Pneumonia in Children

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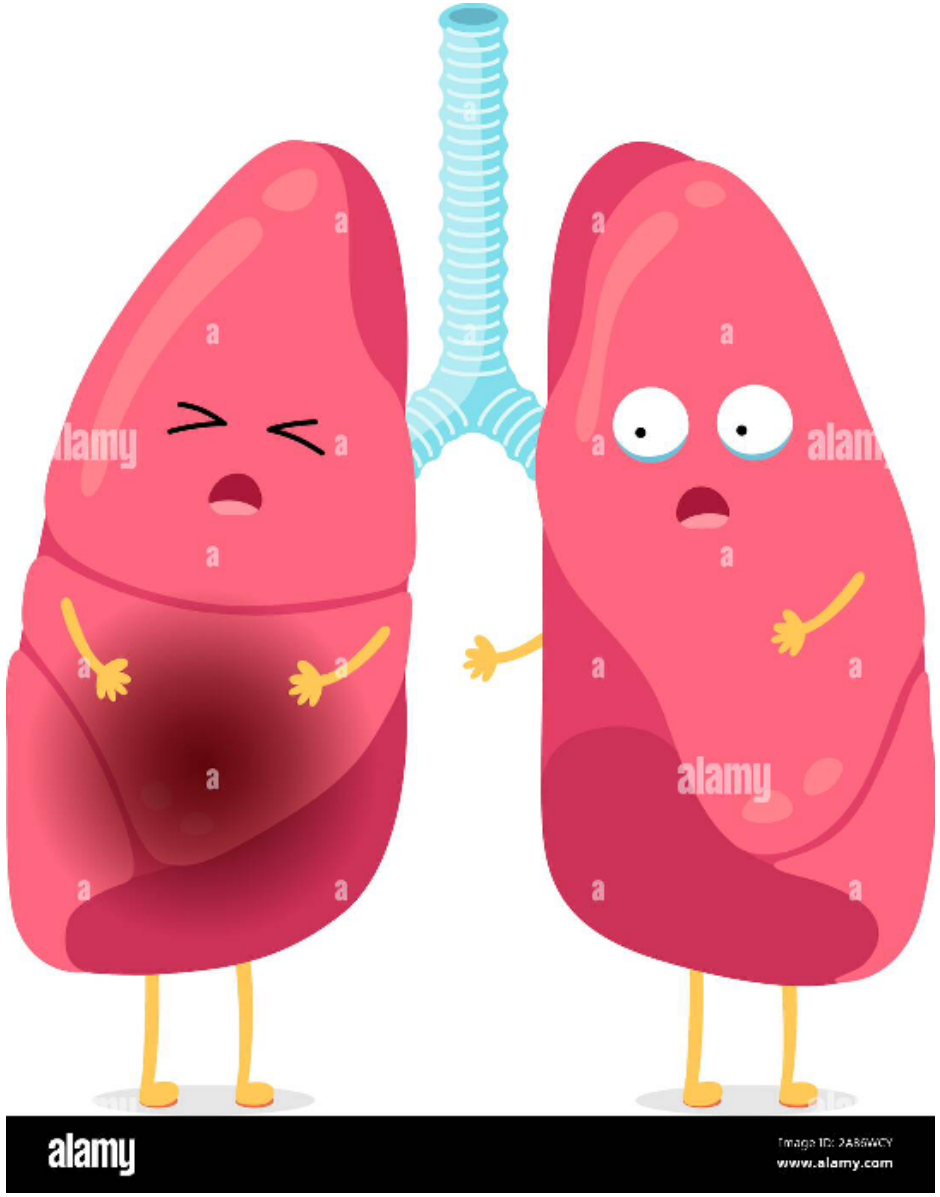


Objectives of the lecture

- Pneumonia in children
  - Clinical presentation
  - Diagnosis
  -Management

What is pneumonia ??

- Pneumonia is an acute infection of the pulmonary parenchyma.
- The term “Lower Respiratory Tract Infection” (LRTI) may include pneumonia, bronchiolitis and / or bronchitis.
- Bronchopneumonia: a patchy consolidation involving one or more lobes, usually involves the dependent lung zones (basal).
- Interstitial pneumonia : patchy or diffuse inflammation involving the interstitium is characterized by infiltration of lymphocytes and macrophages.
- Congenital pneumonia, presents within the first 24 hours after birth.

According to WHO

- Pneumonia accounts for 14% of all deaths of children under 5 years old, killing 740 180 children in 2019.

- Pneumonia can be prevented by immunization, adequate nutrition, and by addressing environmental factors such as indoor air pollution, parental smoking and living in crowded homes.

- **Classifications:**

✔ *Anatomical :*

lobar or lobular, bronchopneumonia and interstitial pneumonia.

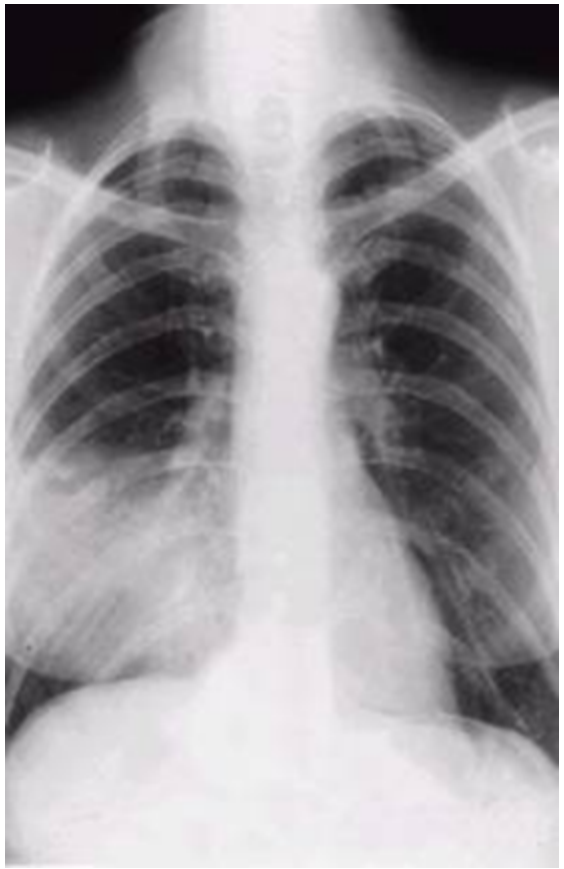
✔ *Etiology:*

Viral or Bacterial

Lobar Pneumonia

- Affecting one or more lobes, or part of a lobe of the lung.
- Bronchi not primarily affected and remain air filled -> air bronchograms; generally no volume loss
- Less common due to early treatment
- DDx: Aspiration and Pulmonary Embolus

