Dynamic Spirometry

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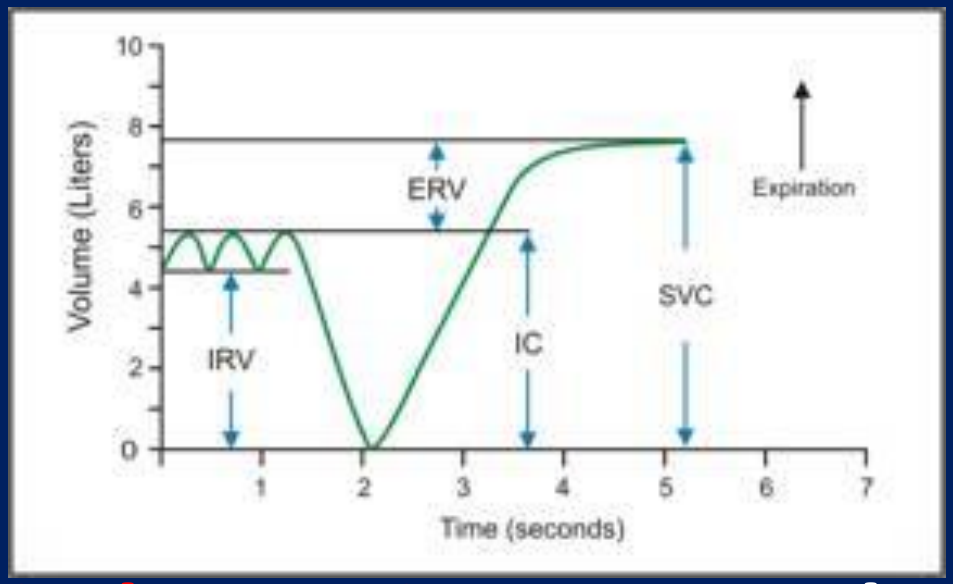
Spirometry

It provides an objective measurement of lung function.

It analyzes volume and velocity of expired air

Static test

Performed without regard to time



Relaxed Vital capacity: Max Volume of air expired during relaxed expiration after a maximal inspiration

Dynamic test

Performed at forcible and max effort against time

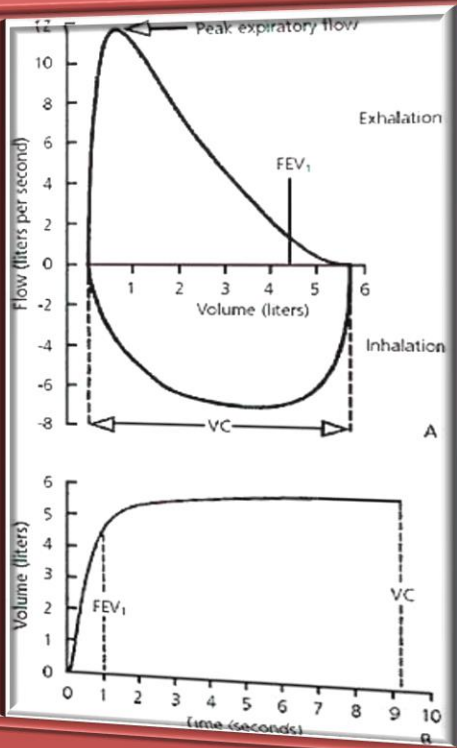
Measures the rate at which the lung changes volume during forced breathing.

Forced vital capacity

The max volume of air that can be forcibly and rapidly exhaled following a max inspiration.

Two types of curves can be obtained

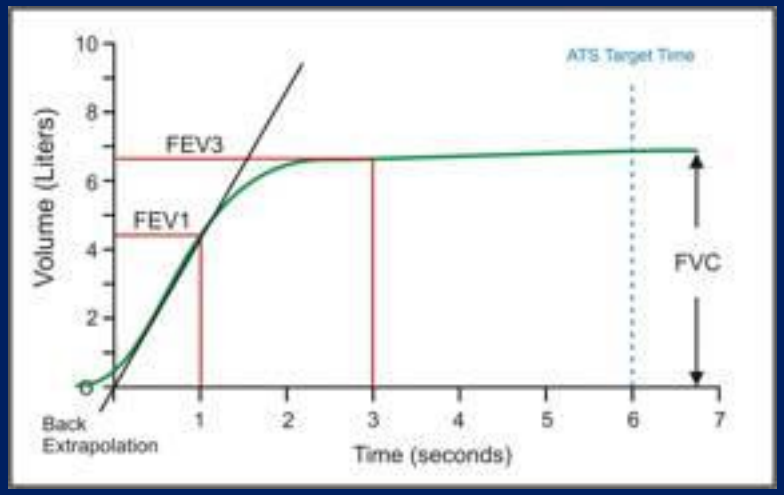
Forced expiratory curve



Flow Volume curve

Forced Expiratory Curve

- The subject takes a maximal inspiration and then exhales as rapidly, as forcibly,& as maximally as possible.
- Duration of the forced effort: 3 – 5 sec
- A plot of exhaled volume against time:



FEV_1 : Volume of air expelled in the 1st sec of forced expiration starting from full inspiration

