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BRONCHOOBSTRUCTIVE SYNDROME

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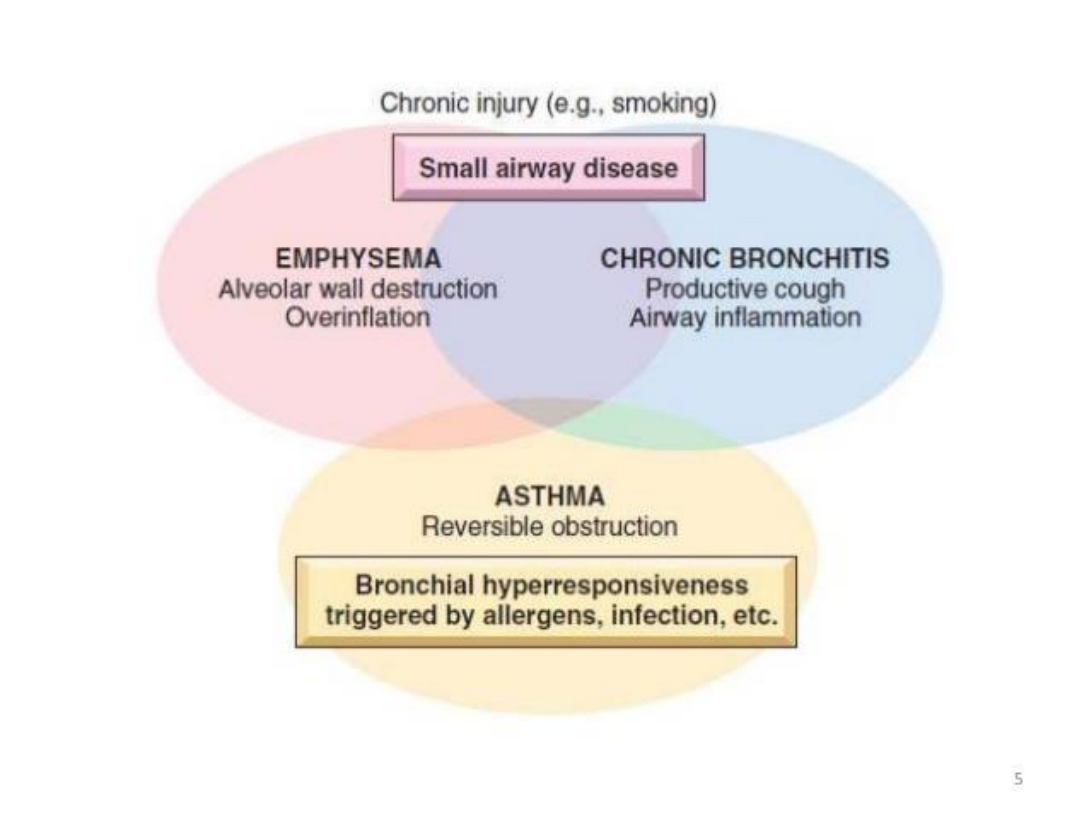
THE OBJECTIVE OF THE LECTURE

Coverage of modern concepts, the course and diagnostic of bronchial obstruction.



PLAN OF THE LECTURE

1. Introduction
2. The urgency and significance of the problem
3. Definition and causes
4. Etiology
5. The Pathogenesis
6. Symptoms and classification
7. Diffencial diagnosis
8. Diagnostic tests
9. Surveilance and Prevention

INTRODUCTION

- **Broncho-obstructive syndrome (BOS)** is a pathological condition with airflow limitation during breathing. Approximately 100 heterogeneous diseases are associated with BOS. In asthma and chronic obstructive pulmonary disease it is a leading clinical syndrome. Airway obstruction consists of reversible and irreversible components, with the inflammation as the main pathogenetic factor, developing under the influence of infectious, allergic, physical or neurogenic triggers. Moreover, the presence of viral or other respiratory infection deteriorates the course of bronchial obstruction, leading to the progression of the disease.
- In most cases, BOS prognosis is serious and depends on the cause of bronchial obstruction, on the forms of the disease, timely conducted pathogenetic therapy and prevention.

http://www.ifp.kiev.ua/doc/journals/upj/19/pdf19-3/ref/32_en.pdf

THE URGENCY OF THE PROBLEM OF BOS

- In childhood, respiratory diseases occupy one of the first places.
- Hereditary factors, environmental pollution, social factors play an important role in it.
- In recent years there has been a marked increase in diseases that occur with an obstructive syndrome, which is very diverse in nature and may be a manifestation of many diseases.
- Manifestation of the syndrome usually occurs on the background of acute respiratory viral infection, it takes a severe course and is accompanied by signs of respiratory failure.
- Early diagnosis of the diseases that caused the obstruction, timely pathogenetic treatment and prevention reduces or eliminates clinical manifestations of the syndrome, and thus improves the quality of life of patients.

https://www.scielo.br/scielo.php?pid=S0021-75572015000800003&script=sci_arttext&tlng=en

THE SIGNIFICANCE OF THE PROBLEM OF BOS

- Inadequate diagnosis
- The lack of a comprehensive program of monitoring of the patients
- The lack of continuity of treatment in the hospital and continuing of treatment on an outpatient basis
- The need for rehabilitation and social adaptation

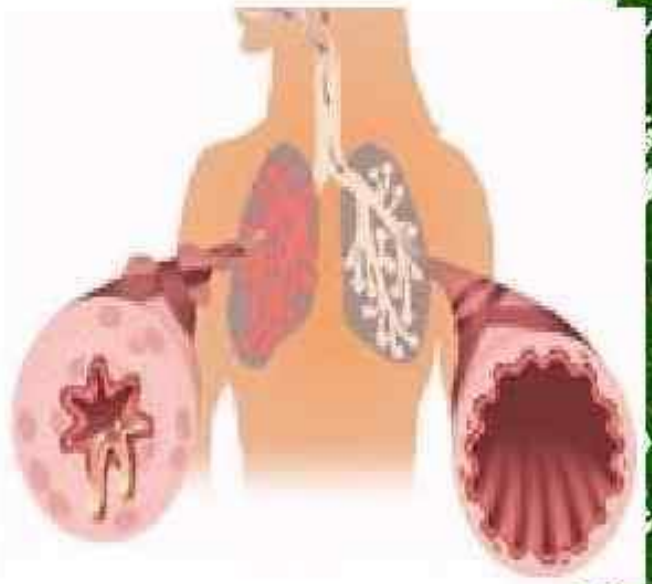
DEFINITION

- **Bronchoobstructive syndrome (BOS)** is a collective term that includes a number of symptoms of clinical manifestations of bronchial obstruction with underlying narrowing or occlusion of the airway. Clinically severe bronchoobstructive syndrome is most common in children, especially young children, but it is not a rare disease among the adult population. Its emergence and development is influenced by various factors, primarily respiratory viral infection. Early diagnosis and treatment of BOS in a therapeutic practice can significantly reduce the number of complications of the disease, improve survival and quality of life of patients.