Lobar Pneumonia

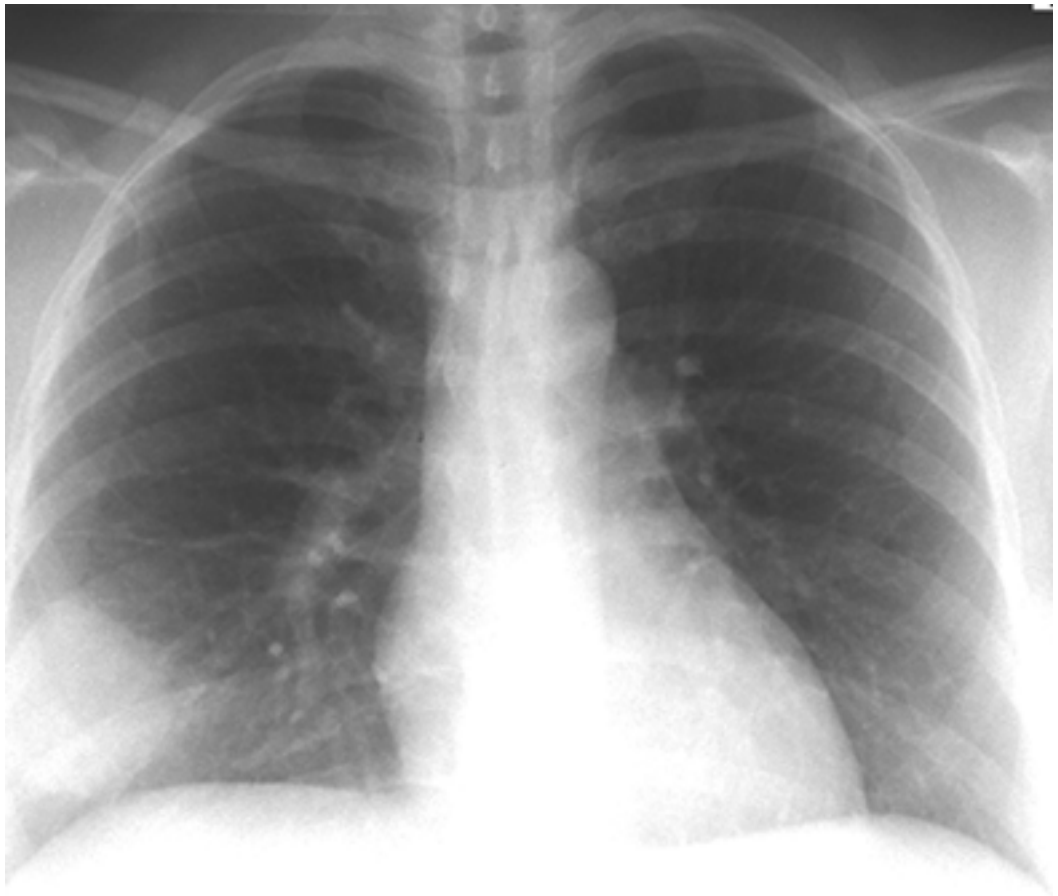


Pathogens

S. pneumoniae

Others

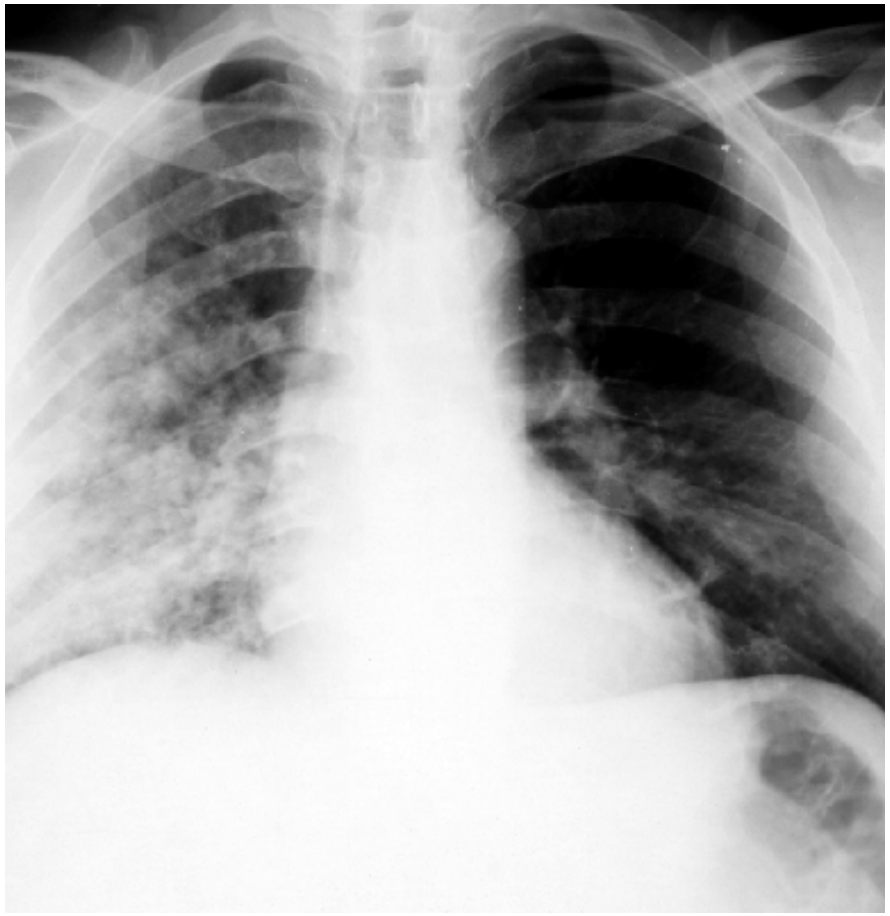
- S. aureus
- H. influenzae
- Fungal



Round Pneumonia

S. pneumoniae
Klebsiella
Any pneumonia in children
Atypical Measles

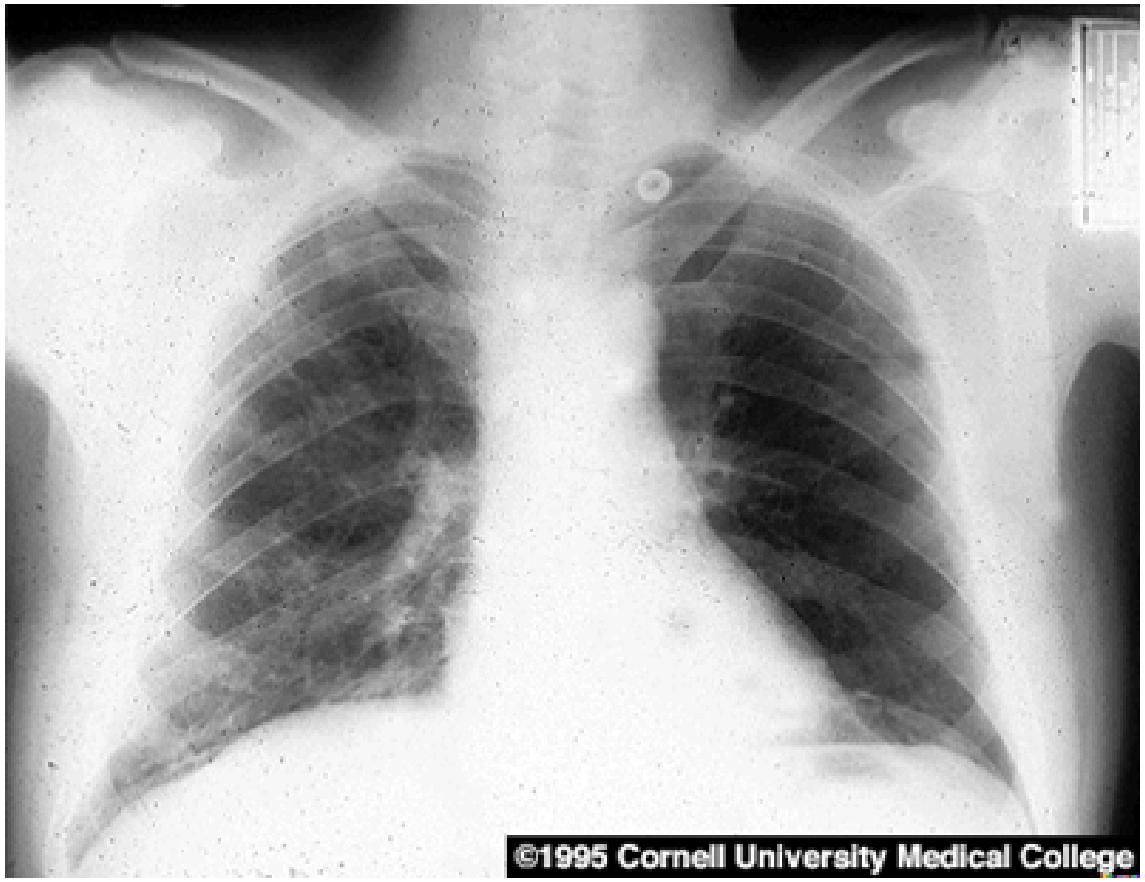
Bronchopneumonia



Primarily affects bronchi and adjacent alveoli -> multifocal patchy opacities

Volume loss may be present as bronchi filled with exudate

Mycoplasma



Among the most common lower respiratory infections worldwide.

Ages 5-20 yrs

Gradual onset of headache, malaise, fever, sore throat, and cough

✔ *Etiology:*

Viral: RSV, Influenza, parainfluanza or adenovirus…….

Bacterial:

- *1st 2 months*: the common agents include: *klebsiella, E. Coli and staphylococci.*
- *3months- 3 years*: *S pneumonia, H influenza and staphylococci*.
- *After 3 years*: common bacteria include *S pneumonia and staphylococci.*
- *Atypical organism*: *Chlamydia sps and Mycoplasma*.
- *Pneumuocystis carinii*: causes pneumonia in immuno-compromized children.

Clinical Features:

- **Onset:** May be insidious starting with URTI or may be acute with high fever, dyspnea and respiratory distress.
- Can present with acute abdominal pain, referred from the pleura.

- **O/E:** signs of respiratory distress:

  Flaring of alae nasi

  retraction of lower chest and

  intercostal spaces.

