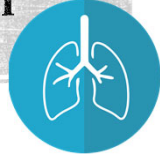


# Understanding pulmonary function testing

Sarah Nielsen MS, APRN, FNP-C



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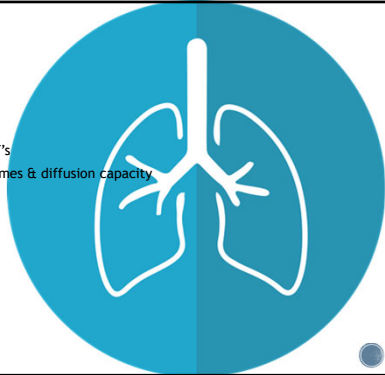
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## Objectives

- Components of PFT
- Understand terminology of PFT's
- Interpret spirometry, lung volumes & diffusion capacity
- Recognize patterns of disease
- Determine severity of disease



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## Indications for testing

- Diagnosis of symptomatic disease
- Evaluate the extent of disease/ monitor course of disease
- Smoker? Test at age 40, even if no symptoms are present
- Repeat testing every 3-5 years is reasonable
- Evaluate treatment/Assess progression of disease
- Screening for high risk patients/ measure effects of exposures
- Pre-surgical testing
- Evaluate abnormal radiological finding (Hyperinflation on CXR)
- Systemic disease (scleroderma, SLE, RA...)



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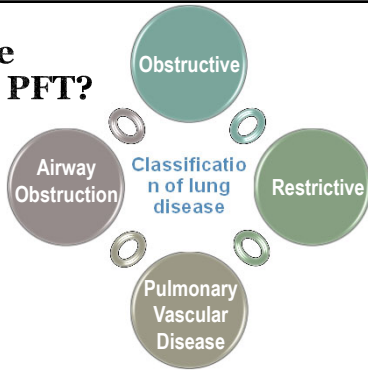
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# What do we learn from PFT?

- How much and how fast air moves in and out of the lungs
- How stiff are the lungs and chest wall (lung compliance)
- Diffusion characteristics




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# Contraindications



- Pneumothorax
- Recent surgery (lung, abdomen, nose, eyes)
- Aneurysm
- Myocardial Infarction
- Acute Pulmonary Embolism
- Severe Hypertension (SBP > 200)
- Confusion/Dementia
- Acute infection (i.e. influenza)
- Tracheostomy

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# Components

- Spirometry
- Lung Volumes
- Diffusing Capacity (DLCO)
- Flow Volume Loop

Dyspnea Rest: No		Dyspnea Exercise: Yes		Cough: Yes		Persistent: Yes		Productive (cc):		Pleur: No	
Smoker: Yes		Cigarettes: Yes		Cigarettes: No		Quit: Yes		Stopped: 10			
How Long: 40		Pre	Post	%Pre	%Post	Pre	Post	%Pre	%Post	Pre	Post
<b>Spirometry</b>											
FVC	Liters	3.43	2.48	72	2.90	85	18				
FEV1	Liters	2.73	2.06	21	0.63	23	13				
FEV1/FVC	%	80	23	29	22	27	-4				
FEF25-75%	L/sec	2.81	2.21	8	2.21	7	-6				
FEF25%	L/sec	8.78	0.38	6	0.38	5	-5				
FEF50%	L/sec	3.53	0.23	7	0.23	6	-3				
FEF75%	L/sec	1.20	0.17	14	0.13	12	-12				
PEF	L/sec	7.45	2.40	39	1.98	27	-31				
FET100%	Sec	11.74	1.98	58	10.32	31					
FIF50%	Liters	3.43	1.98	58	2.33	68	18				
FIF50%	L/sec	4.20	4.20	63	6.63	68	18				
<b>Lung Volumes</b>											
TLC	Liters	6.61	2.17	138							
VC	Liters	3.43	2.46	72							
IC	Liters	2.68	0.71	27							
FRC PL	Liters	3.39	4.40	193							
RV	Liters	1.32	1.47	111							
RV/TLC	%	2.20	4.71	234							
RV	Liters	39	98	167							
RV	%	59	67	167							
<b>Diffusing Capacity</b>											
DLCO	ml/min/mmHg	10.1	7.1	39							
DLCO VA	ml/min/mmHg/L	3.62	1.93	33							
DL	Liters		3.97								
<b>Resistance</b>											
Raw	cmH2O/lsec	1.36	0.80	647							
Gen	L/sec/cmH2O	0.805	0.114	14							
aRaw	cmH2O/Lit	4.90	99.34	1301							
hRaw	L/sec/cmH2O	0.218	0.077	8							

