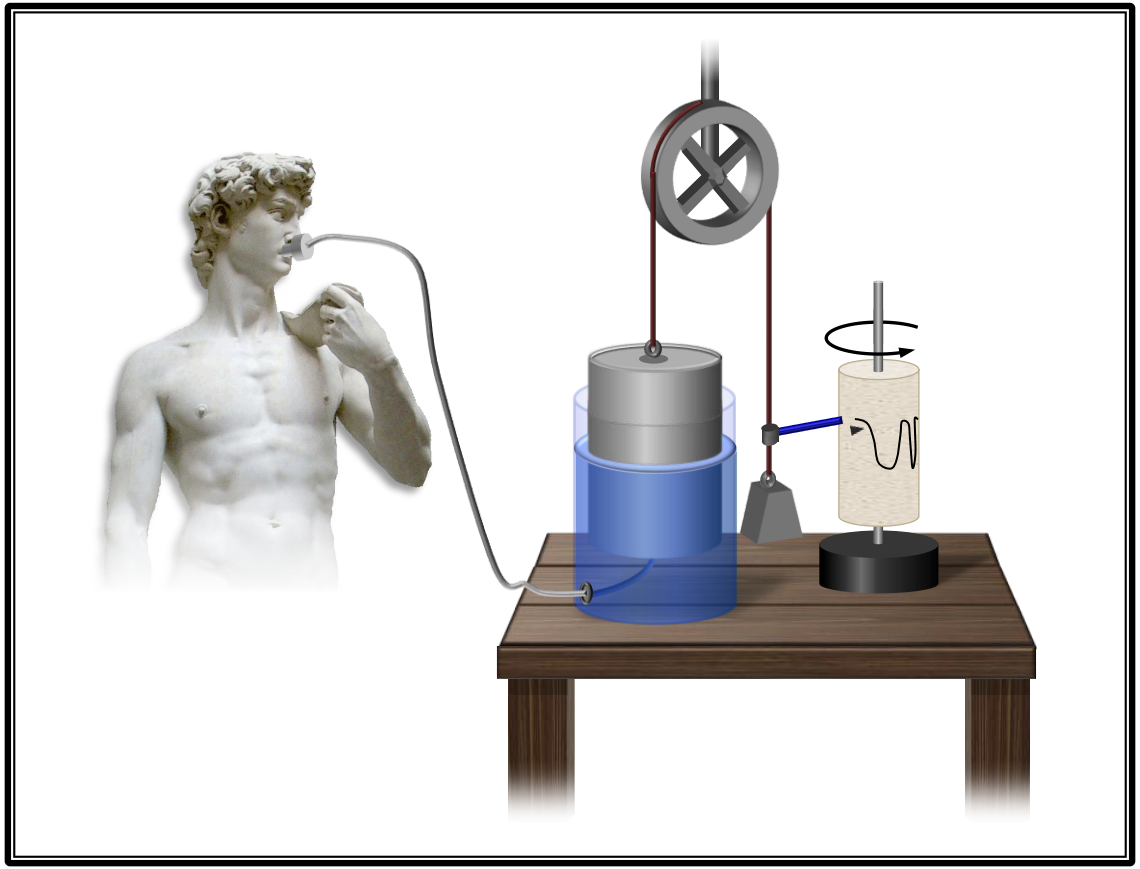
Pulmonary Function Tests

Spirometry

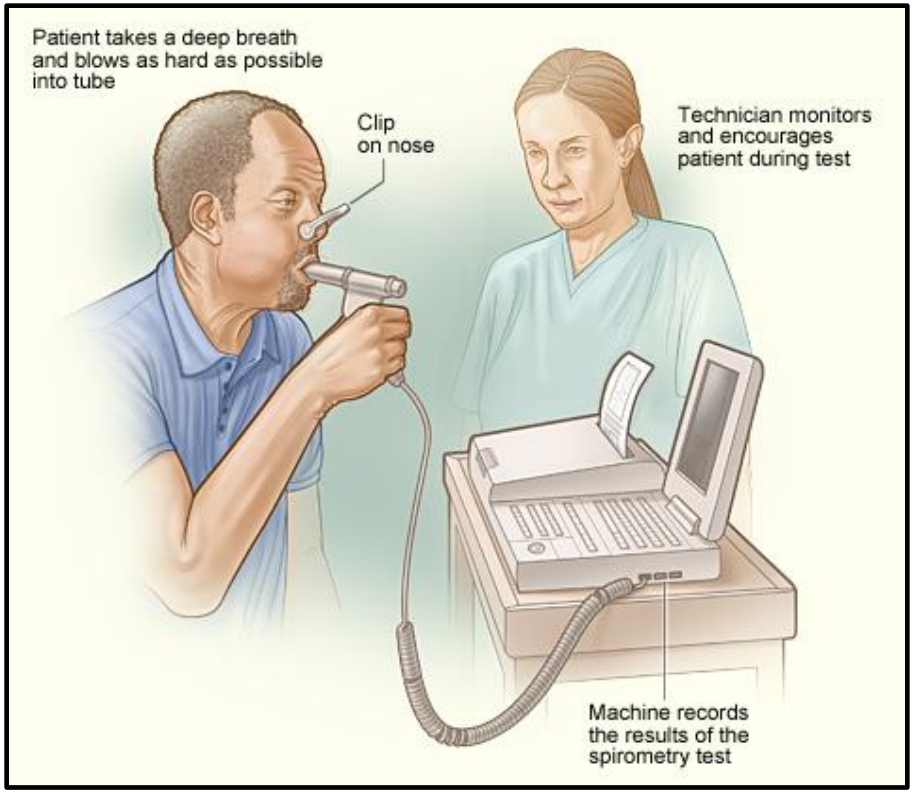
Learning Objectives

- Understand the meaning of FEV_1, FVC, FEV_1/FVC ratio, and the flow-volume loop
