5 minutes before exercise

YELLOW ZONE

Asthma Is Getting Worse

- Cough, wheeze, chest tightness, or shortness of breath, or
- Waking at night due to asthma, or
- Can do some, but not all, usual activities

-Or-

Peak flow: _____ to _____
(50 to 79 percent of my best peak flow)

First

Add: quick-relief medicine—and keep taking your GREEN ZONE medicine.

_____ (short-acting beta$_2$-agonist)

❒ 2 or ❒ 4 puffs, every 20 minutes for up to 1 hour
❒ Nebulizer, once

Second

If your symptoms (and peak flow, if used) return to GREEN ZONE after 1 hour of above treatment:
❒ Continue monitoring to be sure you stay in the green zone.

-Or-

If your symptoms (and peak flow, if used) do not return to GREEN ZONE after 1 hour of above treatment:

❒ Take: _____ (short-acting beta$_2$-agonist) ❒ 2 or ❒ 4 puffs or ❒ Nebulizer

❒ Add: _____ (oral steroid) mg per day For _____ (3–10) days

❒ Call the doctor ❒ before/ ❒ within _____ hours after taking the oral steroid.

RED ZONE

Medical Alert!

- Very short of breath, or
- Quick-relief medicines have not helped, or
- Cannot do usual activities, or
- Symptoms are same or get worse after 24 hours in Yellow Zone

-Or-

Peak flow: less than _____
(50 percent of my best peak flow)

Take this medicine:

❒ _____ (short-acting beta$_2$-agonist) ❒ 4 or ❒ 6 puffs or ❒ Nebulizer

❒ _____ (oral steroid) mg

Then call your doctor NOW. Go to the hospital or call an ambulance if:
- You are still in the red zone after 15 minutes AND
- You have not reached your doctor.

DANGER SIGNS

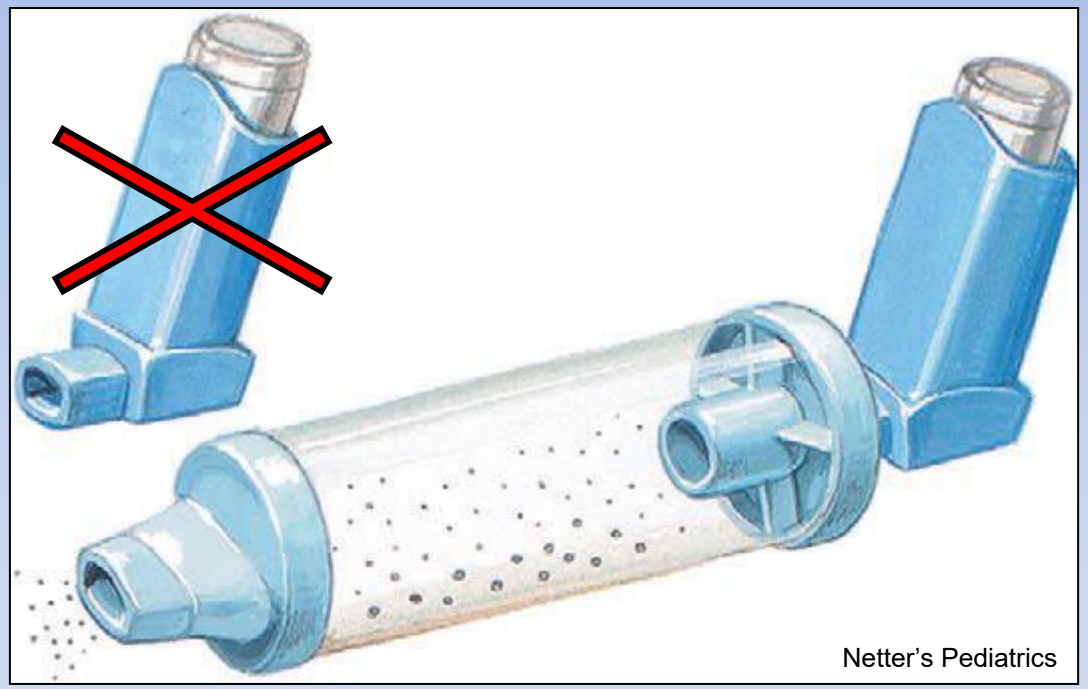
- **Trouble walking and talking due to shortness of breath**
- **Lips or fingernails are blue**

- **Take ❒ 4 or ❒ 6 puffs of your quick-relief medicine AND**
- **Go to the hospital or call for an ambulance _____ (phone) NOW!**

See the reverse side for things you can do to avoid your asthma triggers.

National Heart Lung Blood Institute

Administration of inhaled medications



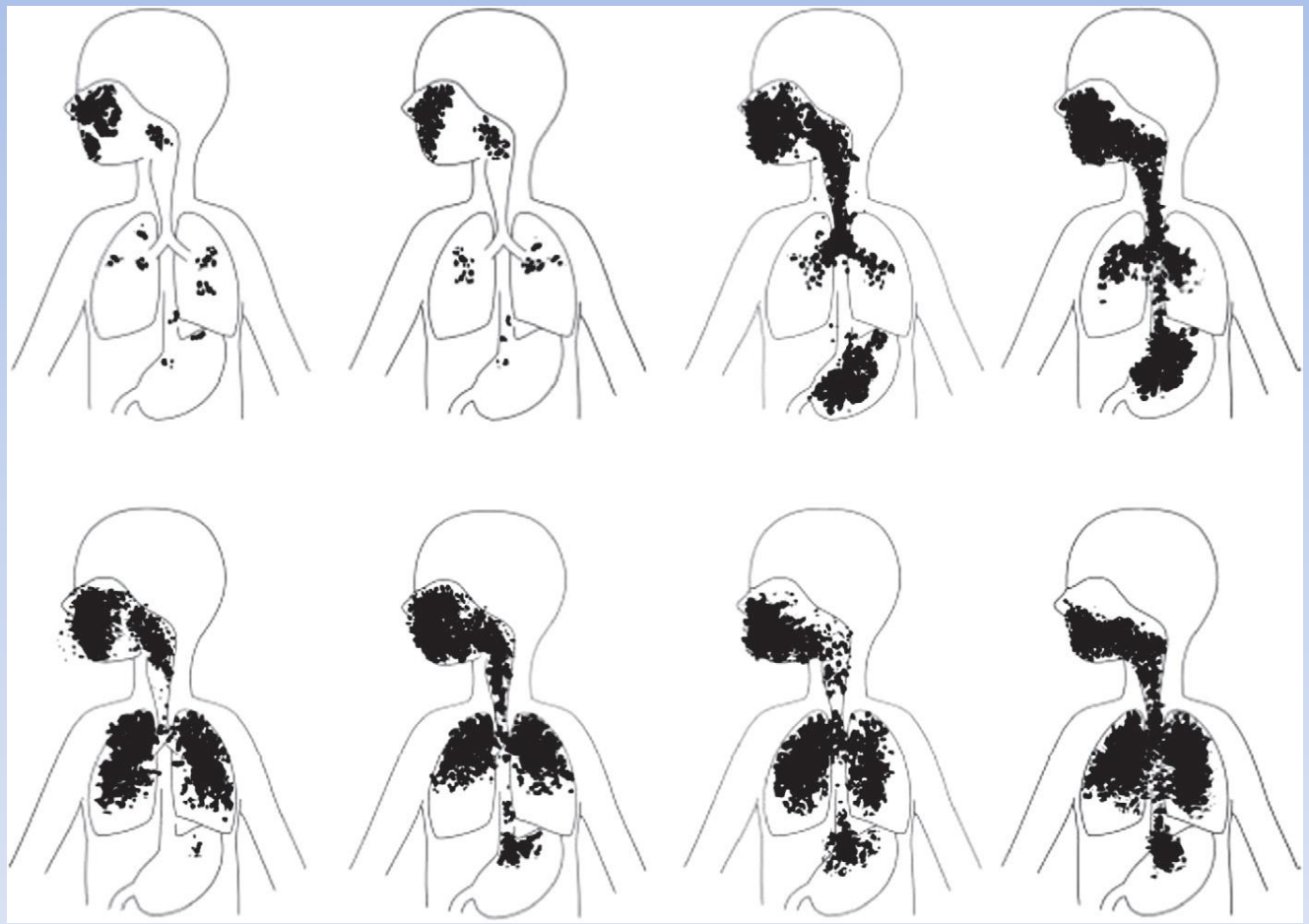
Drug deposition of radiolabeled albuterol in a young child

MDI/Spacer loose mask

Nebulizer loose mask

MDI/Spacer - tight mask screaming

Nebulizer – tight mask screaming



MDI/Spacer – tight mask quiet inhaling

Nebulizer – tight mask quiet inhaling

Eagans Fundamentals of Respiratory Care

INFECTIONS

Infectious Causes of Chronic Cough, By Region

North America

HIV
Tuberculosis
Eastern: blastomycosis
Central: blastomycosis; histoplasmosis
Western: coccidioidomycosis; echinococcosis

- Chlamydia trachomatis – infant with staccato cough occurring in the first few months of life, mucoid conjunctivitis
- Bordetella pertussis (whooping cough or the 100-day cough) - paroxysmal cough followed by a characteristic inspiratory whoop
- Endobronchial tuberculosis → Compression upper airway from enlarged lymph nodes