Comments  
 COPD patient effort  
 VD Abnormal increased to gram

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## Important terms & abbreviations

FVC	Forced Vital Capacity	80%-100%	Total volume of air a patient is able to exhale for the total duration of the test during maximal effort
FEV <sub>1</sub>	Forced Expiratory Volume in 1 Second	80%-100%	Forced expiratory volume in 1 second; total volume of air a patient is able to exhale in the first second during maximal effort
TLC	Total Lung Capacity	80%-117%	The volume of air in the lungs at maximal inflation
RV	Residual Volume	65%-117%	The remaining volume of air in the lung at the end of exhalation
DLCO	Diffusion Capacity for Carbon Monoxide	80%-100%	
FEV <sub>1</sub> /FVC ratio	Ratio of Forced Vital Capacity & FEV <sub>1</sub>	>70%	The percentage of the FVC expired in 1 second
FEF <sub>25-75%</sub>	Forced expiratory flow over the middle 1/2 of the FVC	>60-125%	The average flow from the point at which 25% of the FVC has been exhaled

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## Spirometry

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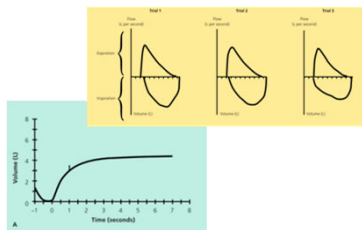
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## Test validity

1. Volume-time curve plateaus/expiration lasts 6 seconds
2. Two best efforts are within 0.2 L
3. Flow-volume loops are free of artifacts




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## Flow Volume Loop

- Illustrates maximum expiratory and inspiratory flow-volume curves
- It is a curve representing the relation between flow rates and volume during VC divided into maximum expiratory and inspiratory flow volume curves
- It can help localize an area of obstruction
- It can identify poor test quality/test mistakes

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## Flow Volume Loop

**OBSTRUCTIVE**

Loop shifts to the left

**NORMAL**

**RESTRICTIVE**

Loop shifts to the right

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## Loops with artifact

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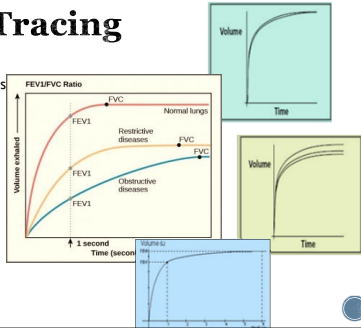
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## Volume Time Tracing

- Three acceptable and consistent traces assures test validity
- Identify cessation in exhalation, slow start, extra breaths, or early stop




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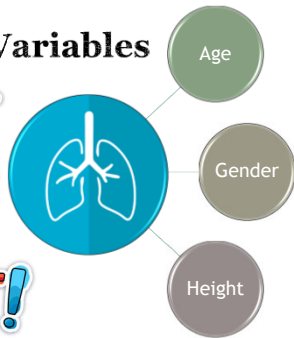
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## Prediction Variables




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## FVC Forced Vital Capacity

Normal FVC: 80%-100% predicted

- Maximally rapid expiratory vital capacity
- Maximal flow is very sensitive to the most common diseases that effect the lung
- BMI > 35 can be associated with a reduction in FVC of 5-10%
- If normal, significant restriction is ruled out

Decreased FVC? Obstruction or restriction

- Problems with the lung
  - Previous resection, lung collapse
  - Areas cannot expand - fibrosis
  - Obstruction
- Problems with the Pleural Cavity
  - Enlarged heart, pleural fluid
  - Tumor
- Restriction of chest wall
  - Cannot inflate/deflate
- Problem with respiratory muscles
  - Diaphragm, intercostals, abdominal muscles

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## Restrictive vs Obstruction

### Obstructive

- Chronic Obstructive Pulmonary disorder (COPD)
- Asthma
- Cystic Fibrosis
- Alpha-1 Antitrypsin Deficiency
- Bronchiectasis
- Bronchiolitis obliterans
- Silicosis