- Be able to use these values during diagnostic evaluations.
- Understand how FEV_1 can be used to grade severity of disease.

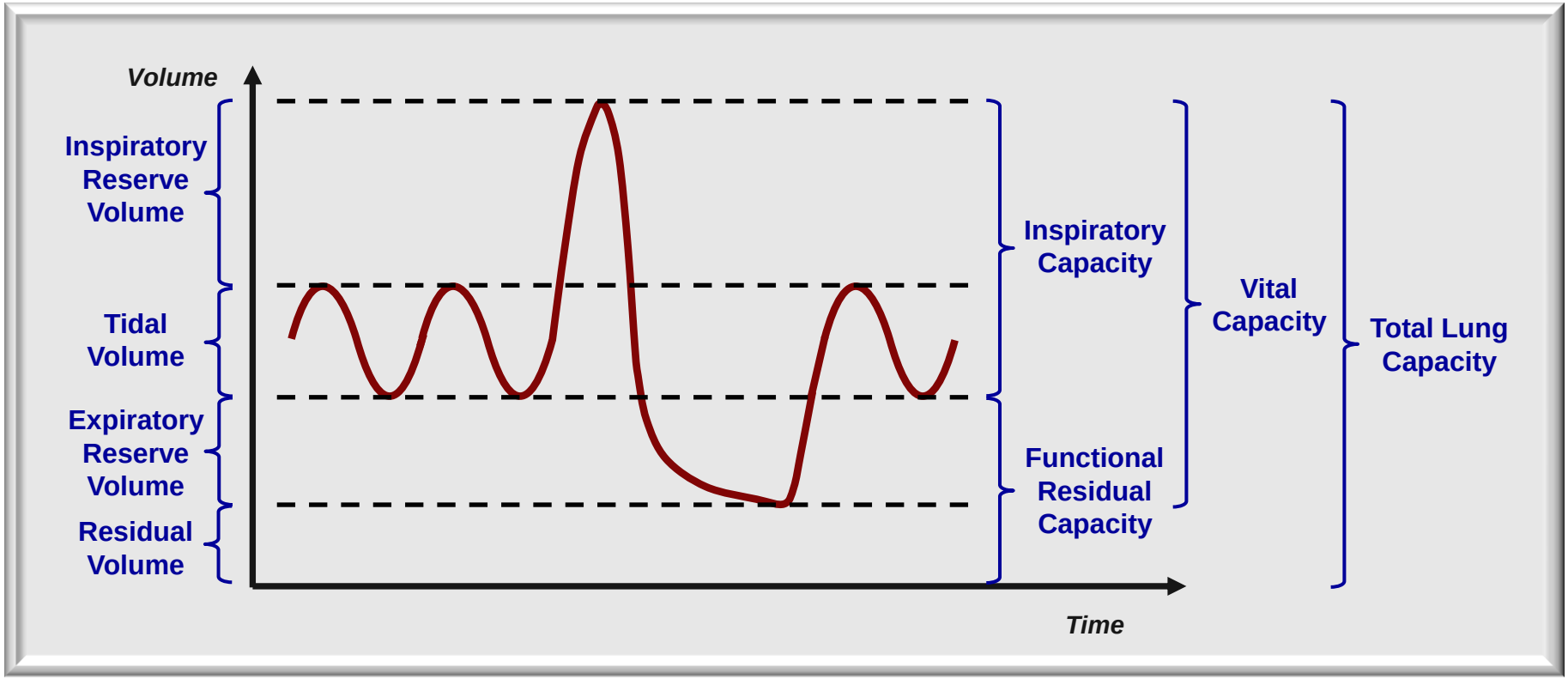
How is Spirometry Performed?



