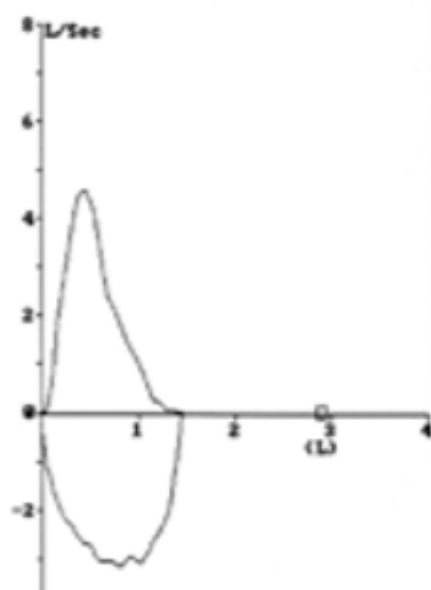
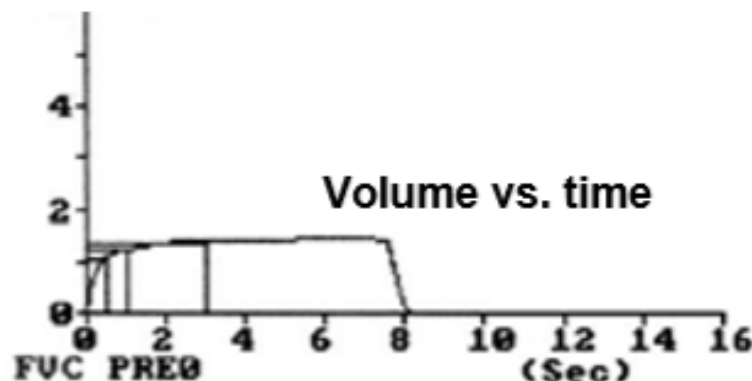


Interpretation

- **Acceptability**
 - ✓ Smooth continuous curve
 - ✓ Good start
 - ✓ Good finish (plateau for 1 sec or 6 seconds total)
- **Reproducibility**
 - ✓ After 3 maneuvers the two largest FVC and FEV₁ are within 150 ml of each other.



Flow vs. volume



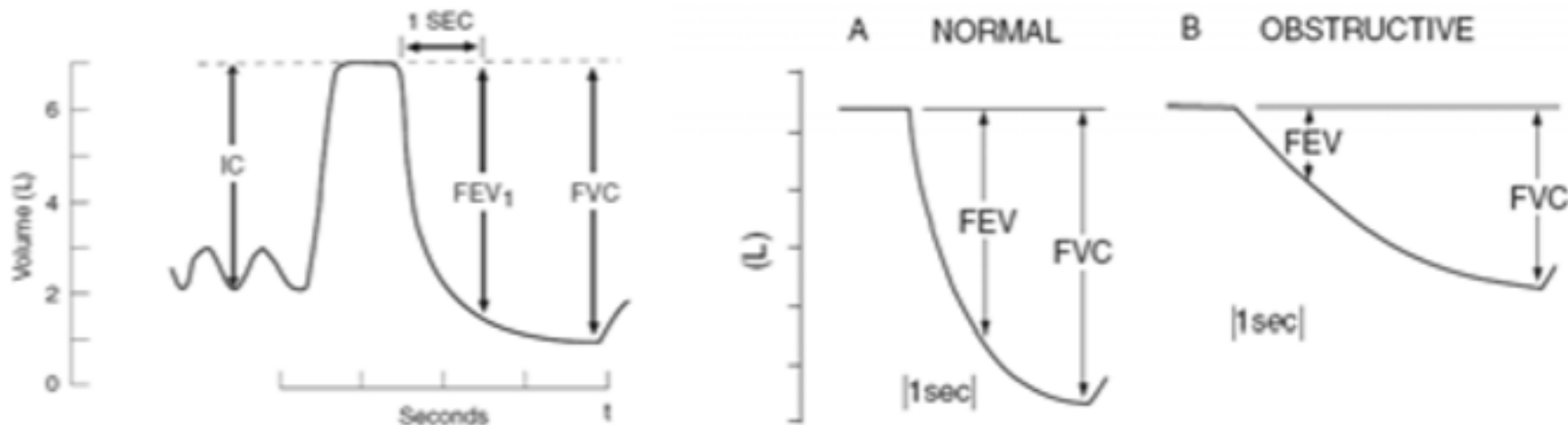
Volume vs. time

**** Look at technicians comments if test is acceptable, reproducible, and if patient gave good effort.**

Interpretation

- Is test acceptable and reproducible?
- Look at flow volume loop
- Examine FEV_1/FVC ratio
- Look at FVC
- If obstruction – is there a post-bronchodilator response
- Classify severity
- Look at lung volumes (specifically TLC)
- Examine DLCO

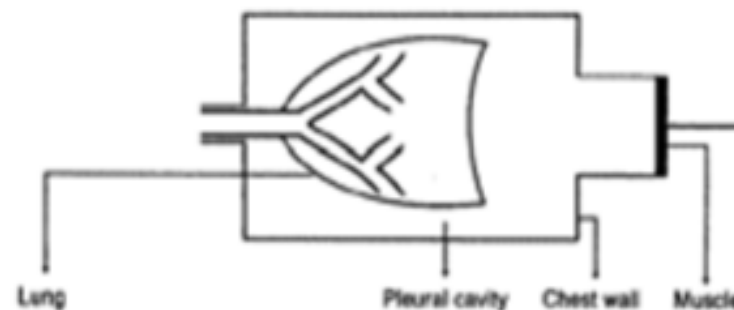
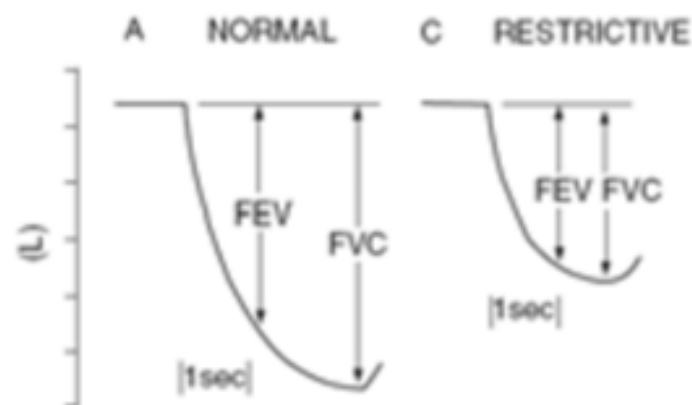
Patterns of Disease



- **Obstructive Pattern**
 - **Decreased FEV₁/FVC ratio**
 - **Asthma, COPD/Emphysema, CF, Bronchiectasis**

Patterns of Disease

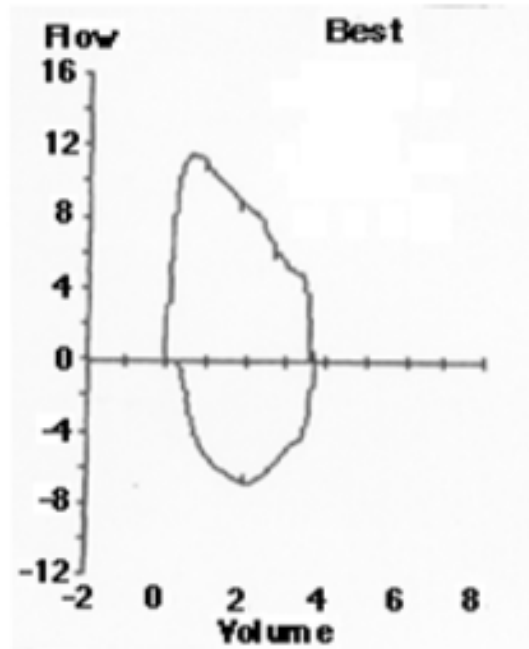
- **Restrictive Pattern**
 - ✓ **FEV₁/FVC** ratio preserved but values decreased
 - ✓ **Parenchymal disease**
 - Idiopathic pulmonary fibrosis (IPF),
 - Pneumoconiosis
 - Interstitial lung diseases
 - ✓ **Restrictive bellows**
 - Neuromuscular disease (ALS, MD)
 - Chest wall abnormalities (obesity, kyphoscoliosis)