Plateau: **FVC**

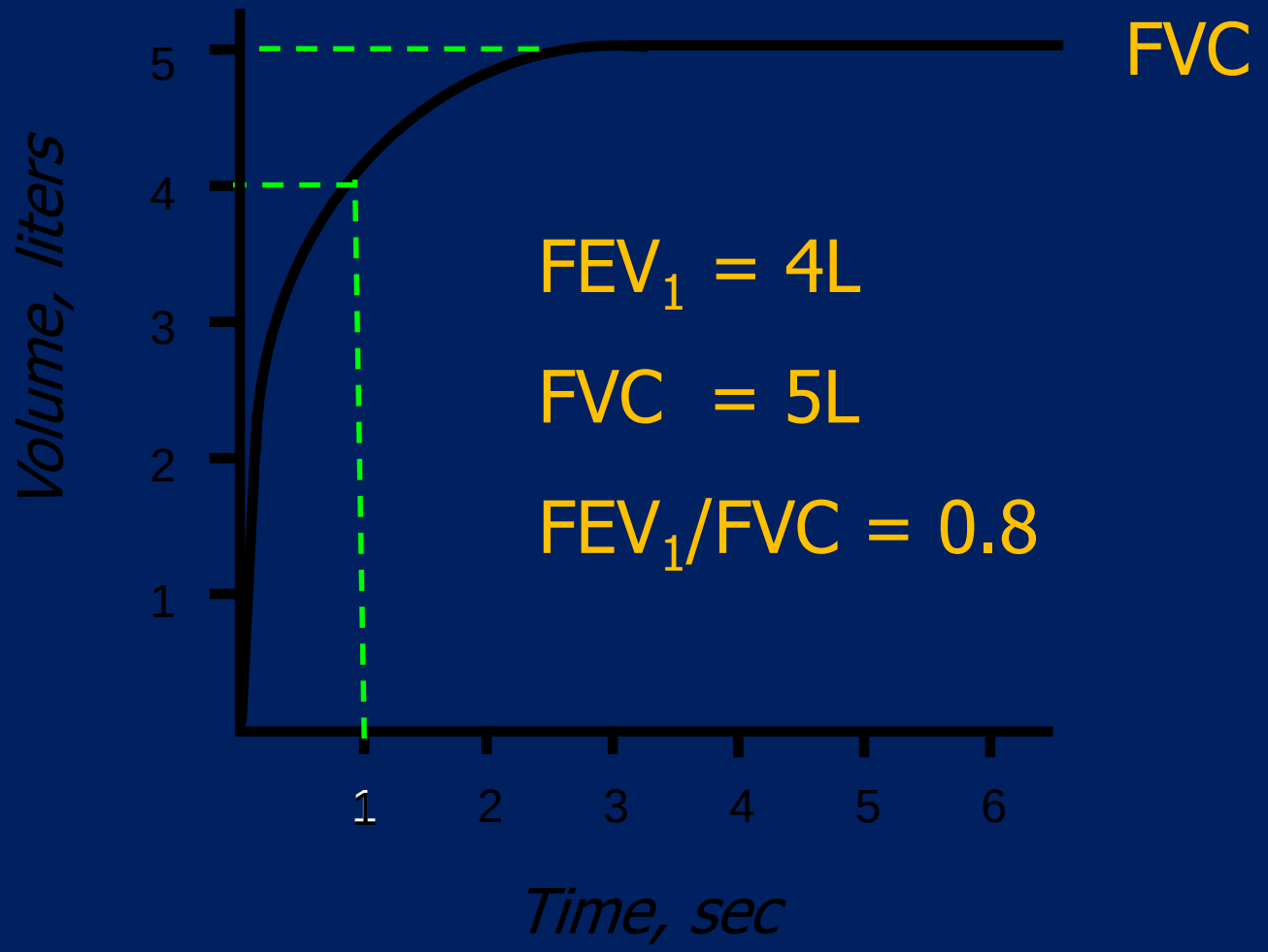
FEV_1 % or ratio = (FEV_1/FVC) * 100

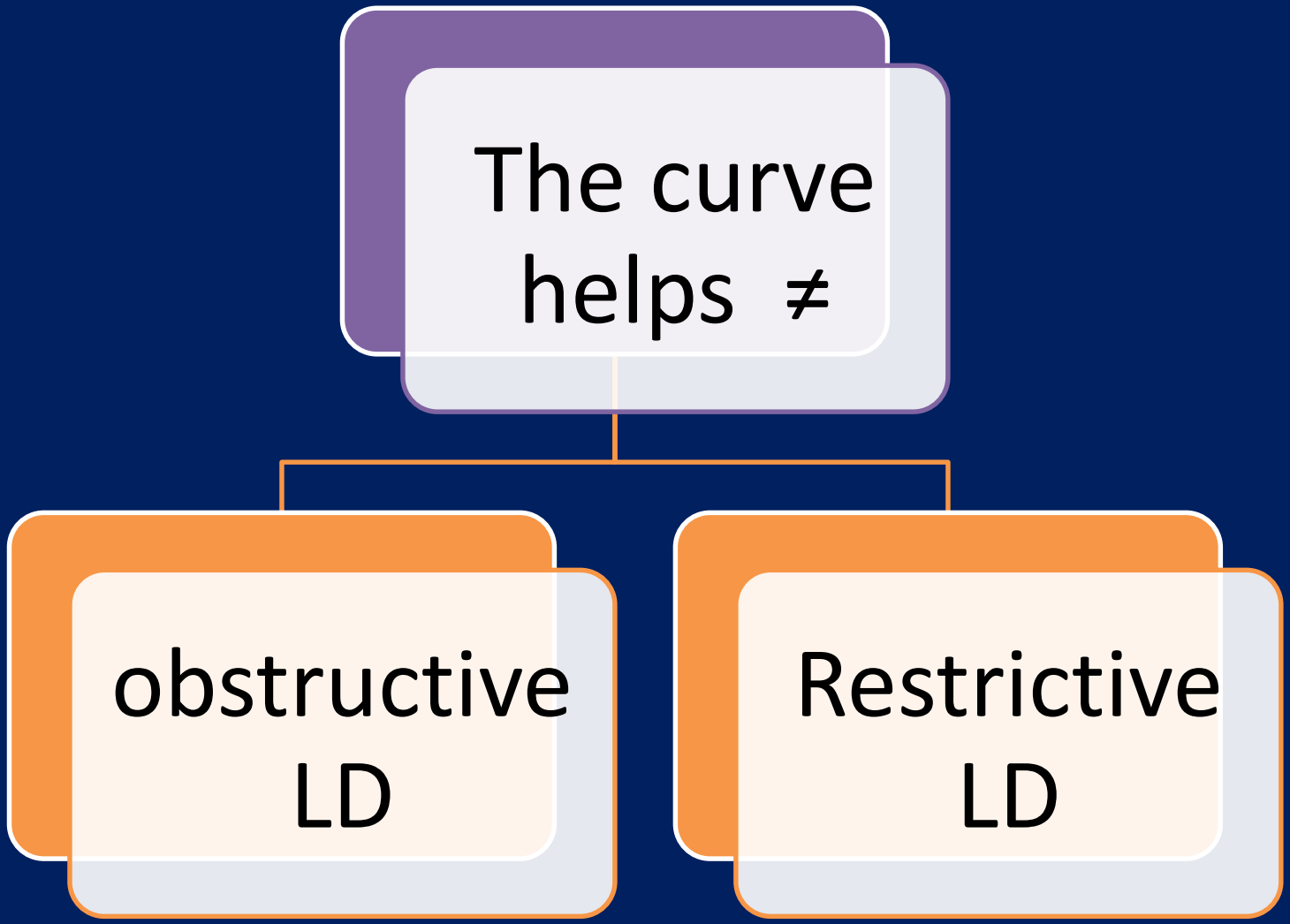
Fraction of the VC expired during the 1st sec of a forced expiration (NL 70%-80%)

- FEV_1 is a useful measure of how quickly the lungs can be emptied.

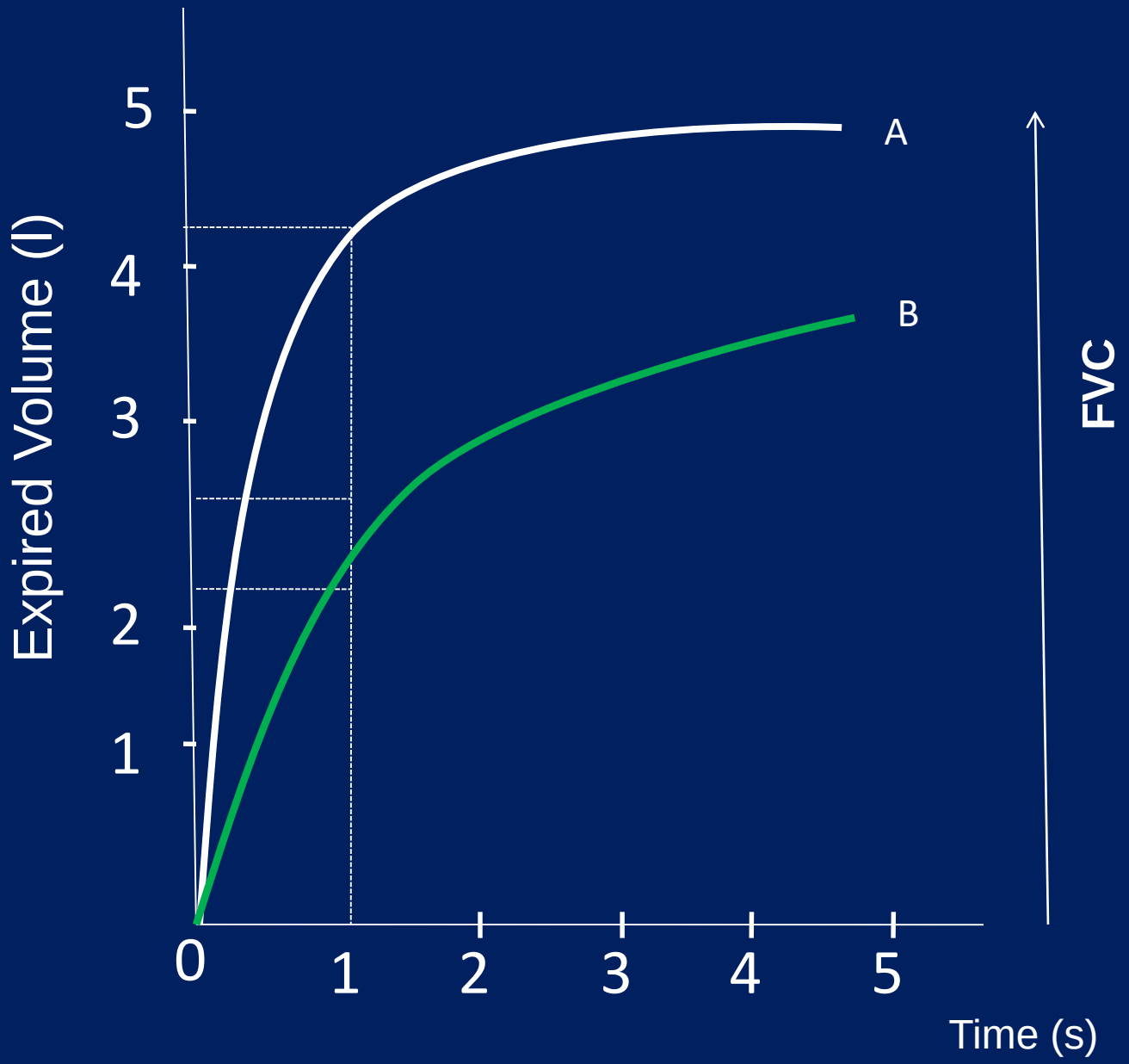
- The ratio is a useful index of airflow limitation.