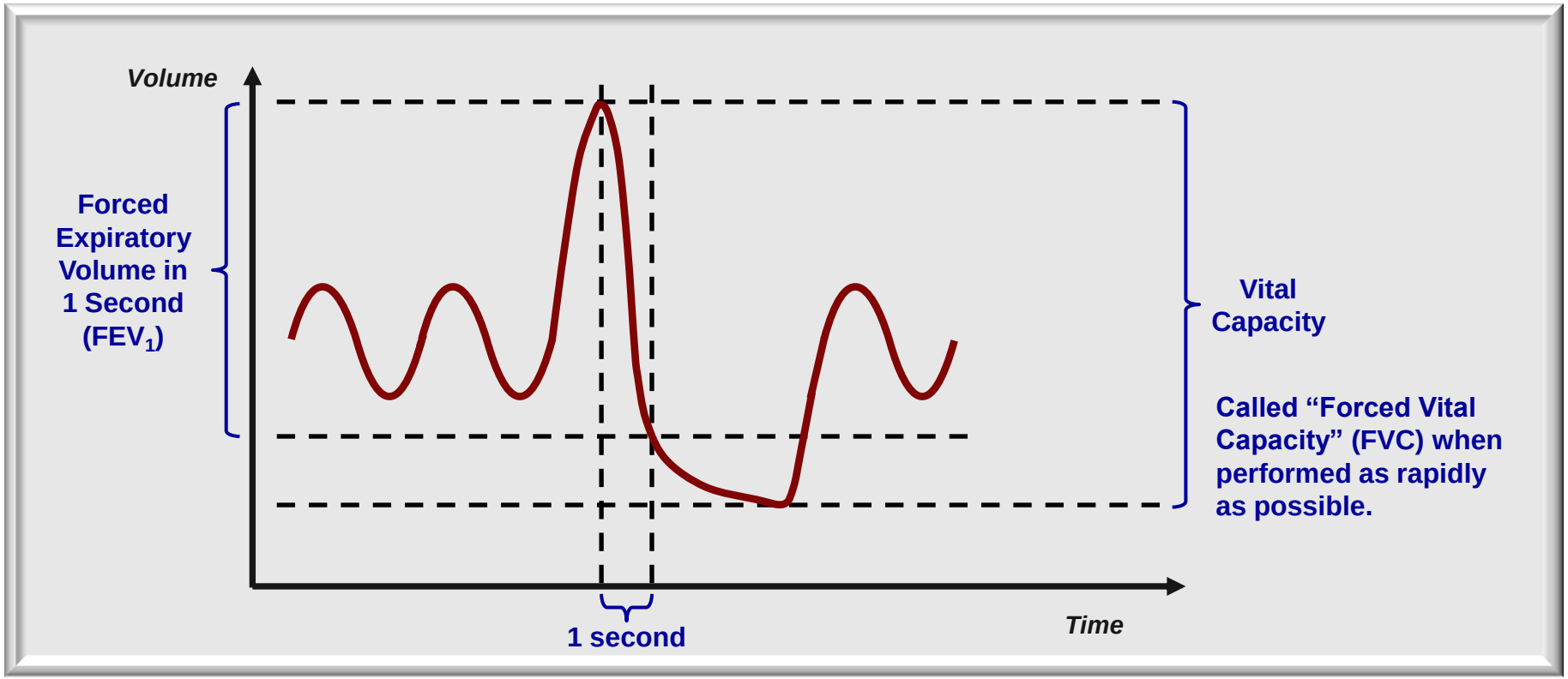
How is Spirometry Performed?