Viral URI

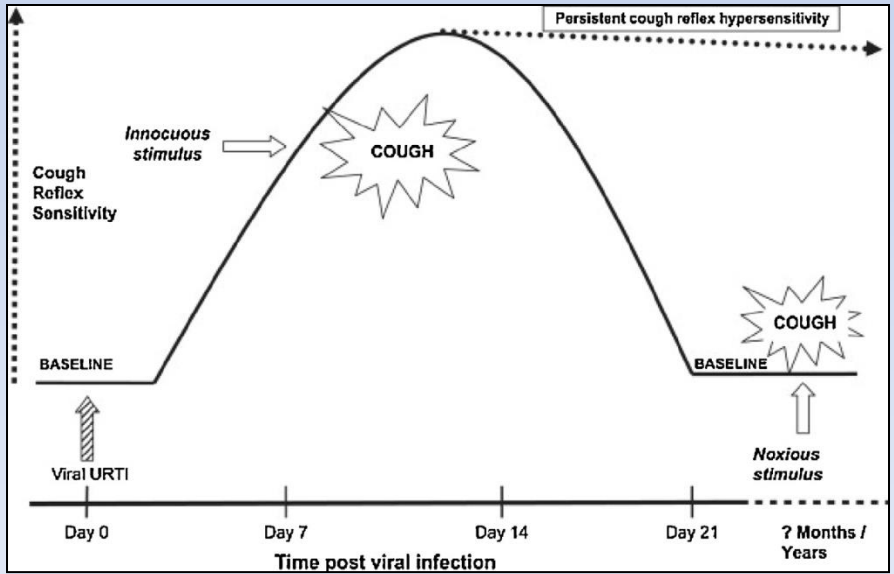
- 6-8 viral infections are normal in a child
- Cough with URI lasts up to 2 wks in 70-80% of children
  - 5% for more than 4 weeks
- Influenza, parainfluenza, adenovirus, RSV, human metapneumovirus etc.
- **Tx:** supportive care and reassurance

Viral URI and Post infectious cough

- Post infectious cough - prolonged acute coughing after an obvious URTI

- Increased cough receptor sensitivity
  - possibilities include inflammation, surfactant abnormalities, stripping of subepithelial cough receptors, or pain-like sensitization of the cough pathway.

- **Tx:** Inhaled corticosteroids?



Chronic cough in children. M. Shields and G Doherty

Cystic Fibrosis

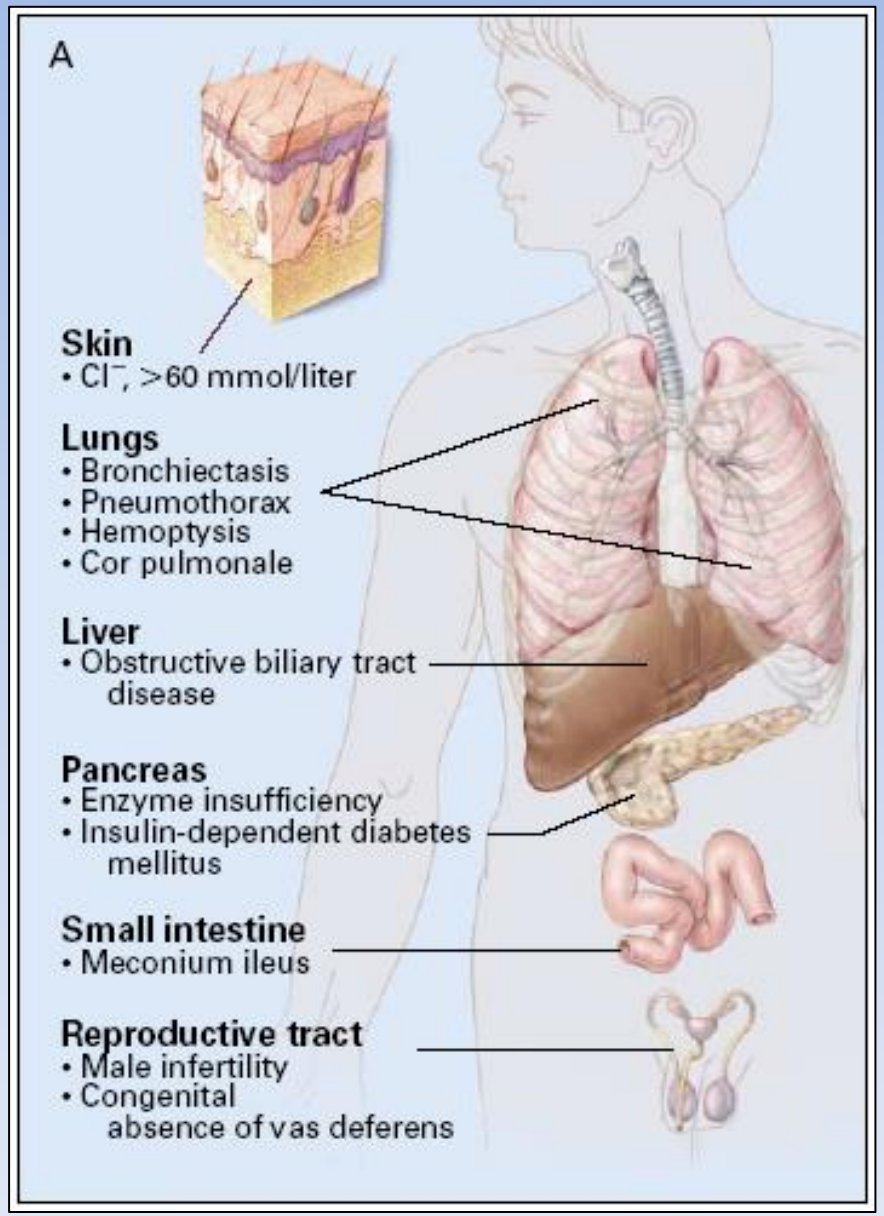
- Genetic condition: Autosomal recessive
  - Must have mutations on both chromosomes
  - 1 in 4 chance of having a child with CF disease if both parents are carriers

- Incidence
  - 1:2,500 to 1:3,000 Caucasians
  - Approximately 30,000 in US
  - Carrier Status: 1 in 25 Caucasians

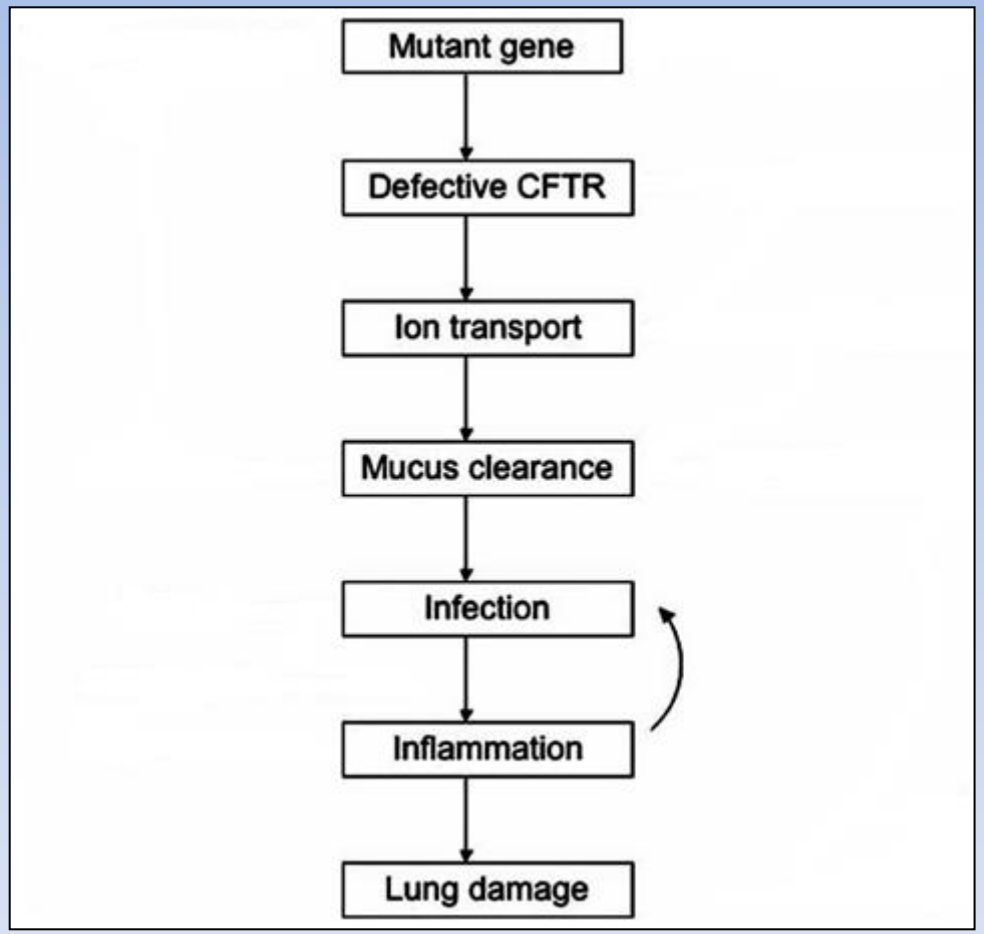
- **Sx:** cough, recurrent pneumonia, sinopulmonary disease, nasal polyps, malabsorption, failure to thrive

The CF Problem Areas

- CFTR is expressed in the epithelial tissue of:
  - Lungs
  - Pancreas
  - Intestines
  - Sweat ducts
  - Liver
  - Reproductive organs

