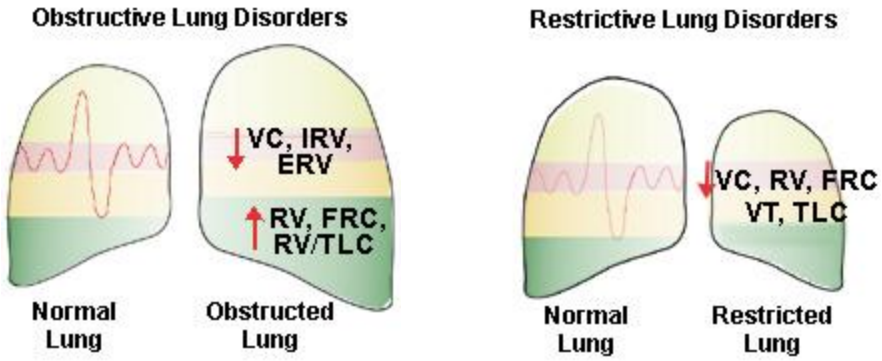
- **Fetus able to survive at 26 weeks of gestation**
- **90% of alveolar development occur after birth until 8years of age.**
- **Higher risk of respiratory insufficiency in infants:**
  - Smaller air passages.
  - Less compliant lungs and more compliant chest wall.
  - Less effective lung mechanics.
- **Obstructive and restrictive lung diseases**

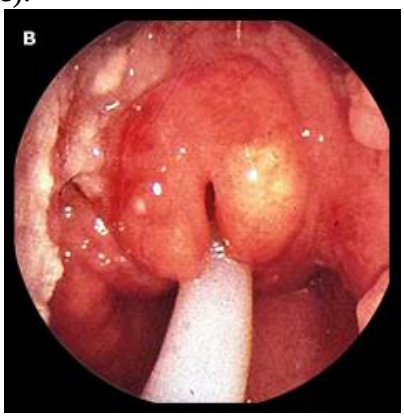
Obstructive	Restrictive
Decreased airflow throw narrowed airways	Decreased amount of air filling the alveoli
Examples: asthma, foreign body aspiration and bronchiolitis	**Examples**: pulmonary edema, pneumonia and pulmonary fibrosis

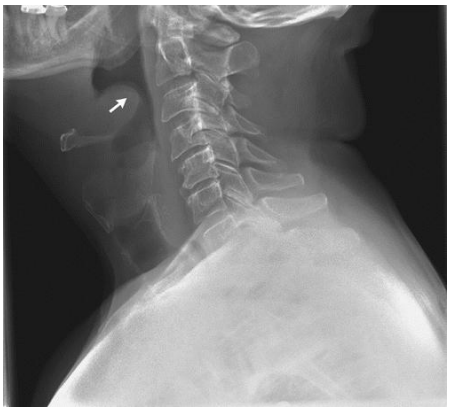


- **Signs of respiratory distress:**
  - Tachypnea and nasal flaring.
  - Cyanosis.
  - Chest retractions.
  - Use of accessory muscles.
  - Expiratory grunting.

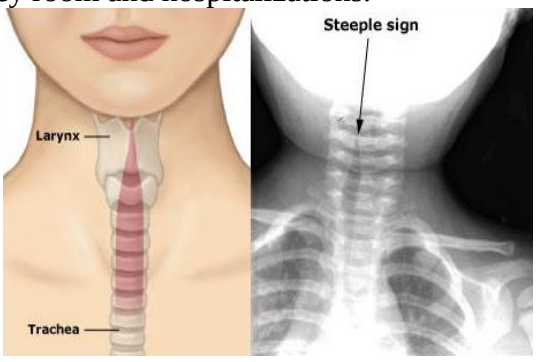
- **Examination findings:**
  - **Inspiratory stridor**: croup and laryngomalacia.
  - **Expiratory wheeze**: asthma and bronchiolitis.
  - **Crackles or rales**: croup or pneumonia.
- **To measure oxygen saturation in a patient:**
  - **Arterial blood gas**: invasive.
  - **Pulse oximetry**: non-invasive.