Signs of Respiratory Distress

1. **Tachypnea, respiratory rate, breaths/min (WHO definition)**
   - Age 0–2 months: >60
   - Age 2–12 months: >50
   - Age 1–5 Years: >40
   - Age >5 Years: >20
2. **Dyspnea**
3. **Retractions (suprasternal, intercostals, or subcostal)**
4. **Grunting**
5. **Nasal flaring**
6. **Apnea**
7. **Altered mental status**
8. **Pulse oximetry measurement ,90% on room air**

O/E:

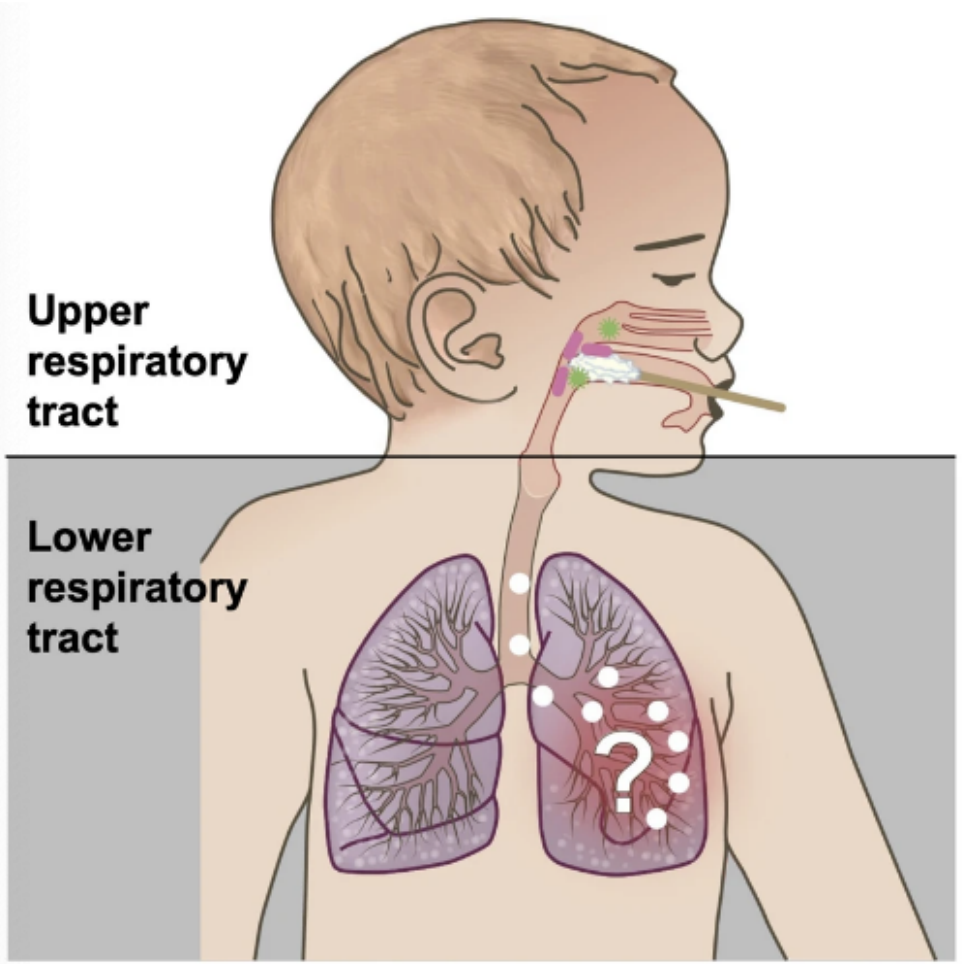
- Signs of consolidation: bronchial breathing
  Increased tactile vocal fremitus
  dull percussion note.

Diagnosis:

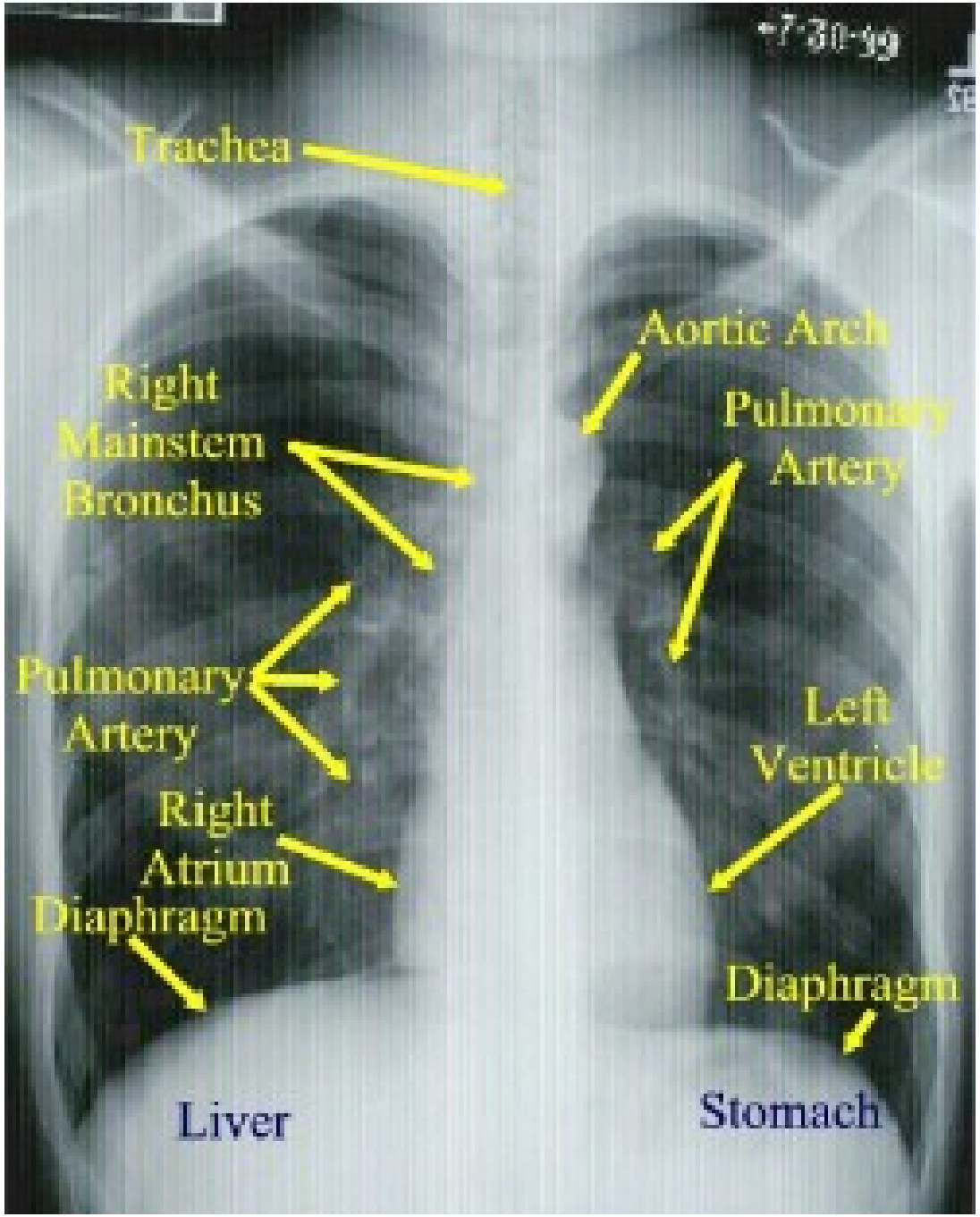
- **CXR:** confirms the diagnosis and may indicate a complication such as pleural effusion or empyema.

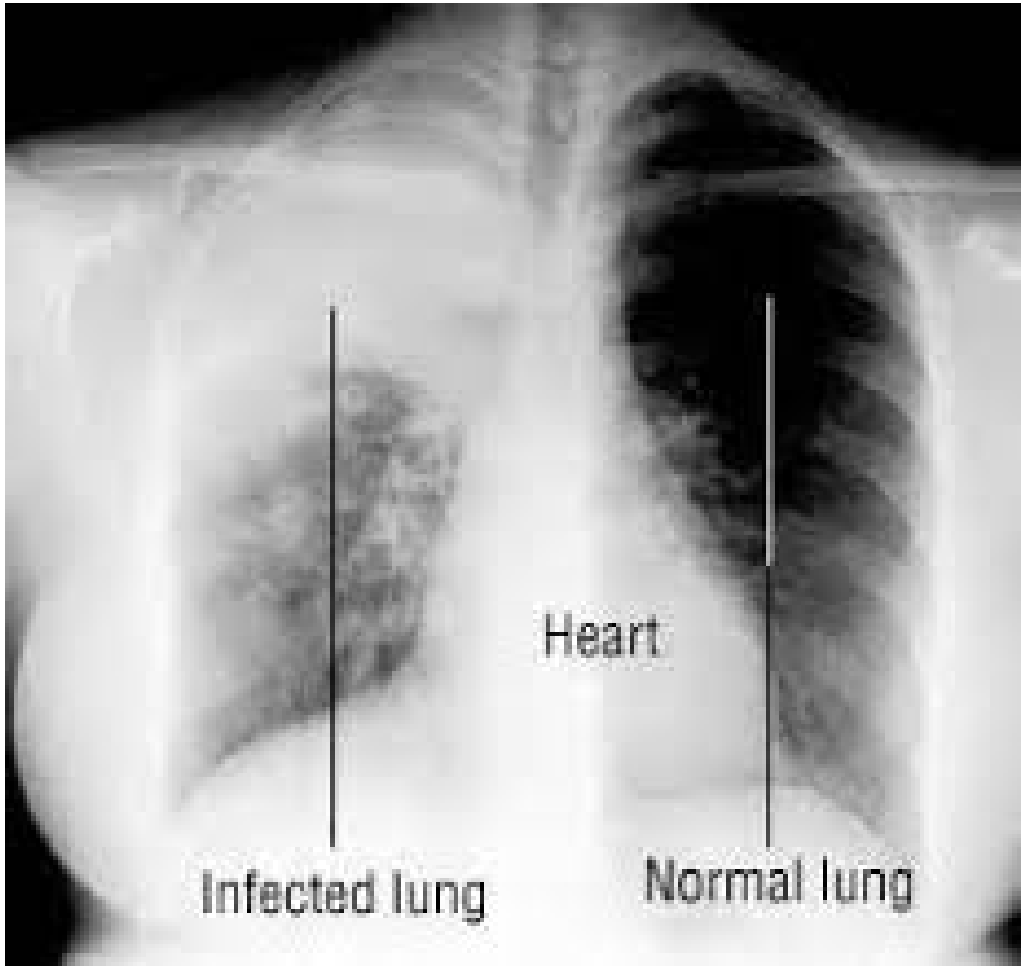
- **Viral pneumonia:** hyperinflation with bilateral interstitial infiltrates and peribronchial cuffing.

