MIR
MEDICAL INTERNATIONAL RESEARCH

Spirometry, Oximetry & Telemedicine

What is Spirometry?

www.spirometry.com
www.oximetry.com

HISTORY OF SPIROMETRY

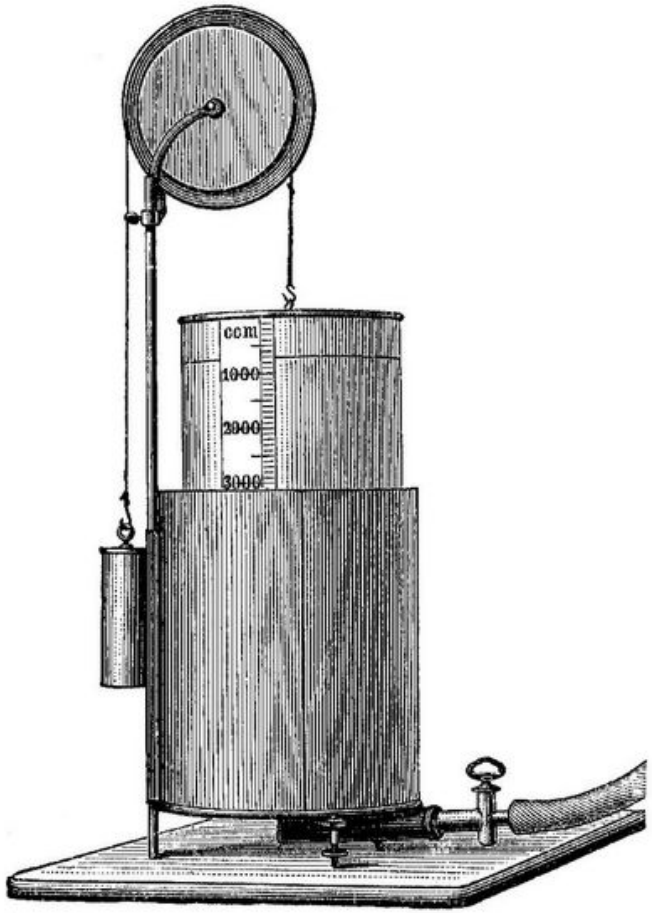
- ✓ The first Spirometer was invented in 1846 by an English surgeon (and violinist!) **John Hutchinson** who presented his first device to the “Royal Physiological Society” in London.

- ✓ Hutchinson showed a direct relationship between a reduction in this parameter and the life expectancy of the individual, and defined the term **Vital capacity (VC)**.

THE BELL SPIROMETER

- ✓ Hutchinson presented a study carried out on 2,130 subjects, and showed that the VC was directly correlated to height and to age, both in men and in women.

- ✓ The spirometer used was a water or bell spirometer.



FEV1 – an introduction

Another surgeon Edward Gaenslar introduced the concept of

FEV1 = Forced expired volume in the 1st second

This reinforced the earlier discovery of Hutchinson and led to the development of the modern concept of FLOW (air velocity)

What is Spirometry?

What does Spirometry measure?

HOW MUCH AIR?

(**Volume**…FVC…measured in “L”)

HOW FAST IT IS EXHALED

(**FLOW**…measured in “l/sec or l/min)

WHY DO SPIROMETRY?

Spirometry is the most basic, objective Pulmonary Function test to asses lung health status.

- ✓ It establishes baseline measurement of patient ‘s lung function.
- ✓ It helps to identify if they have narrow airways or reduced capacity.
- ✓ It determines treatment regimen; Bronchodilators or Nebulizer.

Spriometry is required to make a definitive diagnosis of both Asthma and COPD and it can be done bedside, in a PFT lab or a physicians office.

WHY DO SPIROMETRY?

- ✓As part of a general patient's health program.
- ✓As part of pre-employment screening.
- ✓As part of a regular check for employees working in high risk environments for lung disease.
- ✓As part of yearly evaluations of smokers over 40.
- ✓As part of a smoking cessation program.
- ✓As part of a bedside screening program.

WHY DO SPIROMETRY?