- **Infectious diseases of respiratory tract:**
  - **Epiglottitis:**
    - ✓ It is an acute inflammation and edema of epiglottis that is caused by HIB in children between 2-7 yrs. Now it is rare, due to routine vaccination.
    - ✓ Clinical features: high-grade fever (bacterial infection), musffled speech, dysphagia with drooling and sitting in tripod position with neck hyperextension.
    - ✓ Investigations: CBC (leukocytosis), blood culture (positive if it is caused by HIB) and chest X-ray shows the thumb sign. If visualized with bronchoscope: erythematous swollen epiglottis can be seen (but this is not done because airway obstruction and respiratory arrest can occur at any moment. This condition is a pediatric emergency).
    - ✓ Management: patient is intubated and given IV 3rd generation cephalosporins (ceftriaxone).



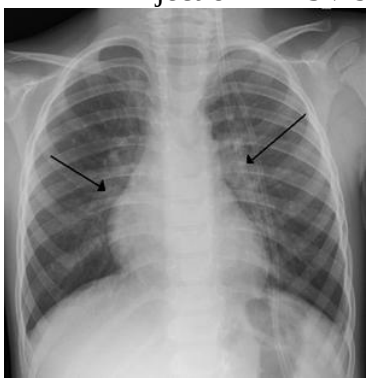
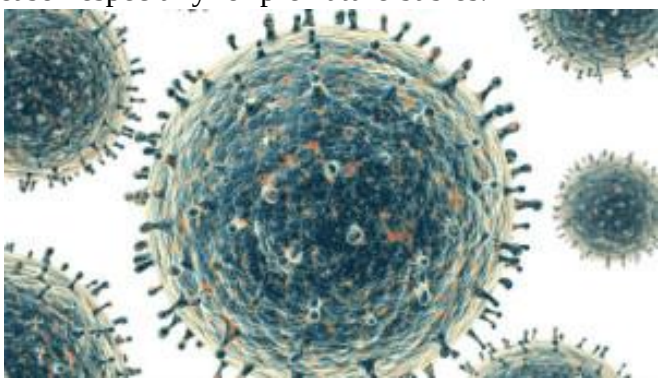


  - **Croup:**
    - ✓ It is an inflammation of larynx, trachea and bronchi that occurs between ages of 3 months to 3 years and is most commonly caused by parainfluenza virus.
    - ✓ Clinical features: low-grade fever (viral infection), inspiratory stridor and barky cough.
    - ✓ Investigations: anterior-posterior view of neck X-ray will show the steeple sign.
    - ✓ Management: mainly supportive (cool mist and fluids). Hospitalization is only indicated for children in respiratory distress. Notice that inhaled epinephrine and a single dose of steroids can be given to reduce the length of time in the emergency room and hospitalizations.



  - **Bacterial tracheitis:**
    - ✓ It is an acute inflammation of the trachea which is caused by S.aureus (in 60% of cases).
    - ✓ Clinical features: high-grade fever, mucus and pus in trachea and stridor.
    - ✓ Management: endotracheal intubation and IV anti-staphylococcal antibiotics (oxacillin) → if there is resistance, vancomycin will be given.

- **Bronchiolitis:**
  - ✓ It is an inflammation of bronchioles that is most commonly caused by RSV virus in male patients younger than 1 year of age. Epidemics occur between November – April.
  - ✓ Clinical features: usually low-grade fever, cough with wheezing and tachypnea.
  - ✓ Investigations: CBC (increased lymphocytes), chest X-ray (hyperinflation of lungs and patchy infiltrates) and RSV can be detected by PCR in nasopharyngeal aspirate.
  - ✓ Management: mainly supportive (hydration and oxygen as needed). The use of nebulized bronchodilators is controversial. Antibiotics and steroids are generally not used. Hospitalization for patients with: respiratory distress, hypoxemia, apnea, dehydration or underlying cardio-pulmonary disease. Notice that recovery occurs mostly within 2 weeks.
  - ✓ Prophylaxis: RSV monoclonal antibody (palivizumab) given as monthly IM injection in RSV season especially for premature babies.