https://therapy-journal.ru/en/archive/article/34481

Syndrome of the bronchial obstruction

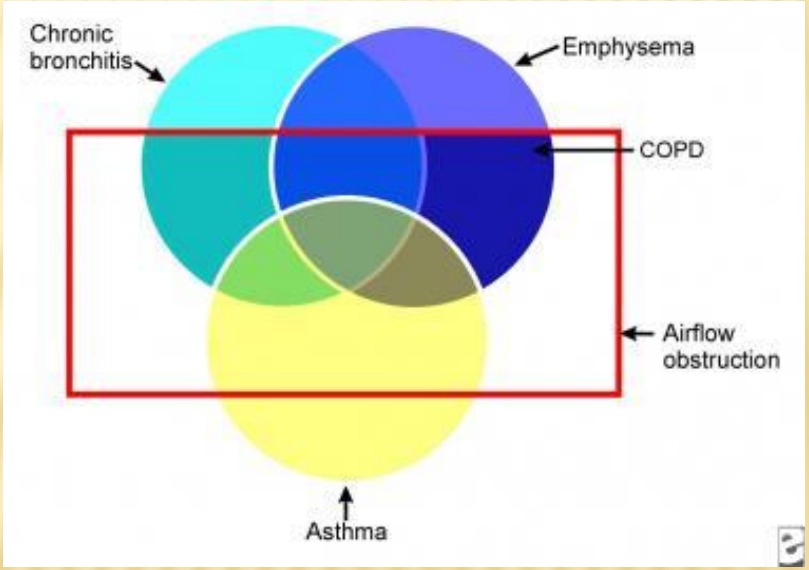
is a complex of symptoms that develops due to limitation of air passing through narrowed airway or increasing of resistance against air flow during ventilation



- In Western literature this clinical symptom complex is currently called wheezing - wheezing syndrome.
- The term "BOS" can not be used as an independent diagnosis. BOS is a symptom complex of any disease, the etiology of which is necessary to determine in all cases of the development of bronchial obstruction.

https://www.ncbi.nlm.nih.gov/books/NBK358/

- Bronchoobstructive syndrome lays in basis of asthma, bronchiectasis, bronchitis, chronic obstructive pulmonary disease (COPD), cystic fibrosis, etc.



https://en.wikipedia.org/wiki/Obstructive_lung_disease /

CAUSES OF BOS

- Most often obstructive conditions occur in patients with a family history of allergies, especially, who often suffer from respiratory infections (more than 6 times).
- Smoking including passive smoking (Chronic Obstructive Pulmonary Disease (COPD))
- Serious asthma symptoms with frequent exacerbations for a long time, which have not been improving with treatment
- Long-term exposure to lung irritants (air pollution (industrial dust , chemical fumes, etc.)

https://www.webmd.com/lung/obstructive-and-restrictive-lung-disease#2

CAUSES OF BOS

- Preterm birth that leads to lung damage (neonatal chronic lung disease).
- A family history of emphysema
- Inherited factors (genes), including alpha-1 antitrypsin deficiency

https://www.webmd.com/lung/obstructive-and-restrictive-lung-disease#2

ETIOLOGY OF BOS

- Acute stenosing laryngotracheobronchitis of viral, bacterial and viral etiology of diphtheria.
- Peritonsillar abscess, retropharyngeal abscess, epiglotit, congenital stridor, hypertrophy of the tonsils and adenoids, cysts, hemangioma and papillomatosis of the larynx.
- In infants - aspiration caused by swallowing disorders, congenital abnormalities of the nasopharynx, chalasia and achalasia of the esophagus, tracheobronchial fistulas, gastroesophageal reflux disease.
- Malformations of trachea, bronchi, respiratory distress syndrome (RDS), cystic fibrosis, bronchopulmonary dysplasia, immunodeficiency, intrauterine infection

THE PATHOGENESIS OF BRONCHIAL OBSTRUCTION

depends on the etiology of the disease. Pathogenetic mechanisms can be divided into two groups:

- 1. Functional (reversible). It is bronchospasm, inflammatory infiltration, edema, violation of mucociliary clearance, hypersecretion.
- 2. Irreversible (congenital stenosis of the bronchi and others).

https://pubmed.ncbi.nlm.nih.gov/8577106/

THE PATHOGENESIS OF BRONCHIAL OBSTRUCTION

- The main factor of the pathogenesis of 1 group BOS is inflammation, which can be both infectious and allergic.
- The mediator of the acute phase of inflammation is interleukin-1 (IL-1).
- It is produced by phagocytic cells and tissue macrophages under the action of infection, allergy and promotes the release of first type mediators (histamine, serotonin) into peripheral blood.
- These mediators are constantly present in the granules of mast cells and basophils, that ensures very rapid biological effects.
- Besides histamine, an important role in the pathogenesis of inflammation is played by mediators of a second type (eicosanoids) generated during the early inflammatory response.

https://pubmed.ncbi.nlm.nih.gov/8577106/

THE PATHOGENESIS OF BRONCHIAL OBSTRUCTION

It is due to histamine, leukotrienes and anti-inflammatory prostaglandins that we observe:

- enhancement of vascular permeability
- edema of bronchial mucosa
- hypersecretion of mucus viscous
- bronchoconstriction

https://pubmed.ncbi.nlm.nih.gov/8577106/

By duration, BOS can be:

- acute (BOS clinical manifestations persist for more than 10 days)
- protracted
- recurrent
- continuously recurring

According to the severity, the obstruction can be identified as:

- mild
- moderate
- severe
- latent bronchial obstruction

COMMON SYMPTOMS OF BOS

- prolonged exhale
- wheezing, noisy breathing (expiratory dyspnoea, BH 50 and more per minute)
- asthmatic fits
- auxiliary muscles participating in breathing
- poorly productive cough
- decrease in oxygen partial pressure.
- depression and anxiety
- weight loss
- tiredness and fatigue
- swollen ankles
- limitations in activity and lifestyle

https://www.nhs.uk/conditions/chronic-obstructive-pulmonary-disease-copd/symptoms/

MILD BOS

- wheezing on auscultation
- no breathlessness and cyanosis at rest
- indices of blood gases are within the normal range
- external respiration function (ERF) indices are moderately reduced
- state of health of the patient, as a rule, does not suffer

https://www.researchgate.net/figure/Classification-of-airway-obstruction_tbl2_268874757/

MODERATE SEVERITY OF BOS

- expiratory or mixed dyspnoea at rest
- cyanosis of nasolabial triangle
- indrawing of compliant places of the chest
- wheezing is audible at a distance
- ERF indices are reduced, but generalized functional bronchial obstruction is slightly broken (pa O_2 is more than 60 mm Hg., pa CO_2 is less than 45 mm Hg.)

https://www.researchgate.net/figure/Classification-of-airway-obstruction_tbl2_268874757/

A SEVERE COURSE OF BOS

- state of health of the patient suffers
- it is characterized by noisy shortness of breath with auxiliary muscles participation
- presence of cyanosis
- ERF indices are sharply reduced
- There are signs of a generalized functional bronchial obstruction, pa O_2 less than 60 mm Hg., pa CO_2 more than 45 mm Hg.

https://www.researchgate.net/figure/Classification-of-airway-obstruction_tbl2_268874757/

CONDITIONS OF BOS

Condition	Main site	Major changes	Causes	Symptoms
Chronic bronchitis	Bronchus	Hyperplasia and hypersecretion of mucus glands	Tobacco smoking and air pollutants	Productive cough
Bronchiectasis	Bronchus	Dilation and scarring of airways	Persistent severe infections	Cough, purulent sputum and fever
Asthma	Bronchus	Smooth muscle hyperplasia, excessive mucus, inflammation, constriction	Immunologic or idiopathic	Episodic wheezing, cough and dyspnea
Bronchiolitis (subgroup of chronic bronchitis)	Bronchiole	Inflammatory scarring and bronchiole obliteration	Tobacco smoking and air pollutants	Cough, dyspnea

https://en.wikipedia.org/wiki/Obstructive_lung_disease /

DIFFERENCE IN CONDITIONS OF BOS

- In asthma the bronchialtubes (airways) are hyperresponsive and usually triggered by breathing in things in the air such as dust, pollen, etc. with recurring episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning
- Bronchiectasis refers to the abnormal, irreversible dilatation of the bronchi caused by destructive and inflammatory changes in the airway walls
- Chronic obstructive pulmonary disease (COPD) is characterized by airflow limitation that is not fully reversible.