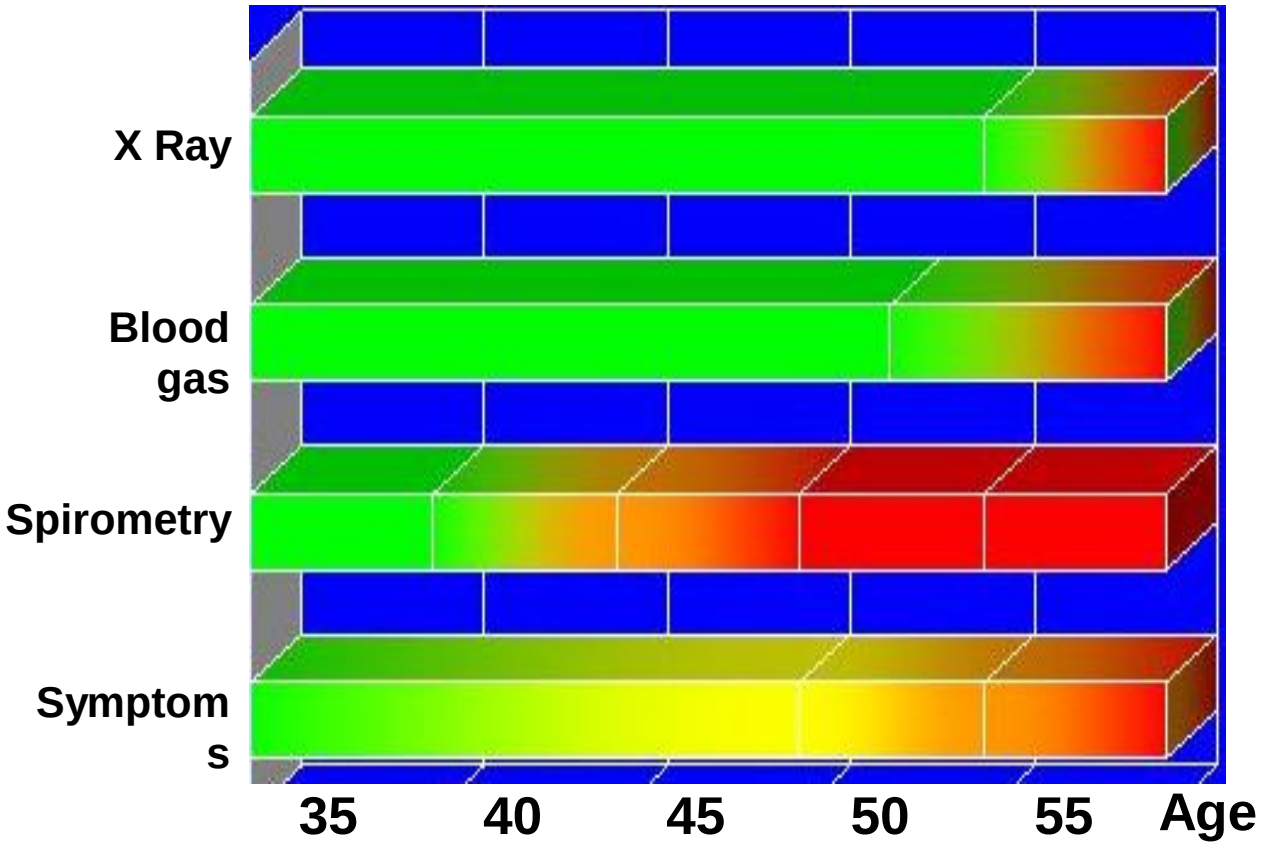
- ✓ Is there a history of dyspnea (shortness of breath) on exertion or at rest?
- ✓ Is there a history of chronic cough or sputum production?
- ✓ Is there a history of wheezing or chest tightness?
- ✓ Is there a history of frequent colds or runny nose?
- ✓ Is there an occupational exposure to inhaled dusts or chemicals?
- ✓ As follow-up visits for patients with lung disease.
- ✓ As management for all patients taking bronchodilators.
- ✓ To evaluate he effects of air pollution.
- ✓ As early detection of congestive heart failure.