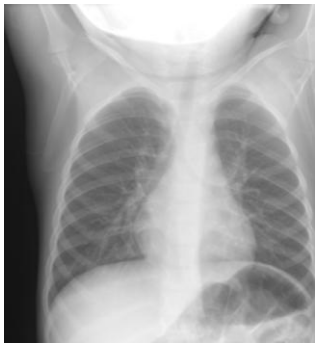



- **Pneumonia:**
  - ✓ It is an infection and inflammation of lung parenchyma.
  - ✓ Etiologies (depending on age):

Age	Etiology
< 1 month	GBS, CMV, HSV, Listeria monocytogens and E.coli
1-3 months	S. pneumoniae, S.aureus and afebrile pneumonia caused by (Chlamydia trachomatis)
3 months – 5 years	S. pneumoniae and S.aureus
≥ 6 years	Atypical pneumonia: viruses, mycoplasma pneumoniae and Chlamydia pneumoniae

  - ✓ Clinical features, investigations and management:

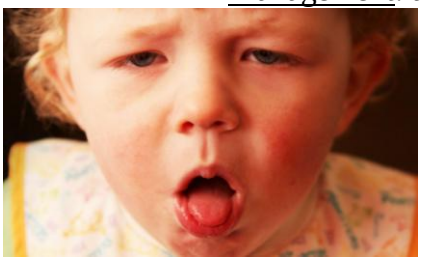
	Viral pneumonia	Bacterial pneumonia
Clinical features	Fever, cough, dyspnea and rales heard on auscultation	
Investigations	WBCs < 20,000 with lymphocyte predominance; CXR shows interstitial infiltrates	WBCs > 20,000 with neutrophil predominance; CXR shows lobar consolidation
Management	Mainly supportive	Antibiotics (amoxicillin or vancomycin if there is resistance) + supportive care

- **Pertussis (whooping cough):**
  - ✓ It is a highly contagious respiratory infection caused by Bordetella pertussis commonly in infants < 6 months of age but now incidence is reduced due to routince vaccination which is beginning at 2 months of age.
  - ✓ Clinical features:

Catarrheal stage (1-2 weeks)	Paroxysmal stage (2-4 weeks)	Convalescent stage (weeks-months)
Conjunctival redness, rhinorrhea, nasal congestion and low-grade fever.	Fits of forceful coughing, whoop (inspiratory gasp at the end of coughing fits) and post-tussive vomiting	Coughing fits are present but becoming less frequent and severe

  - ✓ Investigations: CBC (increased lymphocytes) and culture of nasopharyngeal secretions.
  - ✓ Management: antibiotics (e.g. azithromycin or erythromycin).



- **Non-infectious disorders of respiratory tract:**
  - **Asthma:**
    - ✓ It is a chronic inflammatory disease which is characterized by reversible airway obstruction. It is differentiated from bronchiolitis in that it usually occurs after 2 years of age and 30%-50% will have remission by puberty.
    - ✓ Etiology:
      - ❖ *Risk factors*: prematurity, bottle-feeding and positive family history.
      - ❖ *Triggering factors*: stress, exercise, UPRTIs, dust, smoke and animal dander.
    - ✓ Pathophysiology: the triggering antigen will bind to IgE and this complex subsequently binds to mast cells resulting in the release of cytokines that will lead to:
      - ❖ Smooth muscle constriction of bronchioles.
      - ❖ Mucus plug formation.
      - ❖ Airway wall remodeling.
    - ✓ Clinical features: cough, wheezing, dyspnea and chest tightness (in addition to other respiratory distress signs).
    - ✓ Investigations: CBC (to rule out an infection), CXR (hyperinflation of lungs), spirometry in children older than 5 years of age (decreased expiratory flow rates) and response to bronchodilators trial (most helpful).