Normal Trace Showing FEV_1 and FVC

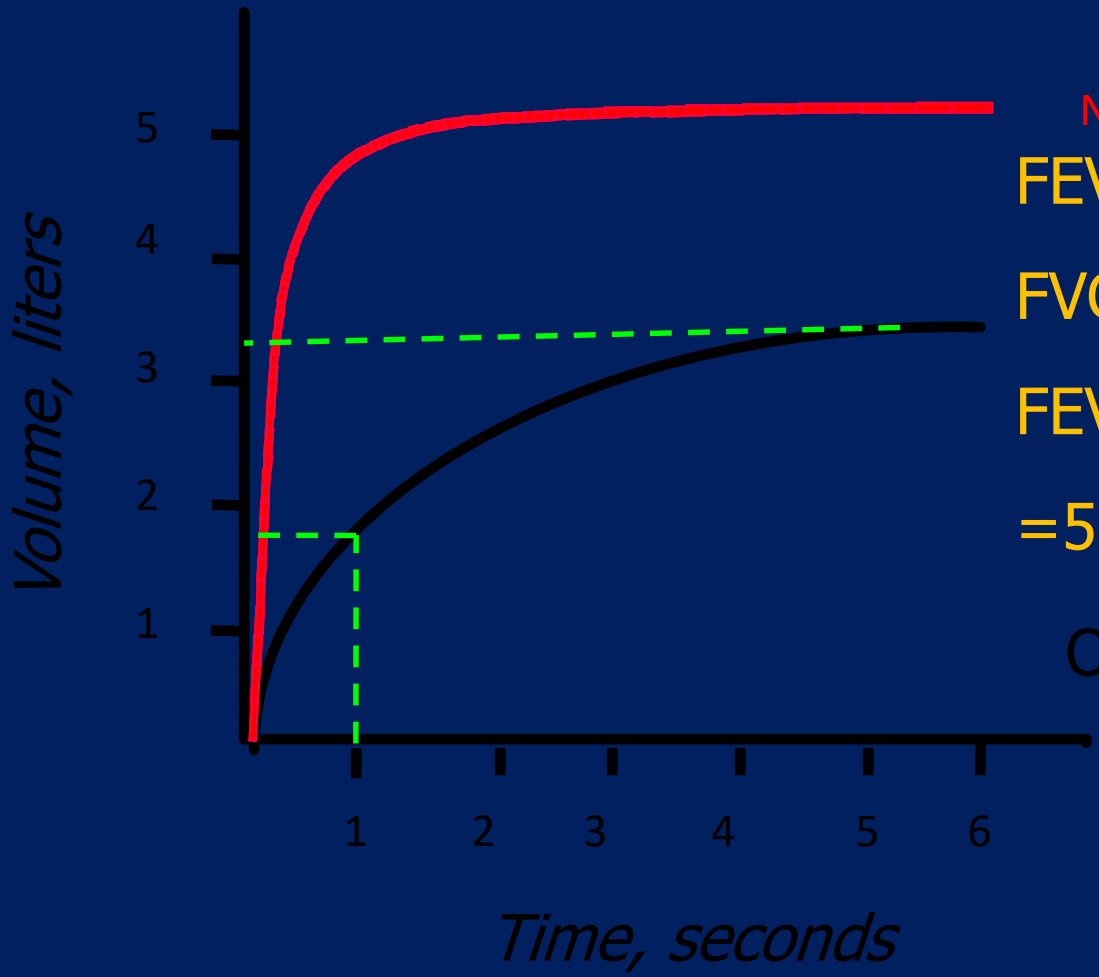



The curve helps ≠
obstructive LD
Restrictive LD

Obstructive lung disease



Obstructive Disease



Normal

FEV_1 = 1.8L

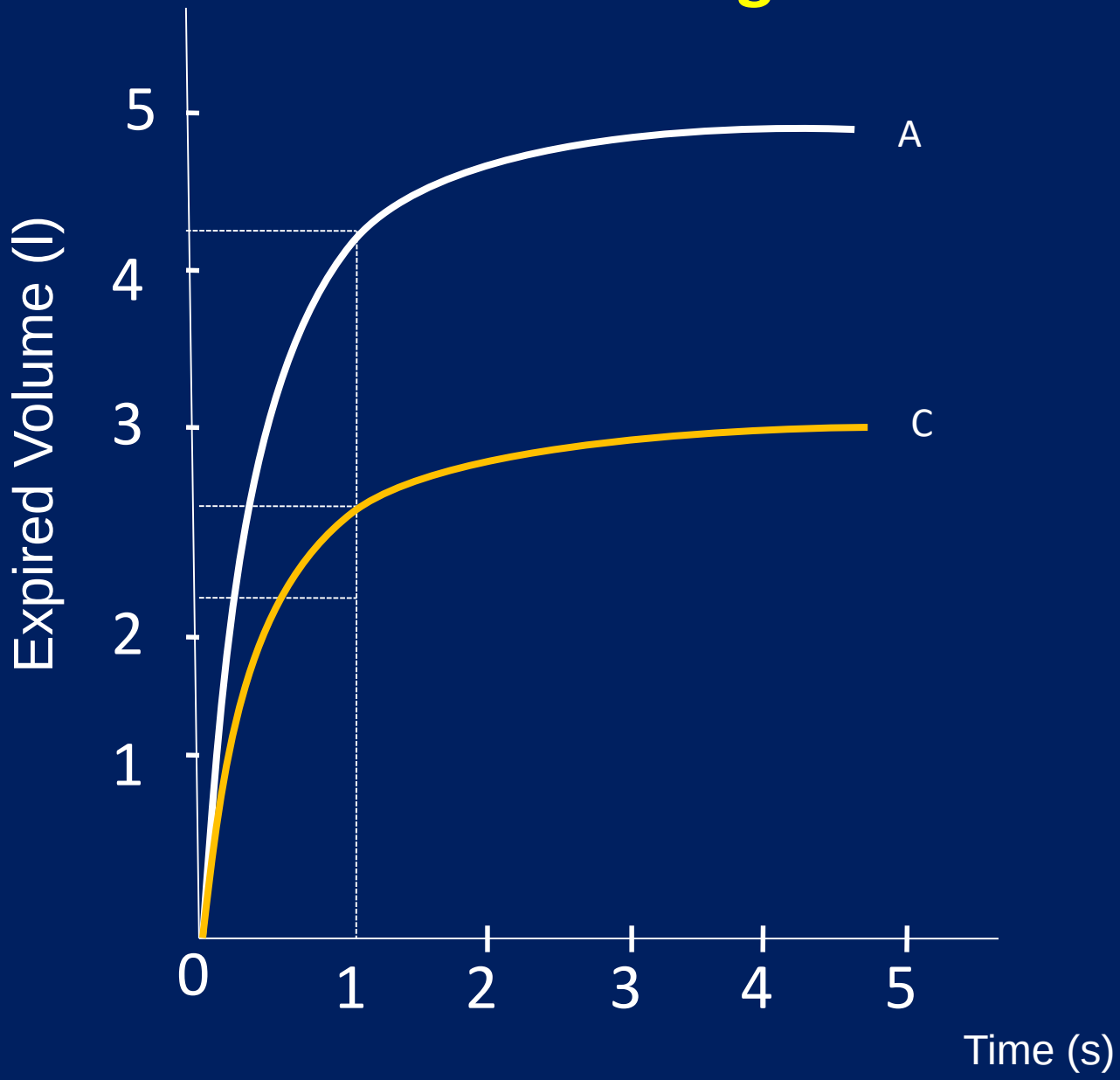
FVC = 3.2L

FEV_1/FVC = 0.56

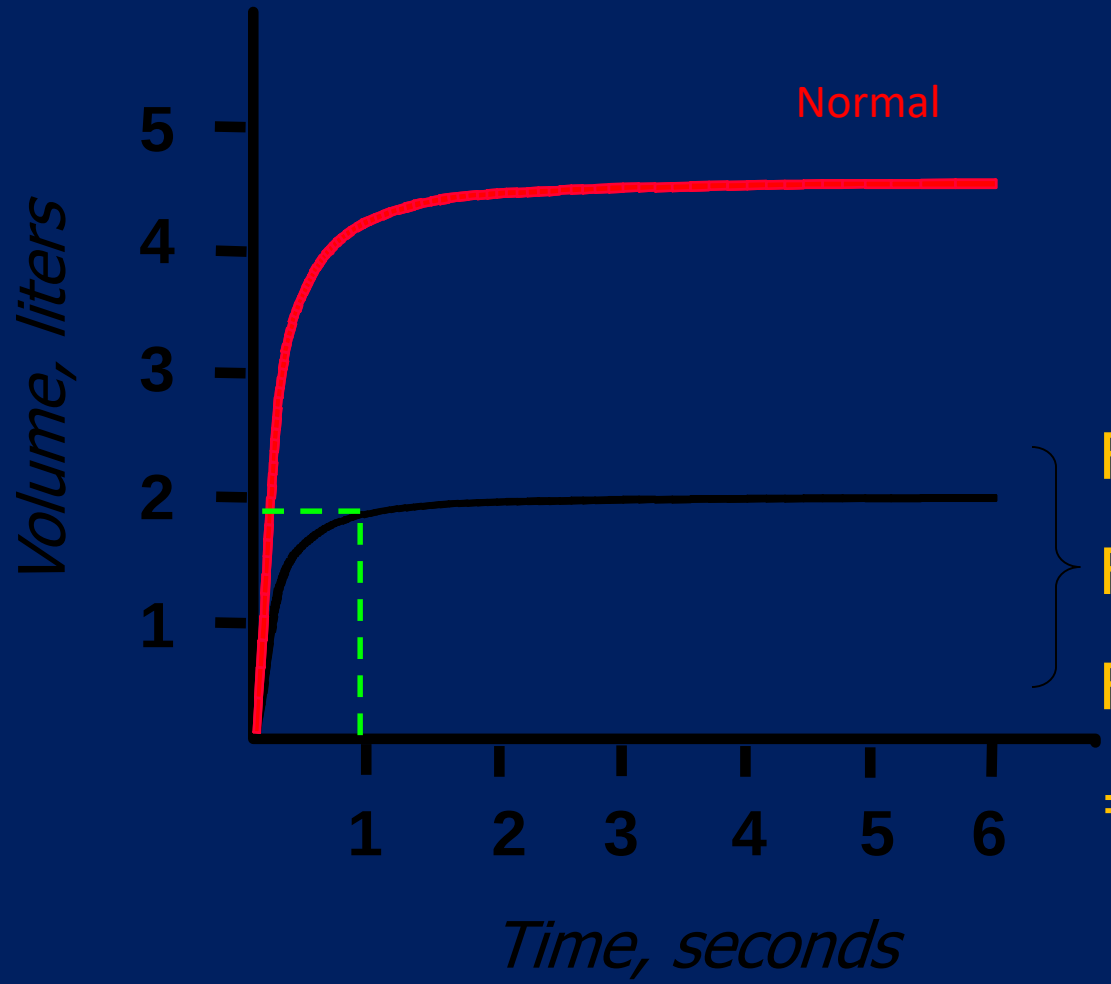
=56%

Obstructive

Restrictive lung disease



Restrictive Disease

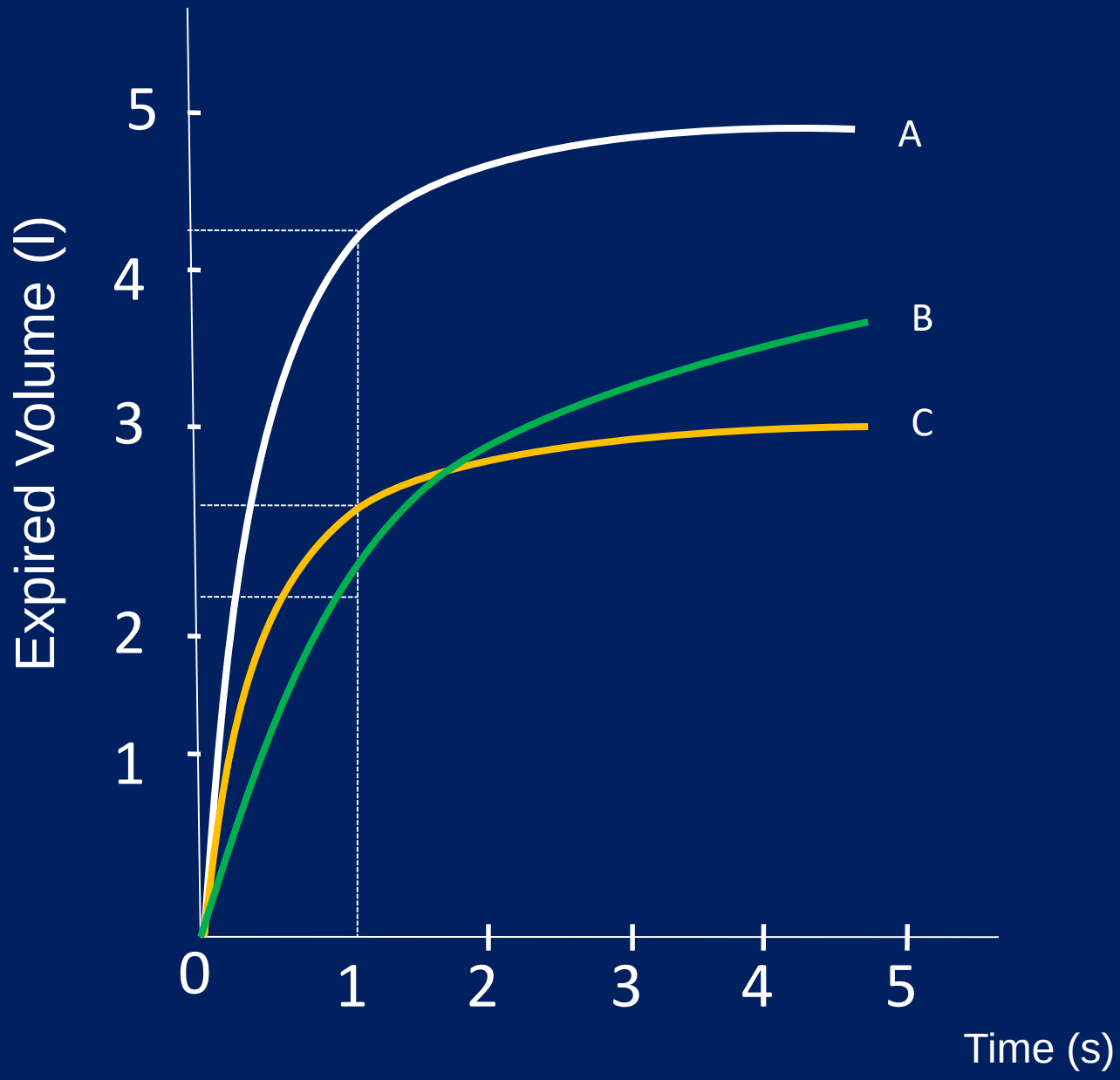