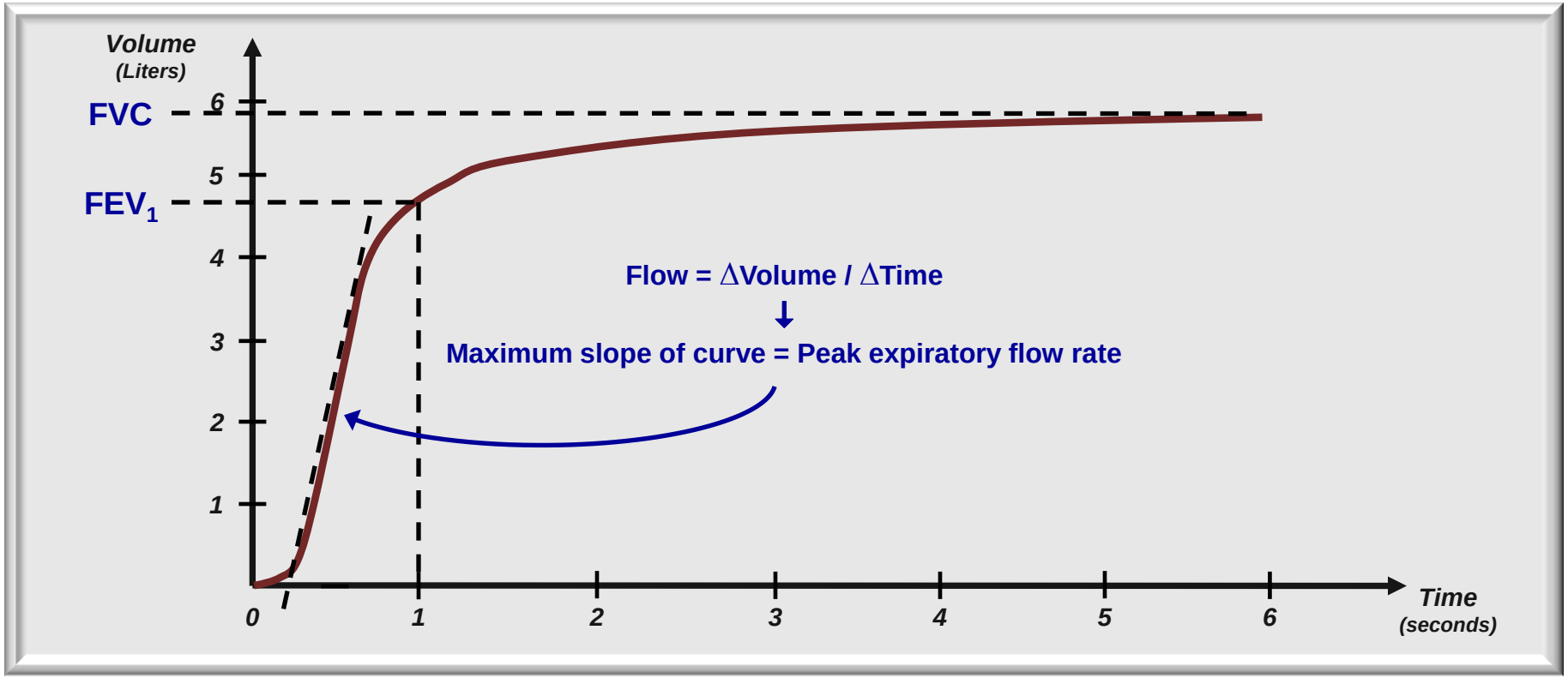
Lung Volumes



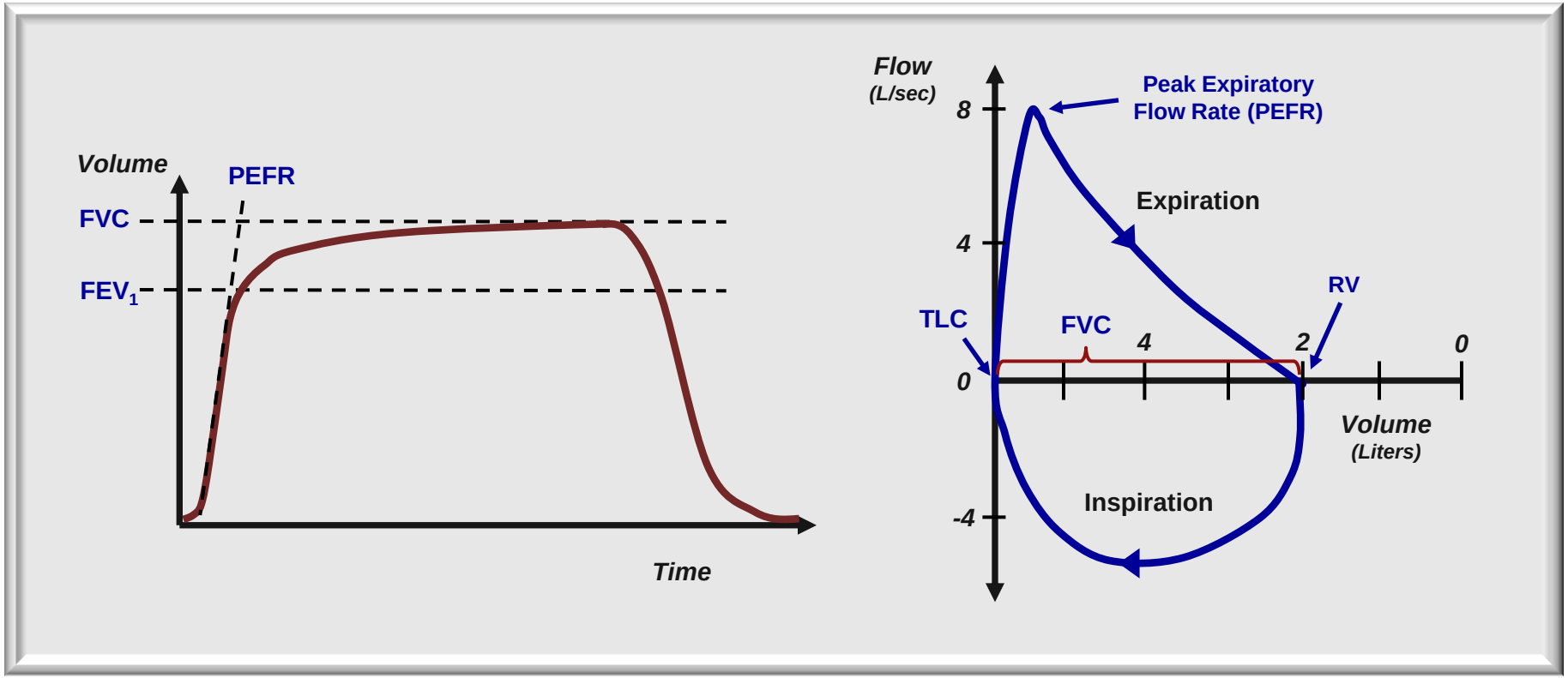
Lung Volumes



FVC Maneuver



Flow-Volume Loop



Values Measured by Spirometry

Major

FEV_1

FVC

FEV_1 / FVC ratio

Flow volume loop

Minor

Peak expiratory flow rate (PEFR)