http://www.meddean.luc.edu/lumen/MedEd/elective/pulmonary/bronchiectasis/bronchi_f.htm /

Differential Diagnosis: COPD and Asthma

COPD

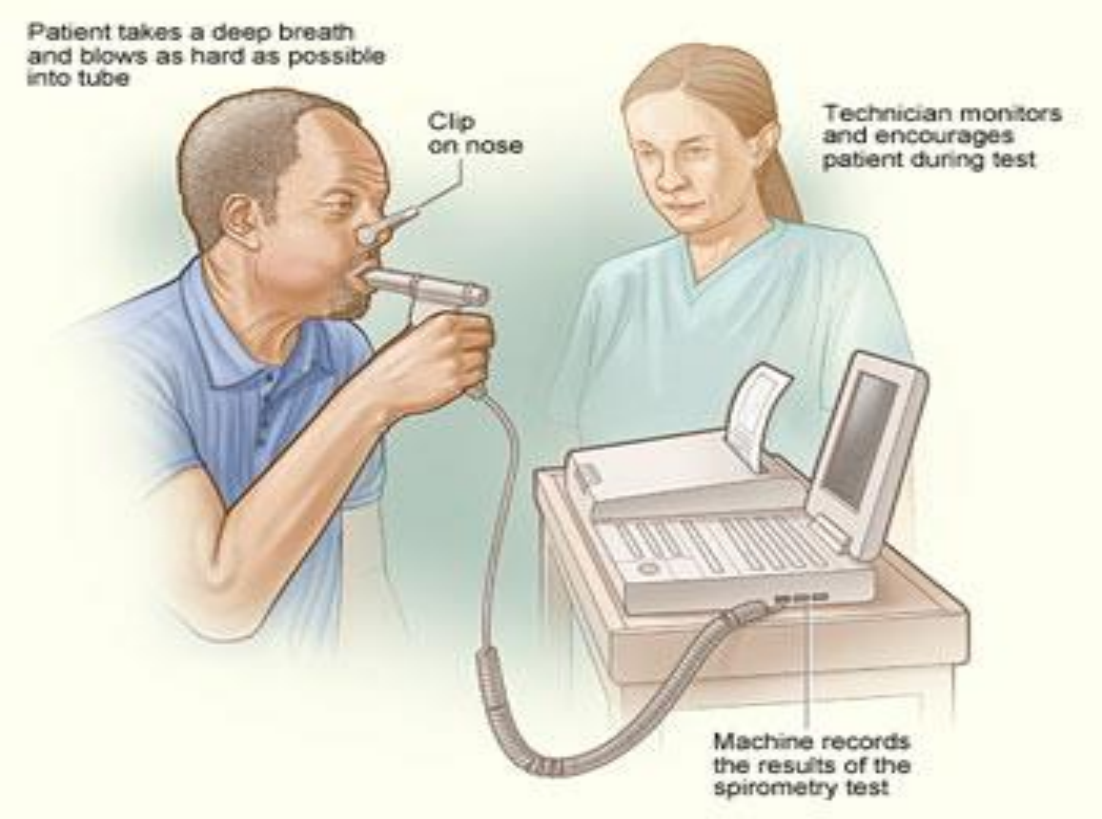
- Onset In mid-life
- Symptoms slowly progressive
- Long smoking history
- Dyspnea during exercise
- Largely Irreversible airflow limitation

Asthma

- Onset early in life (often childhood)
- Symptoms vary from day to day
- Symptoms at night/early morning
- Allergy, rhinitis, and/or eczema also present
- Family history of asthma
- Largely reversible airflow limitation

DIAGNOSTIC FUNCTION TESTS

- **Spirometry** is one type of pulmonary function test. Spirometry is a simple test to measure how much (volume) and how fast (flow) you can move air into and out of your lungs.



https://www.nationaljewish.org/conditions/tests-procedures/pulmonary-physiology/pulmonary-function/spirometry

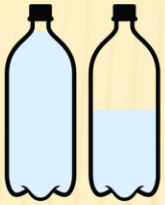
What do the results of my lung function test mean?

Front Cover

Today, you blew out **3.1 liters** of air in one second.

This is called FEV_1 (Forced Expiratory Volume)

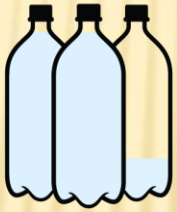
That's about as much air as would fit in one-and-a-half 2-liter bottles of soda.

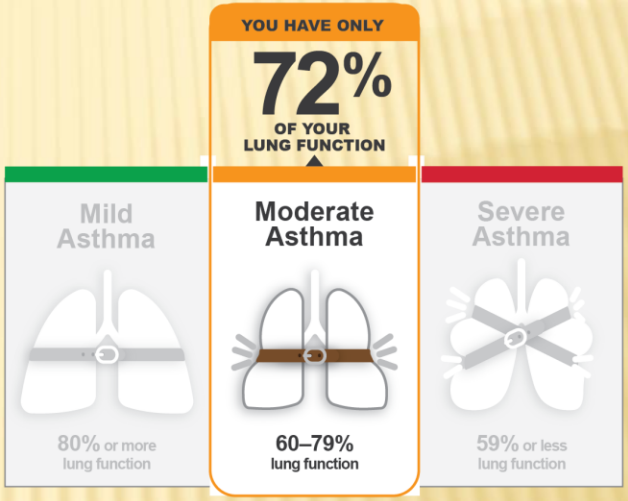


SAME age, height, & race/ethnicity

Men like you should be able to blow out at least **4.3 liters** of air in one second.