WHY DO SPIROMETRY?

Spirometry can help to identify lung diseases in their early stages 10 years, before the onset of symptoms, therefore facilitating an early course of treatment and potentially modifying the course of the disease.

Recent studies on ASYMPTOMATIC PATIENTS (USA-2000) have shown that 7% had significant respiratory pathologies.

SPIROMETRY AND THE EARLY DIAGNOSIS OF OBSTRUCTIVE LUNG DISEASE



Hyatt et al, 1997

WHY DO SPIROMETRY?

"Old fashion test of Lung Capacity is turning out to be the single best indicator of general health status and risk of heart disease."

Framingham Heart Study
National Institute of Health

WHY DO SPIROMETRY?

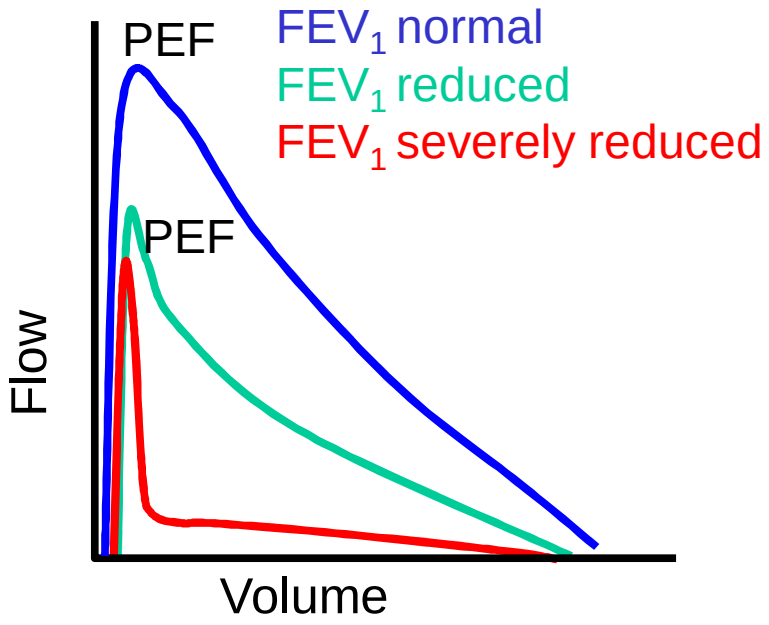
"For the diagnosis and assessment of COPD, Spiro metry is the gold standard. Healthcare workers inv olved in the diagnosis and management of COPD p atients should have access to Spirometry."

The GOLD Workshop Report
www.goldcopd.com

OBJECTIVES?

- ✓ Detects early lung function.
- ✓ Identifies high risk smokers.
- ✓ Reproducible and objective
- ✓ Aids in diagnosis.
- ✓ Predicts future mortality/morbidity.
- ✓ Provides evidence of disease progression.
- ✓ Monitors response to treatment.
- ✓ Monitors the effect of environmental conditions.
- ✓ PEFR may underestimate the degree of airway obstruction.
- ✓ PEFR cannot differentiate between obstruction and restriction.

PEAK FLOW OR SPIROMETRY?