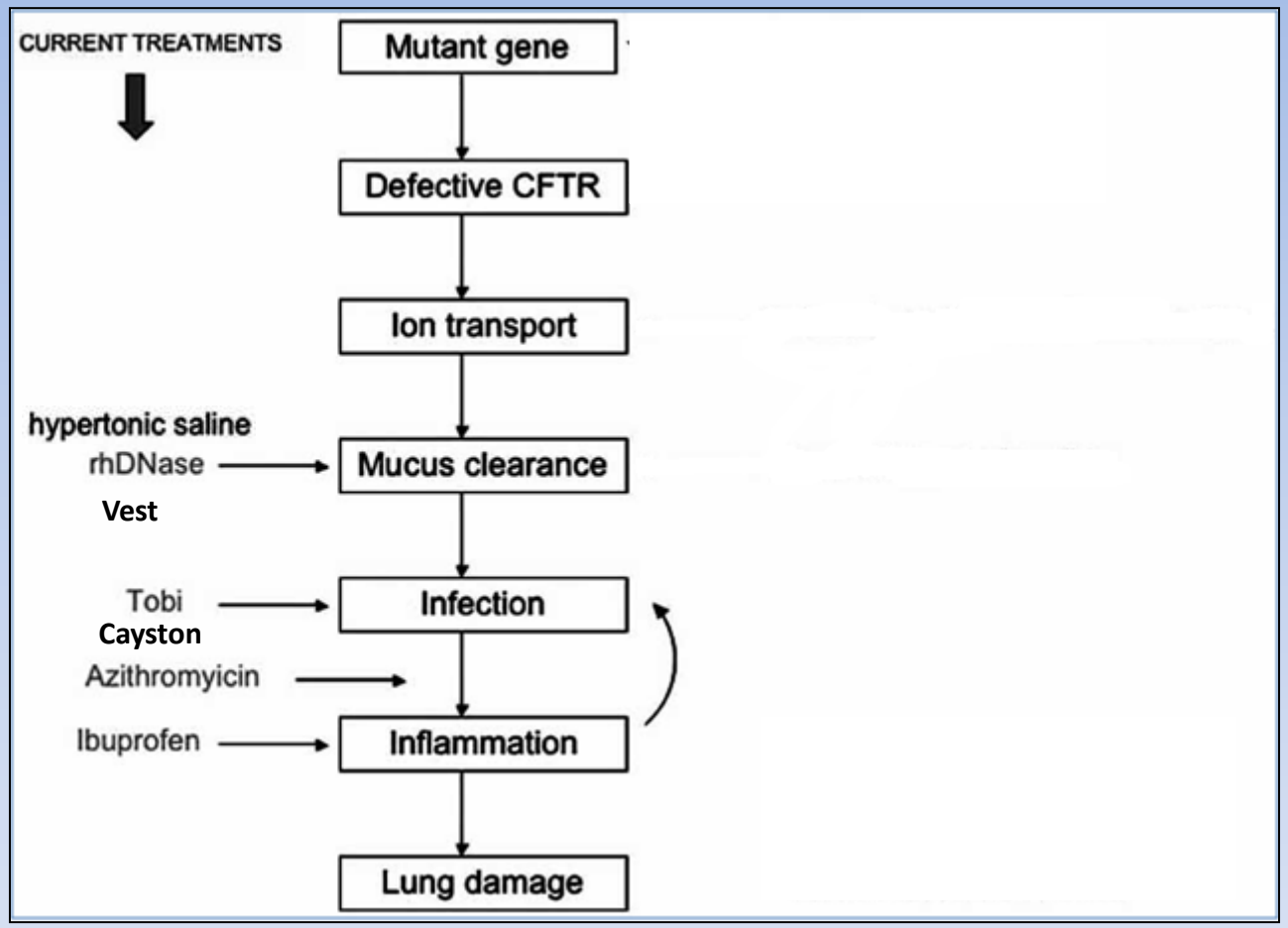


CYSTIC FIBROSIS - Pathophysiology



Conese et. al. *Current Pediatric Reviews, 2009, 5, 8-27*

CYSTIC FIBROSIS - Treatments

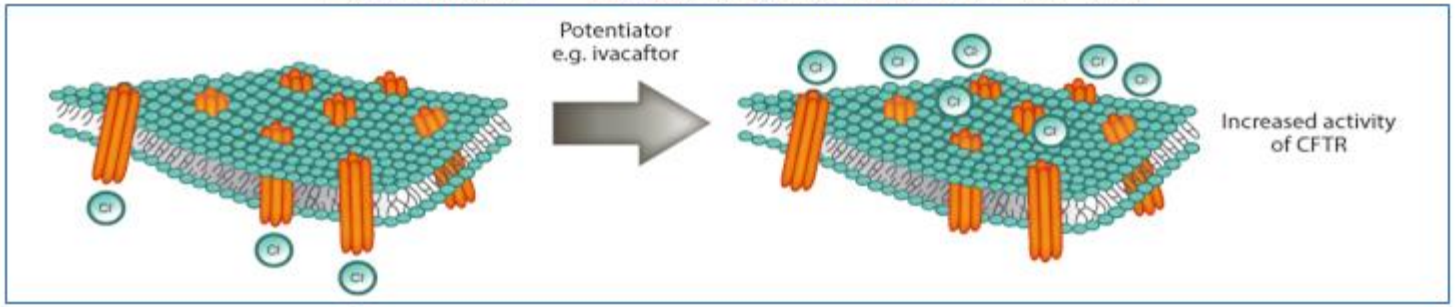


Conese et. al. *Current Pediatric Reviews, 2009, 5, 8-27*

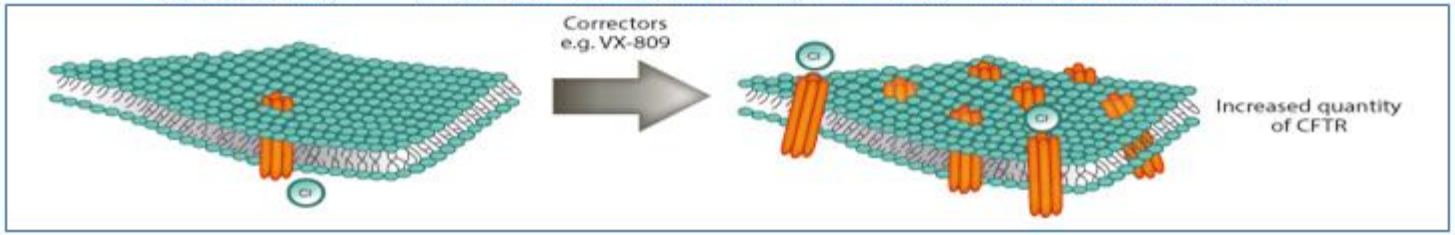
New Therapies in CF

CYSTIC FIBROSIS - Correct CFTR defects

VX-770 (ivacaftor "Kalydeco")
Potentiator – restores function of CFTR



VX-809 (lumacaftor)
Corrector – moves defective CFTR to the cell surface



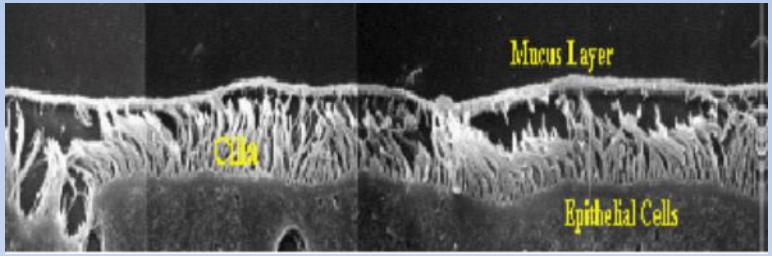
http://www.cftr.info/about-cf/clinical-management-of-cf/cftr-modulators/summary/

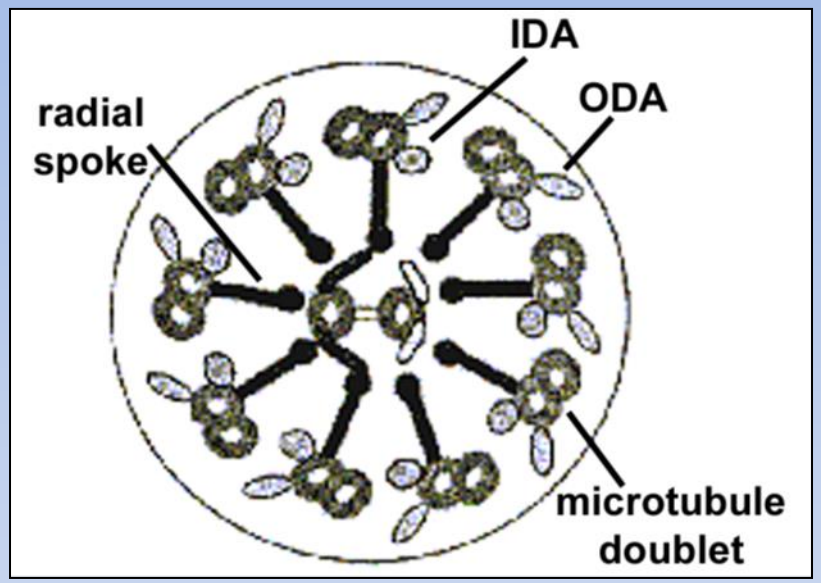
Primary Ciliary Dyskinesia

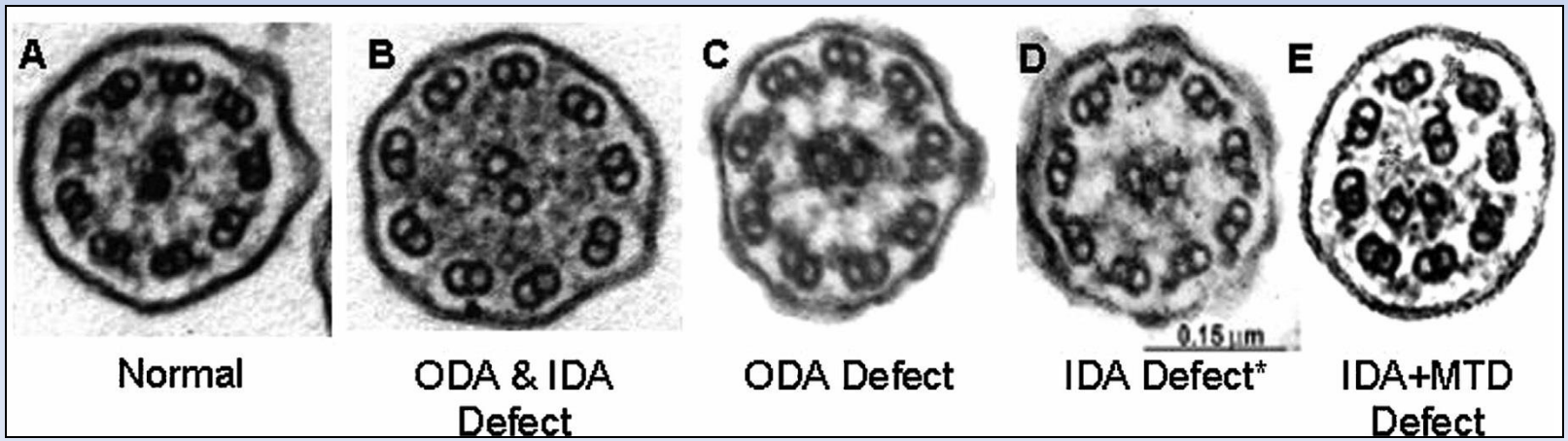
- Immotile Cilia Syndrome
- Autosomal recessive, genetically heterogeneous
- Prevalence: 1:15,000
- Characterized by:
  - Abnormal ciliary motion
  - Impaired mucocilliary clearance
- 50% of patients will have situs inversus totalis (Kartagener's)
- **Sx:** Neonatal respiratory distress, cough since birth, recurrent sinopulmonary infections, chronic bronchitis, otitis media, and male infertility