✓ Management of asthma depending on severity:

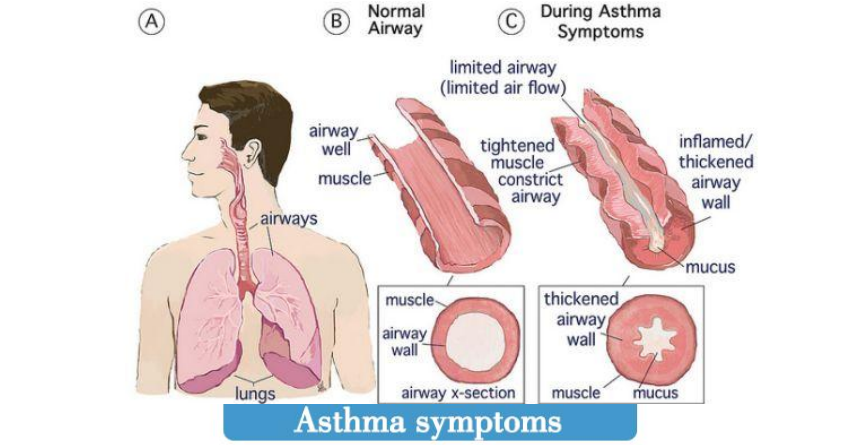
Category	Clinical characteristics	Management
Intermittent	• Day-time ≤ 2/week • Night-time ≤ 2/month	• Short-acting inhaled β_2 agonists
Mild persistent	• Day-time > 2/week • Night-time > 2/month	• Short-acting inhaled β_2 agonists • Low-dose inhaled corticosteroids or cromolyn sodium
Moderate persistent	• Day-time: daily • Night-time > 1 week	• Short-acting inhaled β_2 agonists • Medium-dose inhaled corticosteroids
Severe persistent	• Continuous symptoms	• Short-acting inhaled β_2 agonists • high-dose inhaled corticosteroids and long-acting β_2 agonists • Systemic corticosteroids might be given (prednisolone)

✓ Asthma drugs:

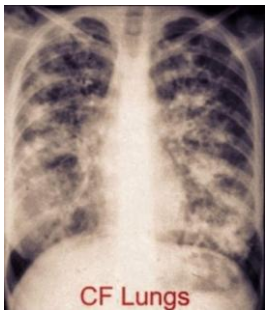
- ❖ *Short-acting β_2 agonists (2-4 hours):* salbutamol.
- ❖ *Long-acting β_2 agonists (12 hours):* salmeterol. They should not be used without an inhaled corticosteroid.
- ❖ *Inhaled corticosteroids*: budesonide.
- ❖ *Anti-cholinergic*: atropine or ipratropium bromide
- ❖ *Leukotriene modifiers*: zafirleukast.

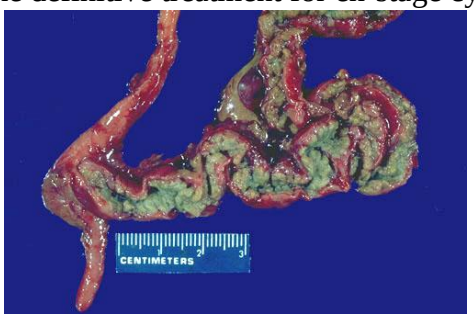
✓ Acute severe asthma management:

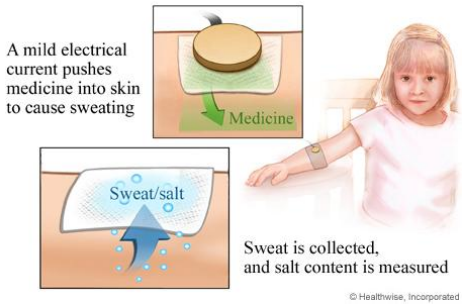
- ❖ High-dose β_2 bronchodilators via nebulizer driven by high-flow oxygen.
- ❖ Short course of oral prednisolone (2-5 days).