### Restrictive

- Interstitial lung Disease
  - Asbestosis, Berylliosis, Esophageal pneumonia, Hypersensitivity pneumonitis, IPF, Sarcoidosis, Silicosis
- Neuromuscular Disorders
  - Amyotrophic lateral sclerosis, Guillain-Barre syndrome, Muscular Dystrophy, MG
- Kyphosis, Scoliosis
- Morbid Obesity
- Ankylosing spondilosis
- Medication Toxicity
  - Amiodarone, Methotrexate, Nitrofurantoin
- Pulmonary alveolar proteinosis




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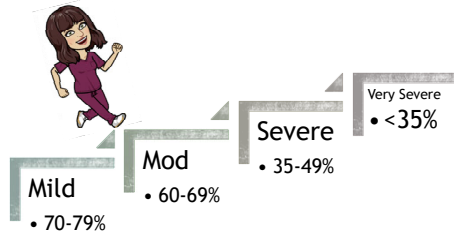
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## Severity of obstruction using FVC




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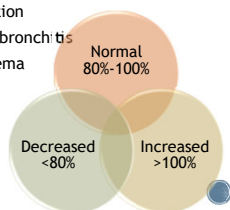
## FEV<sub>1</sub> Forced Expiratory volume in 1 second

Normal FEV<sub>1</sub>: 80%-100% predicted

- Volume of air exhaled in the first second during FVC
- Fairly constant irrespective of lung size
- Normal values

Causes of decreased FVC

- Obstruction
- Chronic bronchitis
- Emphysema
- Asthma




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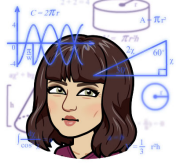
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# FEV<sub>1</sub>/FVC

FEV<sub>1</sub>/FVC <70 = OBSTRUCTION

- The ratio of forced expiratory volume in one second over forced vital capacity
- Quickly identifies persons with airway obstruction when FVC is decreased
- Identify the cause of low FEV<sub>1</sub>



Severity	FEV <sub>1</sub> /FVC % of predicted
Normal	>70%
Mild Obstruction	<70%
Moderate Obstruction	<65%
Severe Obstruction	<50%

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## Classification of airflow limitation severity in COPD

In patients with FEV<sub>1</sub>/FVC <0.70



Gold 1	Mild	FEV <sub>1</sub> ≥ 80 % predicted
Gold 2	Moderate	50% ≤ FEV <sub>1</sub> < 80 % predicted
Gold 3	Severe	30% ≤ FEV <sub>1</sub> < 80 % predicted
Gold 4	Very Severe	FEV <sub>1</sub> < 30 % predicted

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# Lung Volumes & DLCO

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## Methods of measurement

- Helium dilution method
- Body plethysmography
- Nitrogen washout

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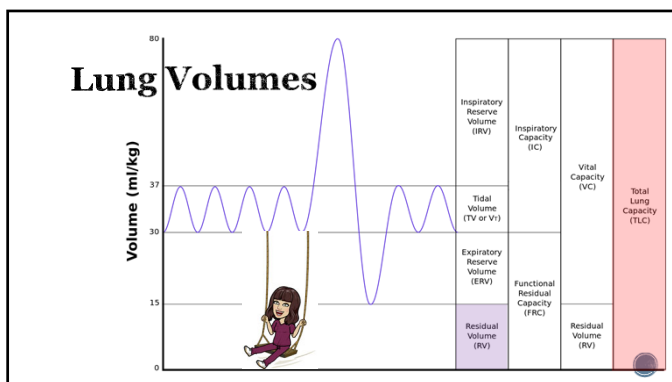
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## RV Residual Volume

- Volume that remains in the lung after complete exhalation
- Increased in obstruction
- Decreased in restriction
- Essentially prevents lungs from collapse
- Increases with age
- Approximately 1L

Decreased  
<80%

Normal  
80%-100%

Increased  
>100%

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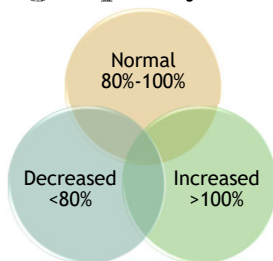
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# TLC Total Lung Capacity

- Vital capacity + Residual Volume
- Decreased in restrictive disease
- Approximately 6 L




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# Residual Volume vs Total Lung Capacity

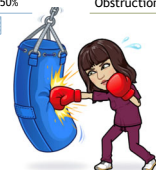
Residual Volume

	Mild	Moderate	Severe
Restriction	55-65%	45-55%	<45%
Obstruction	135-150%	150-250%	>250%