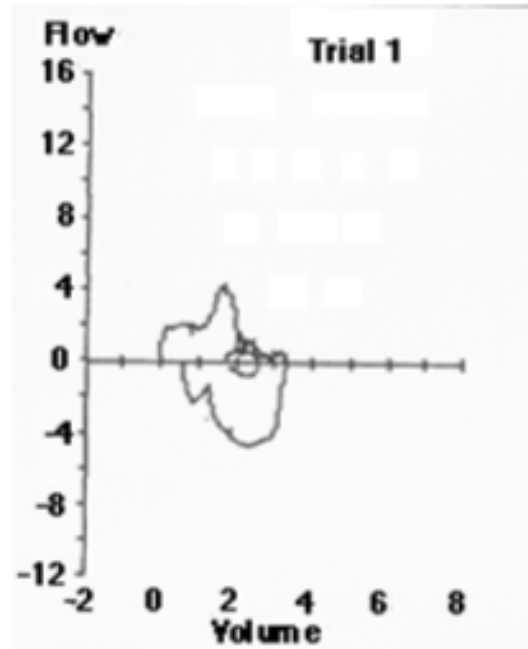
Bronchodilator Challenge

- **Assess lung function at baseline**
- **Administer bronchodilator through a spacer**
- **Re-assess lung function after 15 min**
- **Positive bronchodilator response**
 - **An increase in FEV1 and/or FVC by 12% of control and by > 200 mL**
- **In the lack of a bronchodilator response in the laboratory does not preclude a clinical response to bronchodilator therapy**

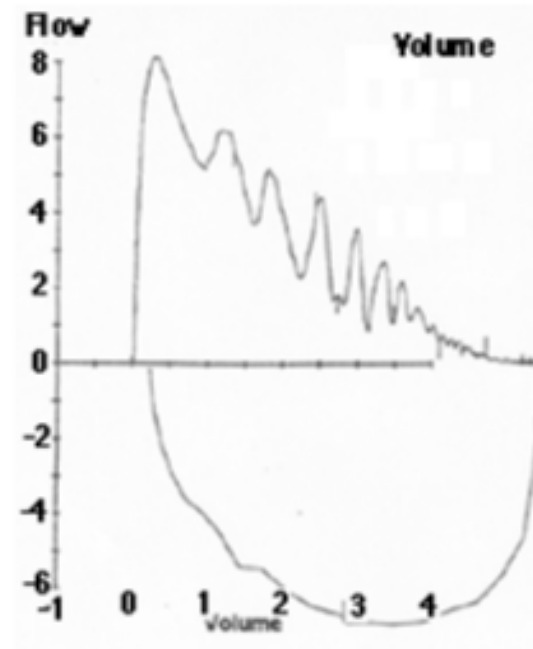
Flow Volume Loop



Early glottic closure



Variable effort



Cough



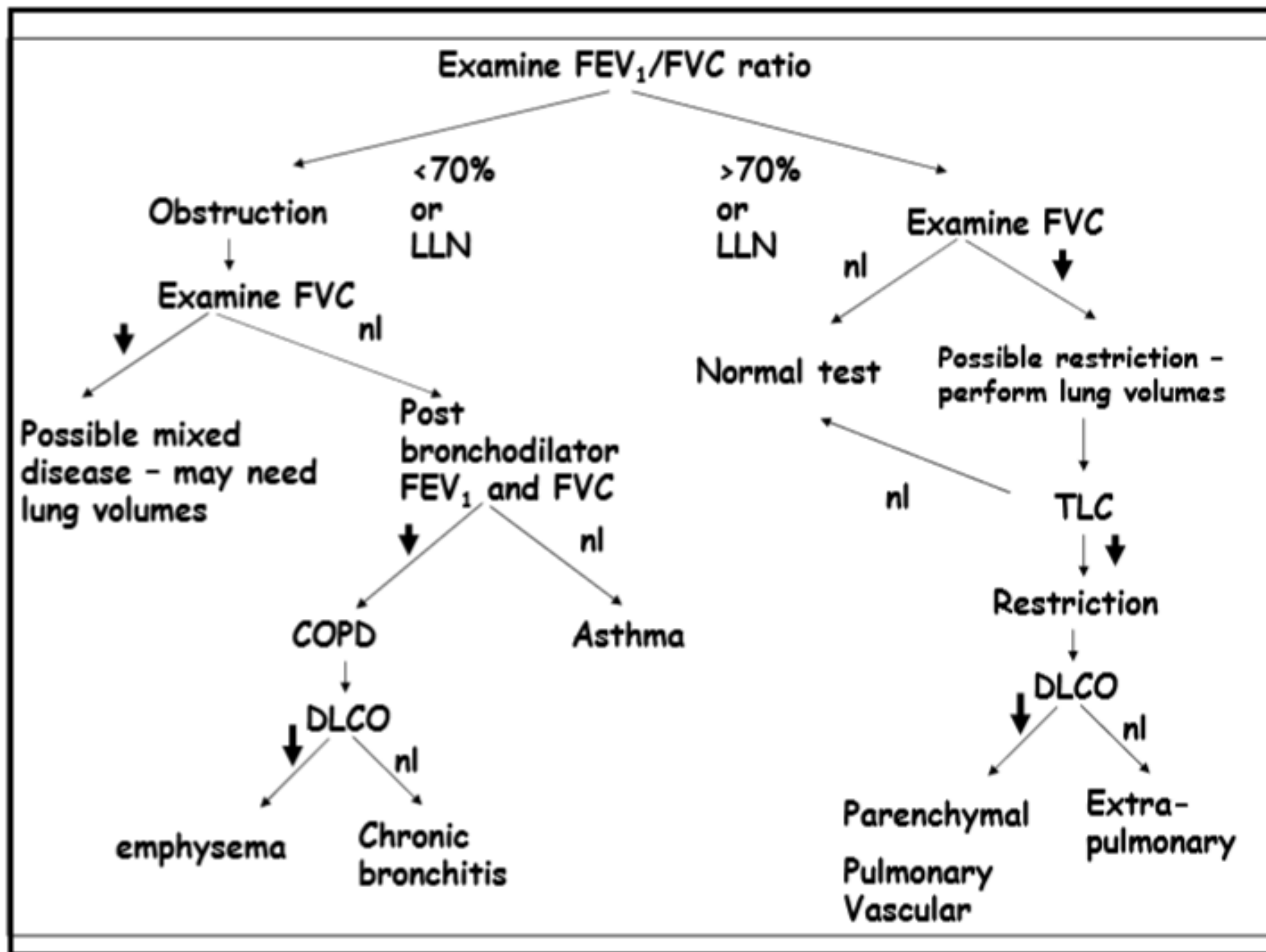
normal



obstructive



restrictive



Case 1

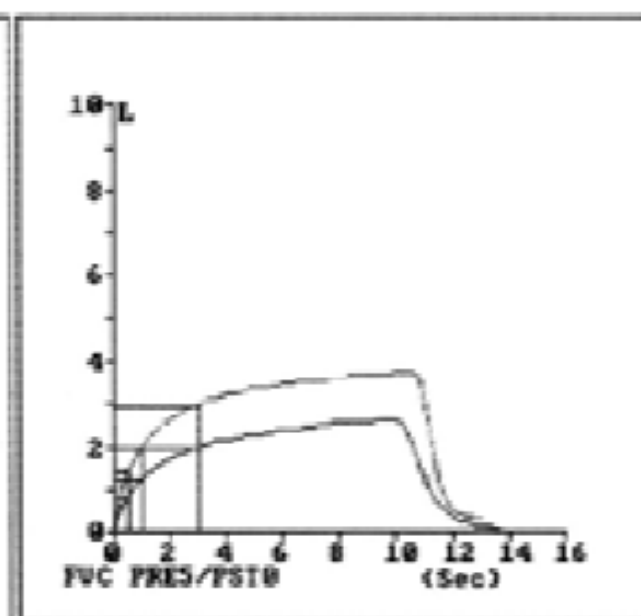
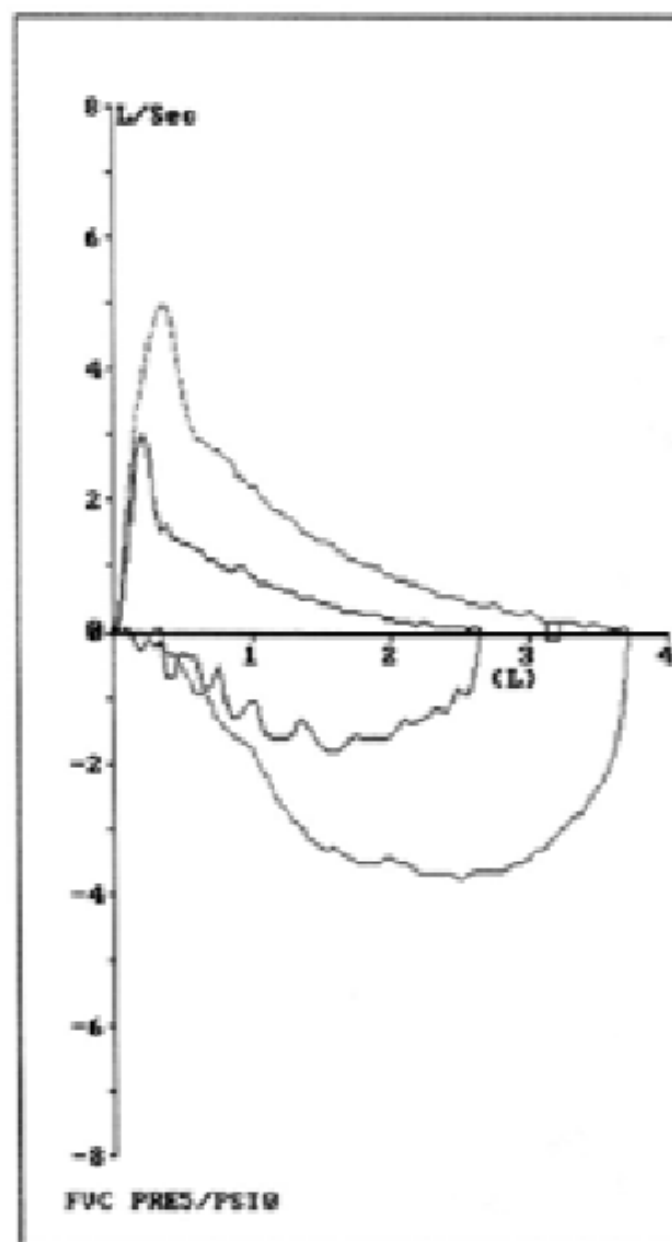
PT:
PT#:
DIAGNOSIS: ASTHMA
RACE: B
SMK HX: NEVER