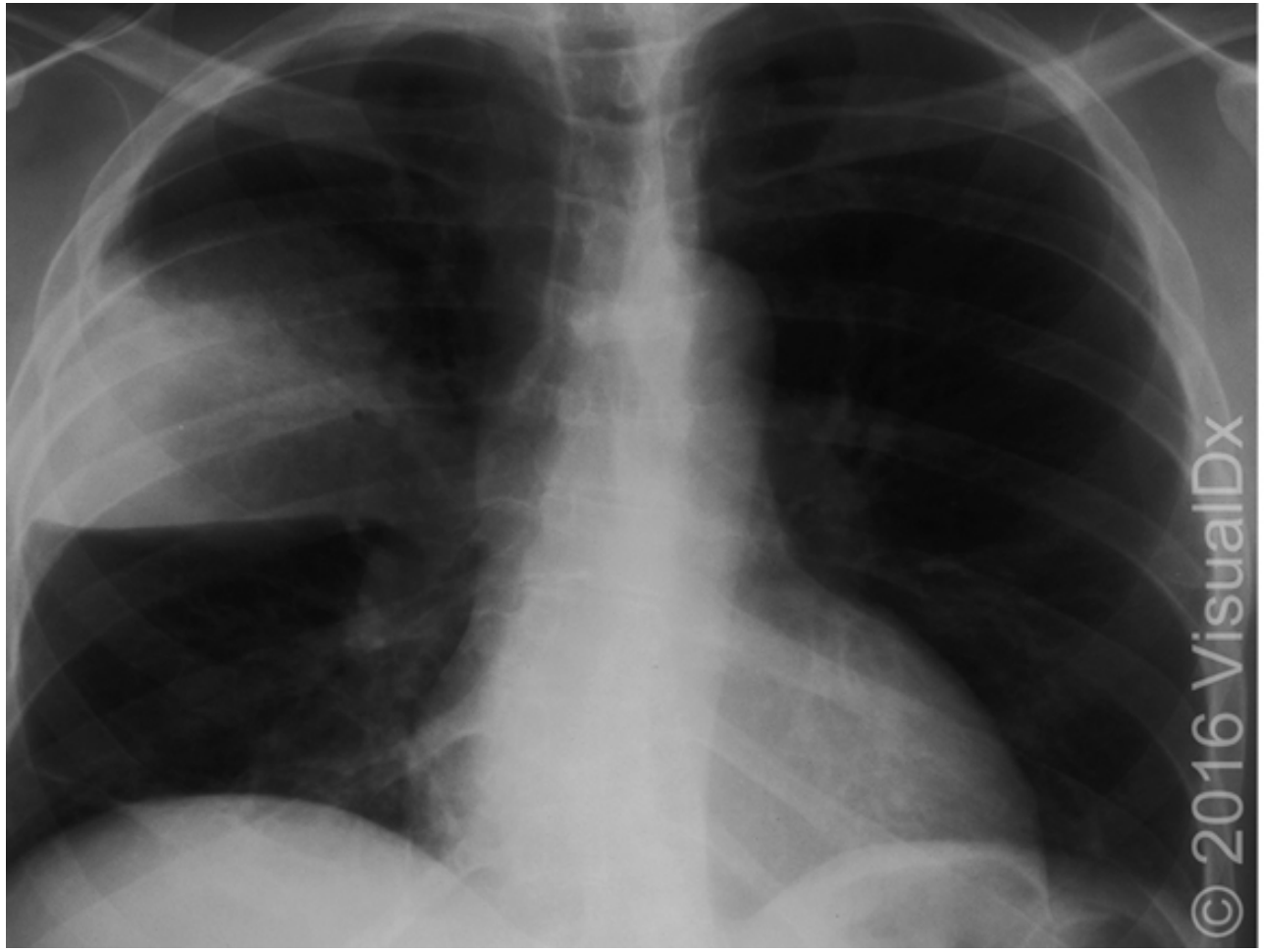
- **Pneumococcal pneumonia:** confluent lobar consolidation.
- **Staphyloccoci:** Cause pneumatocele as well.



Body site	Specimen	Diagnostic method
Upper respiratory tract	Pharyngeal swab Nasopharyngeal swab/secretion	PCR Antigen detection assay
Lower respiratory tract	Sputum Tracheal aspirate **Bronchoalveolar lavage (BAL)** **Lung biopsy** **Pleural fluid**	Gram stain Culture PCR Antigen detection assay
Blood	Whole blood Serum	Culture PCR ELISA ASC ELISpot assay*
Urine	Native urine	Antigen detection assay


Trachea
Aortic Arch
Right
Mainstem
Bronchus
Pulmonary
Artery
Pulmonary
Artery
Left
Ventricle
Right
Atrium
Diaphragm
Diaphragm
Liver
Stomach





Bloods:

- **Peripheral WBC count**: differentiates viral from bacterial.
- *Viral pneumonia*: WBC count can be NL or elevated but not higher than 20.000 with lymphocytosis.

- *Bacterial pneumonia*: is often associated with an elevated WBC count 15,000 – 40,000 with neutrophilia.

- **Blood CX:** should not be routinely performed in nontoxic, fully immunized children.
- should be obtained in children who fail to demonstrate clinical improvement and in those who have progressive symptoms or clinical deterioration after initiation of antibiotic therapy

- **CRP and ESR**

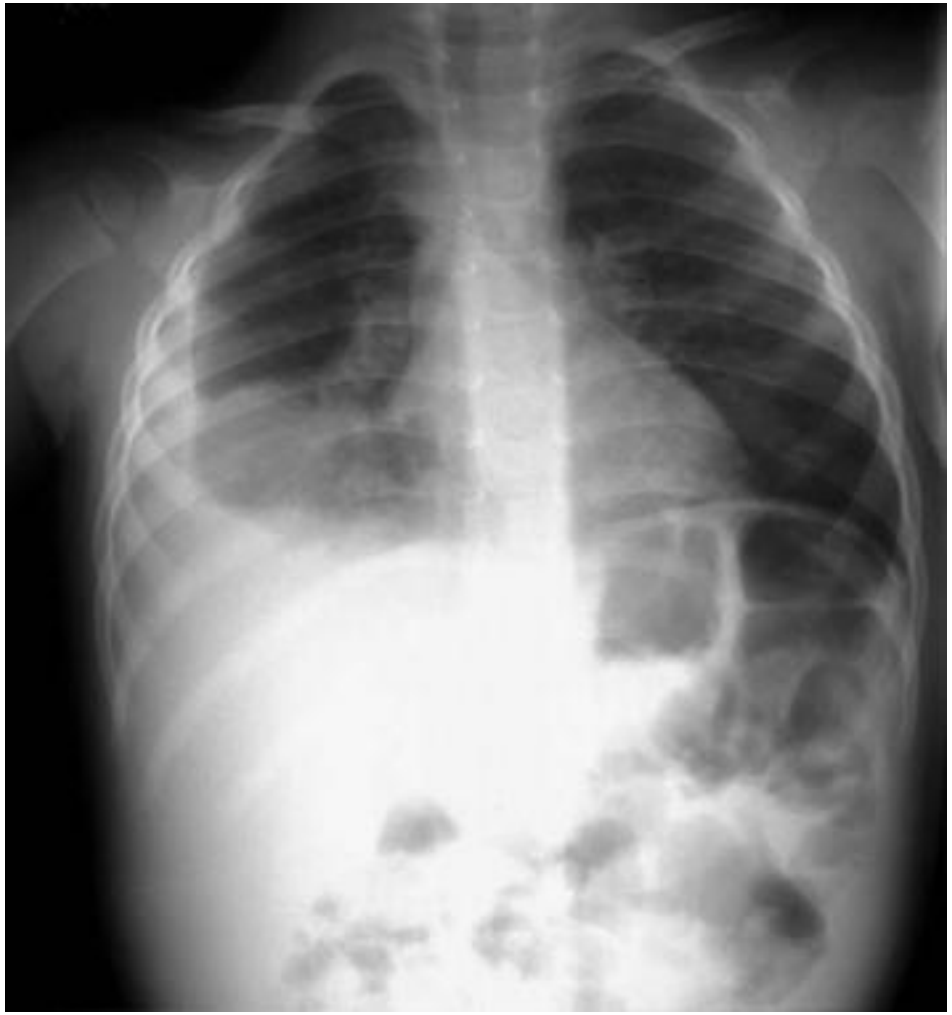
Others

- Viral culture, PCR or antigen isolation in respiratory secretion (NPA).
- Bacterial: sputum culture , ?? Value in children.
- Mycoplasma: IgM titers.

