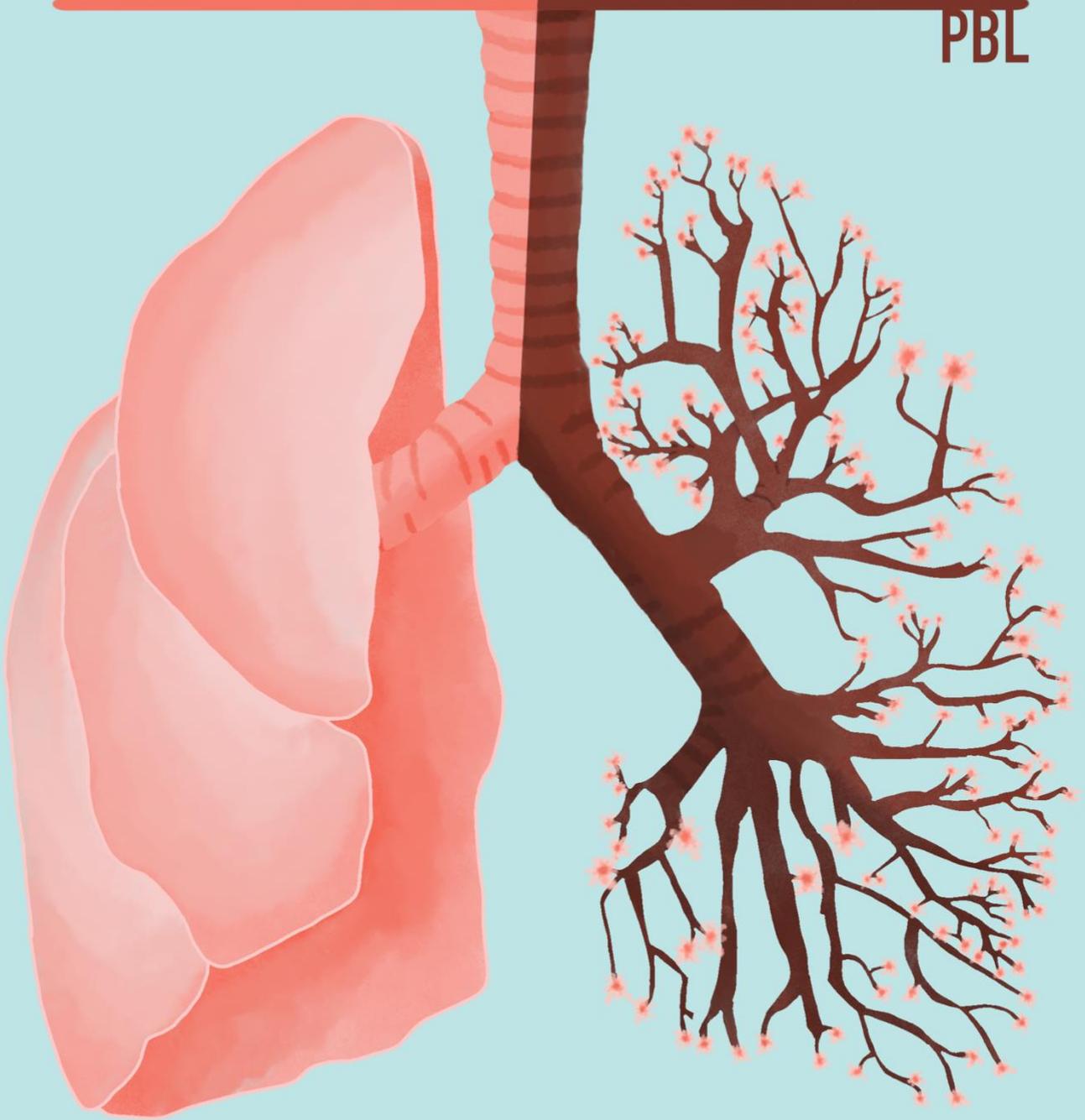


# RESPIRATORY SYSTEM



PBL



**Title:** Sheet2-LRT cases

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**In this lecture we are going to discuss 3 cases of lower respiratory tract diseases in pediatrics.**

We know that the **most common cause of sickness in children are infections**, and the **most common of infections among all systems are Respiratory tract infections** (in pediatrics as well as in adults)

Regarding pediatrics, the **most common cause of hospital admission especially in winter are lower respiratory tract infections** (they cause serious illness), Upper respiratory tract infections are much more common (children can have up to 10 times more upper respiratory tract infections in one year) however, these are not admitted.