Total Lung Capacity

	Mild	Moderate	Severe
Restriction	65-80%	50-65%	<50%
Obstruction	120-130%	130-150%	>150%

*In obstruction RV indicates Air Trapping*



*In obstruction TLC indicates Hyperinflation*




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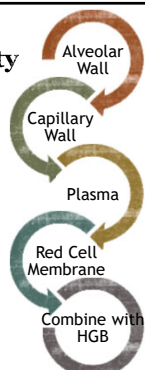
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# DLCO Diffusion Capacity of CO

- DLCO is a measurement of gas enters the blood - the transfer of oxygen from the alveolar gas to the hemoglobin within the red cell
- Diseases that decrease blood flow to the lungs or damage alveoli will cause less efficient gas exchange, resulting in a lower DLCO
- Decreased in quantitative (i.g. pneumonectomy) or qualitative (e.g. COPD, fibrosis) deficit in the membrane
- Can be lowered by anemia or if you are a heavy smoking, therefore asked to avoid smoking because of the CO used to determine this value in the test
- Helps identify if cause of restriction is due to pulmonary parenchymal process or extra-pulmonary process




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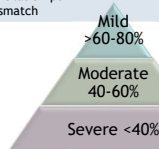
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## Reasons for decreased DLCO

Conditions that decrease surface area	Increased thickness of alveolar-capillary membrane	Miscellaneous causes
Emphysema	Idiopathic pulmonary fibrosis	High carbon monoxide back pressure from smoking
Lung resection	Congestive heart failure	Pregnancy
Bronchial obstruction (tumor)	asbestosis	Ventilation-perfusion mismatch
Multiple pulmonary embolism	Sarcoidosis	
Anemia	Collagen vascular diseases	
	Drug-induced alveolitis/fibrosis	
	Hypersensitivity pneumonitis	
	Histiocytosis	
	Alveolar proteinosis	




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## Increased DLCO

- Asthma
- Morbidly obese
- Alveolar hemorrhage
- Polycythemia vera
- Left-to-right intracardiac shunt
- Any process that produces pulmonary vascular engorgement




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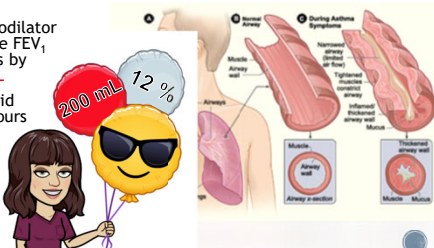
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## Bronchodilator & Airway responsiveness

- A significant bronchodilator response is when the FEV<sub>1</sub> or the FVC increases by both **12% and 200mL**.
- Patient's should avoid bronchodilators 4 hours prior to PFT
- Identify asthma
- Encourage patient compliance




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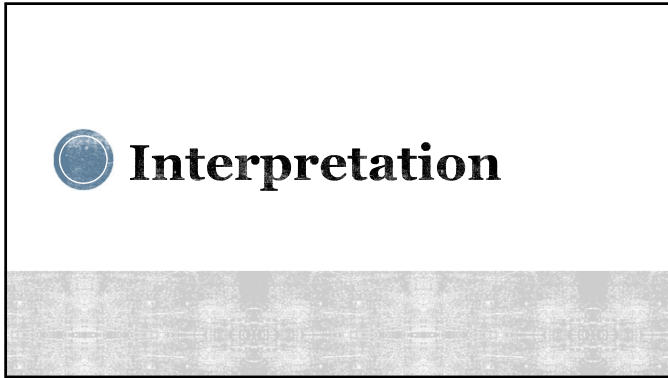
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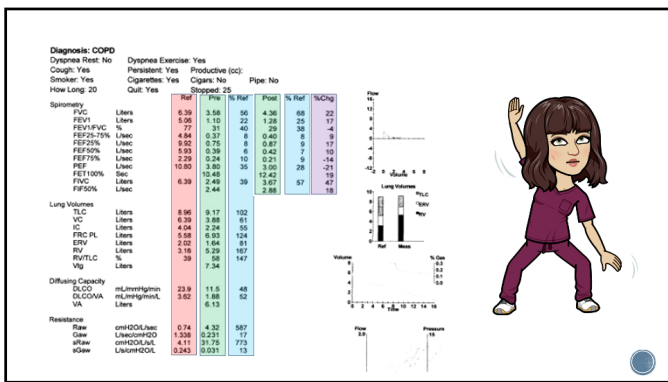
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**STEP 1:  
FEV1/FVC**