This is called FEV_1 PREDICTED



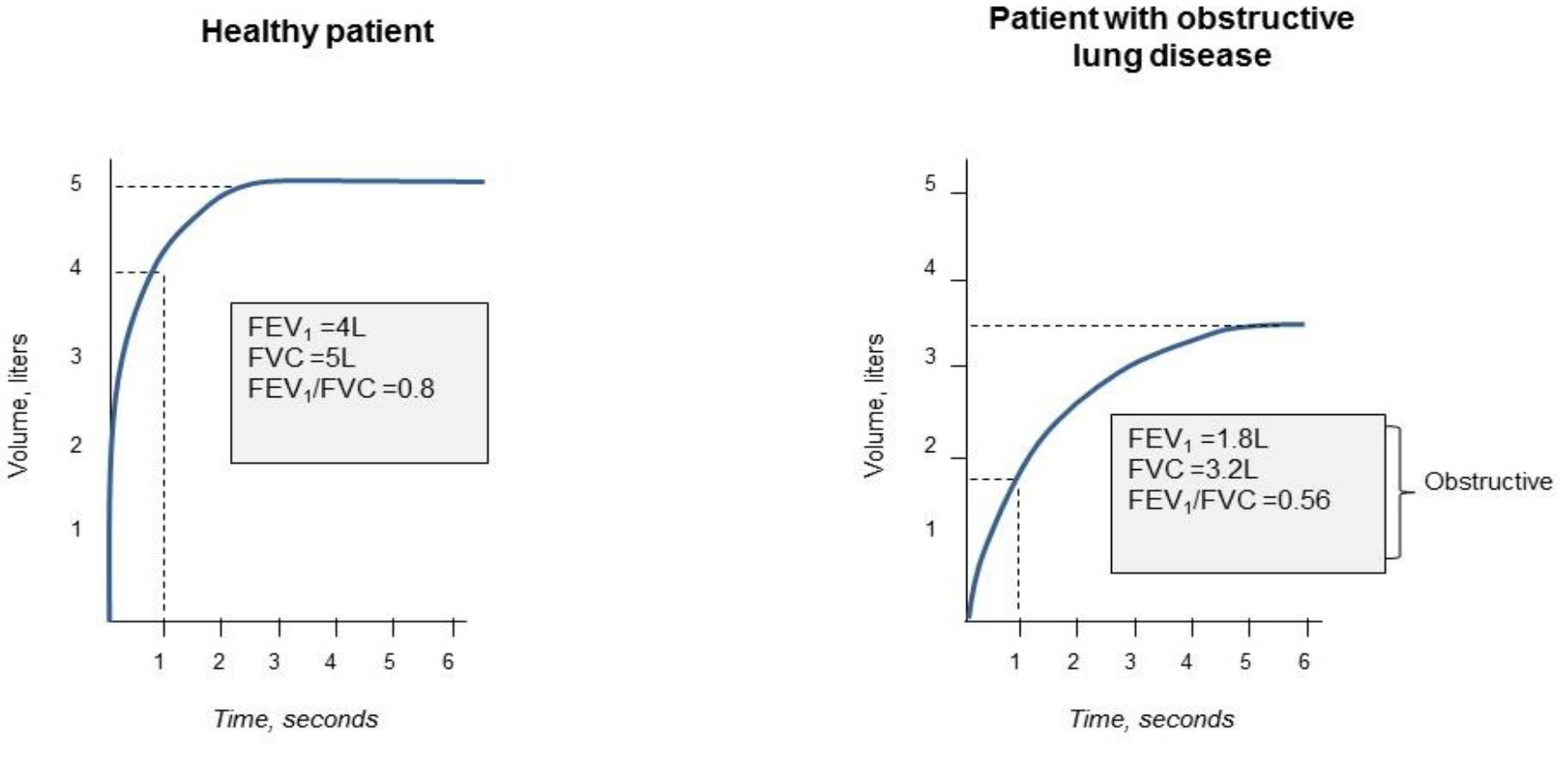


This means that you have only **72%** of your expected lung function, which is classified as **Moderate Asthma**.

This is called FEV_1 % PREDICTED

Inside Pamphlet

https://www.informationisbeautifulawards.com/showcase/4385-tailored-pamphlet-lung-function-test-results



FVC = forced vital capacity, FEV1 = forced expiratory volume in the first second of expiration

https://www.nationaljewish.org/conditions/tests-procedures/pulmonary-physiology/pulmonary-function/spirometry

Classification of COPD by impairment of lung function

	COPD stage	Spirometry (postbronchodilator)
GOLD 1	Mild	FEV_1 ≥80% predicted FEV_1/FVC <0.7
GOLD 2	Moderate	50% ≤ FEV_1 < 80% predicted FEV_1/FVC <0.7
GOLD 3	Severe	30% ≤ FEV_1 < 50% predicted FEV_1/FVC <0.7
GOLD 4	Very severe	FEV_1 <30% predicted FEV_1/FVC <0.7

FEV_1: Forced expiratory volume in 1 second; **FVC:** Forced vital capacity; **GOLD:** Global Initiative for Chronic Obstructive Lung Disease

Classification of COPD severity should be undertaken with care in patients with comorbid diseases or other possible contributors to shortness of breath

Postbronchodilator forced expiratory volume in 1 s (FEV1) to forced vital capacity (FVC) ratio less than 0.7 is required for the diagnosis of COPD to be established

Reference: *Modified from GOLD Global strategies for the diagnosis, management, and prevention of chronic obstructive pulmonary disease updated 2014*

eDucate™

www.educatehealth.ca

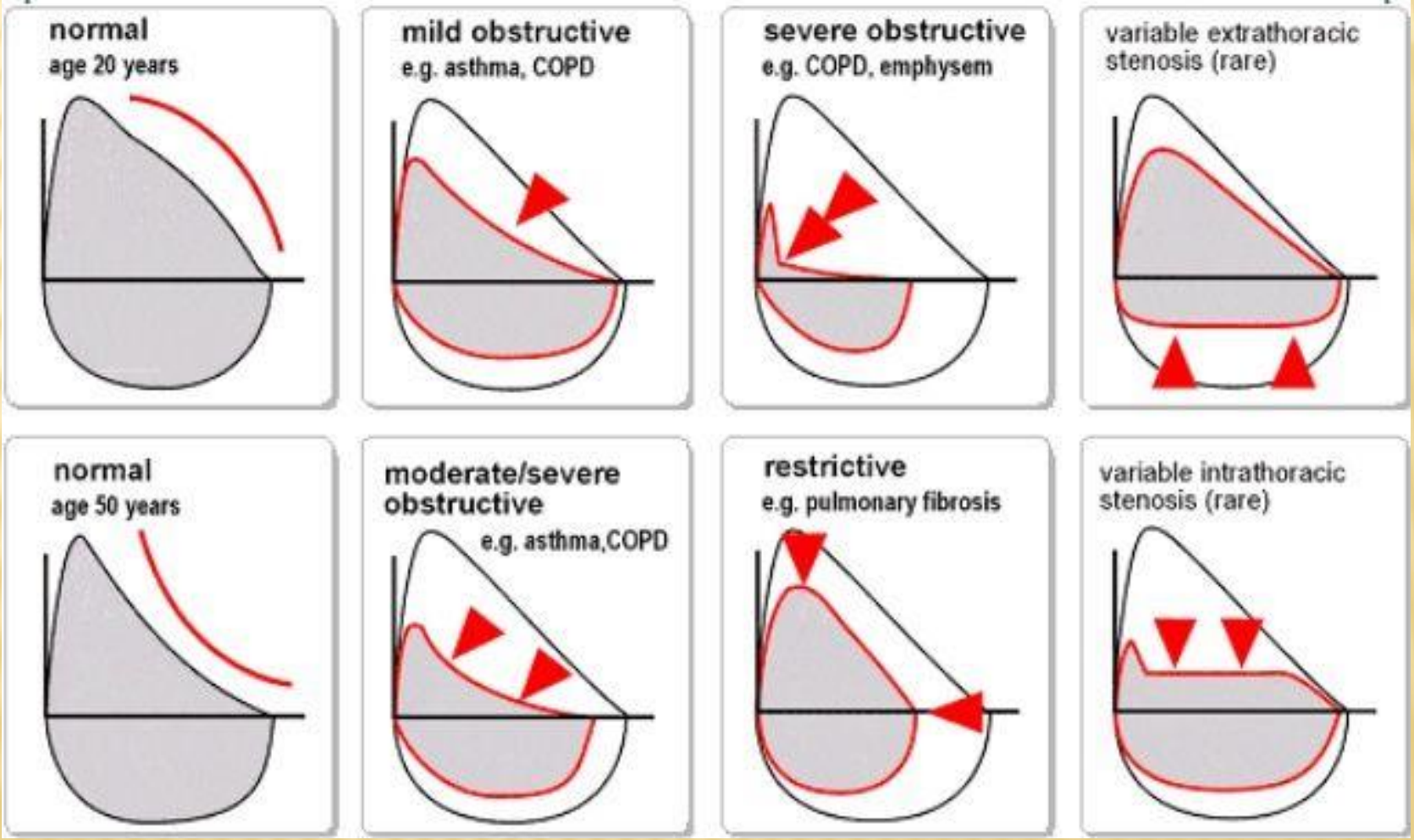
http://www.educatehealth.ca/media/443895/5-lightbox-investigation_and_workup-copd-classification_by_impairment.png