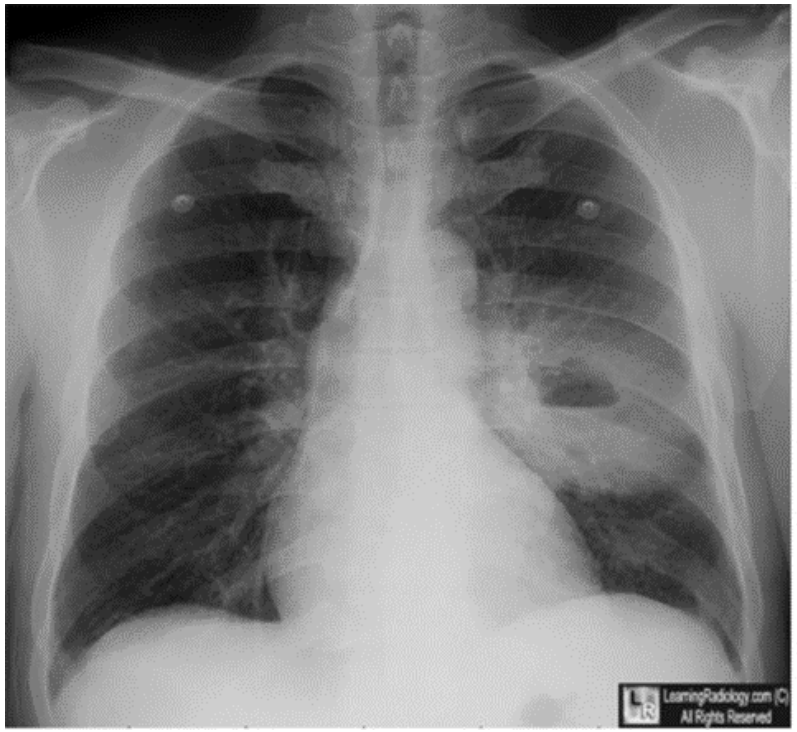
Complications Associated With Pneumonia

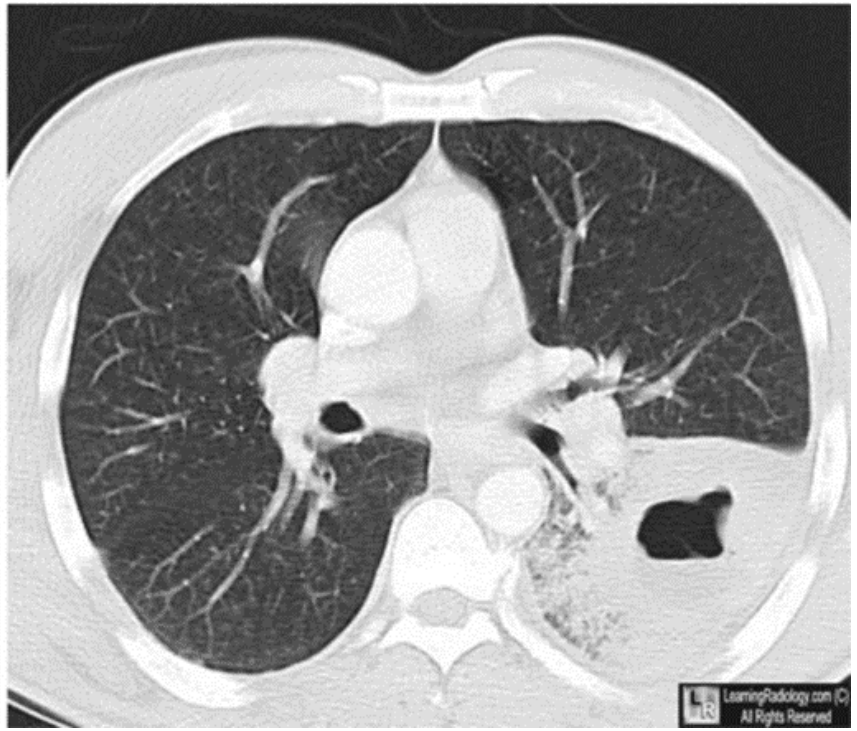
Site	Complication	Pathogens[a]
Local	Pleural effusion or empyema (~ 1%)	*Streptococcus pneumoniae* *Streptococcus pyogenes* *Staphylococcus aureus*
	Necrotizing pneumonia,[b]	*Streptococcus pneumoniae*
	Pneumatocele[b]	*Staphylococcus aureus*
	Lung abscess[b]	*Staphylococcus aureus* Anaerobes
Systemic (extra-pulmonary)	Bacteraemia, sepsis (~ 1%)[c]	*Streptococcus pneumoniae* *Streptococcus pyogenes* *Staphylococcus aureus*
	Rash, urticaria, mucositis (MIRM)[d]	*Mycoplasma pneumoniae*
	Haemolytic uraemic syndrome (HUS)[b]	*Streptococcus pneumoniae*
	Neurological symptoms (e.g., encephalitis)[b]	*Mycoplasma pneumoniae*

Pleural effusion

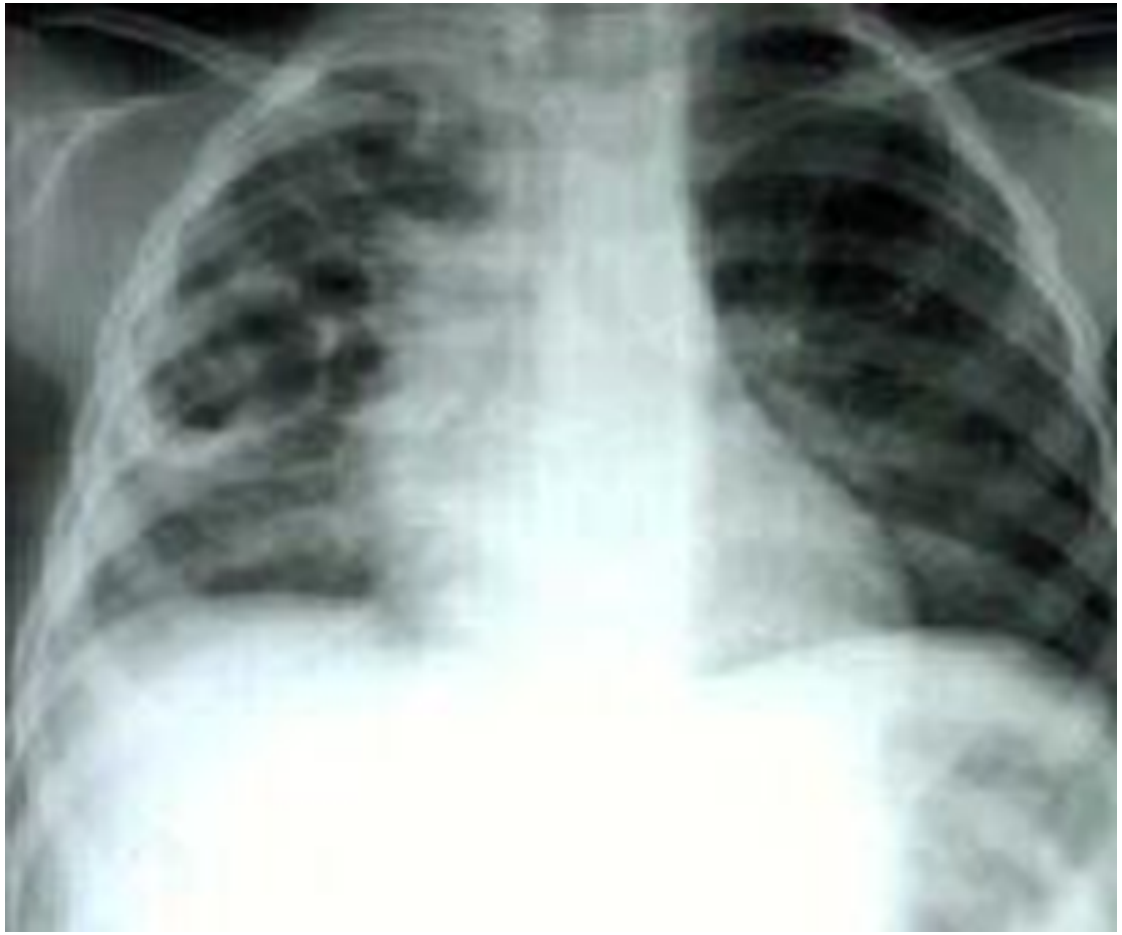


Lung abscess





Cavitary lesions- pneumatocele



Can occur in 50% of Children

Pathogens

S. aureus

S. pneumoniae

H. influenzae

Gram negative
TB & fungal

Treatment: IDSA GUIDELINES

The Pediatric Infectious Diseases Society and the Infectious Diseases Society of America

- *When Does a Child or Infant With CAP Require Hospitalization?*
  - *Children and infants who have moderate to severe CAP:*

    respiratory distress and hypoxemia (sustained saturation of peripheral oxygen [SpO2] <90 % at sea level. (strong recommendation; high-quality evidence)

  - *Infants less than 3–6 months of age with suspected bacterial* CAP are likely to benefit from hospitalization. (strong recommendation; low-quality evidence)

Continue..