FEV_1 = 1.9L

FVC = 2.0L

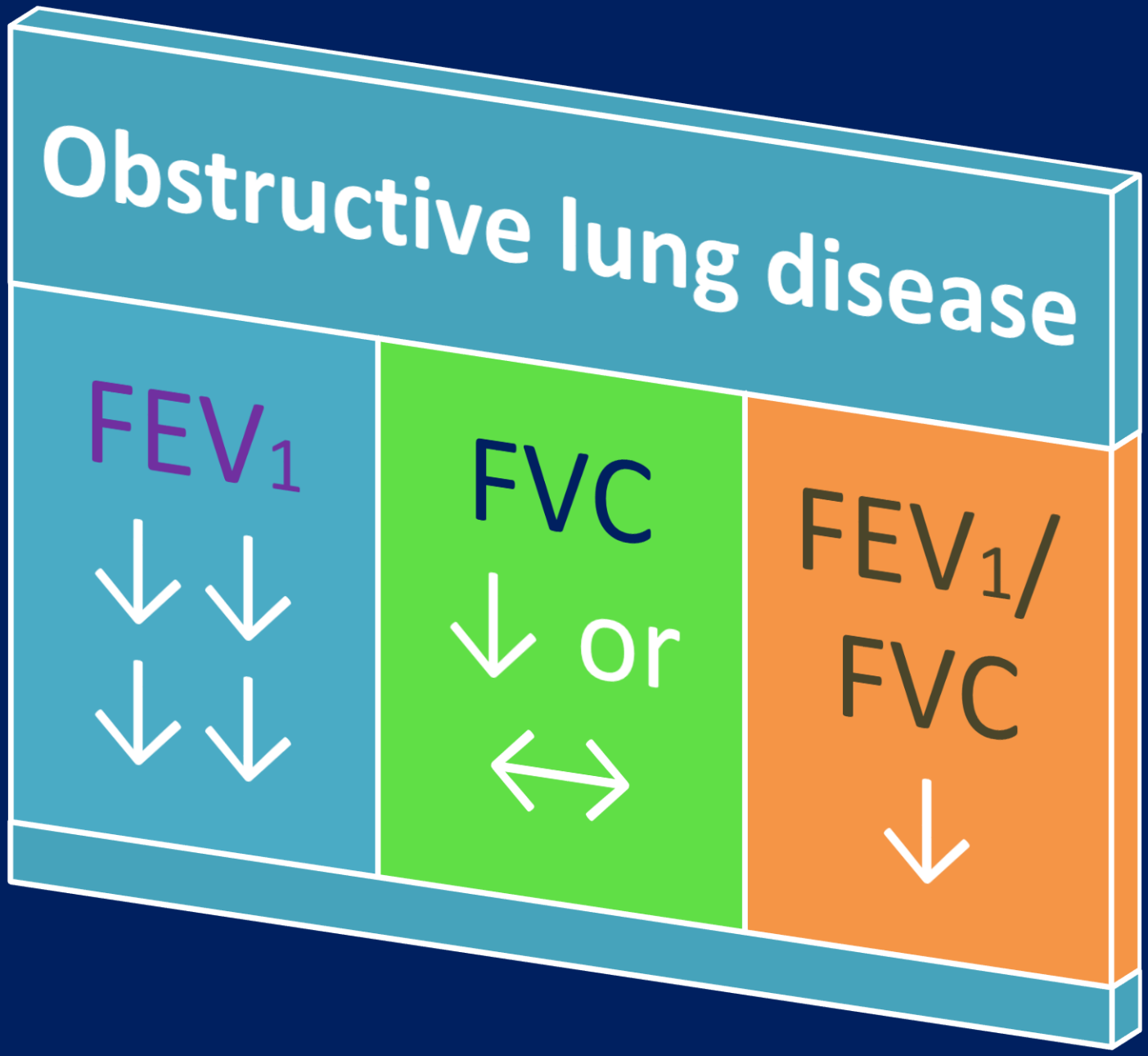
FEV_1/FVC = 0.95

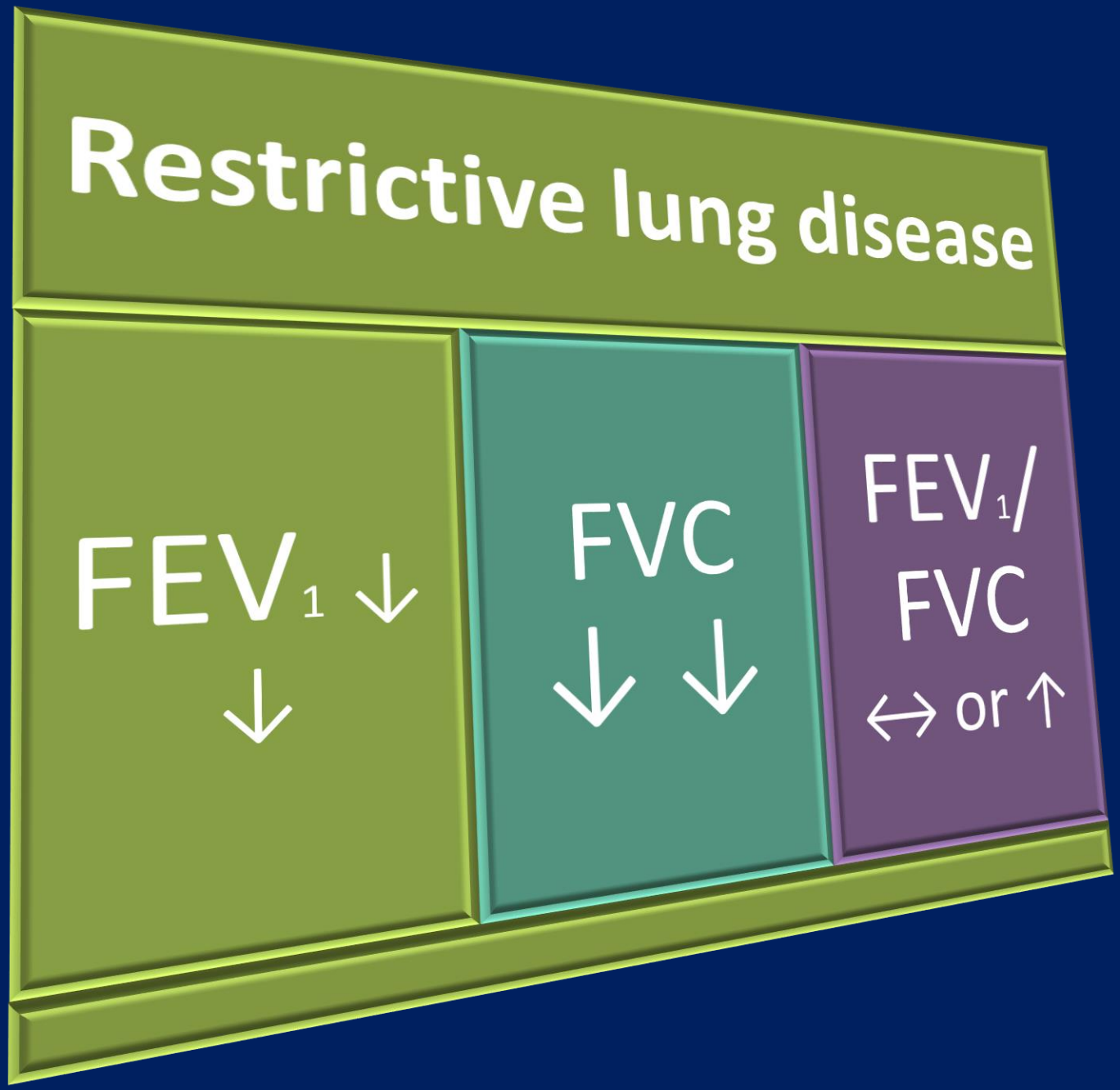
= 95%


Expired Volume (l)
5
4
3
2
1
0
1
2
3
4
5
Time (s)
A
B
C

- The normal and restrictive expire fully in 2 sec.

- The obstructive needs more than 2 sec, the curve rises slowly to reach its highest point.
- He may need more than 6 sec.
- He can or not get rid of all VC depending on the severity of the disease.


Obstructive lung disease
FEV1
↓ ↓
↓ ↓
FVC
↓ or
↔
FEV1/
FVC
↓


Restrictive lung disease
FEV1 ↓
↓
FVC
↓ ↓
FEV1/
FVC
↔ or ↑

Volume	Normal	Obstructive	Restrictive
FVC	5	↓ or ↔ (5)	↓ (3)
FEV_1	4	↓↓↓ (2)	↓ (2.7)
$FEV_1\%$	80%	↓ (40%) (↓ airflow)	↔ or ↑ (90) (Normal airflow)

Results interpretation

- Results are reported as absolute values (litre) ,and as percentages of predicted values based on age, height, sex, ethnicity.