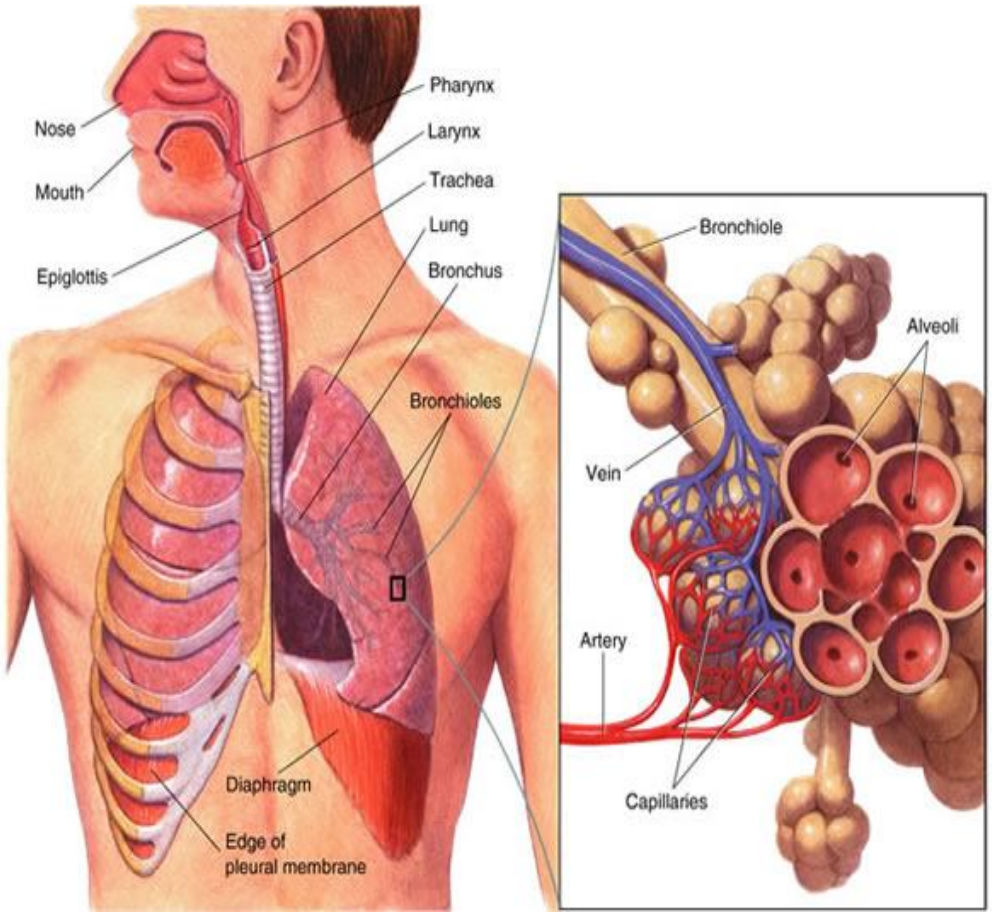
The measurement of the Peak Expiratory Flow (PEF) does ***not*** uncover the extent of the bronchial obstruction.

This can only be identified by measuring the FEV1.

WHO DOES THE TEST?

- ✓ GP – FP – NP – PA
- ✓ Internal Medicine
- ✓ Cardiologist
- ✓ Pulmonologist
- ✓ Asthma/Allergist
- ✓ Respiratory Therapist
- ✓ Occupational Health Nurse or Company Doctor
- ✓ Primary Healthcare Nurse
- ✓ The Patient