- Children and infants with suspected or documented CAP caused by a pathogen with increased virulence, such *as community-associated methicillin-resistant Staphylococcus aureus* ***(MRSA)*** *should be hospitalized.*

(strong recommendation; low-quality evidence)

- Children and infants for whom there is concern about *careful observation at home or who are unable to comply with therapy or unable to be followed up should be hospitalized.* (strong recommendation; low-quality evidence)

In-Patient management

- Adequate Hydration
- Oxygenation
- Antipyretics and pain control
- Monitoring of :
  - . RR
  - . WOB
  - . Temperature
  - . HR
  - . Oxygen saturation

ANTI-INFECTIVE TREATMENT

- **Inpatient:**
  - *presumed bacterial pneumonia:*
    - Ampicillin or penicillin G
    - Alternatives: ceftriaxone or cefotaxime
    - Addition of vancomycin or clindamycin for suspected CA-MRSA

MX- inpatients

- *Presumed atypical pneumonia:*
  - Azithromycin (in addition to B-lactam, if diagnosis of atypical pneumonia is in doubt)

  - Alternatives: Clarithromycin or erythromycin

Outpatient TTT of pneumonia

- *Presumed bacterial pneumonia*
  - Amoxicillin orally (90 ml/kg/day) or amoxicillin clavulanate

- *Presumed atypical pneumonia*
  - Azithromycin, clarithromycin or eryhtromycin

THAN K YOU

Cystic Fibrosis

CF

- Multisystem genetic disease Characterized by*: chronic, progressive obstructive lung disease*
- Other systemic manifestations, such as:

  nutrient malabsorption and malnutrition due to pancreatic insufficiency.

  liver disease and cirrhosis, and CF-related diabetes mellitus (CFRD).

- CF is common in the *Caucasian population* but does occur in all ethnic and racial groups.

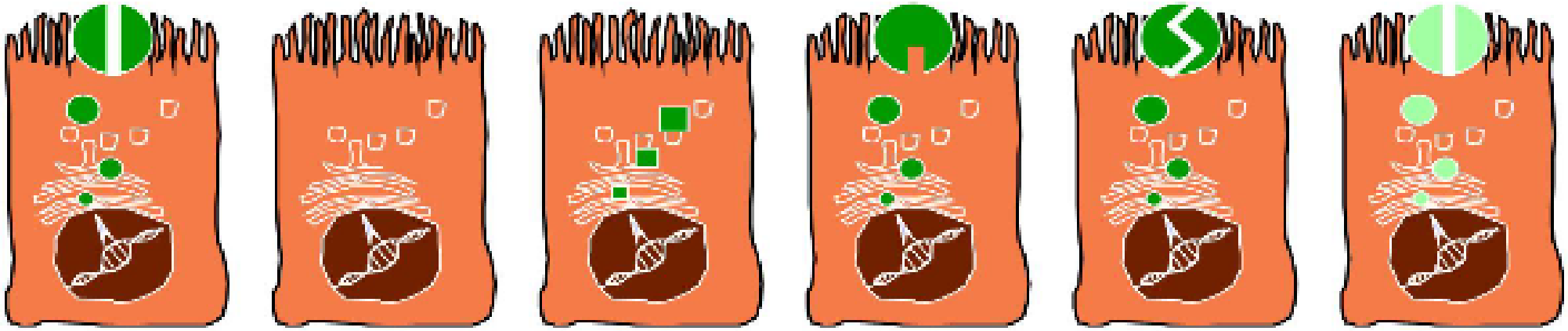
- M/C gene mutated: delta F508

Cystic Fibrosis Transmembrane Conductance Regulator(CFTR)

- Long arm chr 7

  (7q31.2)

CFTR
Classes of Mutations



Normal	I	II	III	IV	V
	No synthesis	Block in processing	Block in regulation	Altered conductance	Reduced synthesis
	G542X	F508del	G551D	R117H D1152H	3849+10kbC→T 5T A455E
	12%	87%	5%	5%	5%

Scriver CR, et al. *The Metabolic and Molecular Bases of Inherited Disease*. 2001:5121-5188.[8]

Diagnosis

- Criteria
  - One of the following
    - . Presence of typical clinical features
    - . History of CF in a sibling
    - . Positive newborn screening test

  - Plus laboratory evidence for CFTR dysfunction
    - . Two elevated sweat chloride concentration on 2 separate days
    - . Identification of 2 CF mutations
    - . Abnormal nasal potential difference measurement

Diagnostic testing

- *Newborn Screening test*: pancreatic derived enzyme immunoreactive trypsinogen [IRT]

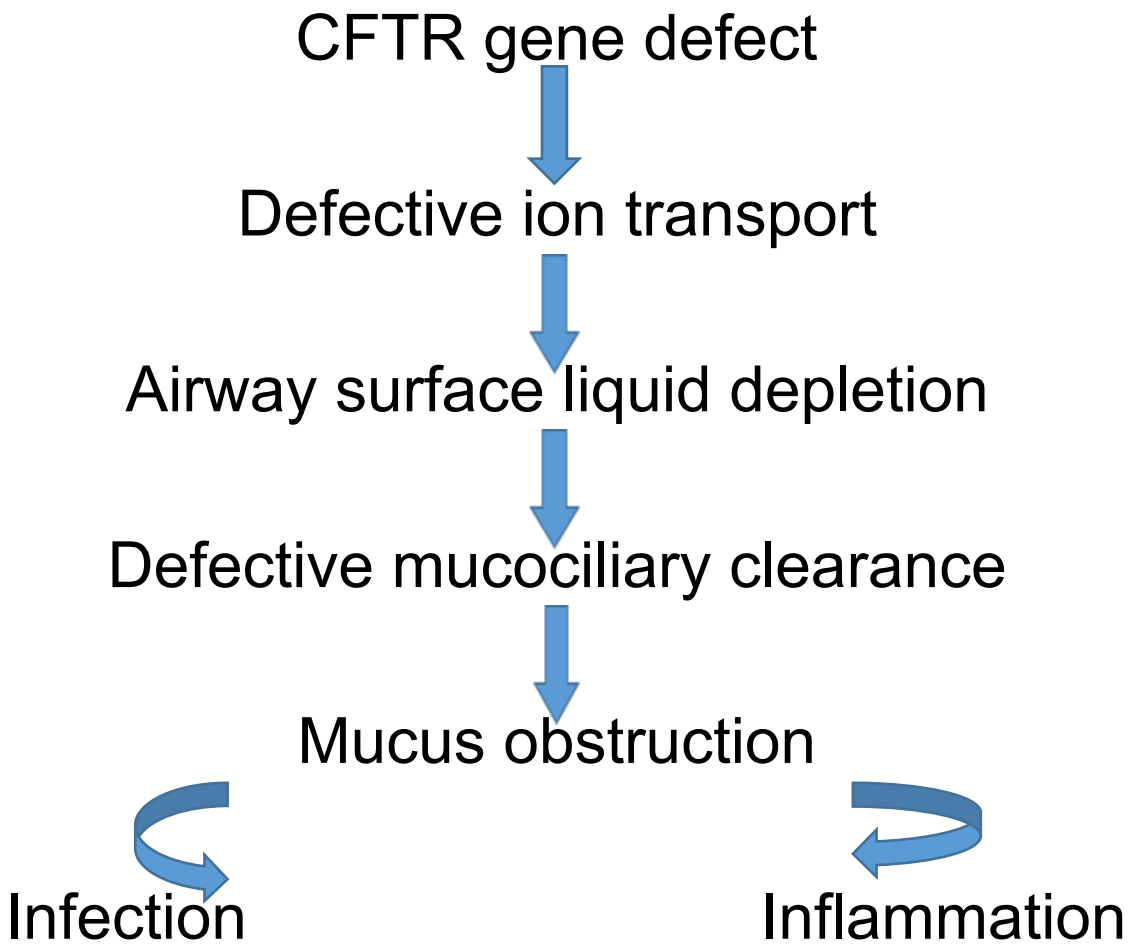
- *Sweat Chloride:* the most useful test for diagnosing CF. ≥60 mmol/L
- Genetic testing
- The standard diagnostic test for pancreatic insufficiency has been the three day fat collection.