**Now let's discuss the first case:**

## CASE 1

**History** (In pediatric cases (0-18yrs) the history is usually taken from the mother, but it could be taken from older pediatric patients who're capable of expressing pain and its site in words):

**Mohammad, a 4 months old infant, Presented with cough**

(remember we said that cough is a symptom of upper and lower respiratory tract diseases), **and wheeze** **الصفير** **for 3 days** (wheeze results from **small airway obstruction**, it is specific for lower respiratory tract diseases, and it could be a symptom (when the mother or family members report that they heard it 🗣️) and a sign.

**And History of URTI** (Upper Respiratory Tract Infection) 2 days prior to onset of symptoms reported as **[runny nose]** **الرشحة**

### Pediatric groups:

0-12 months are infants  
1-5 years are toddlers or pre-school age  
5,6-12 years are school age  
12-18 years are adolescents

### Why do we divide them??

It is important because the diseases, infections, etc. differ with age.

So, until now we have a pathology that started with an upper respiratory tract involvement (runny nose) and then progressed to lower respiratory tract involvement (cough and wheeze)

**How did we know that the upper respiratory tract infection happened first and then progressed to the lower respiratory tract??** As mentioned above the URTI (runny nose) started 2 DAYS prior the onset of the symptoms, and then we had the cough and wheeze for 3 DAYS.

Now what pathology could start in the URT and progress to the LRT (especially in the presence of runny nose)?? **Infection!** Now regarding runny nose, is it related to Bacterial OR Viral infections?? **Viral infection!**

**So, we took many information until now from the history:**

- 1- It is a respiratory problem.**
- 2- It is an URT problem that progressed into a LRT problem.**
- 3- It is a viral problem (because it started with a runny nose).**

In pediatrics usually History and physical examination are enough, we don't need to ask much questions, however, some more

## **Question 1**

### **1-What are the important questions you should ask in history?**

**We can ask about the presence of fever.** Fever confirms that it is an infectious disease.  
-Low grade fever → viral infection                      -High grade fever → Bacterial infection

We investigate the severity of the infection by asking about **the activity & feeding:** because this helps the physician to decide whether the baby has to be admitted to the hospital or not (most of the cases are mild and don't need to be admitted to the hospital, however, 1-2% are admitted)

**Mention anything relevant in:**

**HOI (Hospital Onset of Infection), ROS (Review of Systems, it is common that the viral infection causes diarrhea; because enteroviruses can cause respiratory infection as well as diarrhea. So, review of systems is important), Past medical history, Birth, Social, Vaccination, drug history.**

### **NOTE:**

The most important determinant of the respiratory status of a newborn is the Gestational age (for a good respiratory status the baby must be a term baby – completed 37 weeks after gestation).

### **Side Question: why not ask if the cough is productive or not??**

Regarding the age of the baby (4 months). At this age the child doesn't have the capacity of having a productive cough, even infections that cause a productive cough (like bacterial bronchitis) are not common in this age, also even the sinuses (which are the sites where we excrete the purulent nasal discharge) are not well-developed in pediatric patients (until 4-5 years) .

