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Lung Function Tests

- Also called pulmonary function tests (PFTs)
- Evaluate how well your lungs work.
- The tests determine how much air your lungs can hold, how quickly you can move air in and out of your lungs, and how well your lungs add oxygen and remove carbon dioxide from your blood.
- The tests can diagnose lung diseases and measure the severity of lung problems.

Problems of lung:

- **Obstructive:** shortness of breath due to difficulty exhaling all the air from the lungs. Because of damage to the lungs or narrowing of the airways inside the lungs, exhaled air comes out more slowly than normal. At the end of a full exhalation, an abnormally high amount of air may still linger in the lungs.
- **Restrictive.** This is when the lung tissue and/or chest muscles can't expand enough. This creates problems with air flow, mostly due to lower lung volumes.

Apparatuses of PFTs:

1- Spirometry: is the process by which we can record pulmonary ventilation, record different lung volumes and capacities. The instrument used is called spirometer and the graph obtained is called spirogram.

A spirometer is a device with a mouthpiece hooked up to a small electronic machine.



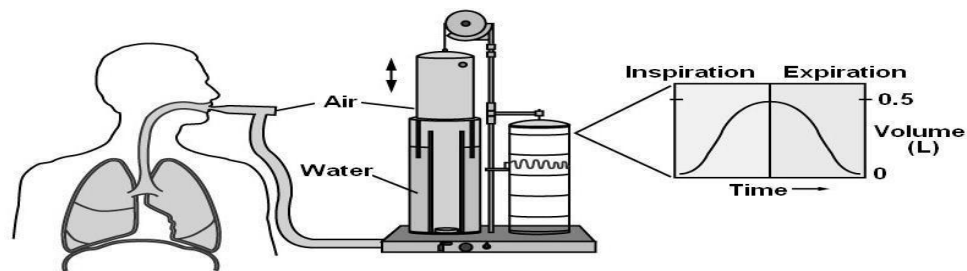
Manual spirometer



electronic spirometer

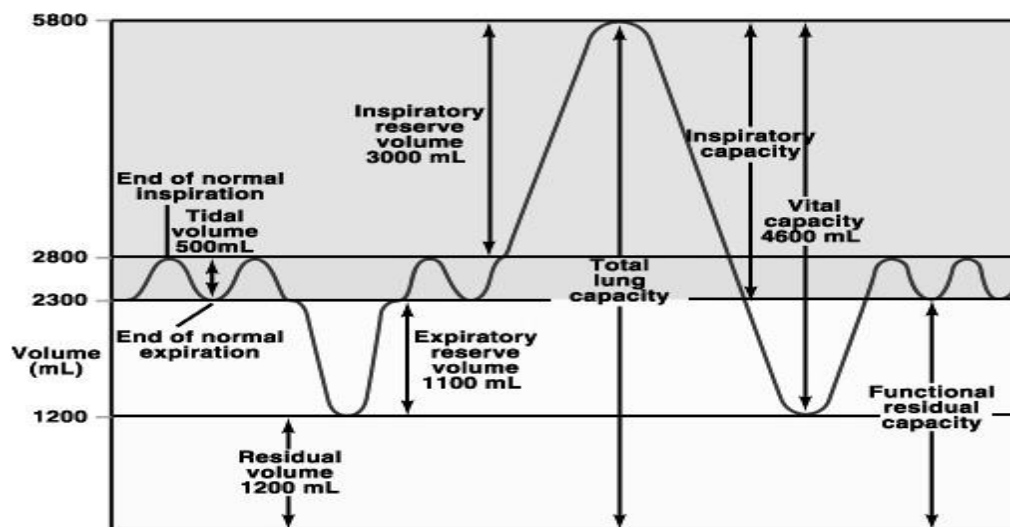
Respiratory Volumes:

- The total capacity of the lungs is divided into various volumes and capacities according to the function of these in the intake or exhalation of air.
- The average total lung capacity of an adult human male is about 6 Liters of air, but only a small amount of this capacity is used during normal breathing.
- The average human respiratory rate is 30-60 breaths per minute at birth, decreasing to 12-20 breaths per minute in adults.
- The total amount of air one's lung can possibly hold can be subdivided into four **Volumes** defined as follow:



1.The Tidal Volume (TV):

Is the volume of air inspired or expired with each normal breath and it is about **500 ml** in average young adult man.