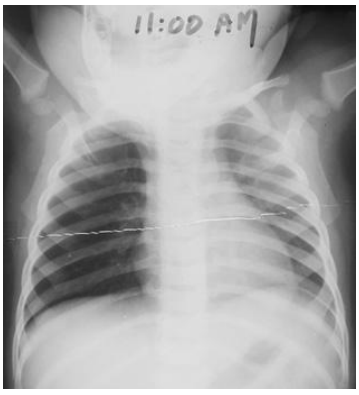
- **Cystic fibrosis:**
  - ✓ It is an autosomal recessive disease in which there is a mutation on chromosome 7 (affecting CFTR gene). It involves multiple systems due to altered content of exocrine glands secretions and the median age of survival is 31 years.
  - ✓ Clinical features:
    - ❖ Chronic progressive pulmonary insufficiency with recurrent respiratory infections (pneumonia) with S.aureus and Pseudomonas. With established disease there is finger clubbing.
    - ❖ Meconium ileus occurs in 20% of infants. Initial treatment is with gastrografin enemas but most cases require surgery.
    - ❖ Pancreatic insufficiency resulting in: steatorrhea, deficiency of fat-soluble vitamins and failure to thrive.
    - ❖ High sweat electrolytes accompanied with hyponatremic, hypochloremic, hypokalemic metabolic alkalosis.
    - ❖ Males are infertile due to absence of vas deferens but females have normal fertility.
  - ✓ Investigations:
    - ❖ *Neonatal screening*: ↑ immunoreactive trypsinogen.
    - ❖ Sweat chloride > 60 mmol/L
    - ❖ Genetic study looking for CFTR gene.
  - ✓ Management: prophylactic antibiotics to prevent recurrent respiratory infections (flucloxacillin), replacement of pancreatic enzymes, fat-soluble vitamins and bronchodilators for wheezing. Notice that lungs transplantation is the definitive treatment for en-stage cystic fibrosis disease.







- **Foreign body aspiration:**
  - ✓ Aspiration of small objects that commonly occur between the age of 3 months-5 years. Commonly aspirated objects include: nuts, medicine, popcorn, grapes and small toy parts.
  - ✓ Clinical features: history of chocking, inspiratory stridor with laryngotracheal foreign bodies, localized wheezing with bronchial foreign bodies (most commonly the right bronchi because it is shorter, less oblique with a wider diameter) and asymmetric air entry on auscultation.



  - ✓ Investigations: radiopaque objects appear in CXR only in 15% of cases! Therefore, you must have a high index of suspicion!
  - ✓ Management: BLS (don't do it if the child is fine because you might dislodge the foreign body); removal of the foreign body is done through rigid bronchoscopy.
- **Apnea of infancy:**
  - ✓ Cessation of breathing ≥ 20 seconds in a term infant which can be central or obstructive (due to hypotonia, obesity or craniofacial anomalies). Notice that short central apnea ≤ 15 seconds is normal in all ages.

- **Apnea of prematurity:**
  - ✓ Unexplained cessation of breathing ≥ 20 seconds in a premature infant.
- **Sudden Infant Death Syndrome (SIDS):**
  - ✓ Sudden unexplained death of an infant < 1 year of age.
  - ✓ Risk factors: prematurity, prone sleeping position, soft bedding and lack of breast-feeding.
  - ✓ Prevention: sleep on the back, firm bedding and breast-feeding.
  - ✓ Management: cardiopulmonary resuscitation.