Ciliated Respiratory Epithelium

- **Ciliary beat:**
  - Coordinated waves to move mucus







Diagnosis, monitoring, and treatment of primary ciliary dyskinesia. A Shapiro

Protracted Bacterial Bronchitis (PBB)

- First described in 2006
- Chronic bacterial infection of the airways characterized by:
  - Chronic wet cough
  - Resolution of cough with at least 2 weeks of antibiotics
  - Absence of other causes of wet/productive cough
- Also known as:
  - Persistent bacterial bronchitis
  - Chronic suppurative lung disease
  - Persistent endobronchial infection
  - Chronic bronchitis of childhood

Protracted Bacterial Bronchitis (PBB)

- one of the most common causes of chronic wet cough, particularly in young children (<5 years of age)

- Etiology?
  - Frequent viral illnesses → airway injury, ↓mucocilliary clearance and ↑neutrophilic inflammation → easier for bacterial growth
  - Tracheomalacia → trapping of mucus → easier bacterial growth

Protracted Bacterial Bronchitis (PBB)

- Diagnosis:
  - Clinical
  - Wet cough lasting at least 4 weeks
  - Absence of other findings to identify another cause of the cough
  - Resolution of cough with at least 2 weeks of antibiotics

- Symptoms:
  - Wet cough with mucus
  - Occurs during day and night
  - Wheezing can occur

Protracted Bacterial Bronchitis (PBB)

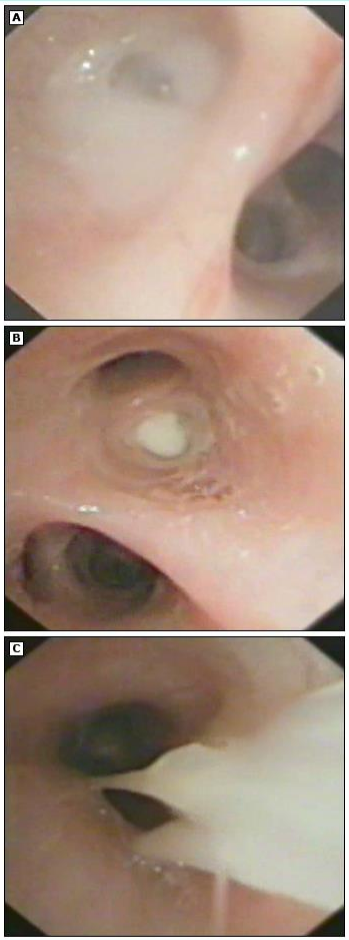
- PBB is caused by typical respiratory pathogens, such as H. influenzae, Streptococcus pneumoniae, and Moraxella catarrhalis

- Treatment:
  - 2-6 week course of broad-spectrum antibiotics (amoxicillin-clavulanic acid, trimethoprim-sulfamethoxazole, cefdinir)
  - Manual CPT
  - Nebulized treatments (albuterol, hypertonic saline)

Protracted Bacterial Bronchitis (PBB)

Mucopurulent secretions

Bronchoscopy in a child with protracted bacterial bronchitis

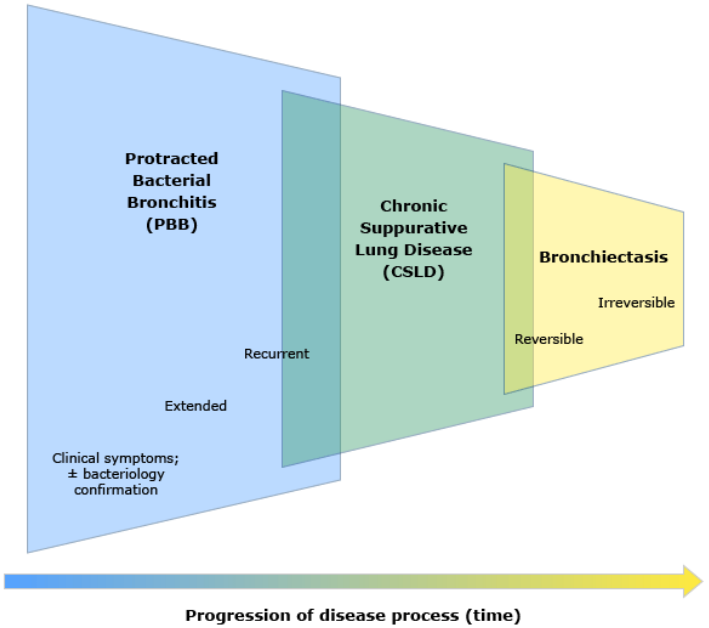


Bronchoscopy in a child with protracted bacterial bronchitis (PBB) reveals mucopurulent secretions in the bronchi.

Courtesy of Drs. Julie Marchant and Anne Chang.

UpToDate®

Spectrum of chronic endobronchial suppurative disease in children



In this pathobiologic model, protracted bacterial bronchitis (PBB), chronic suppurative lung disease (CSLD), and radiographic-confirmed bronchiectasis likely represent a spectrum of disease, with similar underlying mechanisms of airway neutrophilia, endobronchial bacterial infection, and impaired mucociliary clearance. If PBB is untreated, it is likely that some (but not all) children will progress to develop CSLD. Some will ultimately develop bronchiectasis, which is initially reversible but may become irreversible. There is some overlap between these entities.

Modified from: Chang AB, Upham JW, Masters IB, et al. Protracted bacterial bronchitis: The last decade and the road ahead. Pediatr Pulmonol 2016; 51:225. http://onlinelibrary.wiley.com/wol1/doi/10.1002/ppul.23351/abstract. Copyright © 2016 Wiley Periodicals. Reproduced with permission of John Wiley & Sons Inc. This image has been provided by or is owned by Wiley. Further permission is needed before it can be downloaded to PowerPoint, printed, shared or emailed. Please contact Wiley's permissions department either via email: permissions@wiley.com or use the RightsLink service by clicking on the 'Request Permission' link accompanying this article on Wiley Online Library (http://onlinelibrary.wiley.com).

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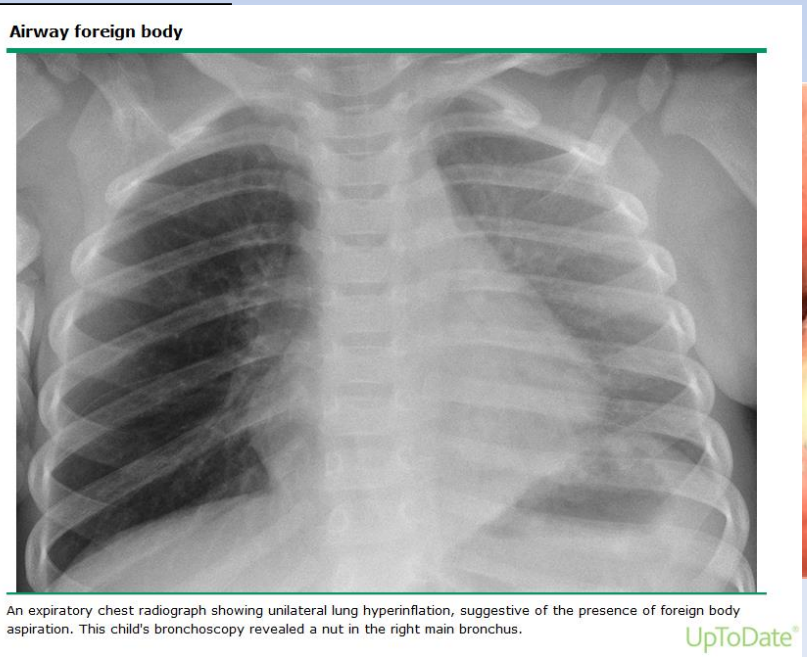
Irritation

- Tobacco smoke, vaping, pollution, firewood, industrial chemicals, dust
- 50% of children >2yrs in families with 2 smokers will have a significant cough
- Adolescents – ask about smoking
- Tobacco smoke exposure:
  - 1st hand smoke exposure
  - 2nd hand smoke exposure
  - 3rd hand smoke exposure

Aspiration

- Acute aspiration:
  - cough that begins suddenly while playing or eating
  - Abrupt onset of cough



Aspiration

- Chronic Aspiration
  - Cough that is triggered during eating
  - Silent aspiration
- More common in:
  - Developmental delay
  - Neuromuscular disease
  - Craniofacial abnormalities
  - Anatomic airway abnormalities (laryngeal cleft, TEF)
- **Dx:** Swallow study