$FEF_{25-75\%}$

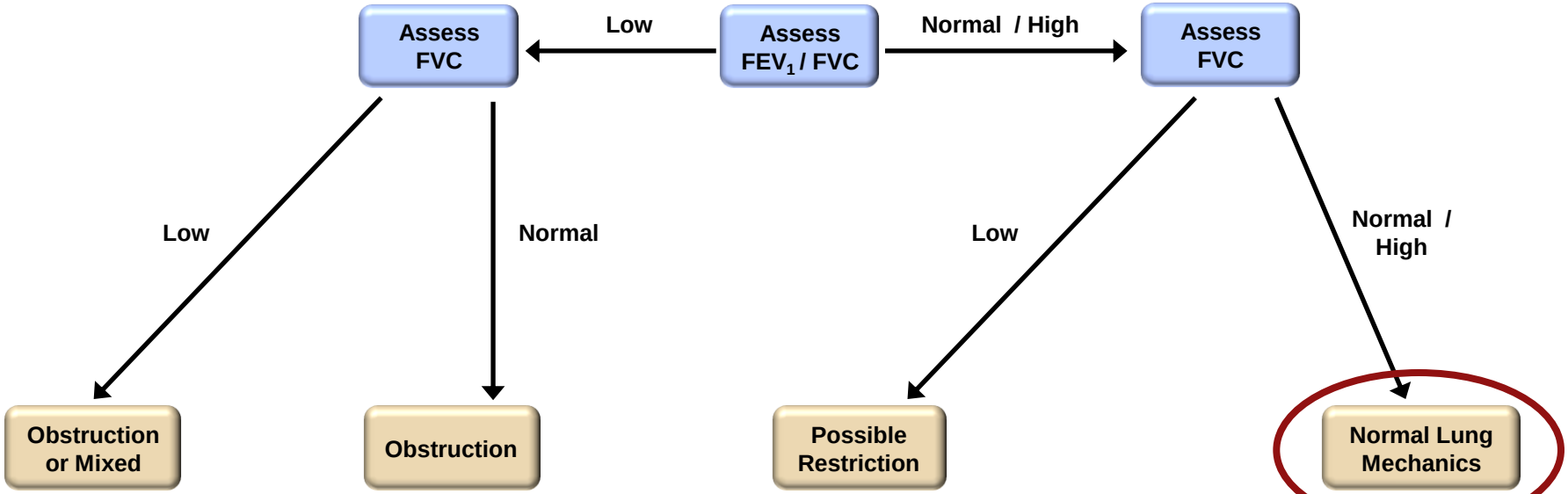
Maximal voluntary ventilation (MVV)

Response to bronchodilators

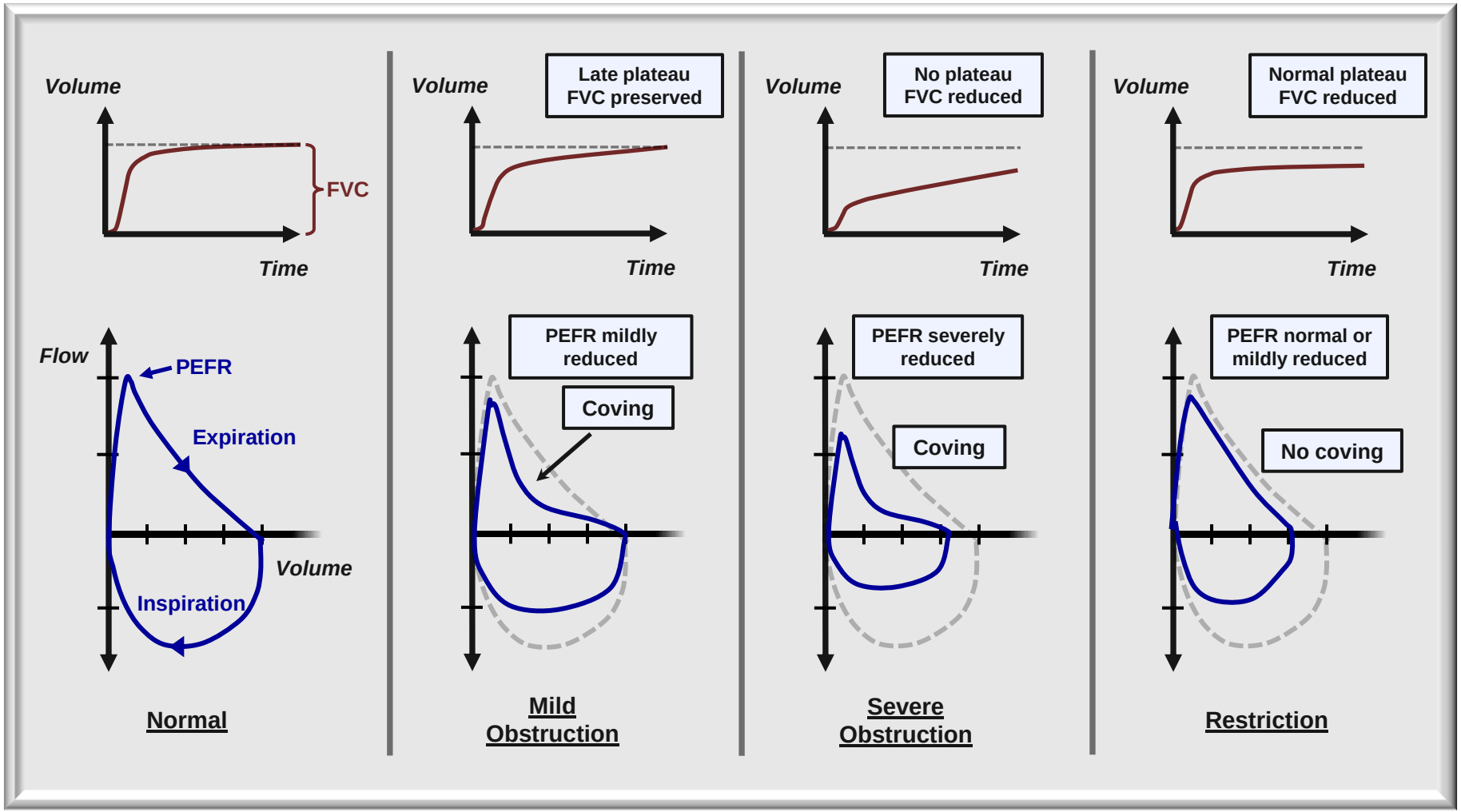
Interpretation of FEV_1, FVC, and FEV_1/FVC Ratio