RM#:
SEX: F
OCC:

DATE: 10/02/2003
AGE: 31
WT: 188.0 lb
HT: 64.0 in

		Pre-Drug*			Post-Drug* M ALBUTEROL		
Spirometry		PREDICTED	PRE	%PRED	POST	%PRED	%CHG
FVC	(L)	3.16	2.62	83	3.72	118	42
FEV1	(L)	2.71	1.21	44	1.97	73	63
FEV1/FVC	(%)	86	46		53	62	14
FEF25-75%	(L/S)	3.76	0.48	13	0.85	22	77
FEFmax	(L/S)	6.42	3.07	48	5.01	78	63
P1VC	(L)	3.16	2.57	81	3.45	109	34

- 31 y/o female with 3 ½ month history of cough usually non-productive. Associated wheezing and mild dyspnea. Started after a viral illness.
- No PMH, ROS negative.
- Lungs – scattered bilateral expiratory wheezes.
- CXR - negative



PT:
PT#:
DIAGNOSIS: ASTHMA
RACE: B
SMK HX: NEVER

OCC:

RM#:
SEX: F

DATE: 10/02/2003
AGE: 31
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FVC	(L)	3.16	2.62	83	3.72	118	42
FEV1	(L)	2.71	1.21	44	1.97	73	63
FEV1/FVC	(%)	86	46		53	62	14
FEF25-75%	(L/S)	3.76	0.48	13	0.85	22	77
PEFmax	(L/S)	6.42	3.07	48	5.01	78	63
FIVC	(L)	3.16	2.57	81	3.45	109	34

- Obstruction with bronchodilator response
- Started on inhaled corticosteroid, as needed B2 agonist, and given peak flow meter.
- Return in 3 weeks revealed cough has almost totally resolved, peak flow has increased from 460 to 600.
- Dx – asthma

Case 2

DIAGNOSIS: DYSPNEA

SEX: M

WT: 215.0 lb

RACE: W

OCC:

HT: 69.0 in

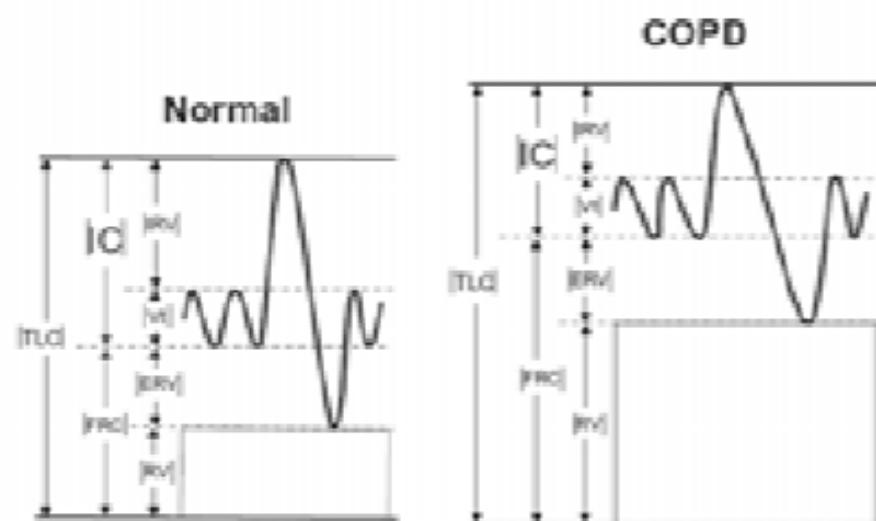
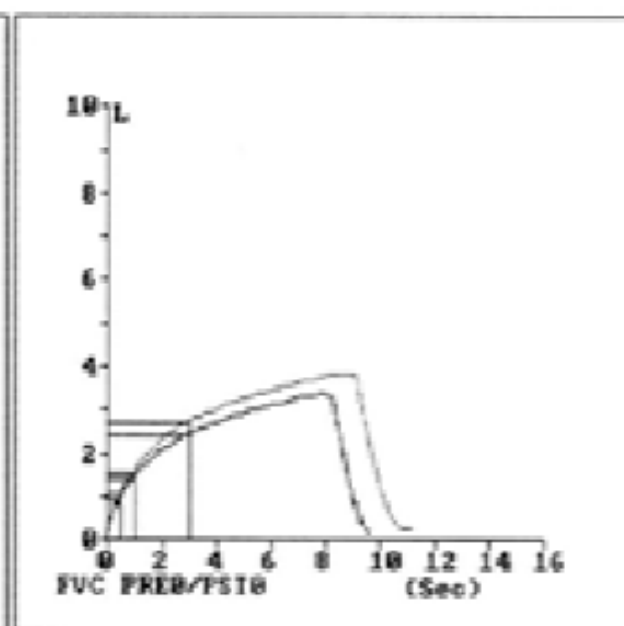
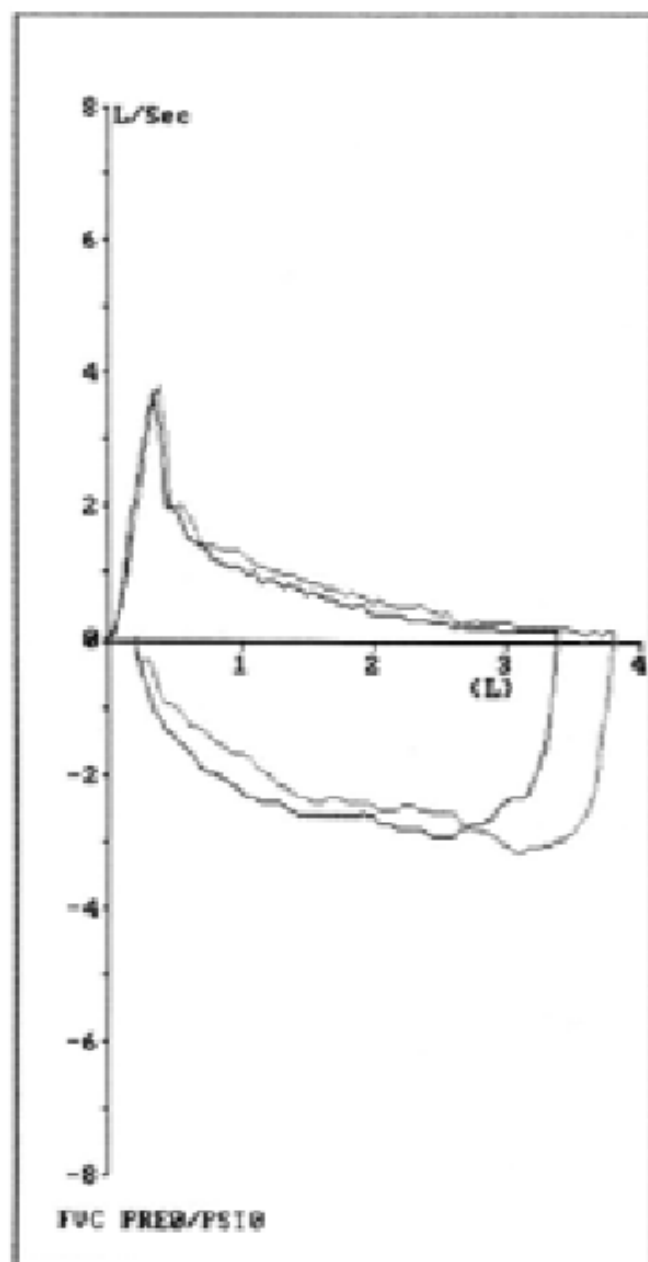
SMK HX: SMOKES CIGARETTES 45Y 1.0P/DAY