- Determine if the FEV1/FVC ratio is decreased
- If FEV1/FVC is <70% obstruction is likely
- If FEV1/FVC >70% an obstructive process is almost always ruled out
- Restriction is still a possibility

**Normal >70%**

		Ref	Pre	% Ref	Post	% Ref	% Chg
<b>Spirometry</b>							
FVC	Liters	4.03	3.87	96	4.00	99	3
FEV1	Liters	3.15	2.78	88	3.09	98	11
FEV1/FVC	%	78	72	92	77	99	8
FEF25-75%	L/sec	3.09	1.78	58	2.03	65	48
FEF25%	L/sec	7.39	7.92	107	8.98	122	13
FEF50%	L/sec	3.91	3.34	85	3.79	97	13
FEF75%	L/sec	1.32	0.52	39	0.88	67	71
PEF	L/sec	8.11	8.52	105	9.14	113	7
FET100%	Sec	5.80	5.80	100	5.52	95	-5
FVC	Liters	4.03	3.53	88	3.58	89	1
FIF50%	L/sec	5.58	5.58	100	6.27	112	12
<b>Lung Volumes</b>							
TLC	Liters	6.44	6.76	105			
VC	Liters	4.03	4.11	102			
IC	Liters	2.93	3.34	114			
FRC PL	Liters	3.33	3.42	103			
ERV	Liters	1.46	0.77	53			
RV	Liters	2.62	2.65	101			
RV/TLC	%	42	39	93			
Vtg	Liters	4.14					
<b>Diffusing Capacity</b>							
DLCO	mL/min/1.37mmHg	23.5	19.3	82			
DLCOVA	mL/min/1.37mmHg	3.42	3.48	102			

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## STEP 2: FVC

- Determine if the FVC is low
  - <80% of predicted
- If FVC is low = Restriction

Normal  
80%-100%

Spirometry		Ref	Pre	% Ref	Post	% Ref	%Chg
FVC	Liters	4.03	3.87	96	4.00	99	3
FEV <sub>1</sub>	Liters	3.15	2.78	88	3.09	98	11
FEV <sub>1</sub> /FVC	%	78	72	92	77	99	8
FEF25-75%	L/Sec	3.09	1.78	58	2.63	85	48
FEF25%	L/Sec	7.39	7.92	107	8.98	122	13
FEF50%	L/Sec	3.91	3.34	85	3.79	97	13
FEF75%	L/Sec	1.32	0.52	39	0.88	67	71
PEF	L/Sec	8.11	8.52	105	9.14	113	7
FET100%	Sec		5.80		5.52		-5
FIVC	Liters	4.03	3.53	88	3.58	89	1
FIF50%	L/Sec		5.58		6.27		12
Lung Volumes							
TLC	Liters	6.44	6.76	105			
VC	Liters	4.03	4.11	102			
IC	Liters	2.93	3.34	114			
FRC PL	Liters	3.33	3.42	103			
ERV	Liters	1.46	0.77	53			
RV	Liters	2.62	2.65	101			
RV/TLC	%	42	39	93			
Vtg	Liters		4.14				
Diffusing Capacity							
DLCO	mL/min/Hg/min	23.5	19.3	82			
DLCO/VA	mL/min/Hg/min/L	3.42	3.48	102			

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## Step 3: TLC

- Confirm the restrictive pattern
- This is done by evaluating the total lung capacity
  - If the TLC is <80% of predicted

Normal  
80%-100%

Spirometry		Ref	Pre	% Ref	Post	% Ref	%Chg
FVC	Liters	4.03	3.87	96	4.00	99	3
FEV <sub>1</sub>	Liters	3.15	2.78	88	3.09	98	11
FEV <sub>1</sub> /FVC	%	78	72	92	77	99	8
FEF25-75%	L/Sec	3.09	1.78	58	2.63	85	48
FEF25%	L/Sec	7.39	7.92	107	8.98	122	13
FEF50%	L/Sec	3.91	3.34	85	3.79	97	13
FEF75%	L/Sec	1.32	0.52	39	0.88	67	71
PEF	L/Sec	8.11	8.52	105	9.14	113	7
FET100%	Sec		5.80		5.52		-5
FIVC	Liters	4.03	3.53	88	3.58	89	1
FIF50%	L/Sec		5.58		6.27		12
Lung Volumes							
TLC	Liters	6.44	6.76	105			
VC	Liters	4.03	4.11	102			
IC	Liters	2.93	3.34	114			
FRC PL	Liters	3.33	3.42	103			
ERV	Liters	1.46	0.77	53			
RV	Liters	2.62	2.65	101			
RV/TLC	%	42	39	93			
Vtg	Liters		4.14				
Diffusing Capacity							
DLCO	mL/min/Hg/min	23.5	19.3	82			
DLCO/VA	mL/min/Hg/min/L	3.42	3.48	102			