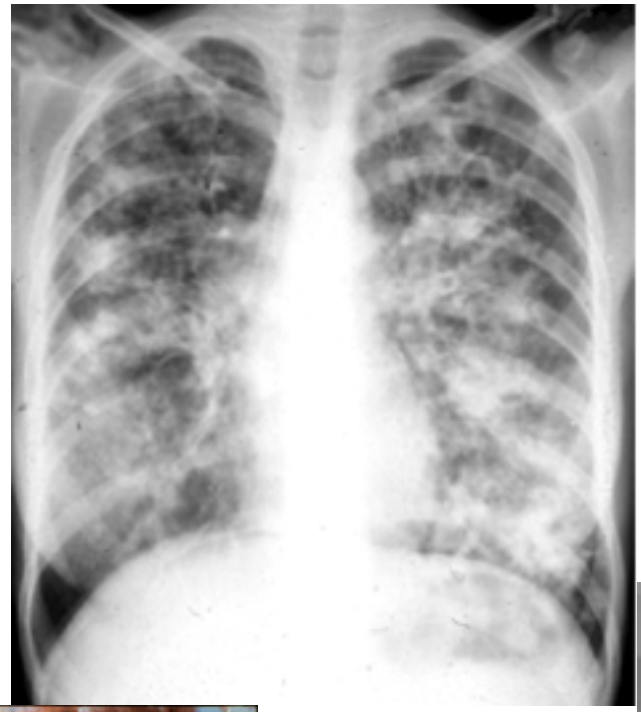
Sweat Chloride testing

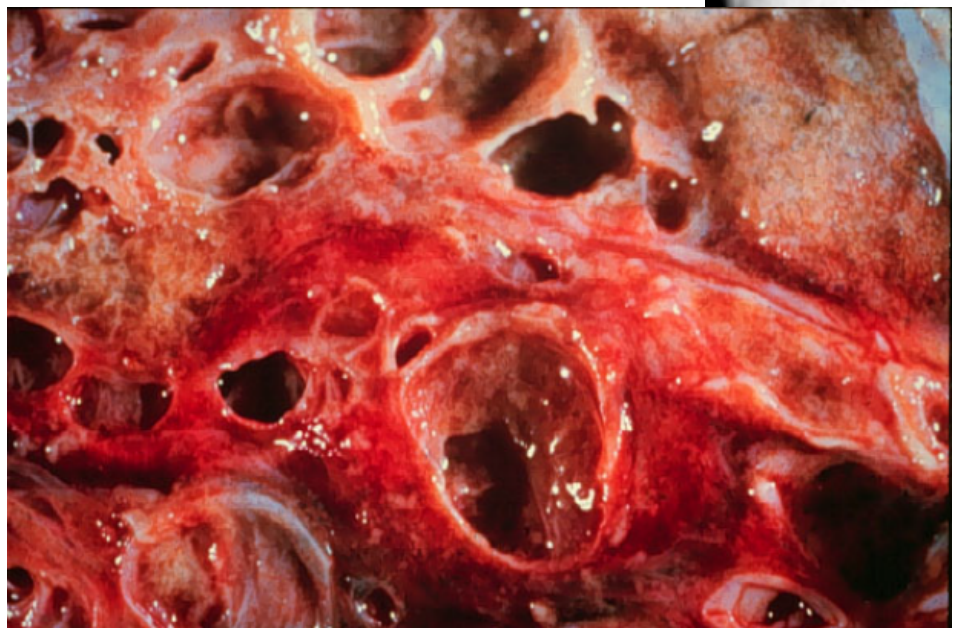
- IF NBS +ve: Sweat Cl testing when the *infant weighs >2 kg*, and is *at least 36 wk of corrected gestational age.*

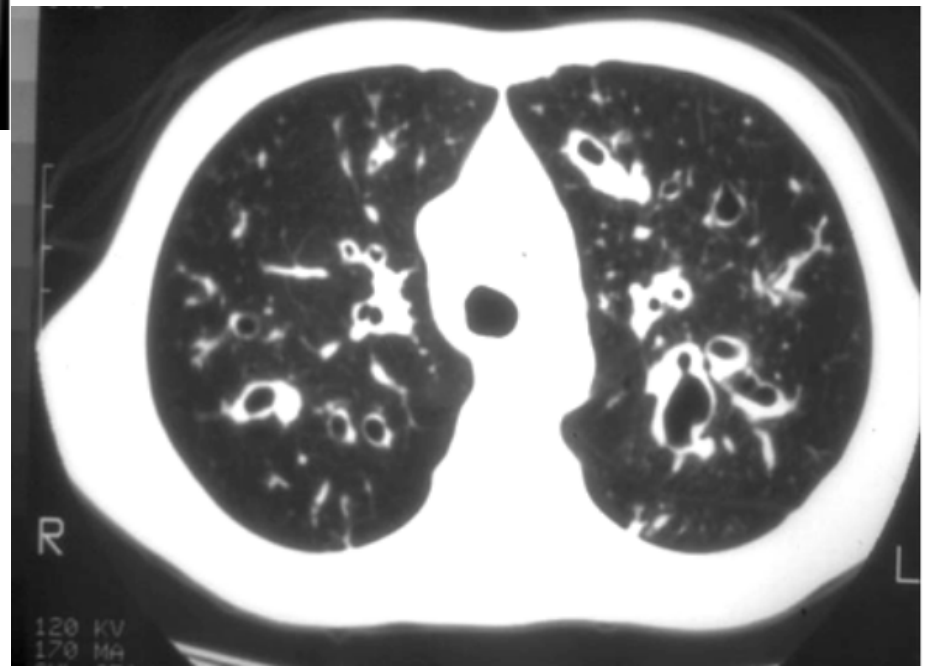
- Newborns greater than *36 wk gestation and >2 kg body weight* with a *positive CF newborn screen, should have sweat chloride testing performed as soon as possible after 10 d of age, ideally by the end of the neonatal period (4 wk of age).*
- *In children </= 6 months: sweat Cl <30 is negative, 30-59 is An intermediate sweat chloride value (consider extended CFTR gene analysis), >/= 60 mmol/l …CF*

CF Pathophysiology





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120 KV
170 MA

Pathophysiology

- **Gastrointestinal:**
  - *Pancreas*
    - Absence of CFTR limits function of chloride-bicarbonate exchanger to secrete bicarbonate.
    - Leads to retention of enzymes in the pancreas, destruction of pancreatic tissues.

Pathophysiology

- Intestine

- Decrease in water secretion leads to thickened mucus and desiccated intraluminal contents.
- Obstruction of small and large intestines

-Biliary Tree:

- Retention of biliary secretion
- Focal biliary cirrhosis
- Bile duct proliferation.
- Chronic cholecystitis, cholelithiasis

Manifestations:

- **Respiratory tract:**
  - *Chronic sinusitis.*
    . Nasal obstruction
    . Rhinorrhea
    . Nasal polyps in 25%; often requires surgery