45PACK/YRS

		Pre-Drug* M			Post-Drug* M ALBUTEROL		
Spirometry		PREDICTED	PRE	%PRED	POST	%PRED	%CHG
PVC	(L)	4.60	3.35	73	3.81	83	13
FEV1	(L)	3.63	1.41	39	1.55	43	9
FEV1/FVC	(%)	79	42	54	41	52	-3
FEF25-75%	(L/S)	3.47	0.55	16	0.59	17	7
FEFmax	(L/S)	8.74	3.71	42	3.82	44	2
FIVC	(L)	4.60	3.17	69	3.61	78	13

		Pre-Drug* Avg		
Lung Volumes		PREDICTED	PRE	%PRED
TLC	(L)	6.79	7.85	116
FRC	(L)	3.51	5.04	143
RV	(L)	2.17	4.08	188
ERV	(L)	1.35	0.95	71
RV/TLC	(%)	32	52	161
VC	(L)	4.60	3.76	82
IC	(L)	3.28	2.81	86

		Pre-Drug* Avg		
Diffusion		PREDICTED	PRE	%PRED
Dsb ml/min/mmHg		33.16	11.30	34
Dsb(adj) ml/min/mmHg		33.16	11.30	34
D/VA			2.37	
Hb (gm/100ml)			14.60	
COHb (%)			0.00	
VA(sb) (L)			4.77	



DIAGNOSIS: DYSPNEA

SEX: M

WT: 215.0 lb

RACE: W

OCC:

HT: 69.0 in

SMK HX: SMOKES CIGARETTES 45Y 1.0P/DAY

45PACK/YRS

		Pre-Drug* M			Post-Drug* M ALBUTEROL		
Spirometry		PREDICTED	PRE	%PRED	POST	%PRED	%CHG
FVC	(L)	4.60	3.35	73	3.81	83	13
FEV1	(L)	3.63	1.41	39	1.55	43	9
FEV1/FVC	(%)	79	42	54	41	52	-3
PEF25-75%	(L/S)	3.47	0.55	16	0.59	17	7
PEFmax	(L/S)	8.74	3.71	42	3.82	44	2
FIVC	(L)	4.60	3.17	69	3.61	78	13

		Pre-Drug* Avg			
Lung Volumes		PREDICTED	PRE	%PRED	
TLC	(L)	6.79	7.85	116	← hyperinflation
FRC	(L)	3.51	5.04	143	← Air trapping
RV	(L)	2.17	4.08	188	
ERV	(L)	1.35	0.95	71	
RV/TLC	(%)	32	52	161	
VC	(L)	4.60	3.76	82	
IC	(L)	3.28	2.81	86	

		Pre-Drug* Avg		
Diffusion		PREDICTED	PRE	%PRED
Dsb ml/min/mmHg		33.16	11.30	34
Dsb(adj) ml/min/mmHg		33.16	11.30	34
D/VA			2.37	
Hb (gm/100ml)			14.60	
COHb (%)			0.00	
VA(sb) (L)			4.77	

• Severe airflow obstruction with air trapping and hyperinflation.

• Low DLCO

• Dx - COPD

TABLE 6Severity of any spirometric abnormality based on the forced expiratory volume in one second (FEV₁)

Degree of severity	FEV ₁ % pred
Mild	>70
Moderate	60–69
Moderately severe	50–59
Severe	35–49
Very severe	<35

% pred: % predicted.

Case 3

Test Date:10-25-2005 Age:63 Ht:60.0 in Wt:129 lbs
Gender: Female Race:Caucasian Hb: None BMI:25.2 kg/m2
Adm.#:310272406 Smoke Hx (Pk Yrs): 70.0

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC:L)	2.12	.75	35*
Forced Exp. Vol. 1 (FEV1:L)	1.54	.59	38*
% FEV1/FVC	85.5%	70.7%	
Mid Exp. Flow (FEF25-75:L/sec)	1.27	.48	38*
Peak Flow (PF:L/sec)	4.74	1.76	37*

*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC:L)	2.12	1.22	58*
Exp. Reserve Volume (ERV:L)	.31	.32	71
Thoracic Gas Volume (TGV:L)	2.56	3.46	135*
Residual Volume (RV:L)	2.25	3.17	141*
Total Lung Capacity (TLC:L)	4.45	4.39	99
%RV/TLC	48.9	72.2*	

*ARTERIAL BLOOD GASES	Predict.	Room Air
pH	7.35-7.45	7.39
PaO2 (mm Hg)	83	58*
PaCO2 (mm Hg)	37-43	53*
Bicarb. (meq/L)	23-26	31*
SaO2%	>93%	90*
Alv-art O2 Diff. (mm Hg)	29	21

Test Date:10-25-2005 Age:83 Ht:60.0 in Wt:129 lbs
 Gender: female Race:Caucasian Hb: None BMI:25.2 kg/m2
 Smoke Hx (Pk Yrs): 70.0

Diagnosis:DOE/SOB/Wheezing

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC;L)	2.12	.75	35*
Forced Exp. Vol. 1 (FEV1;L)	1.54	.59	38*
% FEV1/FVC	85.5%	78.7%	
Mid Exp. Flow (FEF25-75;L/sec)	1.27	.48	38*
Peak Flow (PF;L/sec)	4.74	1.76	37*

•Reduced FEV1 and FVC suggest restriction by spirometry

*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC;L)	2.12	1.22	58*
Exp. Reserve Volume (ERV;L)	.31	.22	71
Thoracic Gas Volume (TGV;L)	2.56	3.46	135*
Residual Volume (RV;L)	2.25	3.17	141*
Total Lung Capacity (TLC;L)	4.45	4.39	99
%RV/TLC	48.9	72.2*	

•No evidence of restriction by lung volumes.

•Low FVC – pseudorestriction

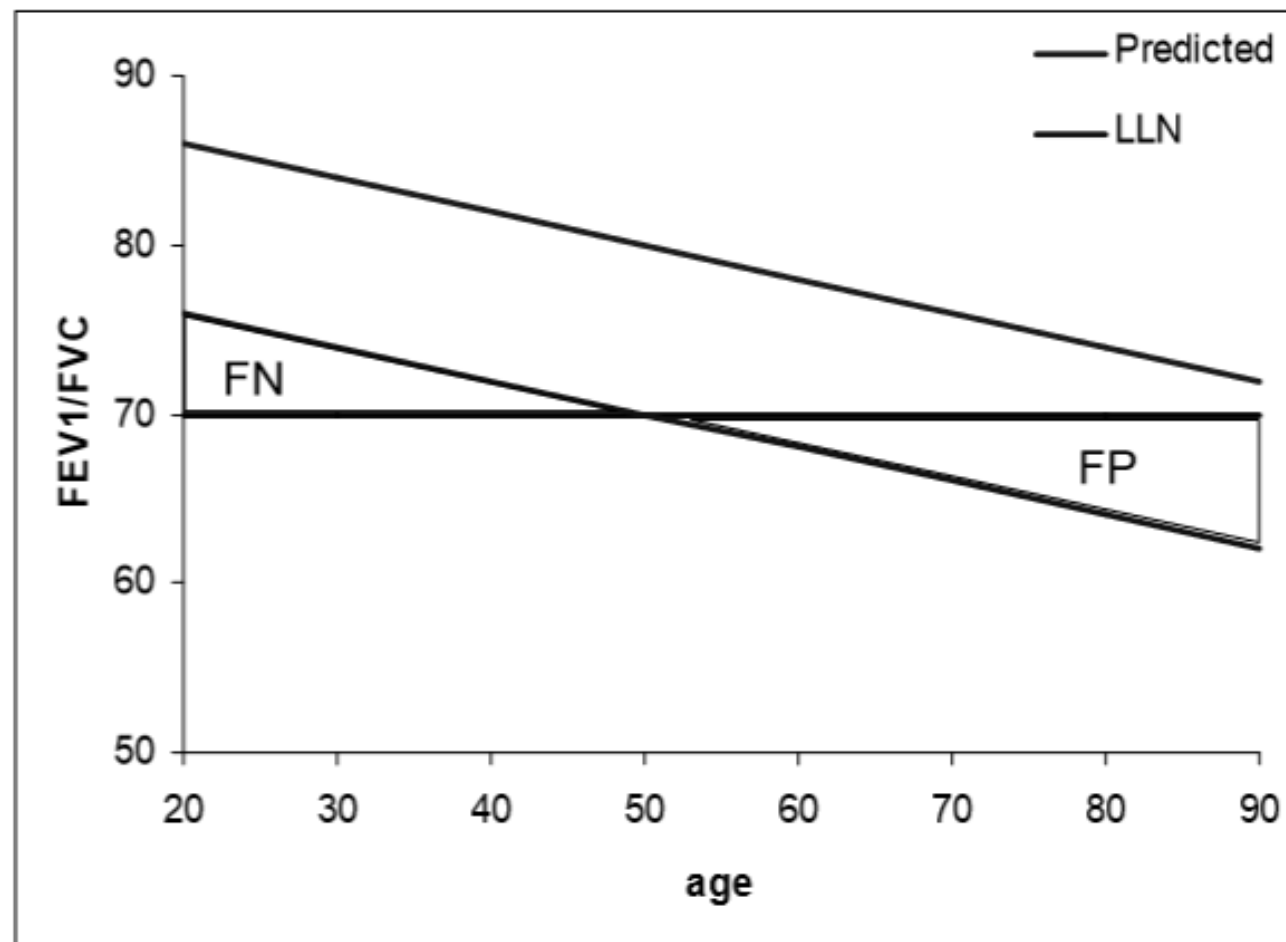
•If use SVC then the FEV1/VC ratio is 48%.