RESPIRATORY ANATOMY

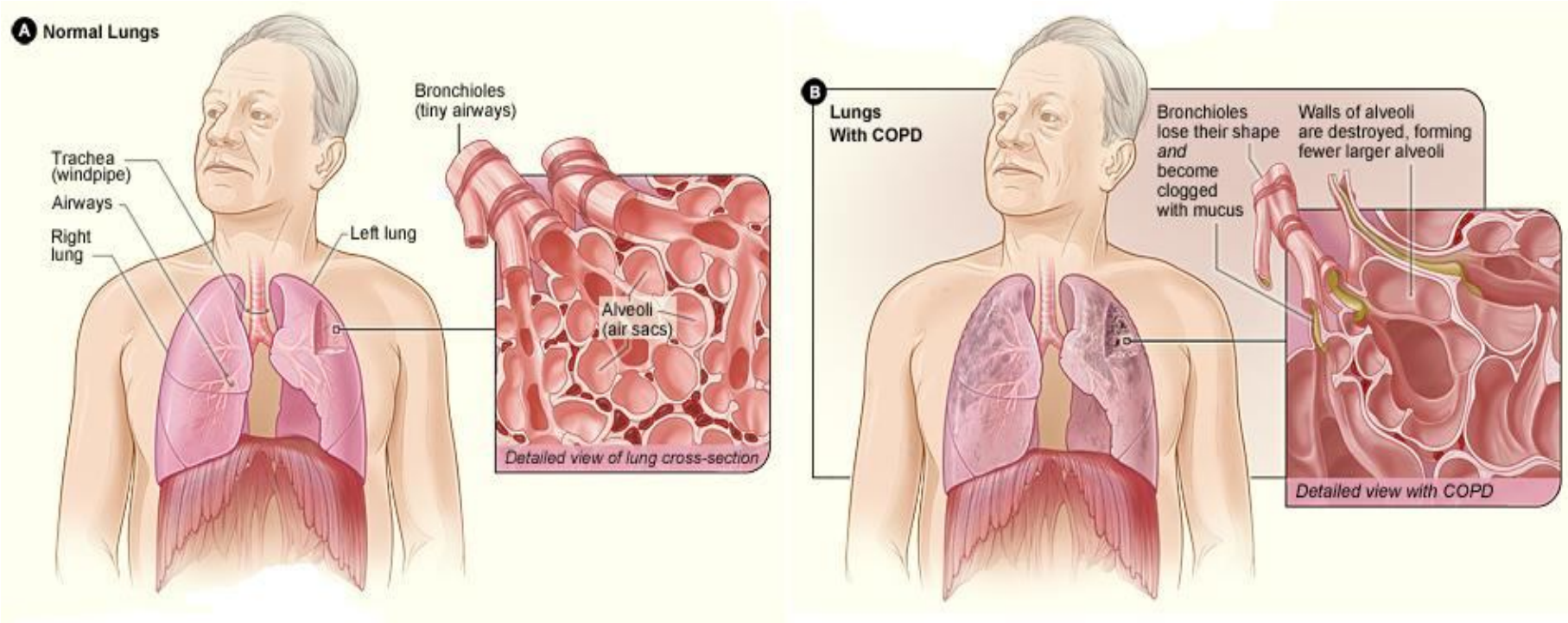


Air will enter the nose where it will be heated and humidified by the Pharynx.

It will them pass through the Trachea into the Bronchus which will split into left and right side of the lung.