- Normal: Both FVC and $FEV_1 \geq 75\%$ of predicted

- If any of FVC and FEV_1 is < 75% of predicted, calculate FEV_1 ratio:
- $FEV_1\% \geq 70\%$ ------→ Restrictive
- $FEV_1\% < 70\%$ ------→ Obstructive

Calculating percentage of predicted values

Patient: 45 year old woman, height 5'3"

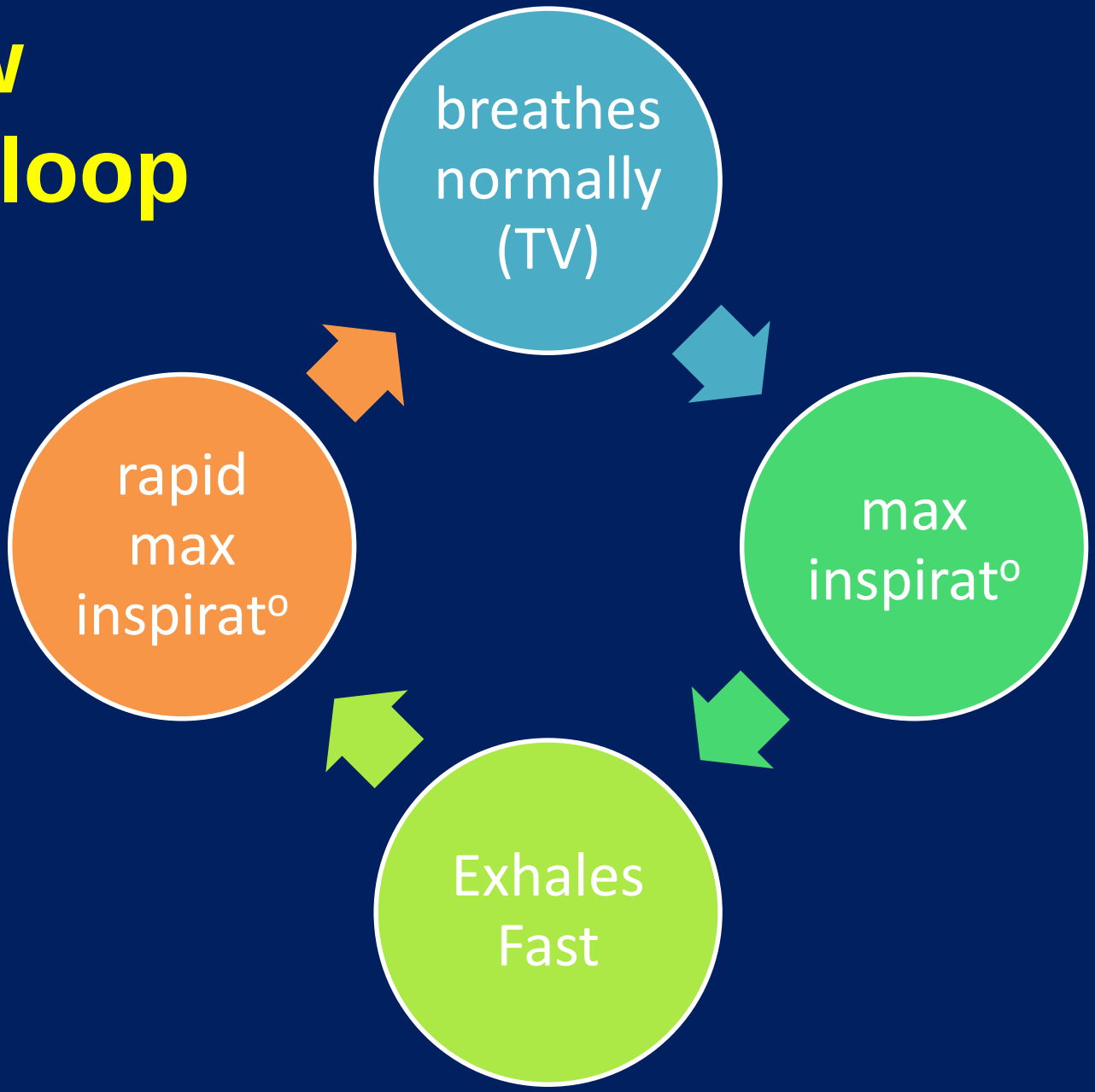
$$FEV_1 \quad \frac{\text{Reading } 1.43}{\text{Predicted value } 2.60} \times 100\% = 55\% \text{ of predicted normal}$$

$$FVC \quad \frac{\text{Reading } 2.5}{\text{Predicted value } 3.03} \times 100\% = 82.5\% \text{ of predicted normal}$$

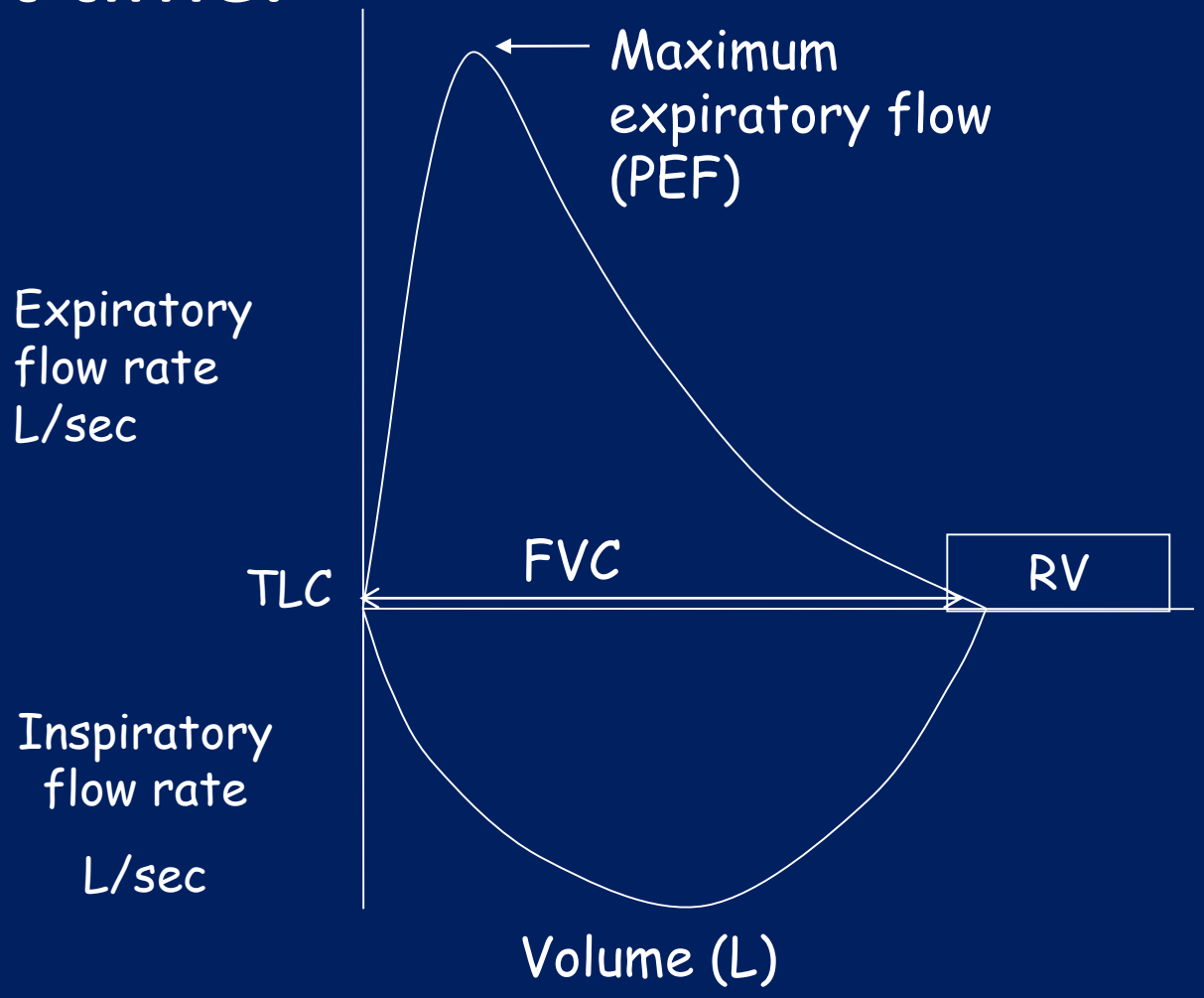
$$\frac{FEV_1}{FVC} \quad \frac{\text{Reading } 1.43}{\text{Reading } 2.5} = 0.57$$

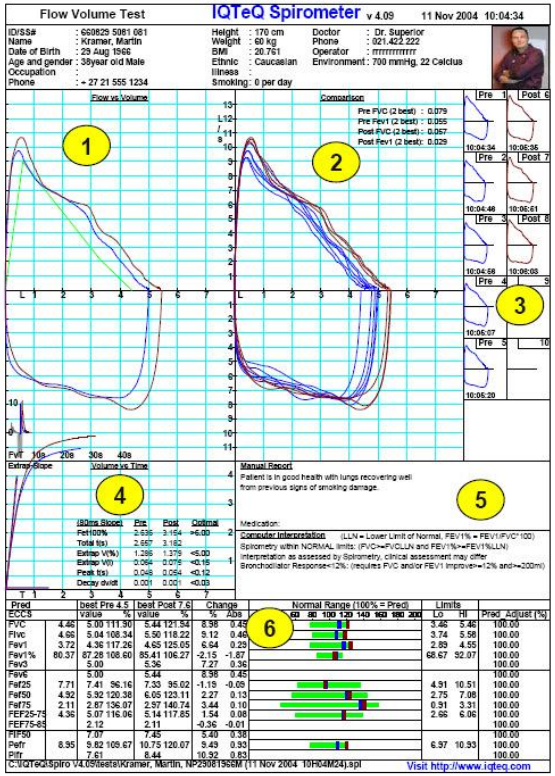
Interpretation: patient has mild airflow obstruction as FEV_1 is between 50% and 80% of predicted normal and FEV_1/FVC is <0.7.