## Question 2

### What are important findings you should look for in Physical Examination?

**First, we take the patient's vital signs:**

- 1- Body Temperature (already mentioned)
- 2- Respiratory Rate (RR): it is high here (Tachypnea)  
Remember that in general mammals (including human beings), the smaller the size of the mammal the higher the Respiratory Rate and Pulse Rate and vice versa.
- 3- Pulse Rate
- 4- Blood Pressure

**Second, we look for the Respiratory Distress Signs:**

1. **Breathing Rate** (we said that it is high here, Tachypnea)
2. **Grunting** (An abnormal sound heard during labored exhalation that indicates a need for high chest pressures to keep the airways open. It is caused by closing of the glottis at the end of expiration)
3. **Nose flaring** (The openings of the nose spreading open while breathing may indicate that a person is having to work harder to breathe)
4. **Retractions.** (A retraction is a medical term for when the area between the ribs, subcostal and in the neck sinks in when a person attempts to inhale) **and others**

**Third**, on auscultation we hear wheezing (wheezing could be heard either using the stethoscope or in more severe cases it could be audible to the family and the physician).

## Question 3

### What important investigations should be performed for this child?

The most likely investigation we do for a patient with respiratory illness is a CXR (Chest X-Ray)

NOTE : remember in acute viral infection history and physical examination are enough to diagnose the case so sometimes there is no need for X-Ray in both adults and pediatrics especially if you are in the clinic and you are aiming to send the patient home (BE CAREFUL WITH RADIATION AROUND CHILDREN).

X-Ray shows Hyperinflated lungs

(Air trapped in the lungs; due to small airway obstruction, similar to all Obstructive LDs).

## How did we know that we have a hyperinflated lungs here??

Because we are able to count the ribs (At least 10 out of the 12 ribs anteriorly and posteriorly, and no other pathologies such as opacities are seen.

We can see congestion in the Broncho-vascular markings (which are prominent bronchial tree and blood vessels)

**NOTE:** This X-Ray looks the same for asthma (because asthma is also air trapping) as well as viral pneumonia; so, the **X-ray is not diagnostic.**



## What is your differential diagnosis??

likely diagnosis (all of which cause Tachypnea, Cough, and wheeze):

1. **Acute viral bronchiolitis**
2. **Viral bronchopneumonia**
3. **Bacterial pneumonia** (excluded because: the baby has a low-grade fever indicating a viral infection, in bacterial infection we have a high-grade fever).
4. **Reactive airway disease** (this is an informal label that physicians apply to patients with symptoms similar to those of asthma; why do we exclude Asthma?? The most important thing to diagnose asthma is to have a chronic illness and repeated episodes but here the baby's status opposes this; since he had cough and wheeze for only 3 days, also a very important thing in diagnosing asthma is the AGE of the patient, we don't diagnose asthma in a 4 months old baby).
5. **Aspiration Pneumonia**
6. **Inhalation of foreign objects** (any foreign body can cause small airway obstruction, and thus, coughing and wheezing, but why did we exclude it here?? There is no history of choking with foreign objects, we have fever, runny nose, and also the AGE of the child (4 months) ; usually the babies that have the tendency to swallow random things and objects are Toddlers [ peaks at 2 years ] they have something called Mouthing; but since our baby in this case is not even crawling so he is unlikely to pick up things and swallow them.

## What is your diagnosis?? **Acute Viral Bronchiolitis**

- Common disease of the LRT in infants, usually most cases < 2 years.
- Inflammatory obstruction of small airways.
- Severe disease more in infants 1-3 months of age.
- Seasonal peak in winter-early spring.
- Most common virus; RSV (Respiratory Syncytial Virus)

## Treatment

- **Primarily supportive**
- Hospitalization, for children with respiratory distress
- If hypoxic (cool humidified oxygen). child sitting with head and chest elevated 30-degree angle with neck extended.
- Hydration: IVF (Intravenous Fluid; consisting of normal saline or half normal saline with some glucose; because the babies here are not breastfeeding well, only for one day and the next day we will return to normal breastfeeding), sometimes we give them NG (Nasogastric) feeds
- **Symptomatic Treatment:** nebulization with Normal saline/Hypertonic saline (in order to make the secretions thinner and easy to cough out
- If worsening respiratory distress, persistent hypoxemia: consider positive pressure ventilation CPAP
- For pending respiratory failure, respiratory failure with acidosis, and apnea: consider intubation and assisted ventilation
- **There is only one antiviral for RSV (respiratory syncytial virus) but it is not very helpful in these patients (which is Ribavirin)**

We use **Pulse oximetry** to measure the patient's oxygen saturation level in order to decide whether to admit him to the hospital or not:

The normal percentage of the oxygen saturation level (according to the oxygen saturation curve) is 92% anything above it is normal but below it is abnormal and considered hypoxemia, so the purpose for hospital admission is mainly for oxygen support.