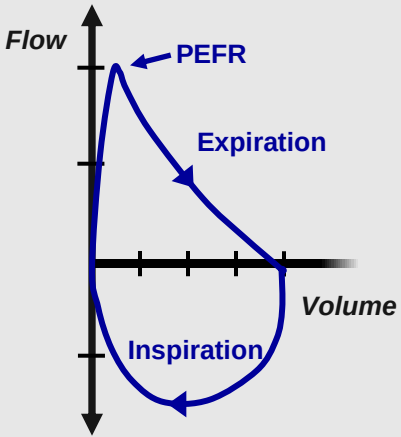
	FEV_1	FVC	FEV_1 / FVC Ratio (Tiffeneau Index)
Obstructive Lung Disease	**Normal** (very mild obstruction) **or** **Decreased** (mod/severe obstruction)	**Normal** (mild/mod obstruction) **or** **Decreased** (severe obstruction)	**Decreased** (< 70%)
Restrictive Lung Disease	**Normal or Decreased**	**Decreased**	**Normal or Increased** (≥ 70%)

Interpretation of Spirometry



Where is pulmonary vascular disease?


Volume
FVC
Time
Flow
PEFR
Expiration
Volume
Inspiration
Normal
Volume
Late plateau
FVC preserved
Time
PEFR mildly
reduced
Coving
Mild
Obstruction
Volume
No plateau
FVC reduced
Time
PEFR severely
reduced
Coving
Severe
Obstruction
Volume
Normal plateau
FVC reduced
Time
PEFR normal or
mildly reduced
No coving
Restriction



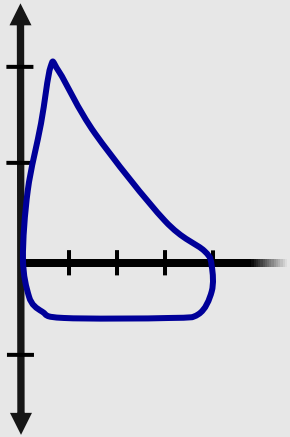
Normal

Examples

Vocal cord paralysis

Tracheomalacia

Airway tumor

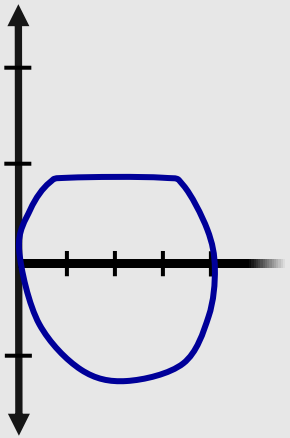


Variable Extrathoracic Airway Obstruction

Examples

Tracheomalacia

Airway tumor



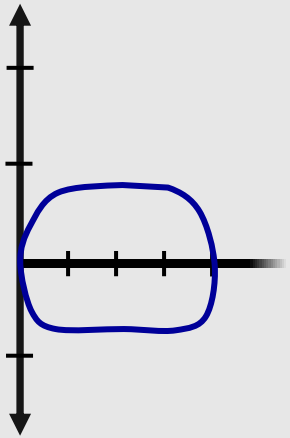
Variable Intrathoracic Airway Obstruction