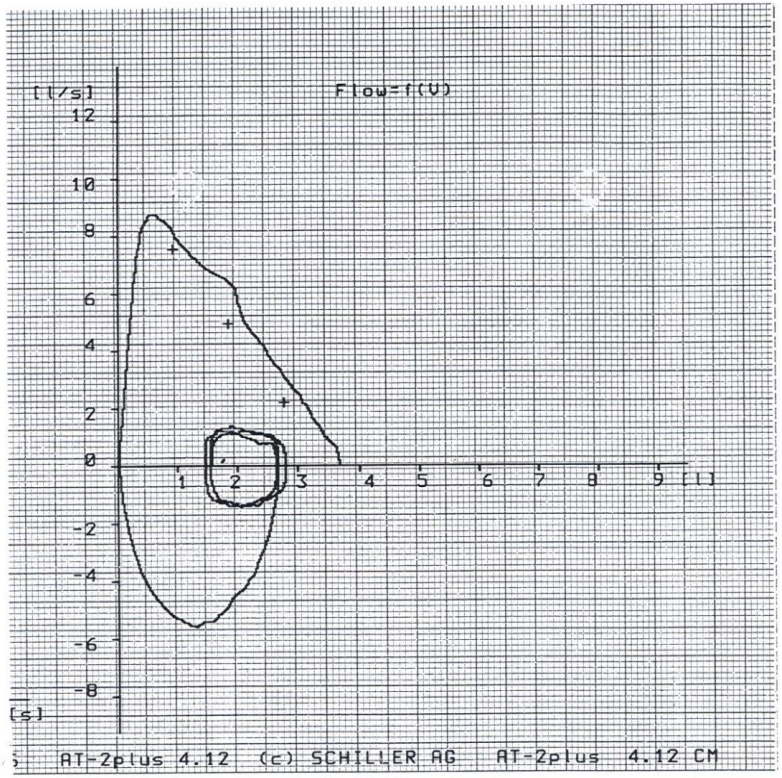
Flow Volume loop



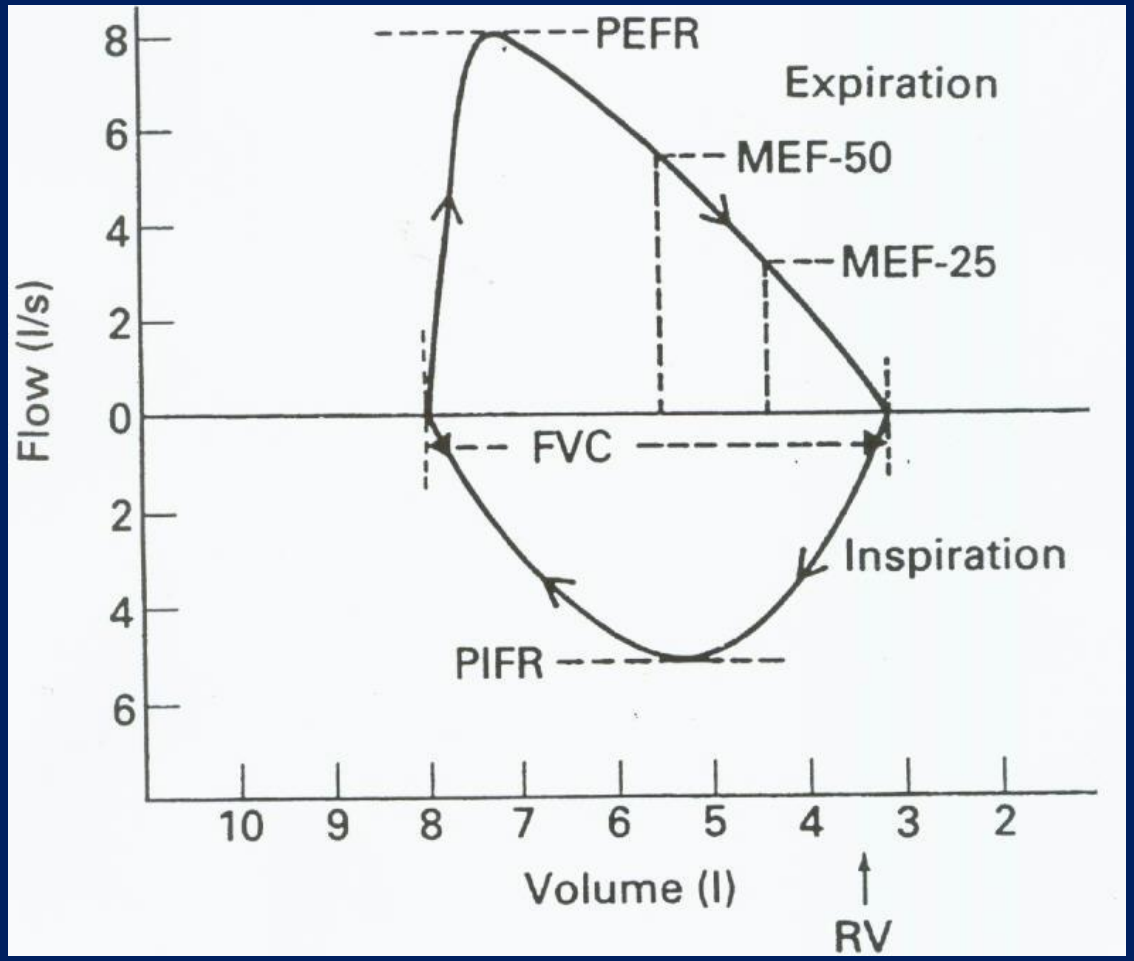
This measures exp & insp flow as a function of exhaled volume rather then against time.




Flow Volume Test
IQTeQ Spirometer v 4.09
11 Nov 2004 10:04:34
ID/SS# : 680829 5081 081
Name : Kramer, Martin
Date of Birth : 29 Aug 1968
Age and gender : 38year old Male
Occupation :
Phone : + 27 21 555 1234
Height : 170 cm
Weight : 60 kg
BMI : 20.761
Ethnic : Caucasian
Illness :
Smoking: 0 per day
Doctor : Dr. Superior
Phone : 021.423.222
Operator : rrrrrrrrrrrrr
Environment : 700 mmHg, 22 Celcius
Flow vs Volume
Comparison
Pre FVC (2 best) : 0.079
Pre Fev1 (2 best) : 0.055
Post FVC (2 best) : 0.057
Post Fev1 (2 best): 0.029
Volume vs Time
Manual Report
Patient is in good health with lungs recovering well from previous signs of smoking damage.
Medication:
Computer Interpretation
Spirometry within NORMAL limits: (FVC>=FVCLLN and FEV1%>=FEV1%LLN)
Interpretation as assessed by Spirometry, clinical assessment may differ
Bronchodilator Response=12%: (requires FVC and/or FEV1 improve>=12% and>=200ml)
Visit http://www.iqteq.com


Flow=f(V)
AT-2plus 4.12 (c) SCHILLER AG AT-2plus 4.12 CM

Flow Volume loop



- **Measurements on flow V loop**

PEFR : Greatest flow achieved during the maneuvre = 6- 12 l/sec

PIFR = max flow speed achieved during forceful inspiratory effort=6 l/sec

MEF50: max expiratory flow at 50% of FVC = 4-6 l

FVC measured over the X-axis

Maximal Flow

The inspiratory and the 1st early expiratory flow rates (flows generated near the TLC) are effort (muscle) dependent: the greater one can raise pleural pressure (the harder one forces the air out), the greater the resulting air flow.