Aspiration

H type TEF

GERD

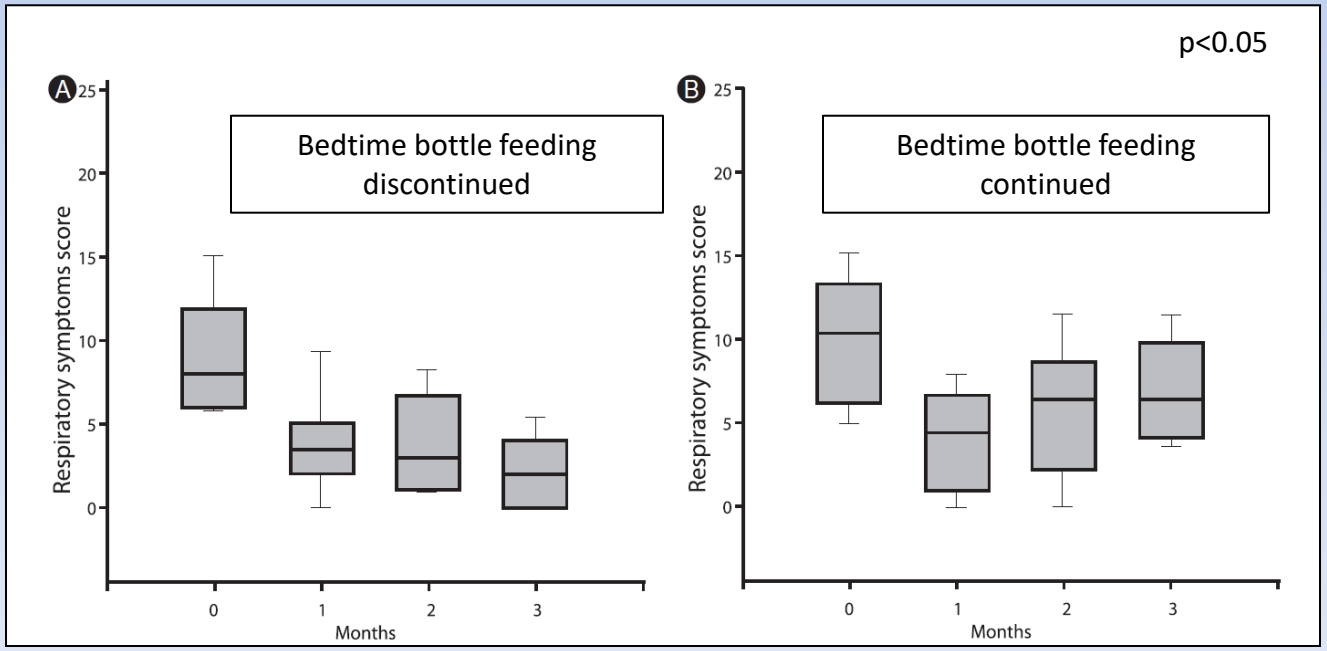
- **Sx:** Cough in the first hour after eating or which is worse while supine

- 2 main mechanisms of cough in GERD:
  - Micro or macro-aspiration of esophageal contents into the tracheo-bronchial tree
  - Acid in the distal esophagus stimulating a vagally mediated esophageal-tracheobronchial cough reflex (GI symptoms may be absent)

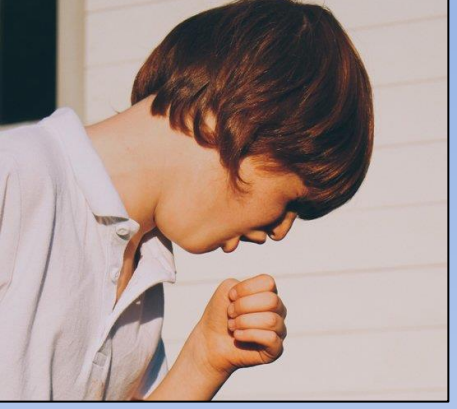
- **Tx:** GERD precautions. Trial H2 blocker or PPI

“Baby bottle bronchitis”

- Microaspiration due to bottle propping
- **Sx:** chronic cough, wheeze, recurrent pneumonia

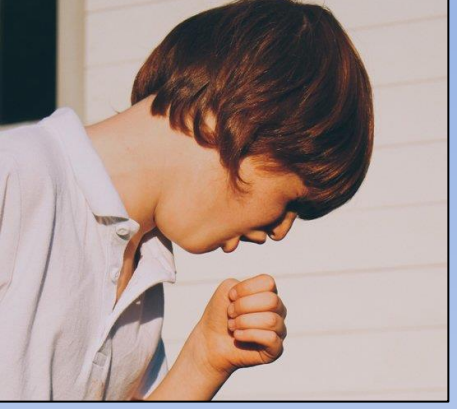


Prolonged bedtime bottle feeding and respiratory symptoms in infants. H. Kim.



Tic cough (HABIT COUGH)

- Not a conscious or voluntary cough
- Cough may start spontaneously or after a URI
- Childhood and early adolescence (4-18yo, mean10)
- Secondary gain - school avoidance and attention
- Frequently treated for cough and asthma with little improvement
- Often associated with anxiety, obsessive-compulsive behavior, and other somatoform disorders (abdominal pain and headache)



Tic cough (HABIT COUGH)

- **Sx:**
  - "Honking", loud, repetitive cough
  - Cough usually does not occur during sleep and decreases or disappears with distraction

- **DDX:** Cough variant asthma, GERD, postnasal drip

HABIT COUGH

Potential stressors underlying habit cough.

- Frequent family relocation
- Changing schools and peer groups
- Transition between separated or divorced parents' homes
- Bullying at school or in local community
- Academic achievement [under- or overachievement, trouble with teacher(s)]
- Family issues, parental discord, sibling disagreements
- Pressure from parents (sporting, academic)
- Pressure from sporting coaches
- Peer pressure (sex, drugs, criminality)

Ensure that family expectations are in alignment with the child's abilities by mobilising family and school resources to address common triggers for habit cough. These measures may include:

- Address bullying at school
- Decrease extracurricular activities
- Moderate high expectations of academic performance by child or family
- Moderate high expectations of sporting performance by child or family
- Match child's academic capacities to expectations (may require intelligence quotient assessment)

Habit cough: assessment and management. D. Fitzgerald and K Kzlowska.

HABIT COUGH

- Treatment:
  - Behavioral therapy (simple suggestion, reassurance)
  - Biofeedback

Major elements of a 15-minute suggestion-therapy session for habit cough*

• Open the session expressing confidence that the coughing will be stopped.
• Explain the cough as a vicious cycle that started with an initial irritant that is now gone, and that the cough itself is causing more irritation more cough.
• Instruct the patient to concentrate solely on holding back the urge to cough, for an initially brief timed period (eg, 1 minute). Progressively increase this time period and utilize an alternative behavior, such as sipping lukewarm water or inhaling a soothing cool mist from a vaporizer, to "ease the irritation."
• Tell the patient that each second the cough is delayed makes it easier to suppress further coughing.
• Repeat expressions of confidence that the patient is developing the ability to resist the urge to cough; "it's becoming easier to hold back the cough, isn't it" (nodding affirmatively generally results in a similar affirmation movement by the patient).
• When the patient shows that he or she is able to suppress the cough (usually for about 10 minutes), ask in a rhetorical manner, "you're beginning to feel that you can resist the urge to cough, aren't you?" (said with an affirmative head nod).
• Close the session when the patient can repeatedly respond positively to the question, "do you feel that you can now resist the urge to cough on your own?" This question is only asked after the patient has gone 5 minutes without coughing.
• Express confidence that if the urge to cough recurs, the patient can do the same thing at home (autosuggestion)¶

* Habit cough is also known as tic cough.
¶ The autosuggestion is for 15-minute sessions at home, in which the patient concentrates on holding back the cough using sips of lukewarm water to "ease the irritation causing cough".

Vocal Cord Dysfunction

- Paradoxical vocal cord motion
- Often misdiagnosed as resistant asthma
  - 30-50% of patients with VCD also have asthma
- “High functioning teenage females”
- **Sx:** Sudden onset of inspiratory stridor with throat tightness, hoarse voice, and dry cough
- **Triggers:** Exercise and stress
- **Physical exam:** Inspiratory stridor over the glottis

Vocal Cord Dysfunction

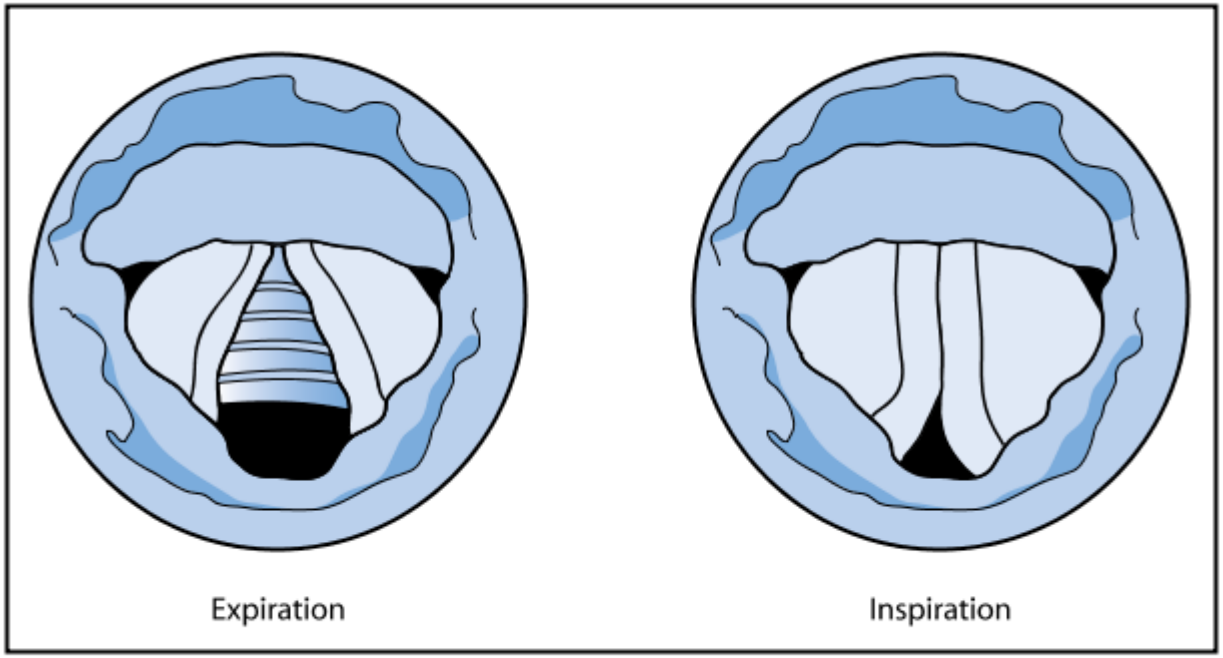
Vocal Cord Dysfunction (VCD) and Exercise-Induced Asthma (EIA)[a]