The Bronchus will reduce in size and become Bronchioles where they will attach to grape like structures called the Alveoli.

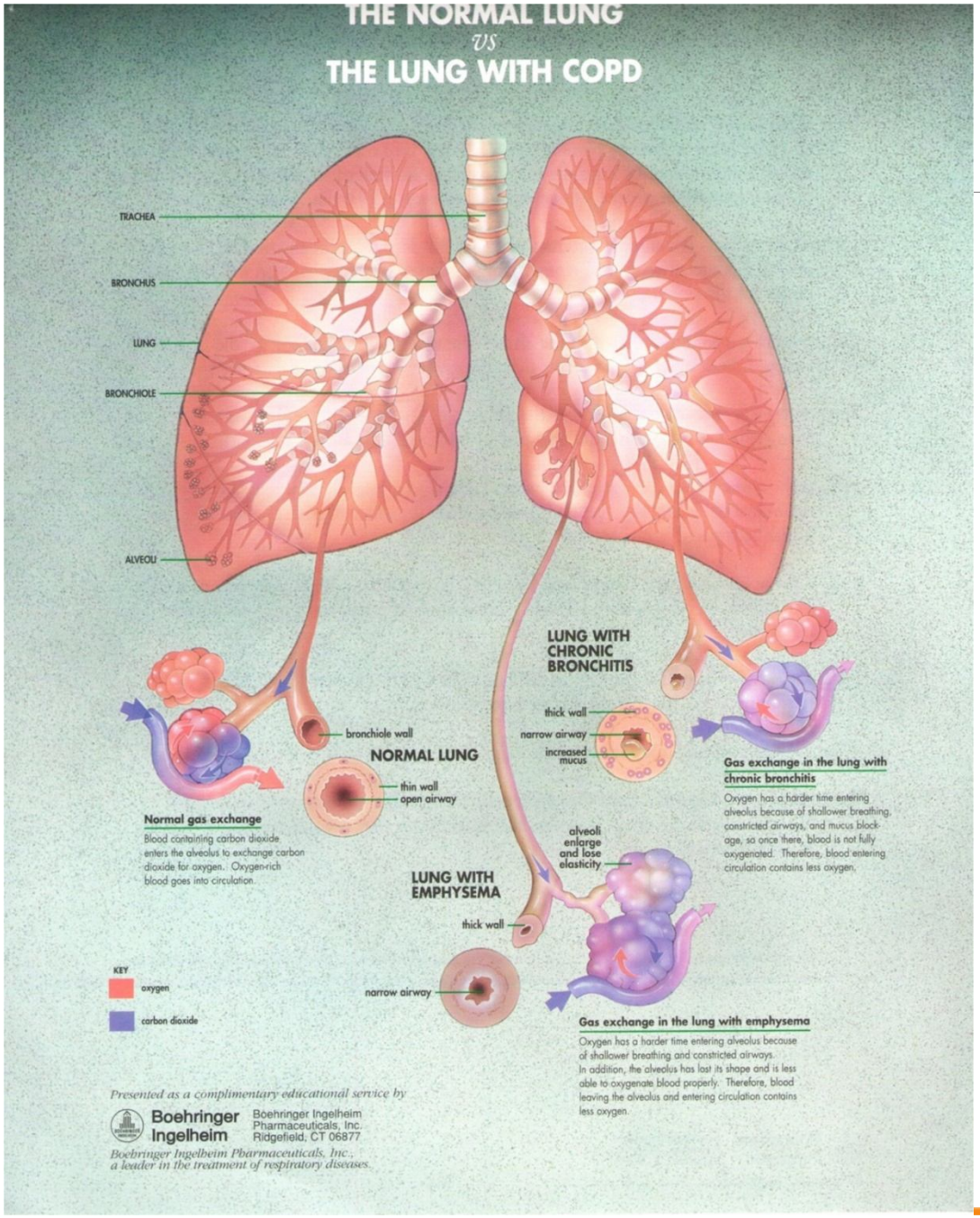
It is in the Alveoli where respiration takes place. Here the exchange of carbon dioxide for oxygen occurs in the capillary beds and respiration takes place.