DIAGNOSTIC FUNCTION TESTS

- **The flow-volume loop** is a plot of inspiratory and expiratory flow (on the Y-axis) against volume (on the X-axis) during the performance of maximally forced inspiratory and expiratory maneuvers. The patient is instructed to take a full inspiration (to total lung capacity), exhale forcefully and completely into the mouthpiece (to residual volume [RV]), and then inspire forcefully and fully back to total lung capacity. Typically, a flow-volume loop needs to be requested specifically, as an order for "spirometry" frequently yields just the expiratory portion.
- The normal expiratory portion of the flow-volume curve is characterized by a rapid rise to the peak flow rate, followed by a nearly linear fall in flow as the patient exhales toward RV . The inspiratory curve, in contrast, is a relatively symmetrical, saddle-shaped curve. The flow rate at the midpoint of vital capacity (between total lung capacity and residual volume), known as the forced expiratory flow-50 (FEF_{50}), is normally slightly less than the flow rate at the midpoint of inspiration, known as the forced inspiratory flow-50 (FIF_{50}). Thus, the ratio FEF_{50}/FIF_{50} is normally <1.

https://www.uptodate.com/contents/flow-volume-loops

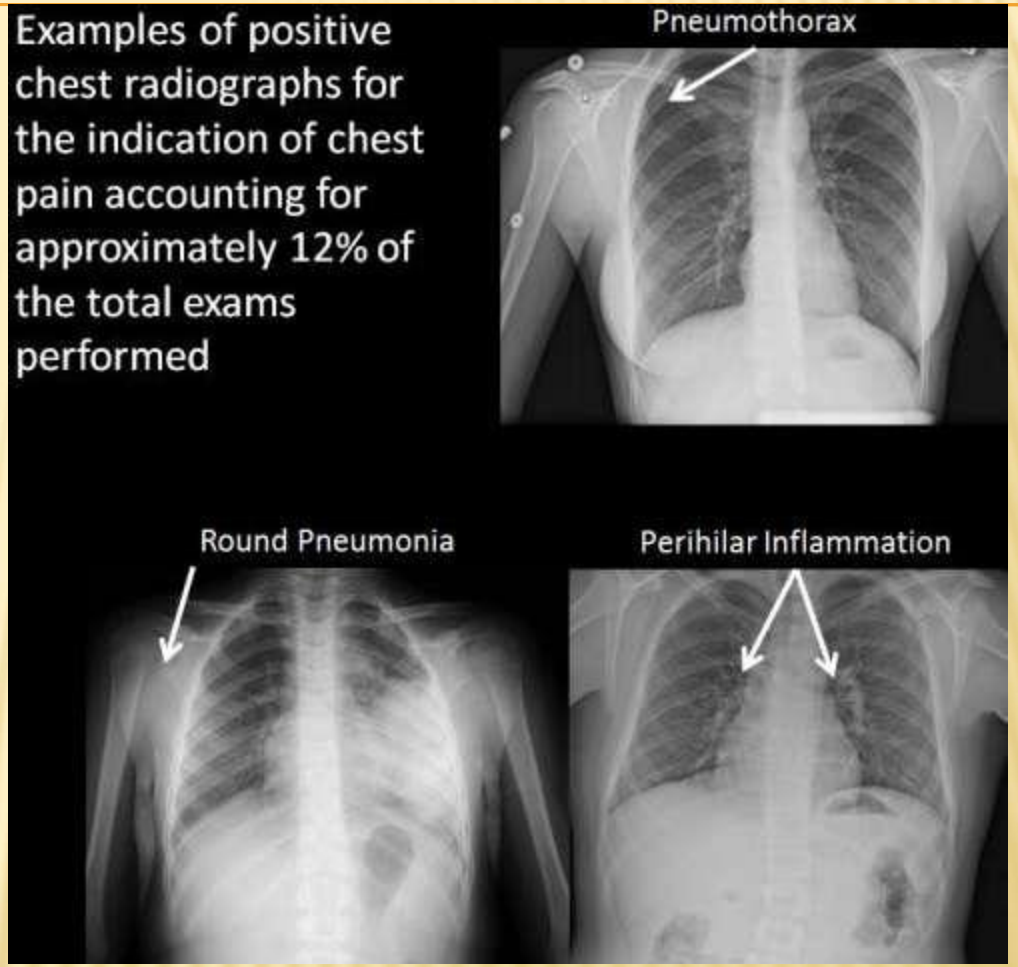
Normal & abnormal FV Loops



https://www.lungfunction.com.au/flow-volume-loops.html

DIAGNOSTIC FUNCTION TESTS

- **Chest X-rays** can detect cancer, infection or air collecting in the space around a lung, which can cause the lung to collapse. They can also show chronic lung conditions, such as emphysema or cystic fibrosis, as well as complications related to these conditions.



https://www.mayoclinic.org/tests-procedures/chest-x-rays/about/pac-20393494
https://medicalxpress.com/news/2014-12-chest-x-rays-children-unnecessary.html

DIAGNOSTIC FUNCTION TESTS

- **An arterial blood gas (ABG)** is a blood test that measures the acidity, or pH, and the levels of oxygen (O2) and carbon dioxide (CO2) from an artery. The test is used to check the function of the patient's lungs and how well they are able to move oxygen into the blood and remove carbon dioxide. This test is commonly performed in the ICU and ER setting; however, ABGs can be drawn on any patient on any floor depending on their diagnosis.

https://nurse.org/articles/arterial-blood-gas-test/#:~:text=What%20is%20an%20Arterial%20Blood,blood%20and%20remove%20carbon%20dioxide.

Value	Normal	Abnormal	
pH	7.35–7.45	<7.35 Acidosis	>7.45 Alkalosis
PaO2	>90 mmHg	75–89 mmHg Mild hypoxia	<75 mmHg Severe hypoxia
PaCO2	35–45 mmHg	<35 mmHg Alkalosis	>45 mmHg Acidosis
HCO3	18–24 mEq/l	<18 mEq/l Acidosis	>24 mEq/l Alkalosis

- PaO2 (measured in mmHg or kPa) is an accurate reflection of the ability of the lungs to transfer oxygen to the blood. A low PaO2 represents hypoxaemia and can initiate hyperventilation.

https://veteriankey.com/blood-gas-acid-base-analysis-and-electrolyte-abnormalities/.

- PaCO2 (in mmHg or kPa) indicates the effectiveness of alveolar ventilation. Alveolar ventilation determines PaCO2. Hyperventilation results in a decreased PaCO2 (hypocapnia), whereas hypoventilation increases PaCO2 (hypercapnia). Changes in ventilation may occur in patients with primary pulmonary disease, central nervous system (CNS) impairment, or may occur as a compensatory change in patients with metabolic disturbances.

https://veteriankey.com/blood-gas-acid-base-analysis-and-electrolyte-abnormalities/.