*ARTERIAL BLOOD GASES			Predict.	Room Air
pH	7.35-7.45		7.35	7.39
PaO2 (mm Hg)	83		58*	
PaCO2 (mm Hg)	37-43		53*	
Bicarb. (meq/L)	23-26		31*	
SaO2%	>93%		90*	
Alv-art O2 Diff. (mm Hg)	29		21	

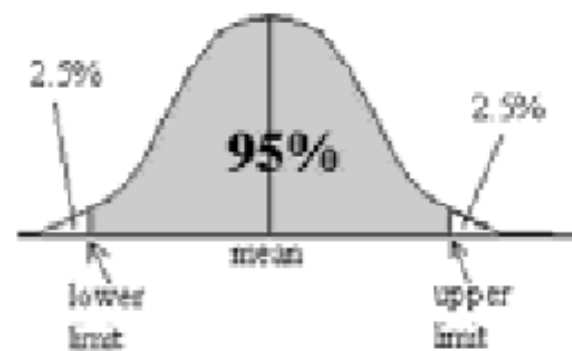
Dx - Severe oxygen-dependent chronic obstructive pulmonary disease

What's normal?

- **Reference Populations**
 - **Comparable to the patient population with regards to:**
 - » **Age**
 - » **Height**
 - » **Gender**
 - » **Ethnicity**
- **Spirometric reference values**
 - **Developed from National Health and Nutrition Examination Survey (NHANES III)**
 - **7,429 asymptomatic, lifelong nonsmoking subjects**
 - **Included Caucasians, African-Americans, and Hispanic-Americans**



- FEV1/FVC is inversely proportional to age and height.



Case 4

Test Date:01-23-2004 Age:90 Ht:63.0 in Wt:123 lbs
Gender: female Race:Caucasian Hb: None BMI:21.8 kg/m2
Smoke Hx (Pk Yrs):
Diagnosis:Preoperative evaluation, respiratory Secondary:Lung Mass

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC;L)	2.16	2.42	112
Forced Exp. Vol. 1 (FEV1;L)	1.37	1.68	123
% FEV1/FVC	74.5%	69.4%	
Mid Exp. Flow (FEF25-75;L/sec)	.84	.99	118
Peak Flow (PF;L/sec)	4.89	4.56	93

*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC;L)	2.16	2.42	112
Exp. Reserve Volume (ERV;L)	.32	1.14	356
Thoracic Gas Volume (TGV;L)	2.86	3.15	110
Residual Volume (RV;L)	2.54	2.01	79
Total Lung Capacity (TLC;L)	4.90	4.43	90
%RV/TLC	51.8	45.4	

*ARTERIAL BLOOD GASES		
	Predict.	Room Air
pH	7.35-7.45	7.34*
PaO2 (mm Hg)	83	80
SaO2%	>93%	96
PaCO2 (mm Hg)	37-43	43
Bicarb. (meq/L)	23-26	24
Alv-art O2 Diff. (mm Hg)	32	13

Case 5

Test Date: 03-12-2004 Age: 58 Ht: 64.0 in Wt: 147 lbs
 Gender: male Race: Caucasian Hb: 13.2 g/dl BMI: 25.2 kg/m2
 [Redacted] Smoke Ex (Pk Yrs): 40.0
 [Redacted]

	PRED	ACTUAL	%PRED	
*SPIROMETRY				
Forced Vital Capacity (FVC:L)	3.26	2.92	90	
Forced Exp. Vol. 1 (FEV1:L)	2.44	1.50	61*	
% FEV1/FVC	80.4%	51.4%	*	
Mid Exp. Flow (FEF25-75:L/sec)	2.79	.47	17*	
Peak Flow (PF:L/sec)	8.23	6.61	80	
*INSPIRATORY LOOP				
FEF50%/FIF50% (normal<1.0)	.24			
*LUNG VOLUMES Plethysmography				
Slow Vital Capacity (SVC:L)	3.26	2.92	90	
Exp. Reserve Volume (ERV:L)	1.03	.63	61	
Thoracic Gas Volume (TGV:L)	2.90	3.57	123	
Residual Volume (RV:L)	1.87	2.94	157*	
Total Lung Capacity (TLC:L)	5.78	5.86	101	
%RV/TLC	32.0	50.2*		
*DIFFUSING CAPACITY				
				Hb CORR/%PRED
Diff. Cap. (DLCO:ml/min/mm Hg)	26.5	12.7	48*	14.7 55*
Single breath TLC (VAr L)	5.66	4.29	76	
DLCO/VA	4.65	2.96	64*	3.43 74*

- 58 yo AAM smoker with cough
- 40PY tob history
- Yearly history and physical exam—c/o mild dyspnea

Case 5

	PRED	ACTUAL	%PRED	
*SPIROMETRY				
Forced Vital Capacity (FVC:L)	3.26	2.92	90	
Forced Exp. Vol. 1 (FEV1:L)	2.44	1.50	61*	
% FEV1/FVC	80.4%	51.4%	*	
Mid Exp. Flow (FEF25-75:L/sec)	2.79	.47	17*	
Peak Flow (PF:L/sec)	8.23	6.61	80	
*INSPIRATORY LOOP				
FEF50%/FIF50% (normal<=1.0)	.24			
*LUNG VOLUMES Plethysmography				
Slow Vital Capacity (SVC:L)	3.26	2.92	90	
Exp. Reserve Volume (ERV:L)	1.03	.63	61	
Thoracic Gas Volume (TGV:L)	2.90	3.57	123	
Residual Volume (RV:L)	1.87	2.94	157*	
Total Lung Capacity (TLC:L)	5.78	5.86	101	
%RV/TLC	32.0	50.2*		
*DIFFUSING CAPACITY				
			Hb CORR/%PRED	
Diff. Cap. (DLCO:ml/min/mm Hg)	26.5	12.7	48*	14.7 55*
Single breath TLC (VA: L)	5.66	4.29	76	
DLCO/VA	4.65	2.96	64*	3.43 74*

Lung age = 97 yo

Lung Age

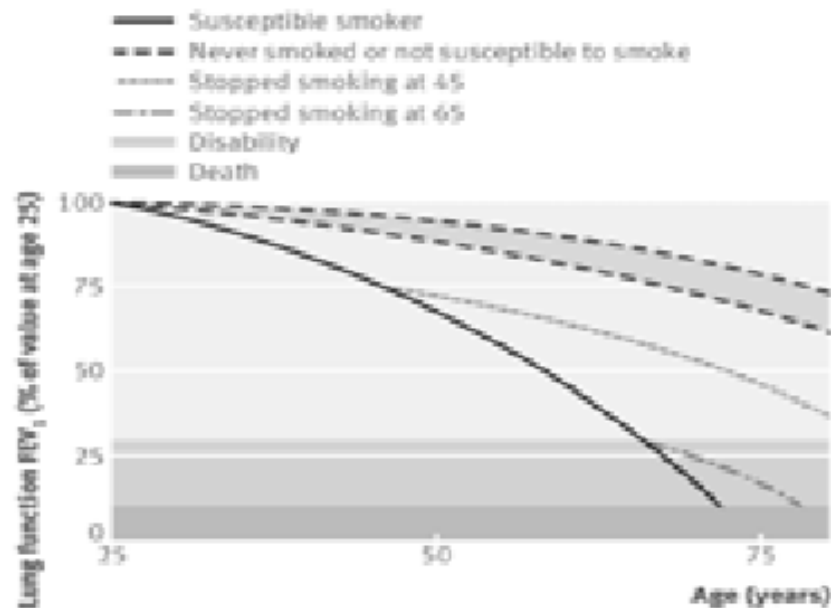


Fig 1 | Graph of lung function against age showing how smoking accelerates age related decline in lung function (adapted from Fletcher and Peto¹¹)