  - *Chronic Cough:*
    . Persistent
    . Viscous, purulent, green sputum

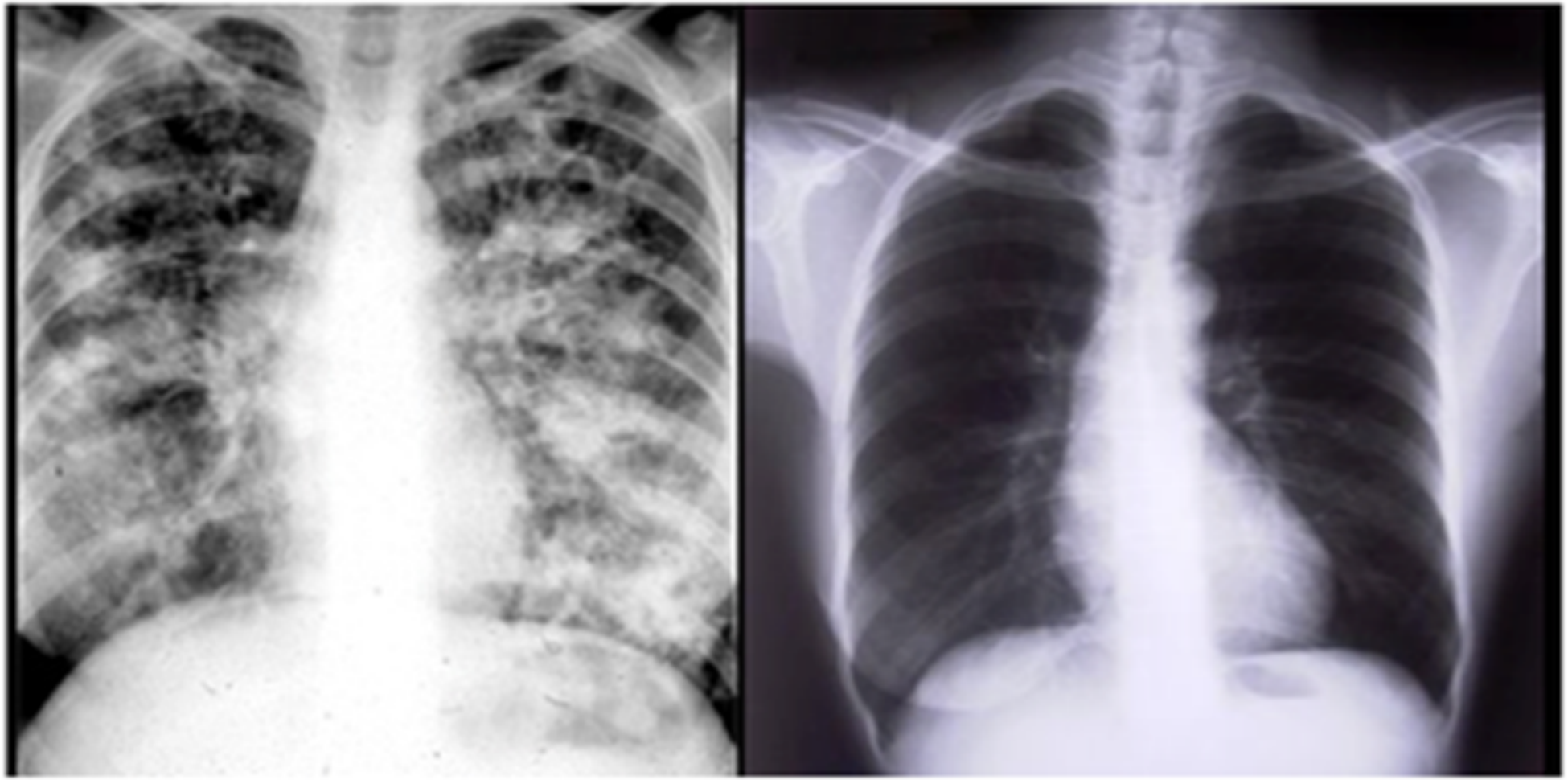
Manifestations

- *Infection:*
  . Initially with H. influenza and S. aureus
  . Subsequently P aeruginosa
  . Occassionally, Burkholderia gladioli, proteus, E. coli, klebsiella.

- *Lung Function:*
  . Small airway disease is first functional lung abnormality
  . Progresses to reversible as well as irreversible changes in FEV1
  . Chest x-ray may show hyperinflation, mucus impaction, bronchial cuffing, bronchiectasis

Complications

- ***Respiratory Tract:***
  - . Pneumothorax : 10% of CF pts
  - . Hemoptysis
  - . Digital clubbing
  - . Cor pulmonale
  - . Respiratory failure



Cystic Fibrosis Lung

Healthy Lung

Complications

- **Gastrointestinal:**
  - *Meconium ileus*
    . Abdominal distention
    . Failure to pass stool
    . Emesis

  - *DIOS: distal intestinal obstruction syndrome*
    . RLQ pain
    . Loss of appetite
    . Emesis
    . Palpable mass
    . May be confused with appendicitis

Gastrointestinal complications

- Exocrine pancreatic insufficiency
    . Found in > 90% of CFpts
    . Protein and fat malabsorption
    . Frequent bulky, foul-smelling stools
    . Vitamins A,K,E,D malabsorption

- Increased incidence of GI malignancy

Genitourinary

- Late onset puberty
  . Due to CLD and inadequate nutrition.

- >95% of male pts with CF have azospermia due to obliteration of the vas dererens
- 20% of female pts with CF are infertile

Treatment

- ***Major objectives:***
  - Promote clearance of secretions
  - Control Lung infection
  - Provide adequate nutrition.
  - Prevent intestinal obstruction

TTT: Lung

- > 90% of CF pts die from complications of lung infection
- ***Antibiotics:***
  - Early intervention, long course, high dose
  - Staphylococcus-anti staph: fluclox

  - Pseudomonas-treated with two drugs with different mechanisms to prevent resistance- e.g: cephalosporin (ceftazidime) + aminoglycoside(amikacin, gentamicin)

  - Use of aerosolized antibiotics

Lung

- ***Increasing mucus clearance***
  . Long-term DNAse treatment increase time between pulmonary exacerbations
  . Inhaled beta-adrenergic agonists to control airway constriction
  . Oral glucocorticoids for allergic Bronchopulmonary aspergillosis (ABPA)

Lung:

- ***Atelectasis***
  . Chest PT + antibiotic
- ***Respiratory Failure and cor pulmonary***
  . Vigorous medical management
  . Oxygen supplementation
  . NIV
  . Lung transplantation

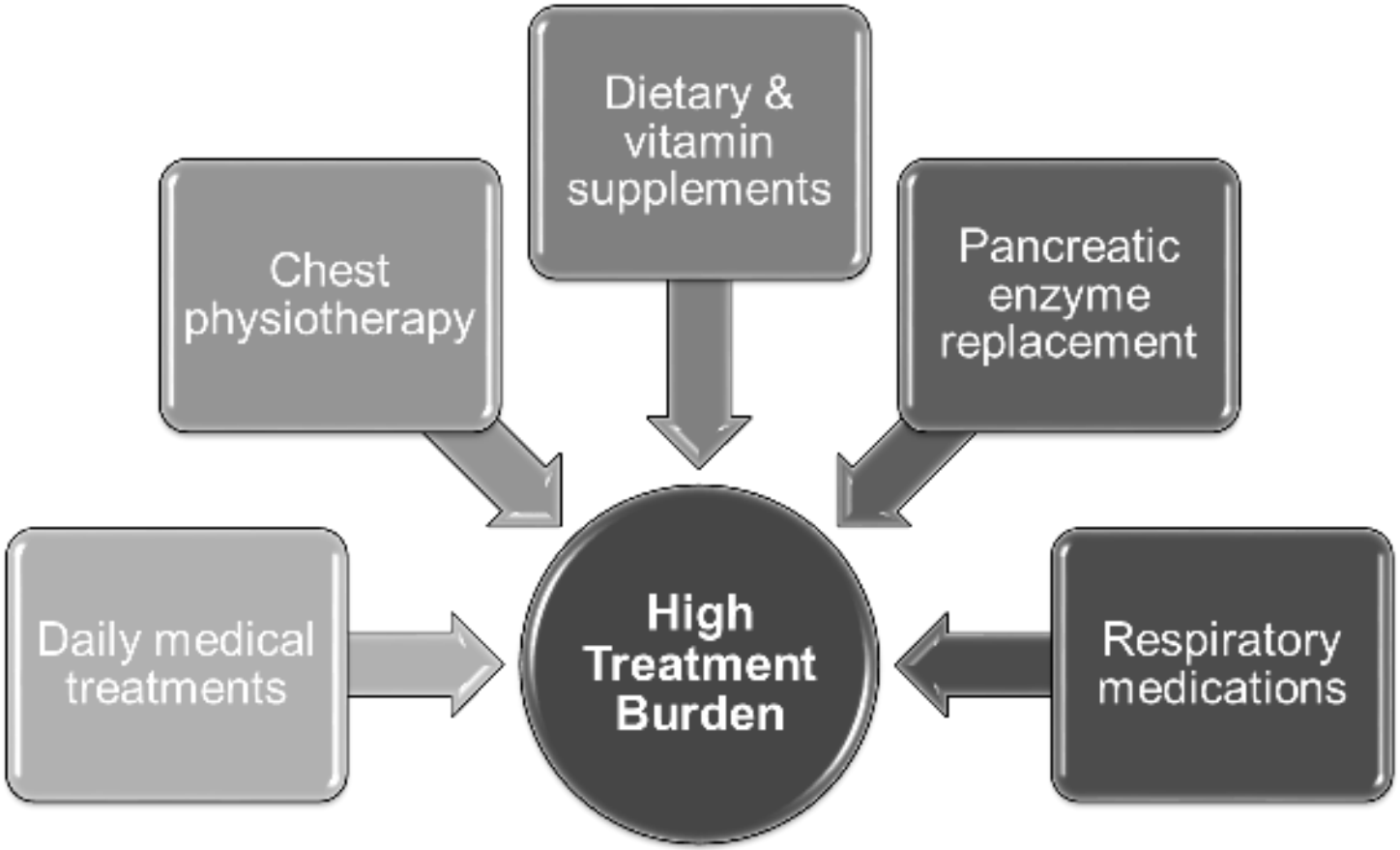
Treatment

- ***Gastrointestinal:***
  - Pancreatic enzyme replacement
  - Replacement of fat-soluble vitamins- especially Vitamin E & K
  - insulin for hyperglycemia
  - Intestinal obstruction
    - . Pancreatic enzymes (creon) +osmotically active agents
    - . Distal-hypertonic radio contrast material via enema

TTT: Gastrointestinal

- End-stage liver disease- transplantation
  . 2 year survival rate >50%

Complexity of CF Treatment



Bregnballe, et al. Patient Prefer Adherence. 2011;5:507-15.
Sawicki, et al. Pediatr Pulmonol. 2012;47(6):523-33

Summary

- CF is an inherited monogenic disorder presenting as a multisystem disease
- Pathophysiology is related to abnormal ion transportation across epithelia
- Respiratory, GI and GU manifestations
- Treatment is currently preventative and supportive

THANK YOU