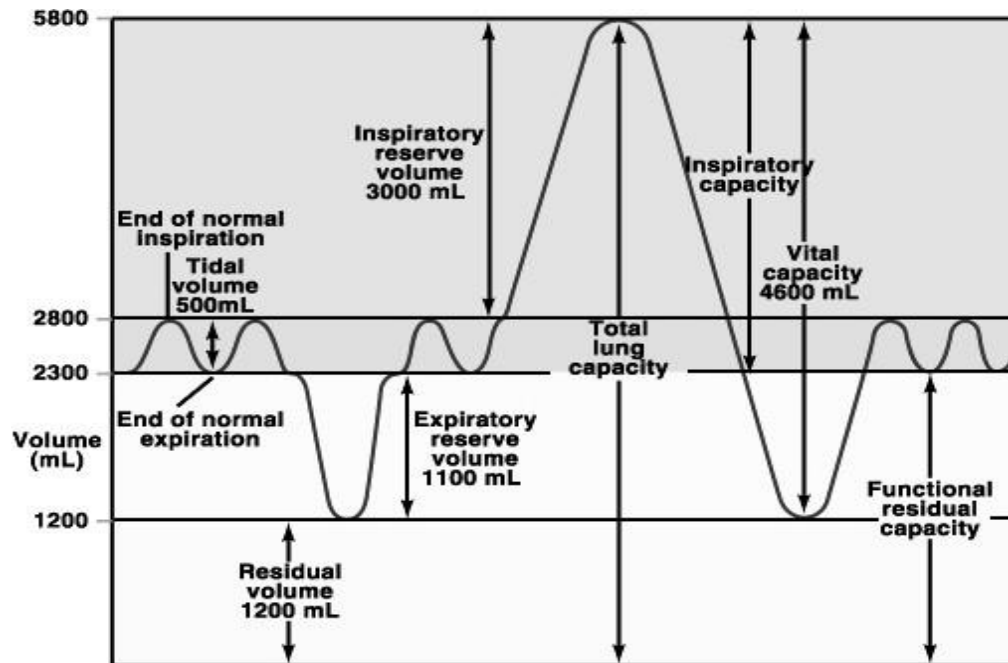


2.The Inspiratory Reserve Volume (IRV):

Is the extra volume of air that can be inspired over and beyond tidal volume and it is about **3000 ml**.

3.The Expiratory Reserve Volume (ERV):

Is the amount of air that can be expired after the normal tidal expiration, which is about **1100 ml**.



4.The Residual Volume (RV):

Is the volume of air remaining in the lungs after the most forceful expiration, which is about **1200 ml**.

This volume cannot be measured directly by spirometer. Therefore, an indirect method must be used usually the helium dilution method.

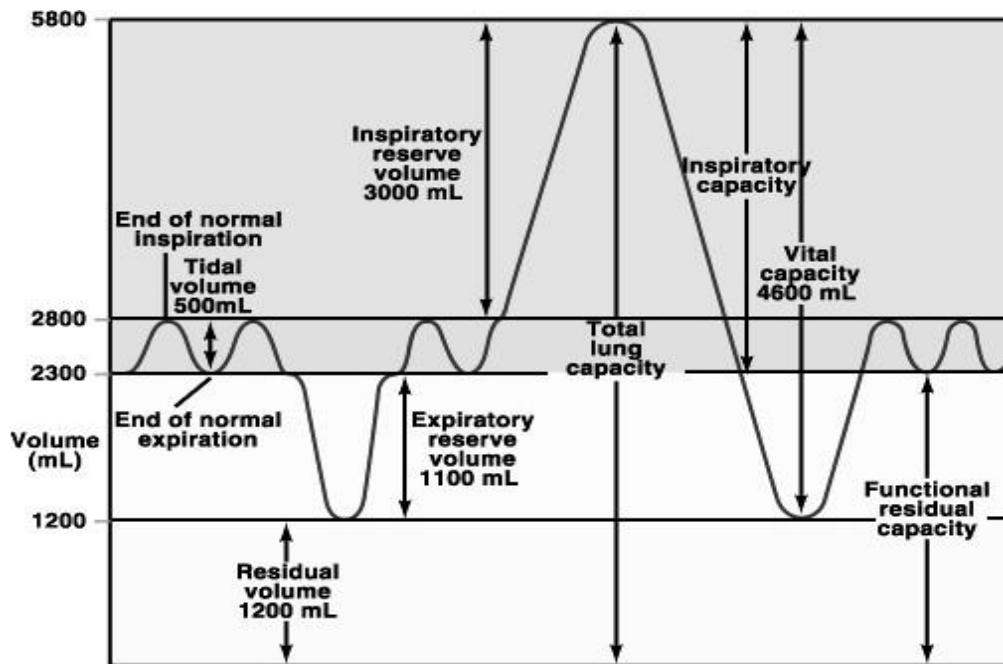
Lung capacities

lung capacities are defined as the combination of two or more lung volumes.

1- Inspiratory capacity (I.C.): the of air that can be inspired by maximal inspiration following a quiet expiration .

it is equal to T.V.+I.R.V. it averages **3500 ml** in adult male

2- Expiratory capacity (E.C.): the volume of air can be expired by maximal expiration it is equal to T.V. + E.R.V.
it averages about **1600 ml** in adult male.



3- Functional residual capacity (F.R.C.): the volume of air remaining in the chest at end of quiet expiration it is equal to E.R.V. + R.V. it averages about **2300 ml** in an adult male.

4- Vital capacity (V.C.): it is the volume of air that can be expired by maximal expiration following maximal inspiration.
It is equal to the I.R.V. + T.V. + E.R.V.
It averages about **4600 ml** in adult male.

- **Forced vital capacity (F.V.C.):**

the maximal volume of air that can be forcefully expired following maximum inspiration.

- **Forced expiratory volume – first second (F.E.V 1):**

the maximal volume of air that can be forcefully expired during the first second following maximum inspiration.

- **Forced expiratory volume - relative (F.E.V1%) :**

the percentage relationship between FVC and FEV1.

$$FEV1\% = FEV1 / FVC * 100 \%$$

5- Total lung capacity (T.L.C.): the volume of air present in the chest at the end of maximal or deepest inspiration.

It is equal to I.R.V. + R.V. + T.V. + E.R.V. it averages **5800 ml** in adult male.

Factor affecting volumes and capacities:

1-Age: T.L.C. and R.V. are increased in old age

2-Sex: male show lung volumes and capacities that are greater than females by about 20 – 25 %

3-Body build: V.C. increased in athletic.

4-Diseases of the respiratory system (restrictive and obstructive diseases)