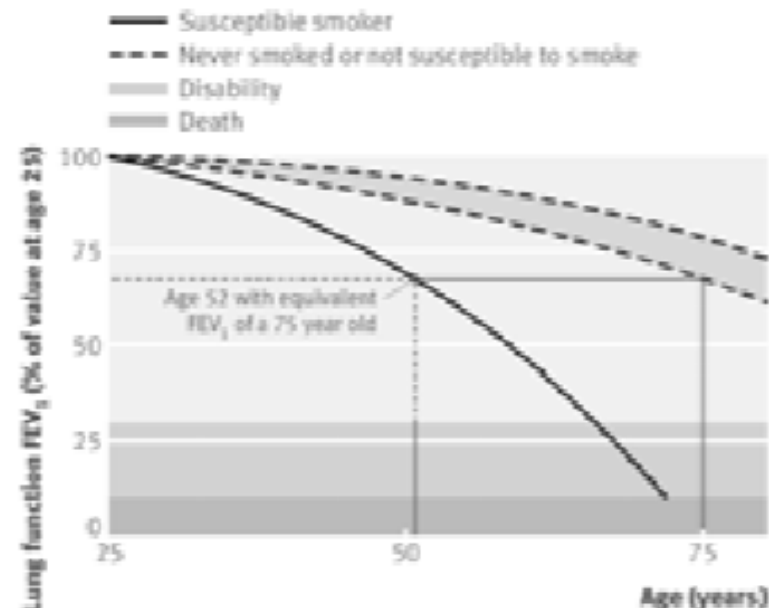


Fig 2 | Explaining lung age to participants (adapted from Fletcher and Peto¹¹)

Lung age calculation formula developed by Morris and Temple³

Men

Lung age = $2.87 \times \text{height (in inches)} - (31.25 \times \text{observed FEV}_1 \text{ (litres)}) - 39.375$

Women

Lung age = $3.56 \times \text{height (in inches)} - (40 \times \text{observed FEV}_1 \text{ (litres)}) - 77.28$

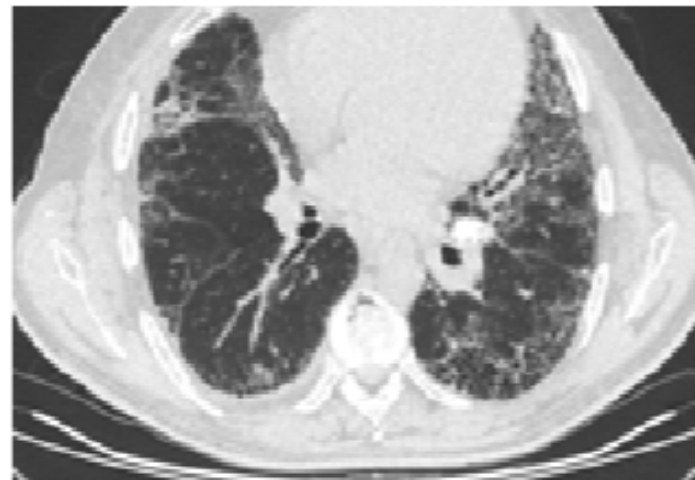
Case 6

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC;L)	5.12	3.52	69*
Forced Exp. Vol. 1 (FEV1;L)	3.93	3.01	77*
% FEV1/VC	76.94	85.54	
Mid Exp. Flow (FEF25-75;L/sec)	3.37	4.40	131
Peak Flow (PF;L/sec)	9.84	12.92	131
*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC;L)	5.12	3.52	69*
Exp. Reserve Volume (ERV;L)	1.54	1.30	84
Thoracic Gas Volume (TGV;L)	3.71	2.90	78
Residual Volume (RV;L)	2.17	1.60	74
Total Lung Capacity (TLC;L)	7.18	5.12	71*
RV/TLC	30.7	31.3	
*DIFFUSING CAPACITY			
			Hb CORR/%PRED
Diff. Cap. (DLCO;ml/min/mm Hg)	30.3	21.0	69*
Single breath TLC (VA; L)	7.01	4.94	70*
DLCO/VA	4.38	4.25	97
*OXIMETRY/OTHER STUDIES			
	Predict.	Actual	
%SaO2(Rest, room air)	>99%	99	
%SaO2(6' walk, room air)	>93%	94	
6' Walk Distance (ft)	>1200	1476	
Dyspnea(Borg Scale 6'walk)	Rest: .5	Max: 2.0	
Heart rate (6' walk, b/min)	Rest: 86	Max: 112	

- **54 yo WM with cough**
- **Ht 71in, wt, 215 lbs**
- **BMI=30**
- **Hgb=14.3**
- **No tobacco hx**
- **Works as a welder, machinist in auto parts assembly**

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC;L)	5.12	3.52	69*
Forced Exp. Vol. 1 (FEV1;L)	3.93	3.01	77*
% FEV1/VC	76.94	85.51	
Mid Exp. Flow (FEF25-75;L/sec)	3.37	4.40	131
Peak Flow (PF;L/sec)	9.84	12.92	131
*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC;L)	5.12	3.52	69*
Exp. Reserve Volume (ERV;L)	1.54	1.30	84
Thoracic Gas Volume (TGV;L)	3.71	2.90	78
Residual Volume (RV;L)	2.17	1.60	74
Total Lung Capacity (TLC;L)	7.10	5.12	71*
RV/TLC	30.7	31.3	
*DIFFUSING CAPACITY			
Diff. Cap. (DLCO;ml/min/mm Hg)	30.3	21.0	69*
Single breath TLC (VA; L)	7.01	4.94	70*
DLCO/VA	4.38	4.25	97
*OXIMETRY/OTHER STUDIES			
Predict.	Actual		
%SaO2(Rest, room air)	>93%		
%SaO2(6' walk, room air)	>93%		
6' Walk Distance (ft)	>1200		
Dyspnea(Borg Scale 6'walk)	Rest: .5	Max: 2.0	
Heart rate (6' walk, b/min)	Rest: 86	Max: 112	

- No evidence of obstruction by spirometry
- Restriction by lung volumes
- Low diffusing capacity
- Some desaturation with 6 minute walk
- Chest CT: pulmonary fibrosis



2/23/06

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC;L)	3.39	2.39	71*
Forced Exp. Vol. 1 (FEV1;L)	2.52	1.43	57*
% FEV1/VC	59.8%	59.8%	*
Mid Exp. Flow (FEF25-75;L/sec)	2.83	.42	15*
Peak Flow (PF;L/sec)	8.07	3.35	42*

*LUNG VOLUMES	Plethysmography		
Slow Vital Capacity (SVC;L)	3.39	2.39	71*
Exp. Reserve Volume (ERV;L)	1.06	.08	8
Thoracic Gas Volume (TGV;L)	3.05	3.12	102
Residual Volume (RV;L)	1.99	3.04	153*
Total Lung Capacity (TLC;L)	5.99	5.43	91
%RV/TLC	32.9	56.0*	

Lung
transplant in
2004.

5/03/06

*LUNG VOLUMES	Gas Dilution		
Slow Vital Capacity (SVC;L)	3.39	2.41	71*
Exp. Reserve Volume (ERV;L)	1.06	.44	42
Functional Resid. Capac.(FRC;L)	3.05	.82	27*
Residual Volume (RV;L)	1.99	.38	19*
Total Lung Capacity (TLC;L)	5.99	2.79	47*
%RV/TLC	32.9	13.6*	

TECHNICIAN COMMENTS: Patient cooperation: good
Gas dilution done to obtain lung volumes due to IV in use.

Case 7

Test Date:03-03-2006

Last Test:02-24-0224

Age:61

Ht:65.0 in

Wt:189 lbs

Gender: male

Race:Caucasian

Hb:10.1 g/dl

BMI:31.4 kg/m2

Smoke Hx (Pk Yrs): 189.0

Diagnosis:Lung transplant

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC:L)	3.39	2.12	63*
Forced Exp. Vol. 1 (FEV1:L)	2.52	1.40	56*
% FEV1/VC	58.1%	58.1%	*
Mid Exp. Flow (FEF25-75:L/sec)	2.89	.89	31*
Peak Flow (PF:L/sec)	8.07	2.88	36*

*INSPIRATORY LOOP	
FEF50%/PIF50% [normal<=1.0]	.42

*LUNG VOLUMES Gas Dilution			
Slow Vital Capacity (SVC:L)	3.39	2.41	71*
Exp. Reserve Volume (ERV:L)	1.06	.44	42
Functional Resid. Capac.(FRC:L)	3.05	.82	27*
Residual Volume (RV:L)	1.99	.38	19*
Total Lung Capacity (TLC:L)	5.99	2.79	47*
%RV/TLC	32.9	13.6*	

*DIFFUSING CAPACITY				Hb CORR/%PRED
Diff. Cap. (DLCO:ml/min/mm Hg)	26.2	15.9	61*	22.2 85
Single breath TLC (VA: L)	5.85	3.79	65*	
DLCO/VA	4.51	4.20	93	5.86 130*