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## Step 4: FEV<sub>1</sub>

- Grade the severity of the abnormality
- This is done by evaluating FEV<sub>1</sub>

Normal  
80%-100%

Spirometry		Ref	Pre	% Ref	Post	% Ref	%Chg
FVC	Liters	4.03	3.87	96	4.00	99	3
FEV <sub>1</sub>	Liters	3.15	2.78	88	3.09	98	11
FEV <sub>1</sub> /FVC	%	78	72	92	77	99	8
FEF25-75%	L/Sec	3.09	1.78	58	2.63	85	48
FEF25%	L/Sec	7.39	7.92	107	8.98	122	13
FEF50%	L/Sec	3.91	3.34	85	3.79	97	13
FEF75%	L/Sec	1.32	0.52	39	0.88	67	71
PEF	L/Sec	8.11	8.52	105	9.14	113	7
FET100%	Sec		5.80		5.52		-5
FIVC	Liters	4.03	3.53	88	3.58	89	1
FIF50%	L/Sec		5.58		6.27		12

Severity	FEV <sub>1</sub> % of predicted
Mild	>70
Moderate	60-69
Severe	<50

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## Step 5: Reversibility

- Determine Reversibility
- Does the FEV1 or the FVC increase after bronchodilators are given?

>12% &  
200mL

Spirometry		Ref	Pre	% Ref	Post	% Ref	%Chg
FVC	Liters	4.03	3.87	96	4.00	99	3
FEV <sub>1</sub>	Liters	3.15	2.78	88	3.09	98	11
FEV <sub>1</sub> /FVC	%	78	72	92	77	99	8
FEF25-75%	L/sec	3.09	1.78	58	2.63	85	48
FEF25%	L/sec	7.39	7.92	107	8.98	122	13
FEF50%	L/sec	3.91	3.34	85	3.79	97	13
FEF75%	L/sec	1.32	0.52	39	0.88	67	71
PEF	L/sec	8.11	8.52	105	9.14	113	7
FET100%	Sec		5.80		5.52		-5
FVC	Liters	4.03	3.53	88	3.58	89	1
FIF50%	L/sec		5.58		6.27		12

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## DLCO

- Is the DLCO reduced?
- Is DLCO increased?

Normal  
80%-100%

Spirometry		Ref	Pre	% Ref	Post	% Ref	%Chg
FVC	Liters	4.03	3.87	96	4.00	99	3
FEV <sub>1</sub>	Liters	3.15	2.78	88	3.09	98	11
FEV <sub>1</sub> /FVC	%	78	72	92	77	99	8
FEF25-75%	L/sec	3.09	1.78	58	2.63	85	48
FEF25%	L/sec	7.39	7.92	107	8.98	122	13
FEF50%	L/sec	3.91	3.34	85	3.79	97	13
FEF75%	L/sec	1.32	0.52	39	0.88	67	71
PEF	L/sec	8.11	8.52	105	9.14	113	7
FET100%	Sec		5.80		5.52		-5
FVC	Liters	4.03	3.53	88	3.58	89	1
FIF50%	L/sec		5.58		6.27		12

Lung Volumes		Ref	Pre	% Ref
TLC	Liters	6.44	6.76	105
VC	Liters	4.03	4.11	102
IC	Liters	2.93	3.34	114
FRC PL	Liters	3.33	3.42	103
ERV	Liters	1.46	0.77	53
RV	Liters	2.62	2.65	101
RV/TLC	%	42	39	93
Vg	Liters		4.14	

Diffusing Capacity		Ref	Pre	% Ref
DLCO	mL/minHg/min	23.5	19.3	82
DLCO/VA	mL/minHg/min/L	3.42	3.48	102

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## Conclusion

- Determine Reversibility
- Does the FEV1 or the FVC increase after bronchodilator treatment
  - >12% and >200mL