In this picture on the left, we see the Alveoli of a healthy lung are plentiful and well defined.

In the lung with COPD on the right, we see a breakdown of the Alveoli which have become larger and reduced in number. Also, they are filling up with mucus and becoming clogged. This reduces the ability to exchange gasses in the blood.

The Bronchioles have also lost shape and are becoming clogged with mucus as well.



LUNG ANATOMY

The process of moving air into and out of the lungs:

Inspiration (active)
Expiration (passive)

External Respiration
is the exchange of gasses between the lungs and the blood in the capillary beds in the Alveoli.

Internal Respiration
is the process of oxidation of glucose to produce energy.

Tissue Respiration
is the chemical processes within the cells/tissues.

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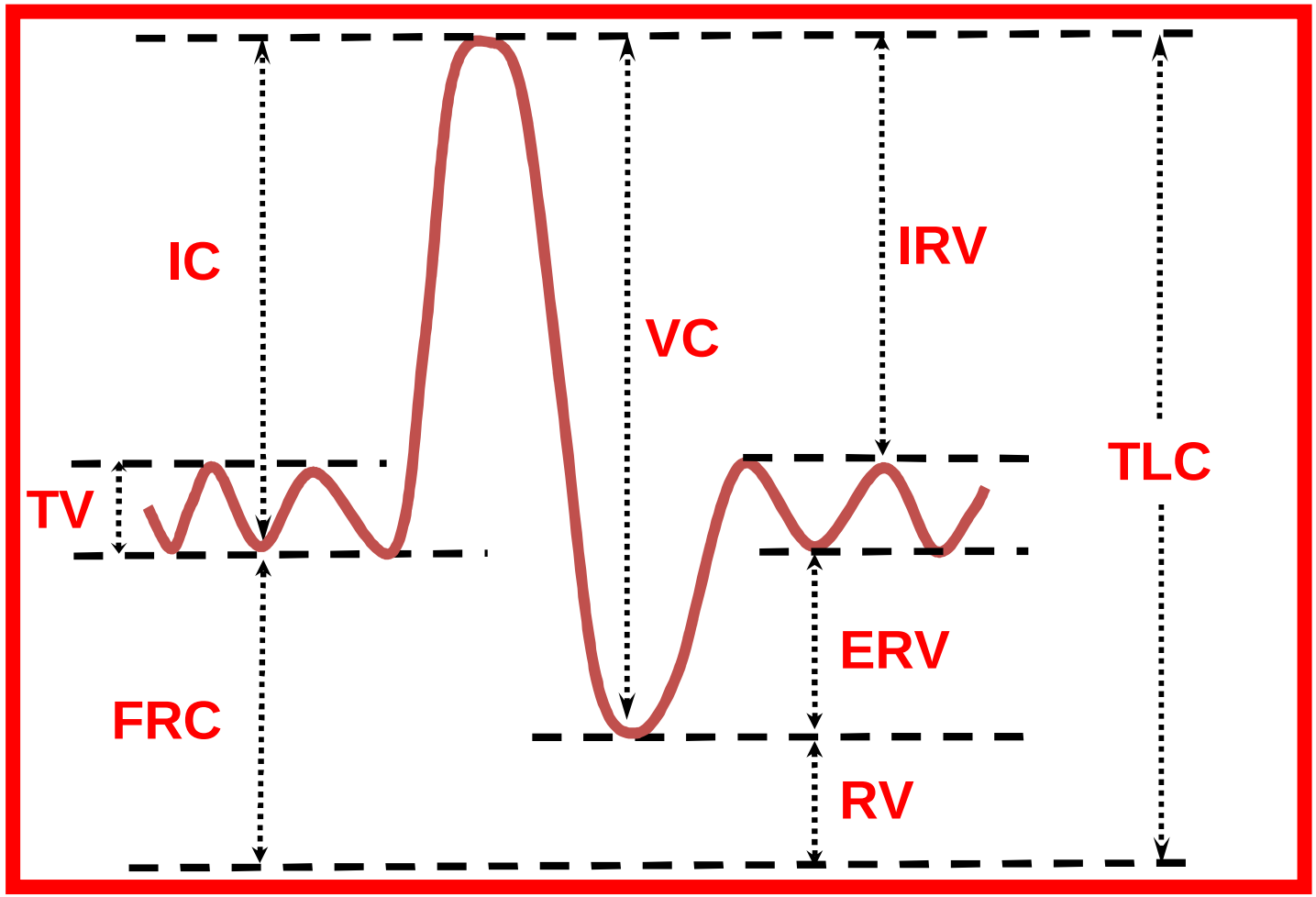
STATIC SPIROMETRIC PARAMETERS



STATIC SPIROMETRIC PARAMETERS

- **TV Tidal volume**

The volume of air during a complete respiratory cycle at rest. It is a volume and measured in liters

- **IC Inspiratory capacity**

The maximum volume of air that can be inspired into the lungs, starting from a complete slow expiration. It is a volume and measured in liters.

- **FRC Functional Residual Capacity**

The volume of gas which remains in the lungs following a complete slow expiration. It is a volume and measured in liters.

- **RV Residual Volume**

The volume of gas which remains in the lungs at the end of a complete expiration. It is a volume and measured in liters.

- **VC Vital Capacity**

The maximum volume of air which can be measured at the end of a complete expiration. It is a volume and measured in liters.

STATIC SPIROMETRIC PARAMETERS

- **ERV Expiratory Reserve Volume**

The volume that can be expired from a position of normal breathing. It is the difference between a normal expiration and a full expiration. It is a volume and measured in liters.

- **IRV Inspiratory Reserve Volume**

The volume of air that can be taken in from a position of normal breathing. It is a volume and measured in liters.

- **TLC Total Lung Capacity**

The total volume of air present in the lungs after a complete inspiration. It is a volume and measured in liters.