## CASE 2

### History:

**6 years old, previously healthy. Presented to clinic with fever for 5 days, reaching 39.5 C** (notice high fever and long duration of fever, so it is going with bacterial rather than viral). **Associated with cough intermittent.** (so, it is a respiratory system illness and it is an infection). **His mother noted rapid breathing and dyspnea worsening with time.** **Had history of URTI 1 week ago** (but it is not active now, no runny nose so it doesn't suit viral infection). **His appetite and activity decreased. Vomited twice** (More with bacterial rather than viral).

## Physical Examination:

- General: looks unwell, has increased WOB (Work of Breathing).
- Vital signs (RR 40 b/m HIGH, PR 110 HIGH, temp 39 HIGH).
- Subcostal and intercostal retractions.
- Chest:
  - Auscultation: decreased air entry on Rt lower side. Bronchial breathing , increased tactile vocal fremitus (Evaluation of tactile fremitus is done by placing the examiner his both hands on the patient’s back , medial to the shoulder blades and asks the patient to say “ ninety-nine” , because we have pulmonary consolidation which conducts the sounds better than the air we will have an increased tactile vocal fremitus), few inspiratory crackles Rt side.
  - Percussion (it is a method of tapping on a surface): dull to percussion (due to the presence of pulmonary consolidation)

## What are clinical investigations needed??

**CXR** ( which is very important here; because we want to see here which lobe is infected and due to the fact that they need antibiotics for the treatment you need to see the response of these antibiotics by doing frequent X-rays to see if the pulmonary consolidation is resolving and also we need to assess the complication of pneumonia such as Pleural effusion-**fluid collection**) CBC, Blood culture, inflammatory markers, etc.

**The X-ray shows typical lobar pneumonia (we have obvious opacification of the middle and lower zones of the right lung).**



## What is your diagnosis??

### **Pneumonia (Specific; Lobar, Bacterial)**

**Pneumonia is an inflammation of the parenchyma of the lungs.**

(alveoli and terminal airspaces in response to invasion by an infectious agent introduced into the lungs through hematogenous spread or inhalation)

## Causes of pneumonia:

### 1-Infectious:

Mostly (Strep. Pneumonia, staph aureus, Mycoplasma p.)

**Except newborns <2 months, the organisms differ in them, Why??** Because the organisms are not from the community surrounding them, but from the birth canal of the mother (Most important organisms present there are Gram -ve bacteria and Group B Streptococcus)

### 2-Noninfectious:

- aspiration of food or gastric juice
- hypersensitivity reactions
- foreign bodies
- Hydrocarbons and lipid substances
- radiation induced pneumonitis

## COMPLICATIONS

1. Pleural effusion (sterile fluid)
2. Direct invasion: Empyema (if the organism invades the fluid we call it Empyema, so pleural effusion and Empyema look the same on X-ray but if we take a sample from both, pleural effusion is culture -ve whereas Empyema is culture +ve), pericarditis.
3. Hematogenous spread (in newborns and very old adults; due to the fact that they have compromised immune system): Meningitis, suppurative arthritis and osteomyelitis (rare).

## Complicated pneumonia

Pleural effusion



We can see in the Pleural effusion X-ray that the costophrenic angle is completely obliterated on the affected side

Necrotizing pneumonia :  
cavitation



## TREATMENT

- In hospitalized children with strep. Pneumonia is ceftriaxone. (3<sup>rd</sup> gen.)
- Bacterial pneumonia; mild, out-patient Mx: oral amoxicillin, cefuroxime, amoxicillin/clavulanic acid.
- School-aged children (Mycoplasma pneumonia) macrolide like azithromycin.
- Sick, hospitalized patients; parenteral cefuroxime. If staph. aureus is suspected (pneumatocele, empyema) clindamycin or vancomycin.
- Viral pneumonia, if mild no respiratory distress no need for AB therapy, 30% of cases have co-existing bacterial infx. Clinical status to decide use of AB for superimposed bacterial infx.