Spirometry		Ref	Pre	% Ref	Post	% Ref	%Chg
FVC	Liters	4.03	3.87	96	4.00	99	3
FEV <sub>1</sub>	Liters	3.15	2.78	88	3.09	98	11
FEV <sub>1</sub> /FVC	%	78	72	92	77	99	8
FEF25-75%	L/sec	3.09	1.78	58	2.63	85	48
FEF25%	L/sec	7.39	7.92	107	8.98	122	13
FEF50%	L/sec	3.91	3.34	85	3.79	97	13
FEF75%	L/sec	1.32	0.52	39	0.88	67	71
PEF	L/sec	8.11	8.52	105	9.14	113	7
FET100%	Sec		5.80		5.52		-5
FVC	Liters	4.03	3.53	88	3.58	89	1
FIF50%	L/sec		5.58		6.27		12

Lung Volumes		Ref	Pre	% Ref
TLC	Liters	6.44	6.76	105
VC	Liters	4.03	4.11	102
IC	Liters	2.93	3.34	114
FRC PL	Liters	3.33	3.42	103
ERV	Liters	1.46	0.77	53
RV	Liters	2.62	2.65	101
RV/TLC	%	42	39	93
Vg	Liters		4.14	

Diffusing Capacity		Ref	Pre	% Ref
DLCO	mL/minHg/min	23.5	19.3	82
DLCO/VA	mL/minHg/min/L	3.42	3.48	102
VA	Liters		5.54	

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**Put it to work!**  
**CHALLENGE Accepted!**

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Spirometry	Ref	Pre	% Ref	Post	% Ref	%Chg	
FVC	Liters	3.43	2.46	72	2.90	85	18
FEV <sub>1</sub>	Liters	2.73	0.56	21	0.63	23	13
FEV <sub>1</sub> /FVC	%	80	23	29	22	27	-4
FEF25-75%	L/sec	2.81	0.23	8	0.21	7	-8
FEF25%	L/sec	6.78	0.38	6	0.36	5	-6
FEF50%	L/sec	3.53	0.23	7	0.23	6	-3
FEF75%	L/sec	1.20	0.17	14	0.15	12	-12
PEF	L/sec	7.45	2.85	38	1.98	27	-13
FET100%	Sec		11.74		15.32		31
FIVC	Liters	3.43	1.98	58	2.33	68	18
FIF50%	L/sec		4.20		4.53		8

Lung Volumes	Ref	Pre	% Ref	
TLC	Liters	5.61	7.17	128
VC	Liters	3.43	2.46	72
IC	Liters	2.65	0.71	27
FRC PL	Liters	3.36	6.46	193
ERV	Liters	1.32	1.47	111
RV	Liters	2.20	4.71	214
RV/TLC	%	39	66	167
Vg	Liters		6.75	

Diffusing Capacity	Ref	Pre	% Ref	
DLCO	mL/mmHg/min	18.1	7.1	39
DLCO/VA	mL/mmHg/min/L	3.62	1.93	53
VA	Liters		3.67	

**Case 1**  
**Gerry Attrick**

Age: 66  
Height: 66 in  
Weight: 154 lbs  
Gender: Male

- Active smoker, 60 pack year smoking history
- Continuous Oxygen at 2 LPM
- Presents to the office with worsening shortness of breath, activity intolerance
- Daily cough with Yellow sputum

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Spirometry	Ref	Pre	% Ref	Post	% Ref	%Chg
FVC	Liters	3.55	3.57	101		
FEV <sub>1</sub>	Liters	3.00	3.15	105		
FEV <sub>1</sub> /FVC	%	85	88	103		
FEF25-75%	L/sec	3.48	4.60	132		
FEF25%	L/sec	6.09	8.04	132		
FEF50%	L/sec	4.03	5.59	139		
FEF75%	L/sec	1.81	2.51	139		
PEF	L/sec	6.49	8.30	128		
FET100%	Sec		7.21			
FIVC	Liters	3.55	3.21	90		
FIF50%	L/sec		3.75			

Lung Volumes	Ref	Pre	% Ref	
TLC	Liters	5.30	4.71	89
VC	Liters	3.55	3.78	106
IC	Liters	2.48	2.43	96
FRC PL	Liters	2.63	2.28	87
ERV	Liters	1.24	1.02	83
RV	Liters	1.70	0.93	55
RV/TLC	%	31	20	64
Vg	Liters		2.76	

Diffusing Capacity	Ref	Pre	% Ref	
DLCO	mL/mmHg/min	26.0	23.4	90
DLCO/VA	mL/mmHg/min/L	4.39	5.23	119
VA	Liters		4.47	