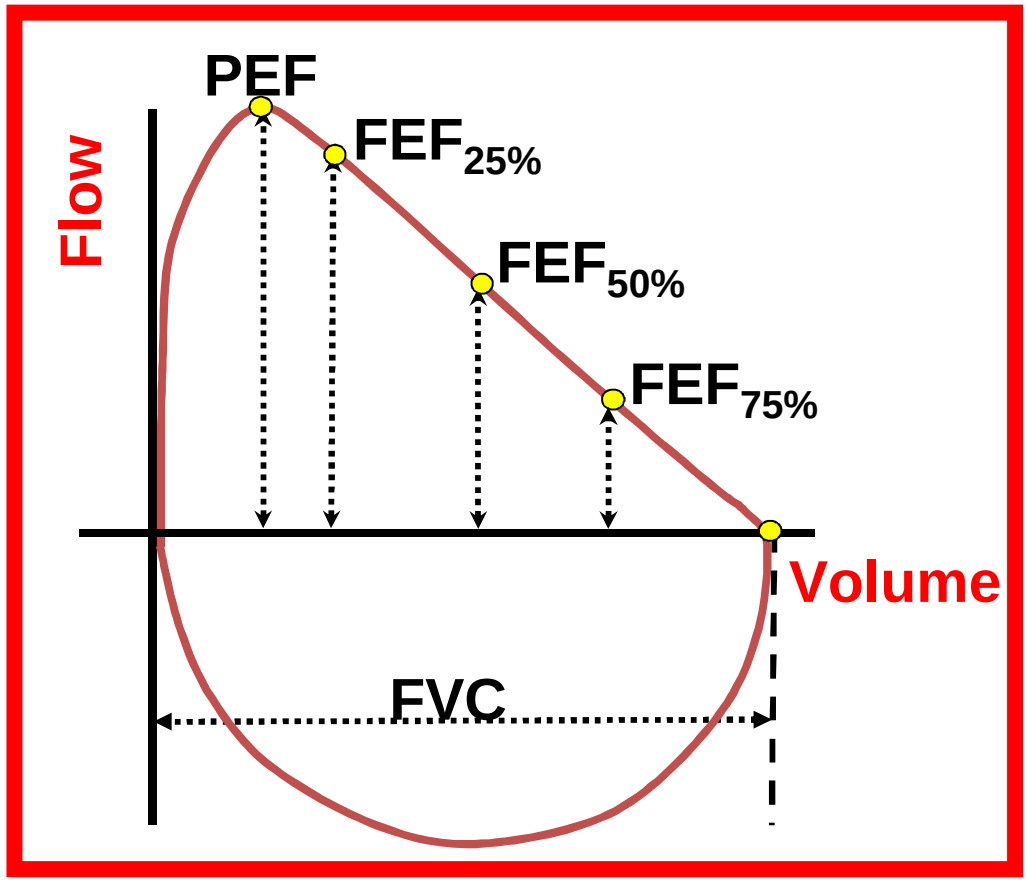
- **RF Respiratory Frequency**

The number of breaths per minute during rest breathing.

- **FET Forced Expiratory Time**

The time taken to expire the total FVC, measured in seconds.

Dynamic spirometry parameters



The Flow/Volume curve

Dynamic spirometry parameters

- **FVC Forced Vital Capacity**

The maximum volume of air that can be expired using the maximum force and velocity, having made a maximum inspiration. It is a volume and measured in liters.

- **FEV_T Forced Expiratory Volume**

The volume of air expired (during a FVC test) in the first **t** seconds. The common values of **t** used are: 0.5,1,3,6 secs.
It is a volume and measured in liters.

- **$FEF_{x\%}$ Forced Expiratory Flow**

The maximum instantaneous flow, measured at a volume equivalent to **x** % of the FVC. The standard values of **x** are: 25%, 50% and 75%. It is a flow and measured in liters/sec.

Dynamic spirometry parameters

- **$FEF_{25\%-75\%}$ Forced Expiratory Flow $_{25\%-75\%}$**

The average expiratory flow in the interval between 25% and 75% of the FVC. It is a flow and measured in liters/sec.

- **PEF Peak expiratory flow**

The maximum value of expiratory flow measured during a forced expiratory test. It is a flow and measured in liters/sec.

- **MVV Maximum voluntary ventilation**

The maximum volume of air that can be ventilated in one minute during forced inspiration and expiration. It is a volume and measured in liters/min.