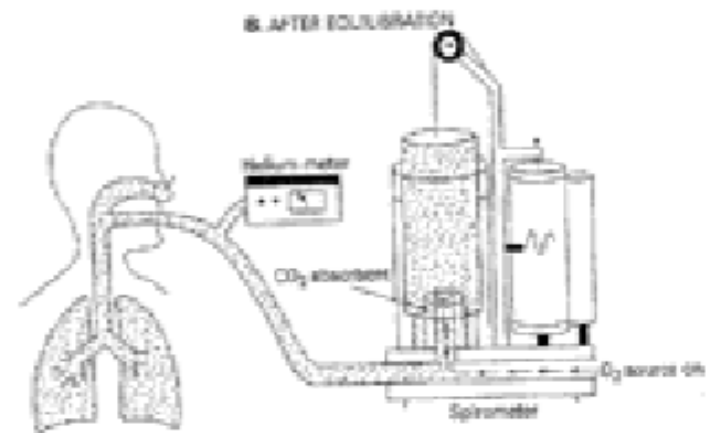
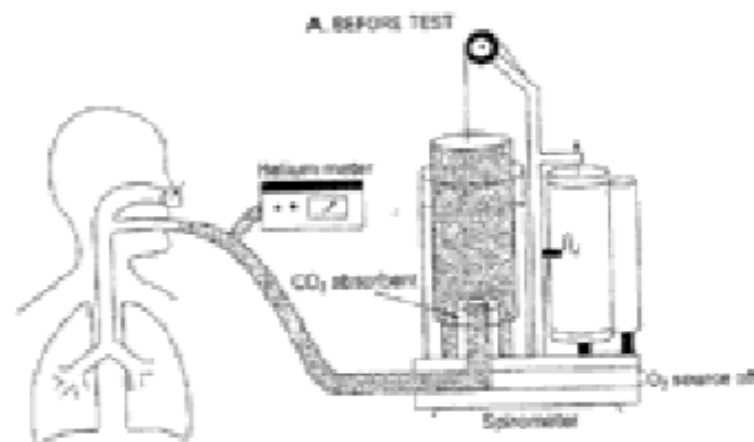
Compare to old PFTs

TECHNICIAN COMMENTS: Patient cooperation: good
Gas dilution done to obtain lung volumes due to IV in use.

Lung Volumes: Gas Dilution

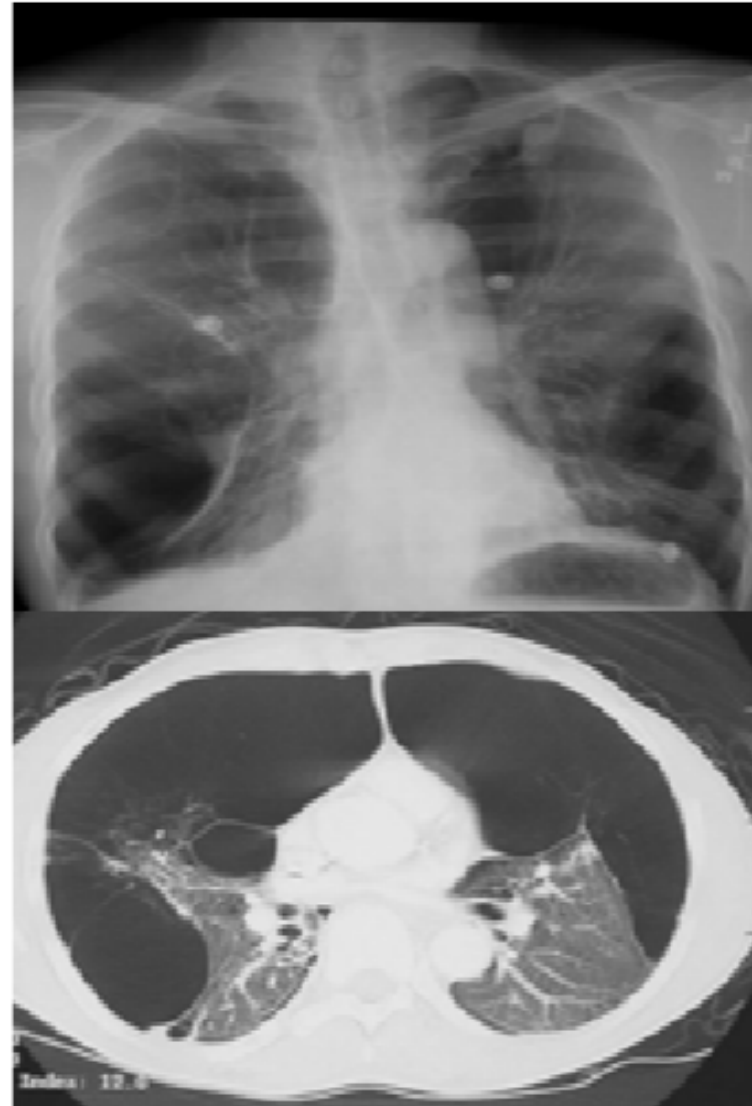
- Helium Dilution

- Inert tracer gas (He) of known initial concentration contained in a circuit of known volume (C_1V_1)
- Diluted by an unknown volume of gas from an additional source (patient)
- Produced CO_2 removed from system and absorbed oxygen replaced
- Measure the new steady-state helium concentration (C_2)
- $C_1V_1 = C_2V_2$



Lung Volumes

- Limitation of gas dilution
 - Assumes all areas of lung equally ventilated
 - Underestimates lung volumes in obstructive disease
 - Communicating gas volumes
 - Leaks



Case 8

Test Date:04-01-2008

Last Test:05-29-2007

Age:67

Ht:63.5 in

Wt:104 lbs

Gender: male

Race:Caucasian

Hb: None

BMI:18.1 kg/m2

Smoke Hx (Pk Yrs):

Diagnosis:Hypoxia

PRED ACTUAL %PRED

*SPIROMETRY

Forced Vital Capacity (FVC:L)	3.49	.54	15*
Forced Exp. Vol. 1 (FEV1:L)	2.58	.45	17*
% FEV1/VC	74.2%	68.2%	
Mid Exp. Flow (FEF25-75:L/sec)	2.05	.52	25*
Peak Flow (PF:L/sec)	7.25	2.15	30*

*INSPIRATORY LOOP

FEF50%/FIF50% (normal<=1.0)		.56	
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*LUNG VOLUMES Plethysmography

Slow Vital Capacity (SVC:L)	3.49	.66	19*
Exp. Reserve Volume (ERV:L)	.90	.10	11
Thoracic Gas Volume (TGV:L)	2.93	1.39	47*
Residual Volume (RV:L)	2.03	1.29	64*
Total Lung Capacity (TLC:L)	5.70	1.95	34*
%RV/TLC	34.8	66.2*	

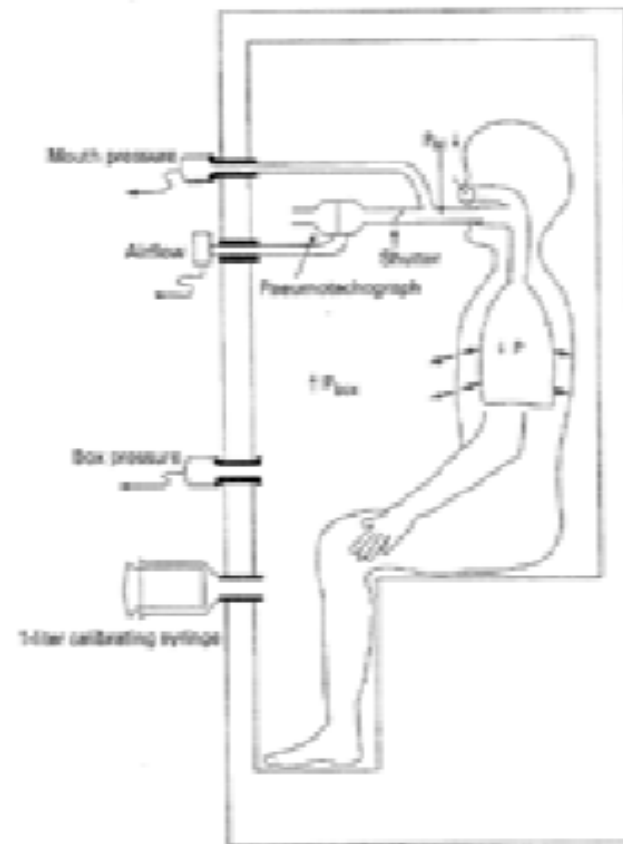
*DIFFUSING CAPACITY

Hb CORR/%PRED

Diff. Cap. (DLCO:ml/min/mm Hg)	24.2	6.8	28*
Single breath TLC (VA: L)	5.57	1.33	24*
DLCO/VA	4.41	5.11	116

Lung Volumes: Body Plethysmography

- Based on Boyle's Law: $P_1V_1=P_2V_2$
- Patient seated within a body box and breathes through a mouthpiece to outside atmosphere via a shutter
- Body box is a closed system and with inspiratory and expiratory efforts
- Pressure changes within the lung, measured at the mouth
- Resulting changes in the lung volume (thoracic gas volume)
- Changes in the lung volume result in opposite changes in the body box system pressure



	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC;L)	3.49	.54	15*
Forced Exp. Vol. 1 (FEV1;L)	2.58	.45	17*
% FEV1/VC	74.2%	68.2%	
Mid Exp. Flow (FEF25-75;L/sec)	2.05	.52	25*
Peak Flow (PF;L/sec)	7.25	2.15	30*