## CASE 3

### History:

**12-year-old child** (old enough to suspect asthma), **presented to the clinic with history of cough for 7 days duration. Cough** (dry -VIP because productive cough is associated with infections- ,worse at night and post exercise, associated with whistling sound), **symptoms started following a recent URTI** (Trigger REMEMBER , the most common trigger is URTI, others include: Allergens such as house dust mites, pollens, animals, molds, smoking (smoking is an irritant), stress, cold weather, etc.) **it worsened over last 2 days with dyspnea at times.**

Past Hx : **previous episodes occurring mostly during winter (VIP for diagnosis)**, has had fever ,**had eczema during early childhood** ([VIP for diagnosis are other atopic conditions such as Urticaria, allergic rhinitis, allergic conjunctivitis as well as food allergy \[the most serious atopy could lead to anaphylaxis and death\]](#)), **here in our case the child had eczema** with Positive family history of similar condition.

### Physical examination

- **Afebrile-not infection** (usually they are afebrile but sometimes the patient may experience asthma and at the same time he has an infection)
- **RR (Respiratory Rate) 35 (20-30) [Tachypnea]**
- **Pulse rate 100 (Tachycardiac)**
- **SPO2 (Oxygen Saturation level) = 89%**; because it is a small airway obstruction it may cause a VQ mismatch (Ventilation Perfusion Mismatch) leading to hypoxia.
- **ENT (Otorhinolaryngology):** Hyperemic throat (since the trigger here is pharyngitis)
- **Intercostal and subcostal retractions**

- **Chest:**  
Diffuse Expiratory wheeze, prolonged expiratory phase with decreased air entry (VIP) [Not Inspiratory], but in severe cases it could be biphasic.
- CVS: normal, liver not palpable, hands: no finger clubbing.

### Question 1

#### 1-What are important questions you should ask in history?

As we said history and physical examination are enough

Mention anything relevant in: HOI, ROS, Past medical, Birth, Social, Vaccination, drug history

### Question 2

#### 2-What important investigation should be performed for this child?

##### CXR

Usually non is needed, to review old chart and previous imaging if available.  
If child is in severe distress, suspected complications or other Differential Diagnosis need to be excluded

If we want to do a CXR (Chest X-ray) it is to investigate further when there're other presentations besides the asthma such as fever due to infection (pneumonia); because it is common to have asthma and pneumonia.



But in a typical asthmatic patient we see hyperinflated lungs (remember that what indicates hyperinflated lungs is the ability to count at least 10 out of 12 ribs, as well as having a parallel diaphragm [we know that the right dome of the diaphragm is higher due to the presence of the liver, but here with hyperinflation, left and right are parallel])

#### What is your DDx (Differential Diagnosis)??

**Bronchial asthma, Cystic Fibrosis, Primary ciliary dyskinesia GERD, Foreign body aspiration**

#### What is your diagnosis?

**Bronchial Asthma**

#### Why Asthma?

Typical signs and symptoms, repeated previous episodes, seasonal variation, presence of atopy and family history

Some investigations that are performed in the clinic:

### 1- Skin Prick Testing (SPT) to common inhaled allergens (it is not diagnostic but to assess the cause of such atopy)

During SPT, the patient's skin is exposed to suspected allergy-causing substances (allergens) By adding a small drop of each allergen (the commonest ones in our community) on a prick on the surface of the skin, the physician will wait, if the patient is allergic to a certain allergen the patient will experience a wheel-reaction (+ve reaction) Notice in the figure below the reaction :-



As you can see from the figure above a lot of allergens could be used in the test such as:

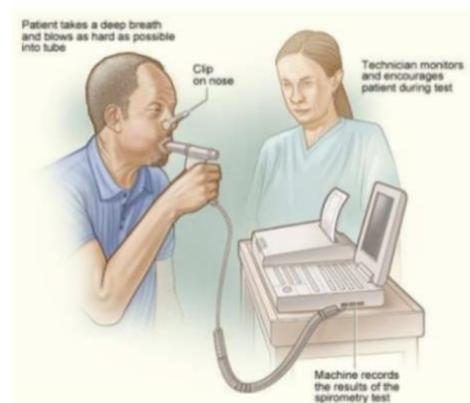
- A- House dust mites (the most common for allergic rhinitis, the problem of it is that it's an indoor allergen; we can't get rid of it as in outdoor allergens (Cat hair, pollens))
- B- Pollens
- C- Cat hair

### 2- Spirometry

Is a common office test used to assess how well your lungs work by measuring how much air you inhale, how much you exhale and how quickly you exhale.

FVC: Forced vital capacity: The maximal air that can be expired after full inspiration

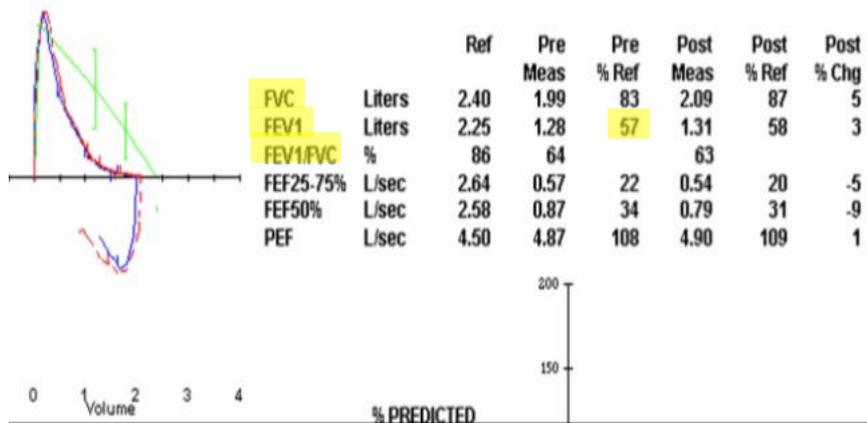
FEV1: Volume that has been exhaled at the end of the first second of forced expiration.



So, in asthmatic patients; due to the small airway obstruction there'll be a low FEV1 (< 80% of predicted), FVC is normal because they have good and big lungs, and the ratio between them is low.

Then you do a post medication test to see if the patient status has improved after giving medications such as bronchodilators. We wait for 10-15 mins after giving the meds and then we redo the test and see if there is improvement of the FEV1 (= higher than 12% change in the FEV1). But remember that spirometry helps in diagnosis, but it isn't definite (because we can have asthmatic patients with normal spirometry, and not all asthmatic patients respond to bronchodilators). Notice the figure below:-

## Spirometry



## Treatment

### 1-Acute settings (rescue drugs):

- O2 100 %for hypoxemia and respiratory distress
- **Rapid-acting beta2-agonists** (SABA) as needed for symptoms (VIP Rescue Drugs), with repeated doses according to the severity of the patient (salbutamol, albuterol)
- Short course of **systemic steroids** (anti-inflammatory)
- **Ipratropium Bromide** nebulized

### 2-For control and prevention of future episodes:-

- **Inhaled corticosteroids (ICS)** (Safe medications unlike the systemic steroids; because they are topical). **first choice in children**
- LTRA leukotriene receptor antagonists
- Combination LABA/ICS (Long-acting B agonists)
- Cromolyn/Nedocromil (Mast cell stabilizers)
- Methylxanthines: Theophylline (systemic steroids for control)
- Systemic steroids

## Methods of inhaled medications delivery options

### Some of the methods of inhaled medications delivery options:-

- 1- Nebulizers
- 2- Dry-powder inhalers



**Remember: Asthma is the most common chronic inflammatory condition in the LRT in adults and children**