Examples

Tracheal stenosis

Goiter

Airway tumor



Fixed Airway Obstruction

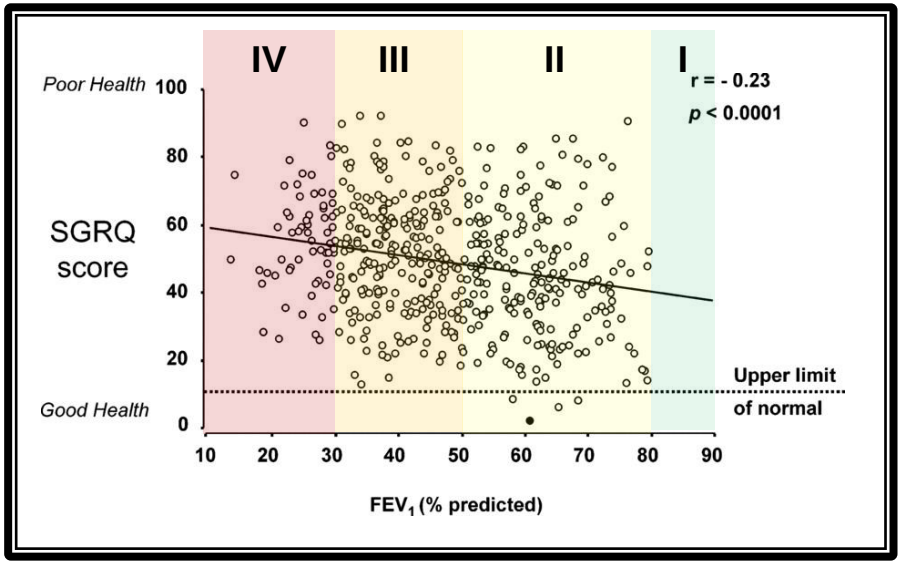
Staging of COPD Based on FEV_1

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) classifies COPD severity based on post-bronchodilator FEV_1.

	FEV_1 compared to predicted for age/gender/height
GOLD Stage I	**$FEV_1 \geq 80\%$**
GOLD Stage II	**$50\% \leq FEV_1 < 80\%$**
GOLD Stage III	**$30\% \leq FEV_1 < 50\%$**
GOLD Stage IV	**$FEV_1 < 30\%$**

Staging of COPD Based on FEV_1

There is only a weak correlation between FEV_1 and quality of life.



Adapted from: Jones PW. Health status and the spiral of decline. COPD. 2009; 6: 59-63.

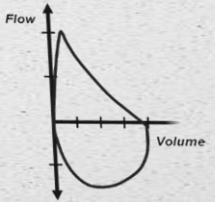
SQRQ = St. George Respiratory Questionnaire – a disease-specific instrument designed to measure impact on overall health, daily life, and perceived well-being in patients with obstructive airways disease. (Higher numbers → more limitations)

Assessing Response to Bronchodilators

- Among patients with obstructive lung disease, > 12-15% increase in FEV_1 after administration of a bronchodilator is considered significant.
- However, a lack of such an increase should not preclude a trial of bronchodilators.

Patient: Don Draper **Age: 42** **Gender: Male**

		Ref	Pre	% Ref	Post	% Ref
Spirometry						
FVC	Liters	3.2	2.3	72	2.5	78
FEV1	Liters	2.6	1.0	38	1.2	46
FEV1/FVC	%	81	43		48	
FEF25-75%	L/sec	2.8	0.6	21	0.7	25
PEF	L/sec	5.9	3.9	66	4.2	71
Lung Volumes						
TLC	Liters	4.9	6.4	131		
VC	Liters	3.2	2.4	75		
IC	Liters	2.1	1.8	86		
FRC	Liters	2.7	3.2	119		
RV	Liters	1.7	3.6	212		
RV/TLC	%	35	56			
Diffusing Capacity						
DLCO	mL/mmHg/min	22	16	73		
DL Adj	mL/mmHg/min	22	14	64		



Comments: Tests are pre and post 4 puffs albuterol