**Case 4**  
**Gladys Canbe**

Age: 34  
Height: 65 in  
Weight: 183 lbs  
Gender: Female

- Occasional cough worse at night
- Nonsmoker
- No significant shortness of breath

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Spirometry							
	Ref	Pre	% Ref	Post	% Ref	%Chg	
FVC	Liters	2.86	1.80	63	2.07	72	15
FEV <sub>1</sub>	Liters	2.33	1.53	66	1.79	77	17
FEV <sub>1</sub> /FVC	%	83	85	102	87	104	2
FEF25-75%	L/sec	3.14	2.07	66	2.53	81	23
FEF25%	L/sec	5.85	3.90	67	4.04	69	-4
FEF50%	L/sec	3.79	3.43	90	5.29	139	54
FEF75%	L/sec	1.51	0.79	52	1.01	67	28
PEF	L/sec	6.27	6.49	103	5.41	86	-17
FET100%	Sec		4.08		4.26		5
FIVC	Liters	2.86	1.95	68	1.85	65	-5
FIF50%	L/sec		2.07		2.29		11

Lung Volumes				
	Ref	Pre	% Ref	
TLC	Liters	5.39	2.95	55
VC	Liters	2.86	2.08	73
IC	Liters	2.39	1.39	58
FRC PL	Liters	1.56	1.56	100
ERV	Liters	1.19	0.69	58
RV	Liters	1.90	0.87	46
RV/TLC	%	35	29	85
Vtg	Liters		1.86	


Diffusing Capacity				
	Ref	Pre	% Ref	
DLCO	mL/mmHg/min	33.7	17.5	52
DLCO/VA	mL/mmHg/min/L	4.01	6.48	162
VA	Liters		2.69	



Age: 48  
Height: 71 in  
Weight: 339 lbs  
Gender: Female

### Case 3 Poppy Cox

- Non-smoker
- C/o shortness of breath and cough
- Severe Obstructive sleep apnea
- Chronic respiratory failure, on oxygen @ 2L/mon 24/7



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Spirometry							
	Ref	Pre	% Ref	Post	% Ref	%Chg	
FVC	Liters	4.69	2.96	63	2.98	63	1
FEV <sub>1</sub>	Liters	3.77	2.52	67	2.55	68	1
FEV <sub>1</sub> /FVC	%	80	85	106	86	107	1
FEF25-75%	L/sec	3.81	4.42	116	4.61	121	4
FEF25%	L/sec	8.19	9.65	118	9.60	117	-0
FEF50%	L/sec	4.66	8.20	176	8.57	184	4
FEF75%	L/sec	1.77	1.30	74	1.43	81	10
PEF	L/sec	8.93	9.99	112	10.65	119	7
FET100%	Sec		5.42		4.92		-9
FIVC	Liters	4.69	2.75	59	2.73	58	-0
FIF50%	L/sec		6.50		7.05		8

Lung Volumes				
	Ref	Pre	% Ref	
TLC	Liters	6.93	3.87	56
VC	Liters	4.69	2.98	64
IC	Liters	3.24	1.76	54
FRC PL	Liters	3.10	2.11	68
ERV	Liters	1.62	1.22	75
RV	Liters	2.40	0.89	37
RV/TLC	%	37	23	63
Vtg	Liters		2.59	

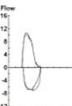
Diffusing Capacity				
	Ref	Pre	% Ref	
DLCO	mL/mmHg/min	31.3	17.7	57
DLCO/VA	mL/mmHg/min/L	3.84	4.43	115
VA	Liters		4.00	



Age: 57  
Height: 71 in  
Weight: 290 lb  
Gender: Male

### Case 4 Felix Cited

- Frequent cough, occasionally productive
- Shortness of breath with activity and at rest
- Oxygen @ 2 LPM 24/7
- Works as a pipefitter
- 20 pack year smoking, quit 1995



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## References

- Gold initiative for Chronic Obstructive Lung Disease (2019). Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. Retrieved from <https://goldcopd.org/wp-content/uploads/2018/11/GOLD-2019-v1.7-FINAL-14Nov2018-WMS.pdf>
- Hyatt, R., Scanlon, P., & Nakamura, M. (2009). Interpretation of Pulmonary Function Tests, A practical Guide 3<sup>rd</sup> ed. Lippincott Williams & Wilkins

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