What is a pulse oximeter?

An oximeter provides accurate blood oxygen saturation and pulse rate reading. This information will help you monitor your condition during exercise, activities of daily living, or air travel.

Pulse Oximetry

SpO_2	Nursing Intervention
>95%	• Considered normal and generally requires no invasive intervention.* • Continue routine monitoring of Pt.
91%–94% NCLEX	• Considered borderline.* • Assess probe placement and adjust if necessary. • Begin oxygen at 2 L/min titrated to SpO_2 >95%.
85%-90% NCLEX	• Immediate intervention for SpO_2 <91%. Elevate head and encourage Pt to cough and breathe deeply. • Assess airway and suction as needed. • Administer oxygen and titrate to SpO_2 >95%. • If condition worsens or fails to improve, assist ventilations manually and prepare to intubate.
<85%	• Administer 100% oxygen, set Pt upright, encourage coughing and deep breathing and suction as needed. • Assist ventilations manually and prepare to intubate if condition worsens or fails to improve. • Consider reversal agents for possible drug-induced respiratory depression.

- The SaO2 (**pulse oximeter**) measures the percentage of haemoglobin actually carrying oxygen, which is why 95–100% is normal.
- The test can be useful in finding out whether oxygen treatment is needed, but it provides less information than the arterial blood gas test.

DIFFERENCE BETWEEN ABG & OXIMETRY

Arterial Blood Gases	Pulse Oximetry
Invasive	Noninvasive
Results delayed	Results immediate
Assessment intermittent	Assessment can be continuous
Assesses oxygenation, ventilation, and acid-base status	Assesses oxygenation only
Corrections routinely made for hyper- or hypothermia	Results misleading in the presence of alkalosis, hyper- or hypothermia, carboxy-hemoglobin, and other factors
Accuracy established	Accuracy in some clinical settings uncertain
Expensive	Less expensive (?)

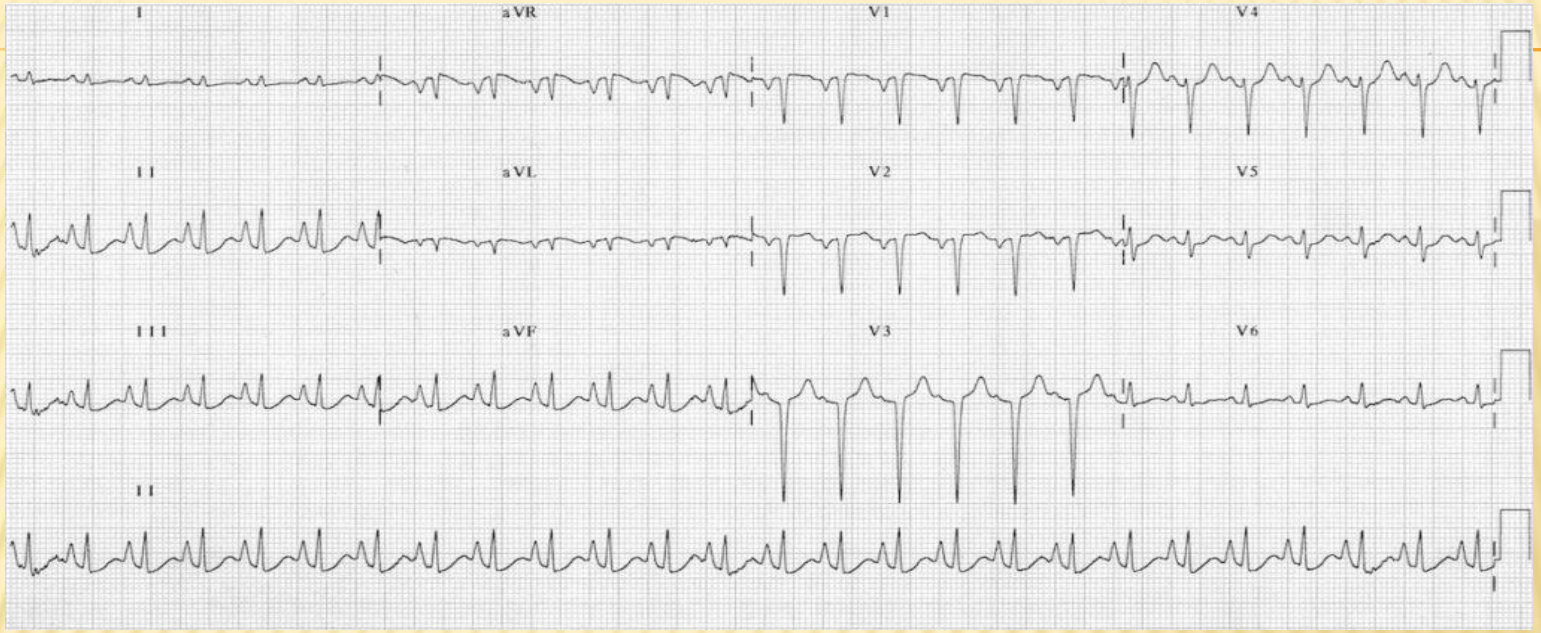
* Reproduced, with permission, from Reference 20

https://www.semanticscholar.org/paper/Pulse-oximetry-versus-arterial-blood-gas-specimens-Pierson/f68931756ce866a682416ba0066a79fda60f2faa

ELECTROCARDIOGRAM FEATURES

- **ECG** changes occur in Chronic Obstructive Pulmonary Disease (COPD) due to:
- The presence of hyperexpanded emphysematous lungs within the chest.
- The long-term effects of hypoxic pulmonary vasoconstriction upon the right side of the heart, causing pulmonary hypertension and subsequent right atrial and right ventricular hypertrophy (i.e. cor pulmonale).