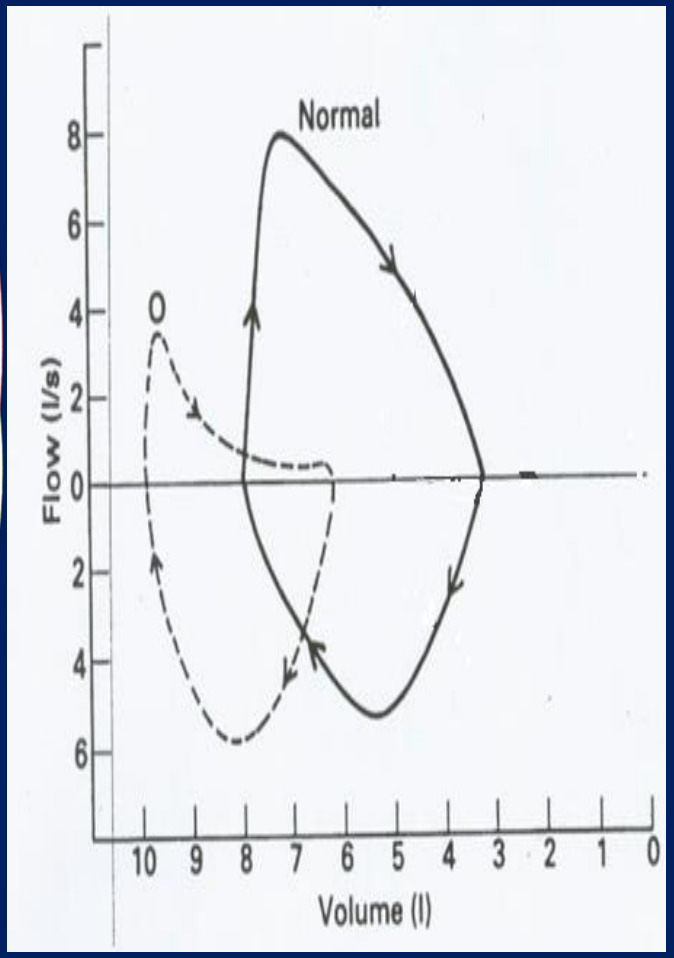
Obstructive LD

MEF50↓

Effort independent part of curve: concave (Curvilinear)

PEFR normal or↓in severe cases

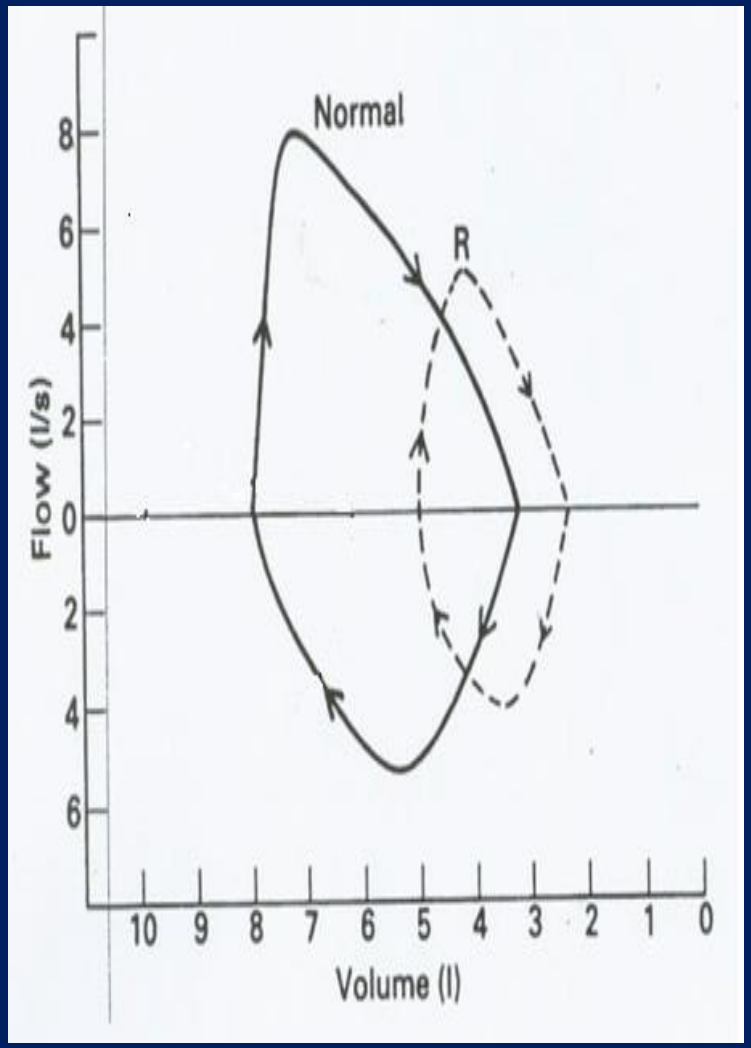
Inspiratory loop Normal

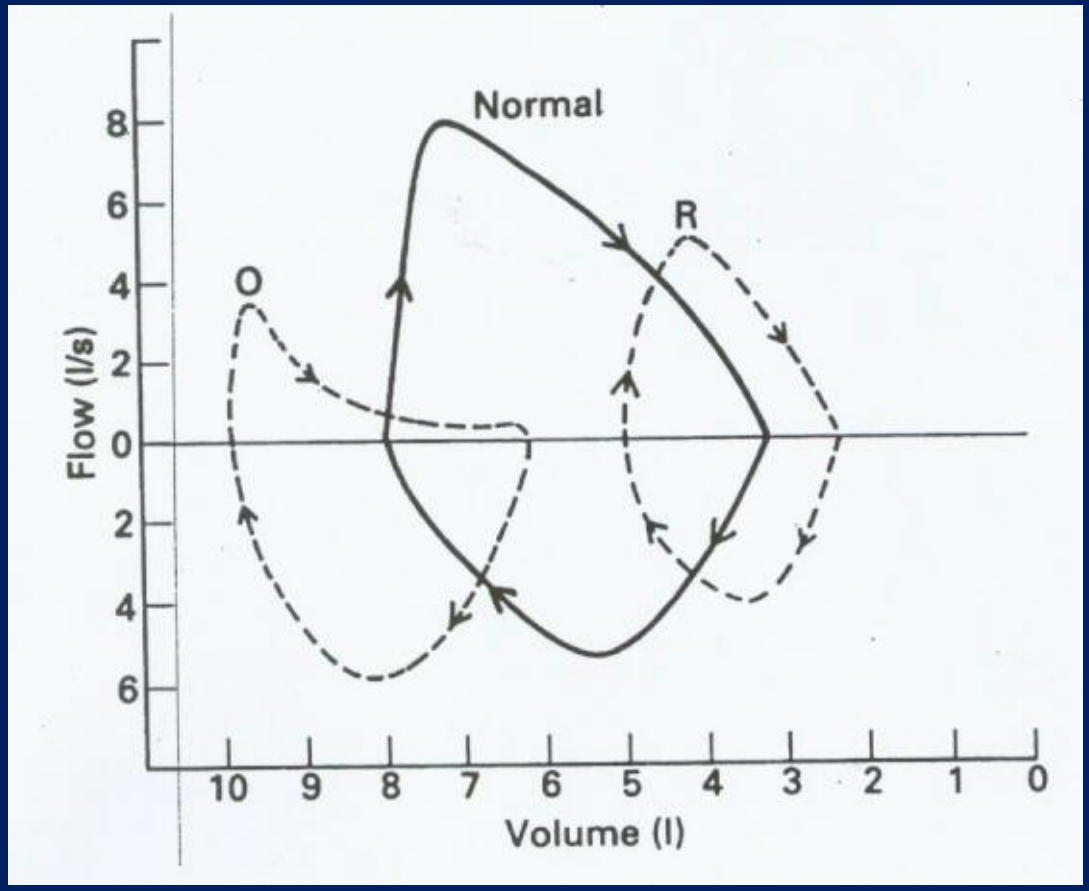


Restrictive LD

Miniature loop (elliptical)

All flow parameters ↓




Normal
R
O
Flow (l/s)
8
6
4
2
0
2
4
6
10
9
8
7
6
5
4
3
2
1
0
Volume (l)

Importance of spirometry

Assess physical fitness.

Helps in the diagnosis of certain pulmonary diseases (obstructive & restrictive).

Follow disease progression.

Thank You