Characteristic	VCD	EIA[b]
Women > men	+	–
Associated psychiatric diagnosis	+	±
Exercise-induced	+	+
Very short duration of symptoms	+	–
Improves with bronchodilator	–	+
Eosinophilia	–	±
Hypoxia	–	+
Syncope	–	+
Dyspnea	+	+
Stridor	+	–
Wheeze	Inspiration	Expiration > inspiration
Spirometry	Blunted inspiration portion of flow-volume loop	Normal inspiration portion of flow-volume loop
Laryngoscopy	Tonic adduction of cords during inspiration or inspiration/expiration	Abduction during inspiration
Chest x-ray	Normal	Hyperinflation

Pediatric Pulmonology. M Light. 2011

Vocal Cord Dysfunction

- **Diagnosis:** Paradoxical motion of vocal cords with posterior glottic opening

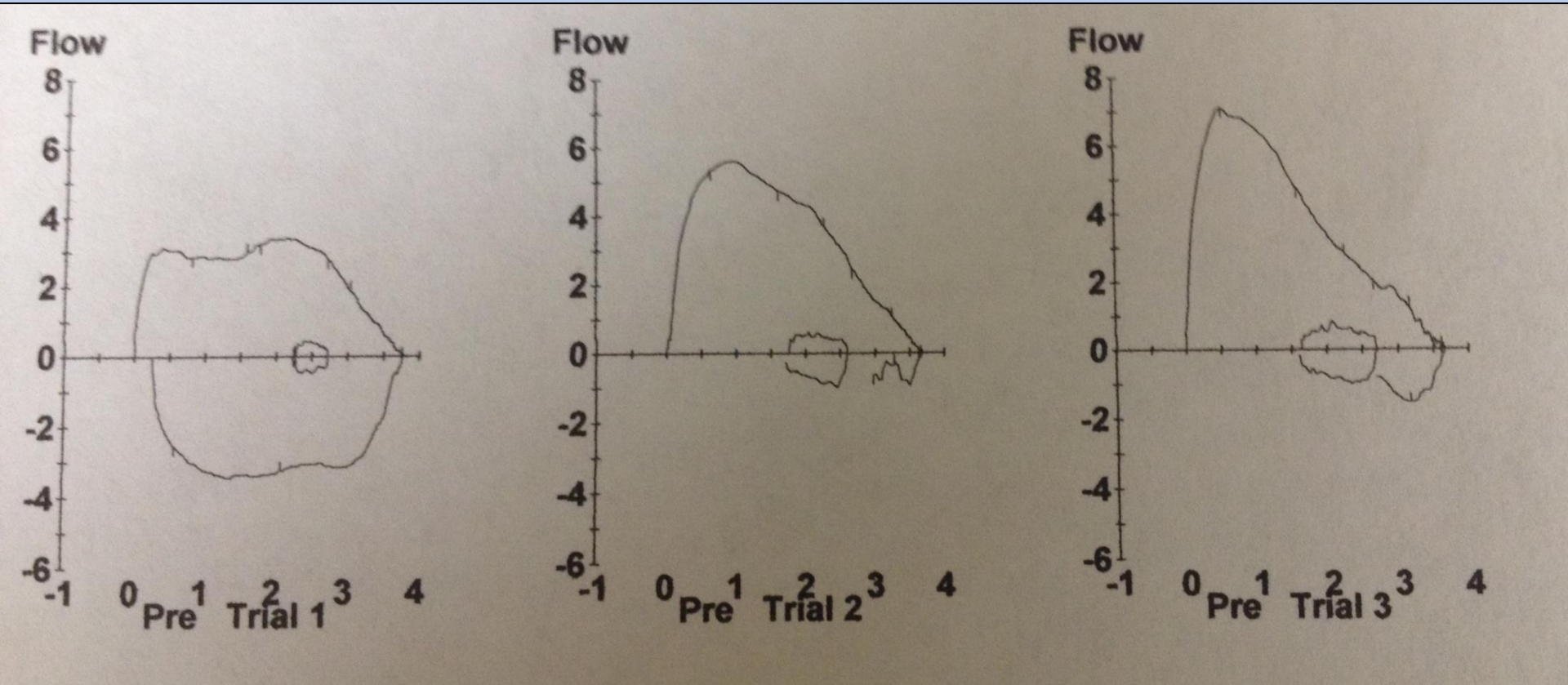


Laryngoscopic appearance of the vocal cords in vocal cord dysfunction.

Pediatric Pulmonology. M Light. 2011

Vocal Cord Dysfunction

- Diagnosis: variable blunting of inspiratory and expiratory flow volume loop



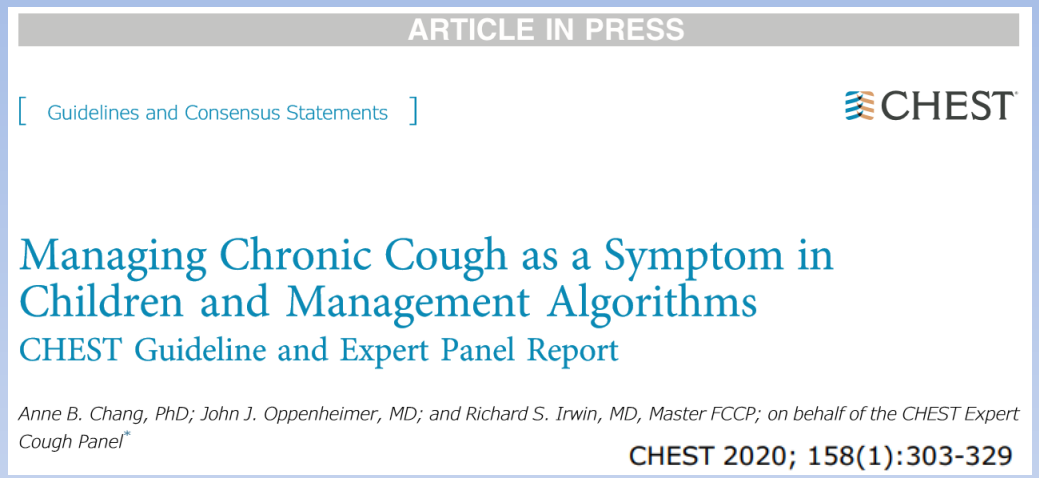
Vocal Cord Dysfunction

- **Treatment:**
  - Treatment of stress disorders
  - Relaxation techniques
  - Biofeedback
  - Speech therapy

Outline

- Definition of cough
- Mechanism of cough
- Specific diseases
- Evaluation and Workup

Chronic cough guidelines



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[Guidelines and Consensus Statements]

CHEST

Managing Chronic Cough as a Symptom in Children and Management Algorithms

CHEST Guideline and Expert Panel Report

*Anne B. Chang, PhD; John J. Oppenheimer, MD; and Richard S. Irwin, MD, Master FCCP; on behalf of the CHEST Expert Cough Panel**