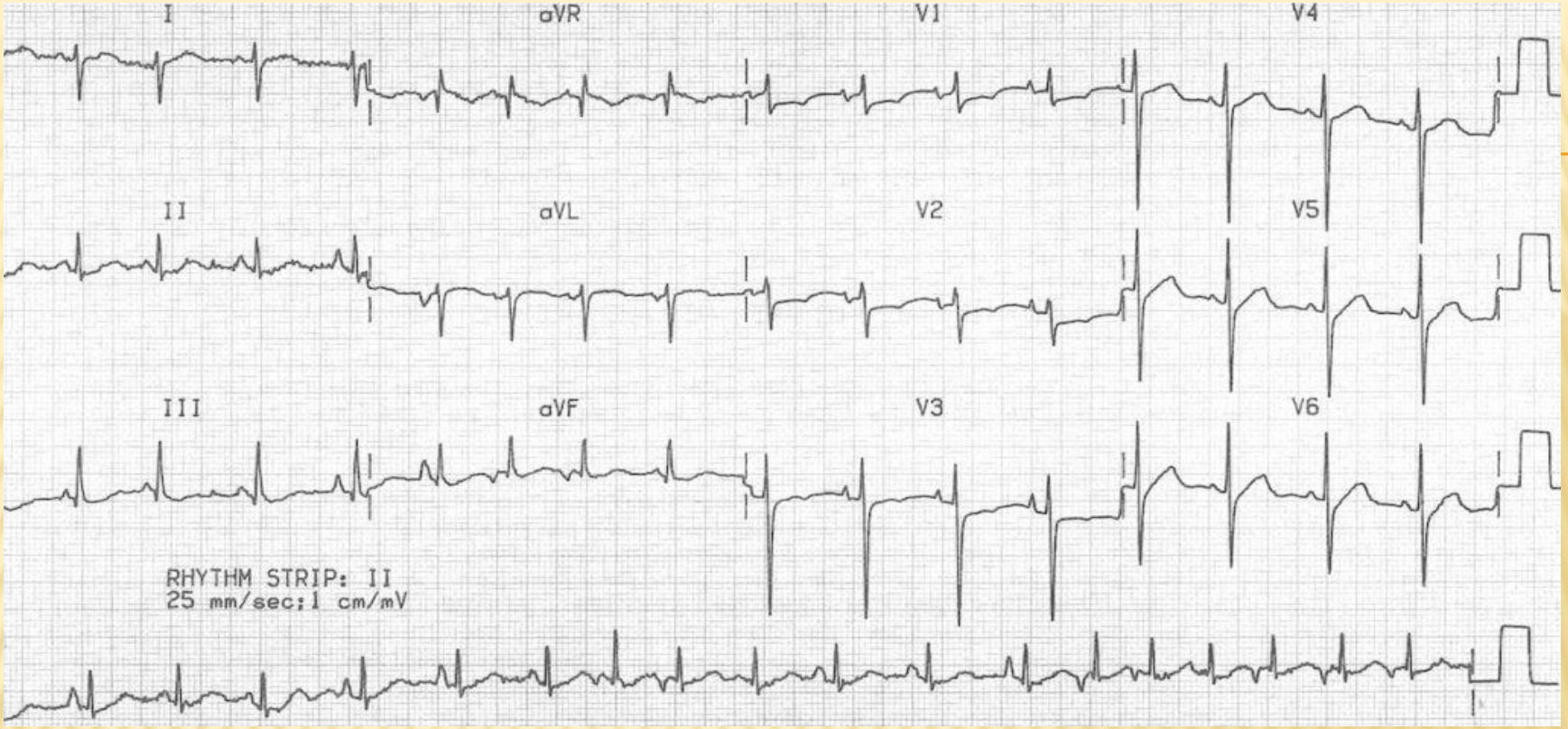
https://litfl.com/ecg-in-chronic-obstructive-pulmonary-disease/



ECG demonstrates many of the features of chronic pulmonary disease:

- Rightward QRS axis (+90 degrees).
- Peaked P waves in the inferior leads > 2.5 mm (P pulmonale) with a rightward P-wave axis (inverted in aVL)
- Clockwise rotation of the heart with a delayed R/S transition point (transitional lead = V5).
- Absent R waves in the right precordial leads (SV1-SV2-SV3 pattern).
- Low voltages in the left-sided leads (I, aVL, V5-6).

https://litfl.com/ecg-in-chronic-obstructive-pulmonary-disease/



- This **ECG** shows multifocal atrial tachycardia with additional features of COPD:
- Rapid, irregular rhythm with multiple P-wave morphologies (best seen in the rhythm strip).
- Right axis deviation, dominant R wave in V1 and deep S wave in V6 suggest right ventricular hypertrophy due to *cor pulmonale*.

https://litfl.com/ecg-in-chronic-obstructive-pulmonary-disease/

DIFFUSING CAPACITY OF THE LUNGS

- A test of the diffusing capacity of the lungs for carbon monoxide (DLCO, also known as transfer factor for carbon monoxide or TLCO), is one of the most clinically valuable tests of lung function.
- The DLCO measures the ability of the lungs to transfer gas from inhaled air to the red blood cells in pulmonary capillaries. The DLCO test is convenient and easy for the patient to perform. The ten seconds of breathholding required for the DLCO maneuver is easier for most patients to perform than the forced exhalation required for spirometry.

https://www.uptodate.com/contents/diffusing-capacity-for-carbon-monoxide#:~:text=DLCO%20%E2%80%93%20The%20diffusing%20capacity%20for,to%20the%20red%20blood%20cells.&text=It%20is%20an%20index%20of,alveolar%20transfer%20of%20carbon%20monoxide. /

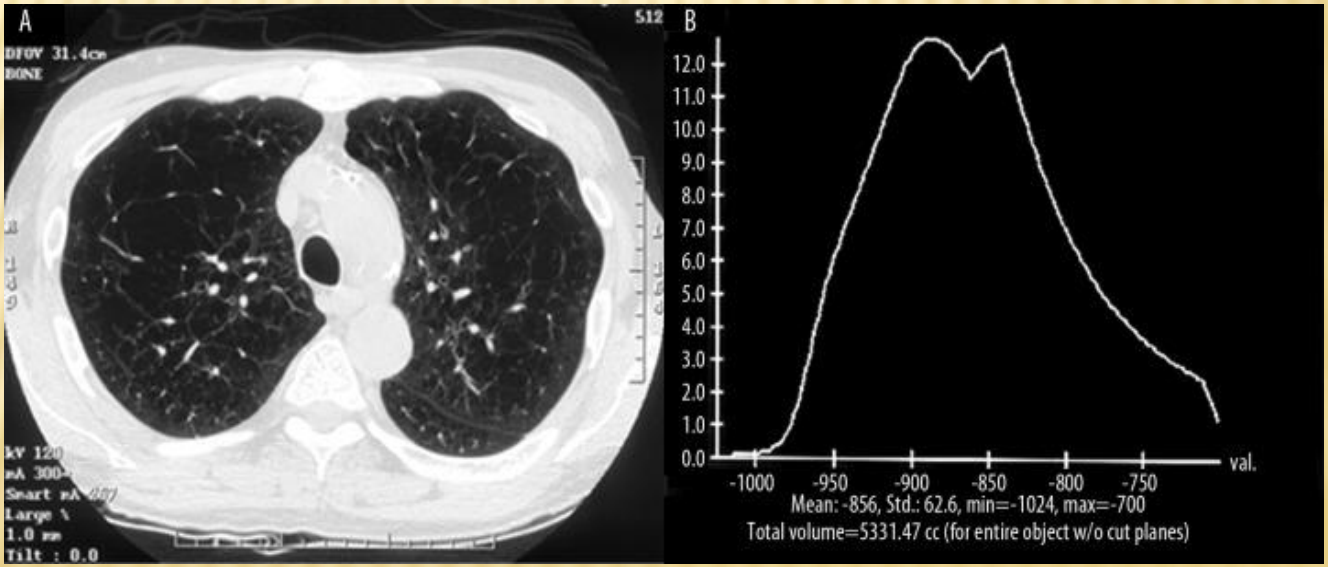
- The following division is frequently employed in clinical practice for the assessment of a reduction of transfer factor:

Table 3. Classification and Severity of DLCO Reductions*
• Normal >75% of predicted, up to 140%
• Mild decrease, 60% to 74%
• Moderate decrease, 40% to 59%
• Severe decrease, <40%
*The units of DLCO are reported as mL of CO per minute per mm Hg.

http://lungfunction.net/basics/transfer-factor.htm

COMPUTED TOMOGRACHY OF THE LUNGS

Computed tomography (CT) allows for early detection of emphysema. CT also makes it possible to quantify the total amount of emphysema in the lungs which is important in order to precisely estimate the severity of the disease. Those abilities of CT are important in monitoring the course of the disease and in attempts to prevent its further progression.



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3389962/

SURVEILLANCE & PREVENTION OF BOS

- National surveillance systems should primarily focus on monitoring the following, bearing in mind the importance of developing and implementing simple methodologies for providing objective measures of trends:

 - cause specific mortality;

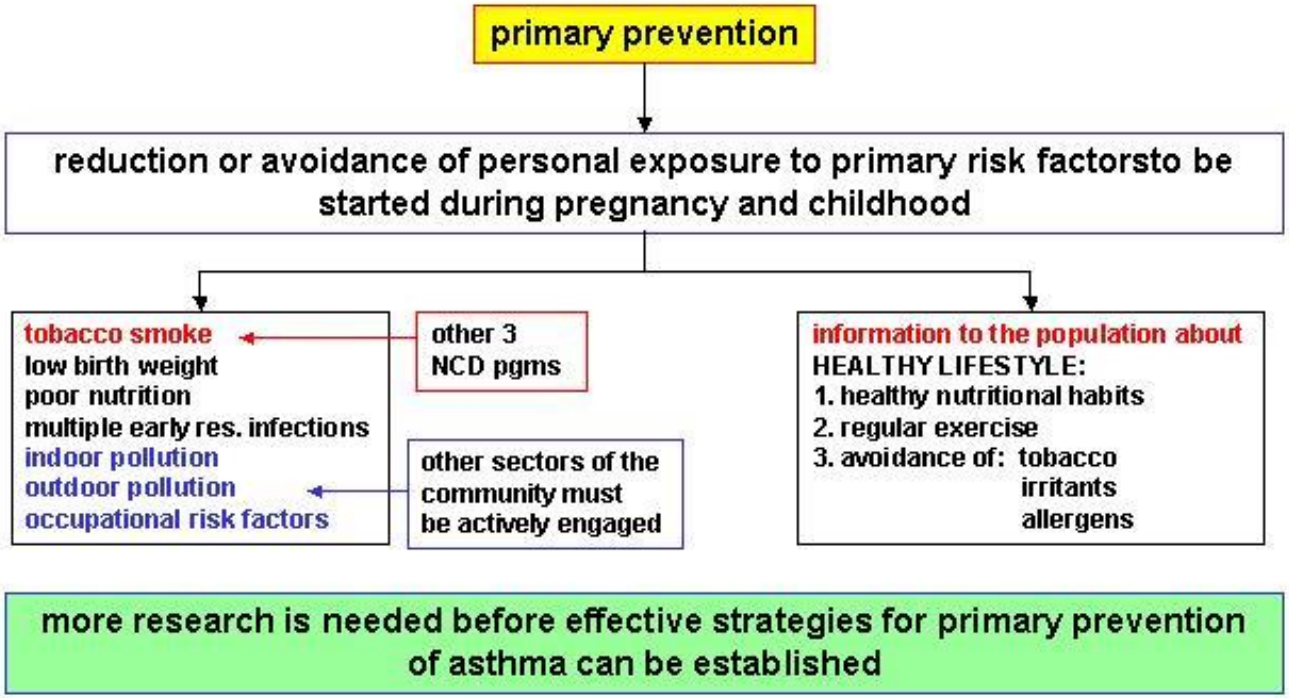
 - risk factor prevalence;

 - certain morbidity data like hospital admissions and consultations due to common respiratory conditions, as well as therapeutic trends.

- Standard indicators should be adopted. These may include lung function measurements, disease progression, absenteeism from school or work, and hospitalisations.

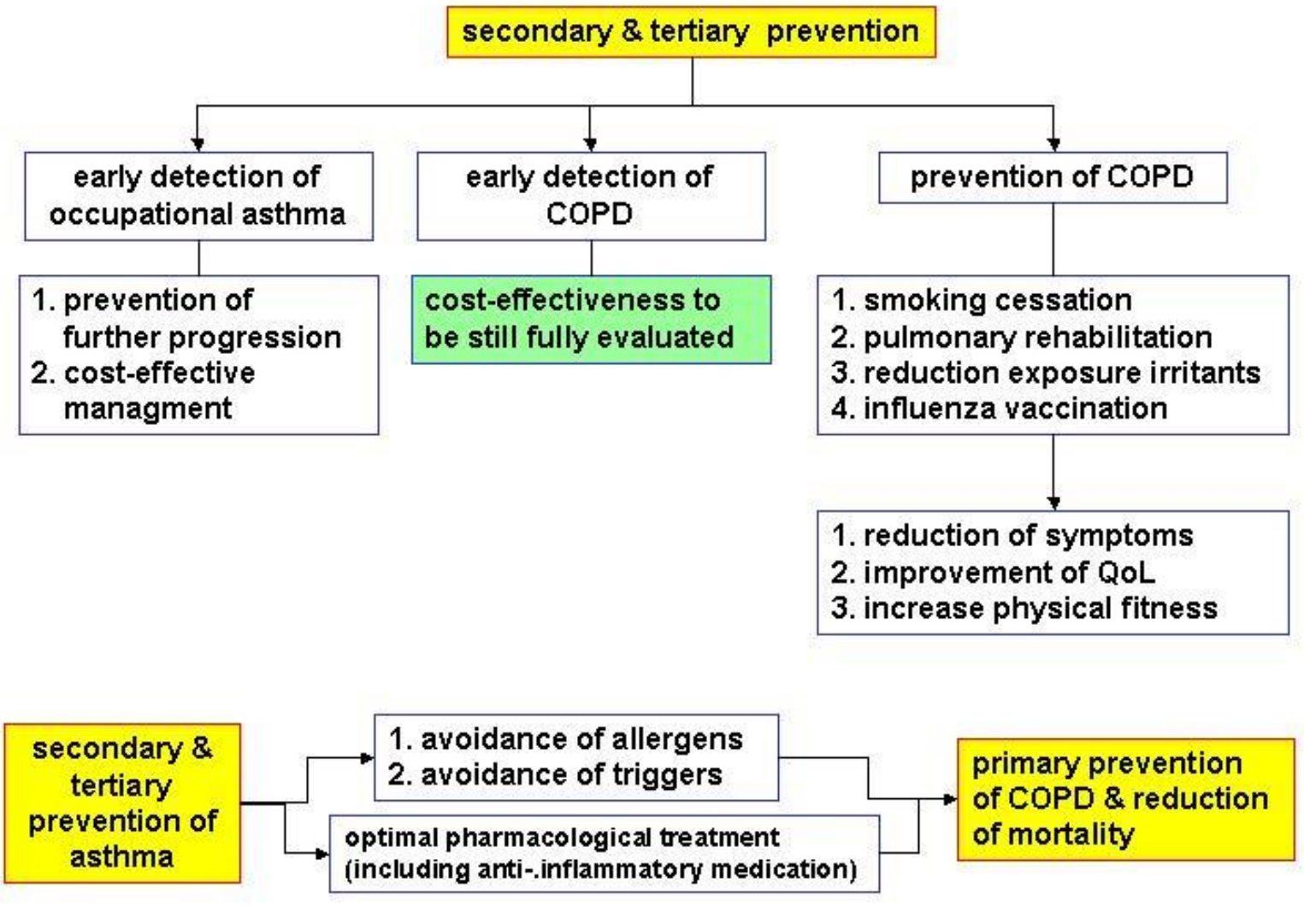
https://www.who.int/respiratory/publications/strategy/en/index5.html

STRATEGIC DIRECTIONS (B)



https://www.who.int/respiratory/publications/strategy/en/index5.html

STRATEGIC DIRECTIONS (C)



https://www.who.int/respiratory/publications/strategy/en/index5.html