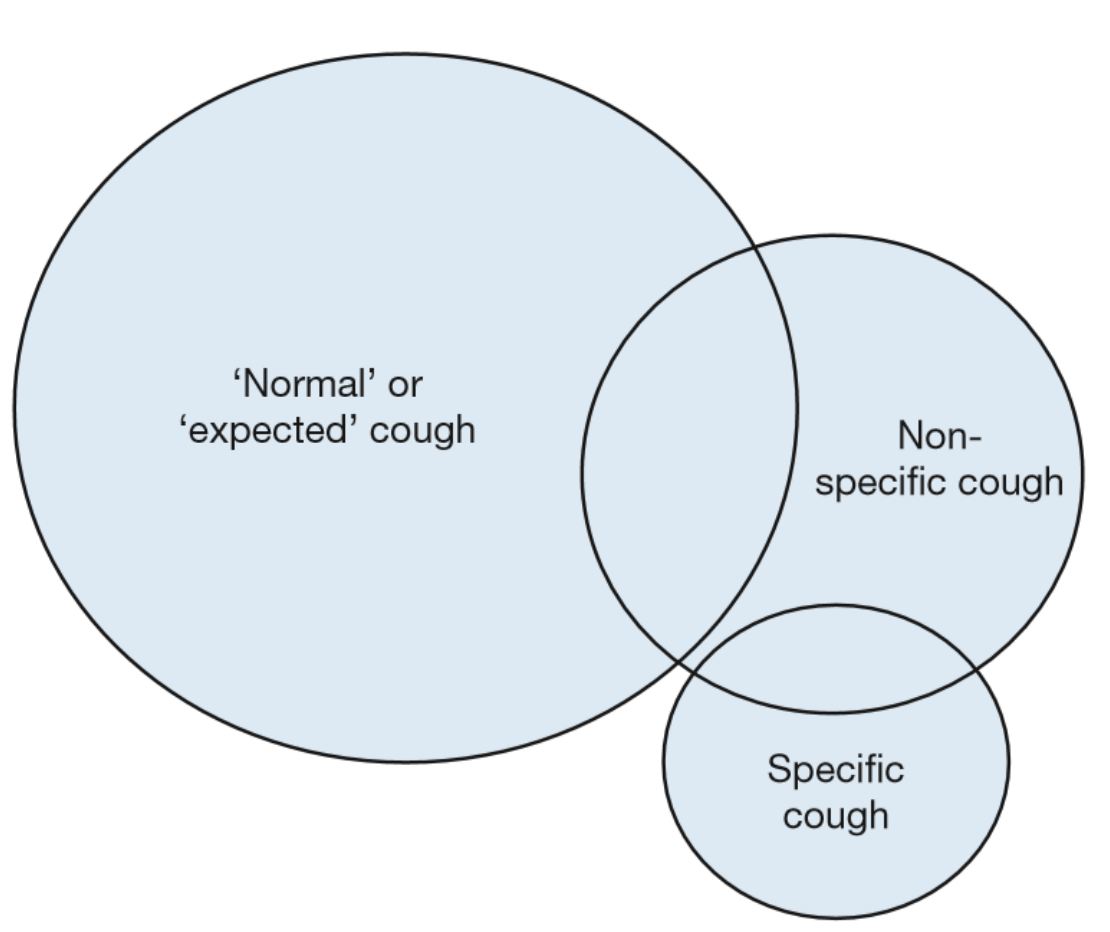
CHEST 2020; 158(1):303-329

- Update of 2006 cough guidelines with new high-quality evidence
- Careful history and examination is warranted before pursuing an expensive workup
- Evaluation can proceed systematically

Types of cough

- Nml: 1-34x/day (mean 11)

-Cough due to common URI in a healthy child that usually lasts less than 2 weeks



-A chronic cough that does not have an identifiable cause

-Dry/nonproductive cough

-NML CXR and spirometry

-Likely to resolve without treatment

-A chronic cough associated with an underlying disease

-wet > dry

Specific cough

TABLE 2] Classical Recognizable Cough in Children

Cough Characteristic	Suggested Underlying Etiology or Contributing Factor
Barking or brassy cough	Croup,[34] tracheomalacia,[35] habit cough[36]
Cough productive of casts	Plastic bronchitis[37]
Honking	Psychogenic[38]
Paroxysmal (with/without whoop)	Pertussis and parapertussis[39,40]
Staccato	Chlamydia in infants[41]

TABLE 1] Pointers to Presence of Specific Cough[a]

Abnormality	Examples of etiology
Symptoms or signs	
Auscultatory findings	Wheeze–see below Crepitations–any airway lesions (from secretions) or parenchyma disease such as interstitial disease
Cardiac abnormalities	Associated airway abnormalities, cardiac failure, arrhythmia
Chest pain	Arrhythmia, asthma
Choked	Foreign body inhalation
Dyspnea or tachypnea	Any pulmonary airway or parenchyma disease
Chest wall deformity	Any pulmonary airway or parenchyma disease
Digital clubbing	Suppurative lung disease
Daily wet/productive cough	Protracted bacterial bronchitis, suppurative lung disease, recurrent aspiration, atypical infections, TB, diffuse panbronchiolitis
Exertional dyspnea	Any airway or parenchymal disease
Facial pain/purulent nasal discharge	Chronic sinusitis (protracted bacterial bronchitis), primary ciliary dyskinesia
Feeding difficulties	Any serious systemic including pulmonary illness, aspiration
Growth failure	Any serious systemic including pulmonary illness such as cystic fibrosis
Hoarse voice/stridor	Laryngeal cleft/problems, airway abnormalities
Hemoptysis	Suppurative lung disease, vascular abnormalities
Hypoxia/cyanosis	Any airway or parenchyma disease, cardiac disease
Neurodevelopmental abnormality	Aspiration lung disease
Recurrent pneumonia	Immunodeficiency, atypical infections, suppurative lung disease, congenital lung abnormalities, trachea-esophageal H-type fistulas
Recurrent infections	Immunodeficiency
Previous history of chronic lung or esophageal disease (eg, neonatal lung disease, esophageal atresia)	Multiple causes (eg, second H-type fistula, bronchiectasis, aspiration, asthma)
Wheeze–monophonic	Large airway obstruction (eg, from foreign body aspiration, malacia and/or stenosis, vascular rings, lymphadenopathy, and mediastinal tumors) TB should be considered in selected settings (eg, high prevalence or HIV)
Wheeze–polyphonic	Asthma, bronchiolitis obliterans, bronchiolitis
Tests	
Chest radiograph (other than peribronchial changes) or spirometry abnormality	Any cardiopulmonary disease

[a]As the causes of chronic cough encompasses the entire spectrum of pediatric pulmonology and extrapulmonary diseases, this list outlines the more common symptoms and signs and is not exhaustive.

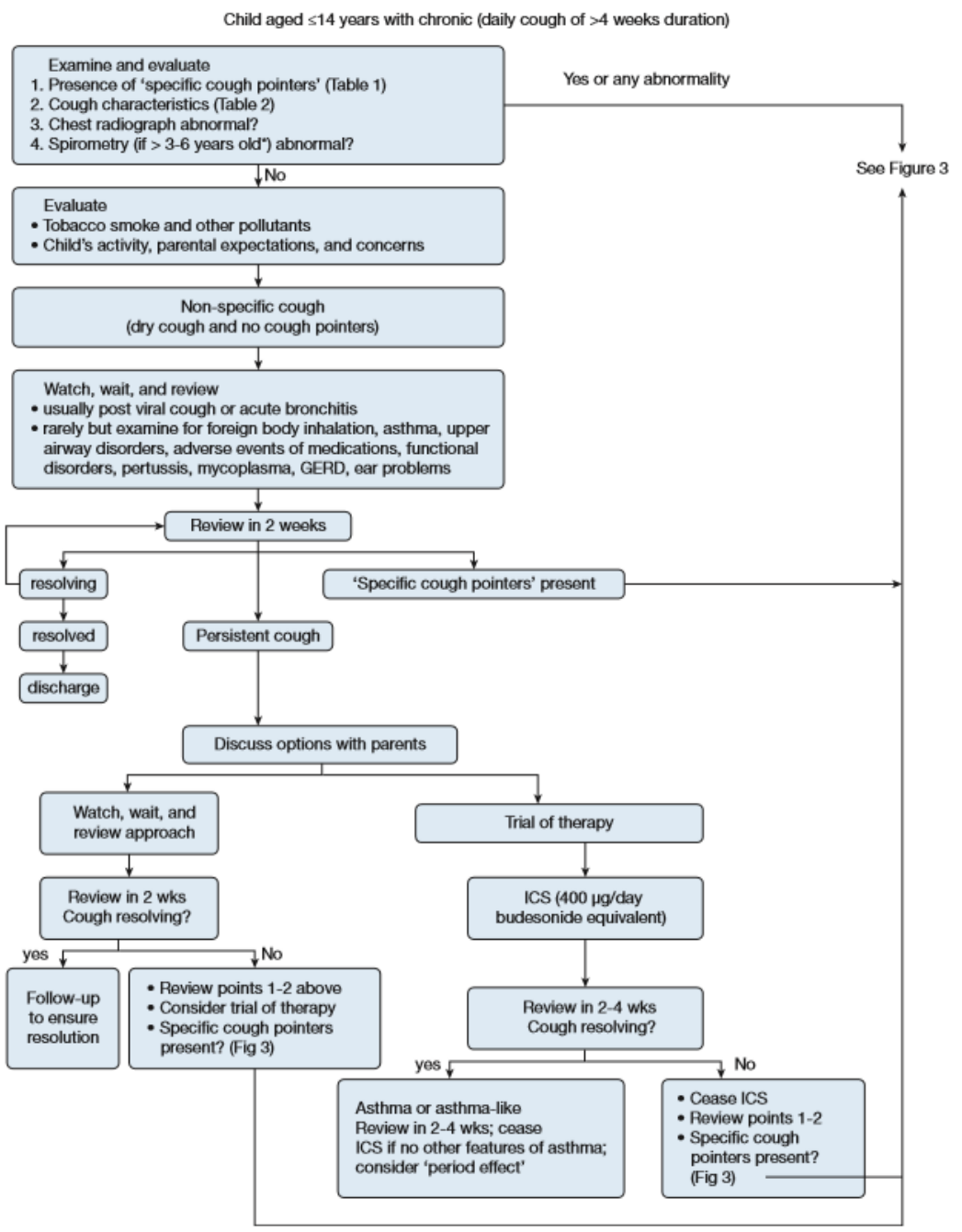


Figure 2 – *Approach to a child aged ≤ 14 years with chronic cough. Children aged > 14 years should be managed as outlined in adult guidelines but there is no good evidence when the age cutoff should be. The algorithm should be read with the accompanying text. *Spirometry can usually be reliably performed in children aged > 6 years and in some children > 3 years if trained pediatric personnel are present.*[33] *GERD = gastroesophageal reflux disease; ICS = inhaled corticosteroids.*

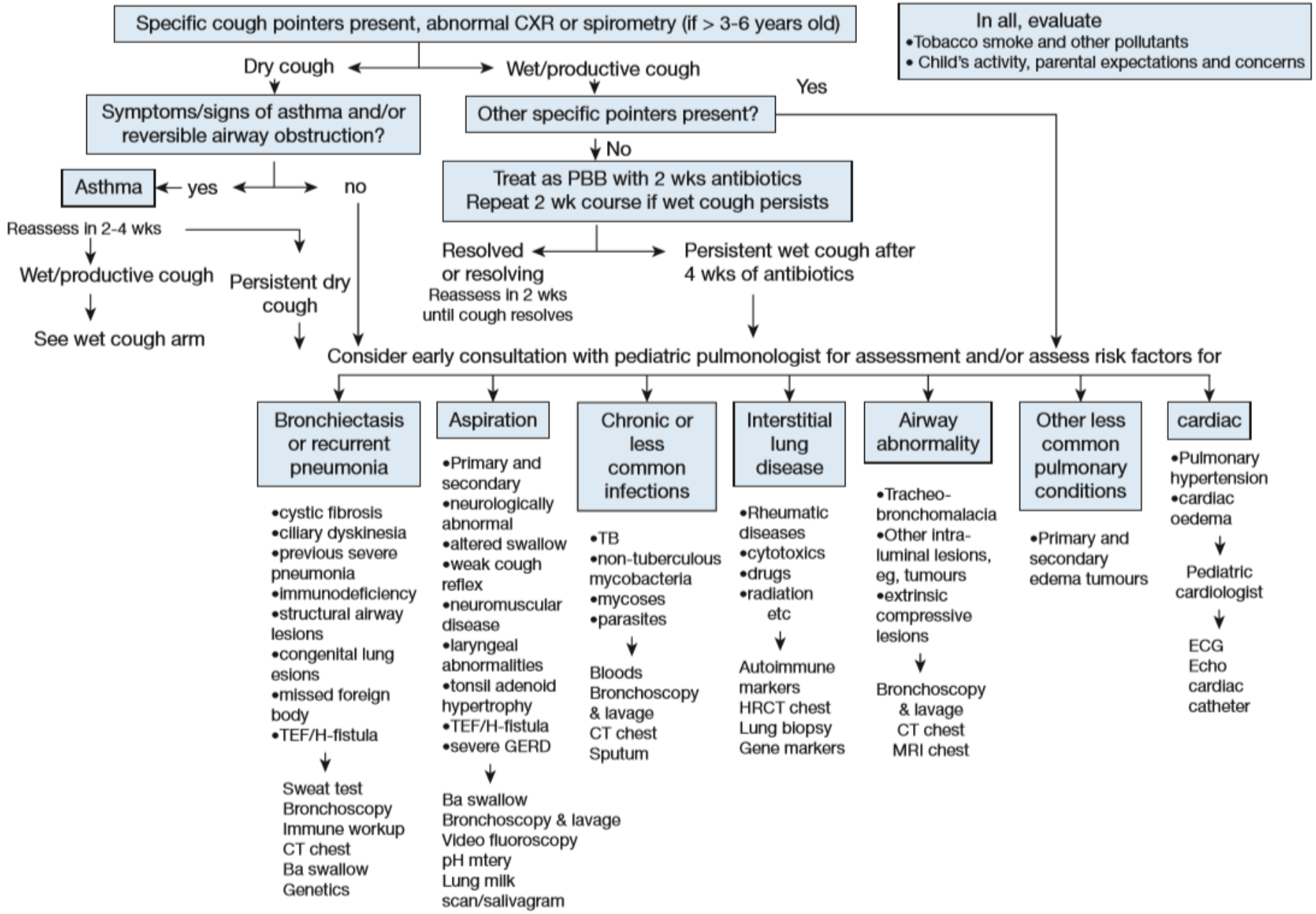


Figure 3 – *Approach to a child aged ≤ 14 years with chronic specific cough (ie, cough associated with other features suggestive of an underlying pulmonary and/or systemic abnormality). CXR = chest radiograph; HRCT = high-resolution CT; PBB = protracted bacterial bronchitis; TEF = tracheal-esophageal firstula. See Figure 2 legend for expansion of other abbreviation.*

Highlights

- **Defining chronic cough in children**
  - Chronic cough definition ≤14yo - presence of daily cough of more than 4 weeks duration
  - Most coughs spontaneously resolve within 4 weeks
  - After 4 weeks is important to carefully assess and not quickly dismiss as post-viral cough

Highlights

- **Using algorithm**
  - Use pediatric specific cough management algorithms and not adult algorithms
    - Adult: asthma, GERD, and upper airway cough syndrome (UACS) (formerly known as post-nasal drip) → empiric treatment
    - Children: asthma, protracted bacterial bronchitis (PBB), and nonspecific cough that resolves spontaneously → DO NOT use empiric treatment
  - Use a systematic approach
  - Use cough characteristics and history to help guide algorithm
  - Obtain CXR and spirometry (when appropriate)
  - Do not routinely perform additional tests (skin prick test, TB test bronchoscopy, chest CT)
  - Evaluate for Bordetella pertussis if clinically suspected
  - Evaluate for exacerbating factors: tobacco smoke and other pollutants

Highlights

- **Treatment**
  - Do not empirically treat for rhinosinusitis, reflux, or asthma
  - If empirical trial is used then use for defined limited duration to confirm or refute the hypothesized diagnosis
  - Determine parental and child's expectations and specific concerns

Highlights

- **Specific etiologies**
  - Wet cough and PBB
    - Recommend 2 weeks of antibiotics targeted to common respiratory bacteria (Streptococcus pneumoniae, Haemophilus influenza, Moraxella catarrhalis) for wet or productive cough unrelated to underlying disease or specific cough pointers (coughing with feeds, general clubbing,…)
      - → cough resolves then diagnose PBB
      - → cough does not resolve → additional 2 weeks of abx
      - → cough persists after 4 wks of abx → further studies (bronchoscopy ± CT)

Highlights

- **Specific etiologies (cont.)**
  - Specific cough pointers (coughing with feed, digital clubbing) → further investigations (flexible bronchoscopy, chest CT, assessment for aspiration, evaluation of immune system)
  - GERD
    - Do not treat for GERD if there are no clinical features (regurgitation, dystonic neck posturing in infants, heartburn/epigastric pain in older children)
    - If there are symptoms treat for 4-8 weeks per guidelines and then reevaluate

Highlights

- **Specific etiologies (cont)**
  - Bronchiolitis
    - Asthma medications and inhaled osmotic agents should not be used
  - TIC cough (previously termed habit cough)
    - Diagnosis can be made when the patient manifests clinical features (suppress ability, distractibility, suggestibility, variability, and presence of premonitory sensation)
    - Treatment - reassurance, counseling, hypnosis, suggestion therapy, referral to psychologist/psychiatrist
  - TB
    - Screen for TB in patients in high TB prevalence areas
  - Postinfectious cough, pertussis, mycoplasma, and other infections
    - Postinfectious cough is likely the most common cause of chronic cough in children in the community

Highlights

- **Nonspecific cough**
  - The cough does not resolve in 2 to 4 weeks reevaluate for emergence of specific etiologies
  - Nonspecific cough with risk factors for asthma → Short (2-4-week) trial of 400 mcg/day of beclomethasone → reevaluate in 2 to 4 weeks

- **Acute cough**
  - Do not use over-the-counter cough and cold medicines
  - Honey may be beneficial
  - Avoid using codeine-containing medications

CONCLUSION

- Cough is a vital defensive mechanism for lung health
- Simply suppressing the cough is not the answer because cough is an essential protective mechanism to keep the airways patent and clear
- Chronic cough is a symptom, not a diagnosis, and the underlying cause should be ascertained

CONCLUSION

- Use cough algorithm to help guide workup

- Refer to pulmonary:
  - Chronic cough does not resolve
  - Workup of specific etiology

REFERENCES

- Pediatric Pulmonology. M Light. 2011
- Acute and chronic cough. Landau LI. Paediatr Respir Rev. 2006;7 Suppl 1:S64-7.
- Chronic cough. Ewing, J. Pediatrics in review. Vol 6 #2. Feb 1995
- The physiology of cough. A Chang. Paediatric Respir Rev. 2006;7 2-8
- Chronic cough in children: A Primary care and Subspecialty Collaborative Approach. R Kaslovsky, M Sadof. Pediatrics in Review Vol 34 No11. November 2013
- Chronic cough. J Ewing. Pediatrics in Review. Vol 16 No2 Feb 1995.
- Chang AB, Oppenheimer JJ, Weinberger MM, Rubin BK, Grant CC, Weir K, Irwin RS; CHEST Expert Cough Panel. Management of Children With Chronic Wet Cough and Protracted Bacterial Bronchitis: CHEST Guideline and Expert Panel Report. Chest. 2017 Apr;151(4):884-890

REFERENCES

- Cough misdiagnosed as asthma. M. Weinberger. Recent Advances in Pediatrics.
- Pediatric Respiratory Medicine. Taussig 2008
- Cough and asthma. P. van Asperen. Paediatric Respiratory Reviews (2006) 7 (26-30)
- Chronic cough in children. M. Shields and G Doherty. Paediatric Respiratory Reviews 14 (2013) 100-106
- Cough in children: when does it matter? J. Massie. Paediatric Respiratory Reviews (2006) 7, 9-14
- Habit cough: assessment and management. D. Fitzgerald and K Kzlowska. Pediatric Respiratory Reviews (2006) 7, 21-25.

REFERENCES

- Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1 to 18 Years. Ellen R. Wald et al. *Pediatrics* 2013;132

- Diagnosis, monitoring, and treatment of primary ciliary dyskinesia. A Shapiro et al. Pediatric Pulmonology 51:115-132 (216)

- Prolonged bedtime bottle feeding and respiratory symptoms in infants. H. Kim. Asia Pac Allergy 2011; 1:30-35

- Eagans Fundamentals of Respiratory Care. 10th Edition.

- Chang AB, Oppenheimer JJ, Irwin RS; CHEST Expert Cough Panel. Managing Chronic Cough as a Symptom in Children and Management Algorithms: CHEST Guideline and Expert Panel Report. Chest. 2020 Jul;158(1):303-329.

"Yes ... I believe there's a question in the back."

Practice Information

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