***INSPIRATORY LOOP**
FEF50%/FIF50% (normal≤1.0)

*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC;L)	3.49	.66	19*
Exp. Reserve Volume (ERV;L)	.90	.10	11
Thoracic Gas Volume (TGV;L)	2.93	1.39	47*
Residual Volume (RV;L)	2.03	1.29	64*
Total Lung Capacity (TLC;L)	5.70	1.95	34*
%RV/TLC	34.8	66.2*	

*DIFFUSING CAPACITY			
Diff. Cap. (DLCO;ml/min/mm Hg)	24.2	6.8	28*
Single breath TLC (VA; L)	5.57	1.33	24*
DLCO/VA	4.41	5.11	116

PFTS: Severe restriction
Reduced DLCO

Dx: Kyphoscoliosis



Case 9

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC;L)	3.38	3.28	97
Forced Exp. Vol. 1 (FEV1;L)	2.41	2.08	85
% FEV1/VC	78.9%	62.8%	*
Mid Exp. Flow (FEF25-75;L/sec)	2.58	.88	34*
Peak Flow (PF;L/sec)	7.43	6.83	92
*INSPIRATORY LOOP			
FEF50%/FIF50% (normal<=1.0)	.25		
*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC;L)	3.38	3.28	97
Exp. Reserve Volume (ERV;L)	1.02	1.39	136
Thoracic Gas Volume (TGV;L)	3.43	3.11	91
Residual Volume (RV;L)	2.41	1.72	71*
Total Lung Capacity (TLC;L)	6.44	5.00	78*
%RV/TLC	37.5	34.4	
*DIFFUSING CAPACITY			
			Hb CORR/%PRED
Diff. Cap. (DLCO;ml/min/mm Hg)	23.6	6.7	28*
Single breath TLC (VA; L)	6.24	4.34	70*
DLCO/VA	3.93	1.54	39*

- 76yo WM with progressive SOB and cough
- 50PY tob hx
- Mild obstruction by spirometry
- Mild restriction by lung volumes
- Severely reduced DLCO
- Increased ERV

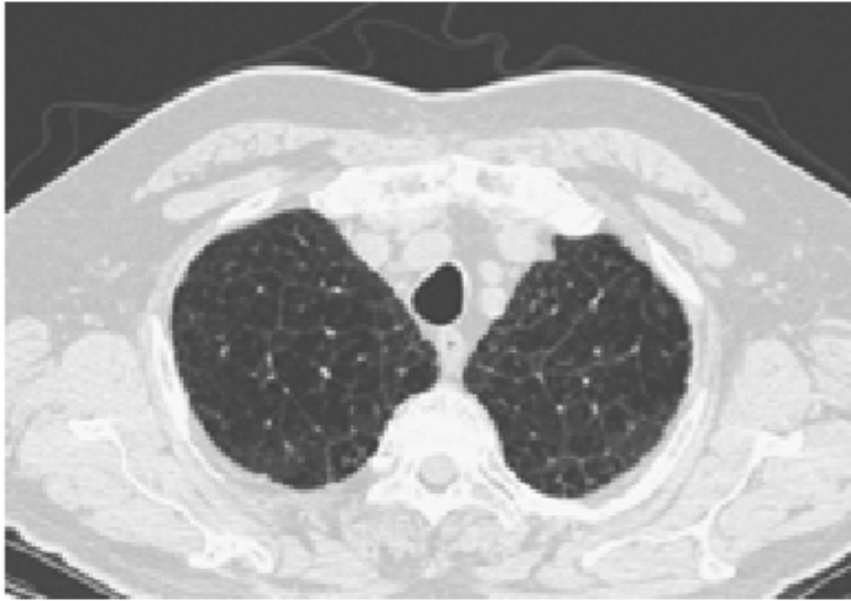
Case 10

Test Date:06-28-2005 Age:32 Ht:99.9 in Wt:140 lbs
Gender: male Race:Caucasian Hb:9.4 g/dl BMI:9.9 kg/m2
Smoke Hx (Pk Yrs): 17.0
Diagnosis:Hodgkin's Disease Secondary:Preoperative Evaluation

	PRED	ACTUAL	%PRED	
*SPIROMETRY				
Forced Vital Capacity (FVC;L)	11.71	2.87	25*	
Forced Exp. Vol. 1 (FEV1;L)	9.17	2.17	24*	
% FEV1/FVC	86.9%	75.6%		
Mid Exp. Flow (FEF25-75;L/sec)	9.01	1.76	20*	
Peak Flow (PF;L/sec)	15.27	5.08	33*	
*INSPIRATORY LOOP				
FEF50%/FIF50% (normal<=1.0)	1.26*			
*LUNG VOLUMES Plethysmography				
Slow Vital Capacity (SVC;L)	11.71	2.87	25*	
Exp. Reserve Volume (ERV;L)	3.68	.95	26	
Thoracic Gas Volume (TGV;L)	6.98	3.00	43*	
Residual Volume (RV;L)	3.30	2.05	62*	
Total Lung Capacity (TLC;L)	12.94	4.92	38*	
%RV/TLC	23.9	41.7*		
*DIFFUSING CAPACITY				
				Hb CORR/%PRED
Diff. Cap. (DLCO;ml/min/mm Hg)	47.5	18.2	38*	25.5 54*
Single breath TLC (VA; L)	12.59	4.23	34*	
DLCO/VA	3.42	4.30	126	6.03 176*

*OXIMETRY/OTHER STUDIES	Predict.	Actual
%SaO ₂ (Rest, room air)	>93%	94
%SaO ₂ (6' walk, room air)	>93%	59*
6' Walk Distance (ft)	>1200	1807
Dyspnea(Borg Scale 6'walk)	Rest: 0	Max: 3
Leg Fatigue (Borg Scale 6' walk)	Rest: 0	Max: 2
Heart rate (6' walk, b/min)	Rest: 65	Max: 153

- Mixed obstruction and restriction pattern
- Decreased DLCO
- Dx: emphysema + pulmonary fibrosis



Case 11

*SPIROMETRY

	PRED	ACTUAL	%PRED
Forced Vital Capacity (FVC;L)	4.78	4.63	97
Forced Exp. Vol. 1 (FEV1;L)	4.11	3.64	89
% FEV1/FVC	86.1%	78.6%	
Mid Exp. Flow (FEF25-75;L/sec)	4.63	3.50	76
Peak Flow (PF;L/sec)	9.59	5.07	53*

- 24yo WM admitted with SOB/DOE, wheezing, inspiratory stridor
- No PMHx, medications
- PSHx sig for exp lap 6 months prior after MVA
- 2 PY Tob hx, occ EtOH
- Dx with asthma but no improvement with meds

*SPIROMETRY

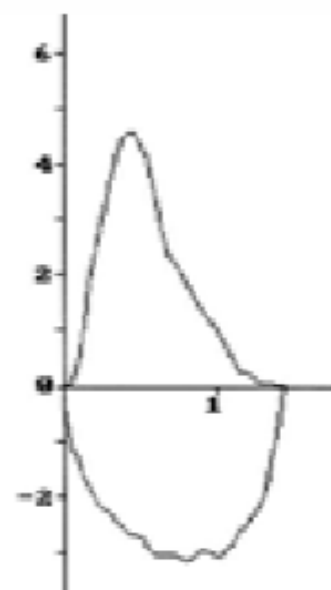
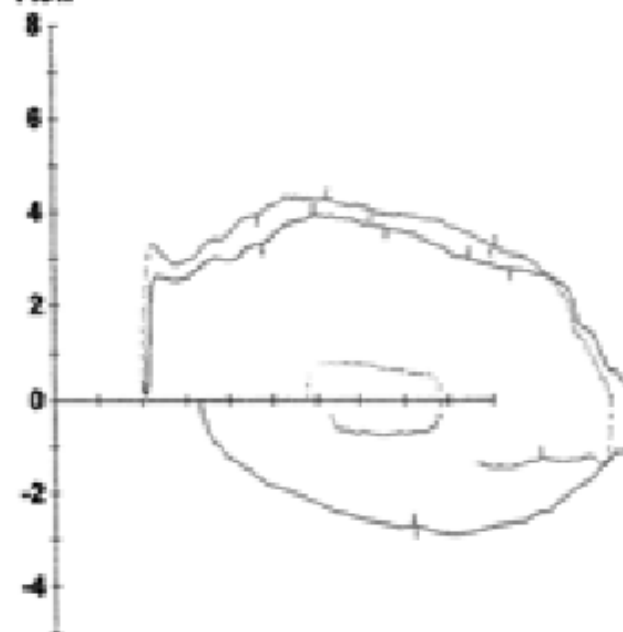
	PRED	ACTUAL	%PRED
Forced Vital Capacity (FVC:L)	4.78	4.63	97
Forced Exp. Vol. 1 (FEV1:L)	4.11	3.64	89
% FEV1/FVC	86.1%	78.6%	
Mid Exp. Flow (FEF25-75:L/sec)	4.63	3.50	76
Peak Flow (PF:L/sec)	9.59	5.07	53*

*INSPIRATORY LOOP

FEF50%/FIF50% (normal<=1.0)

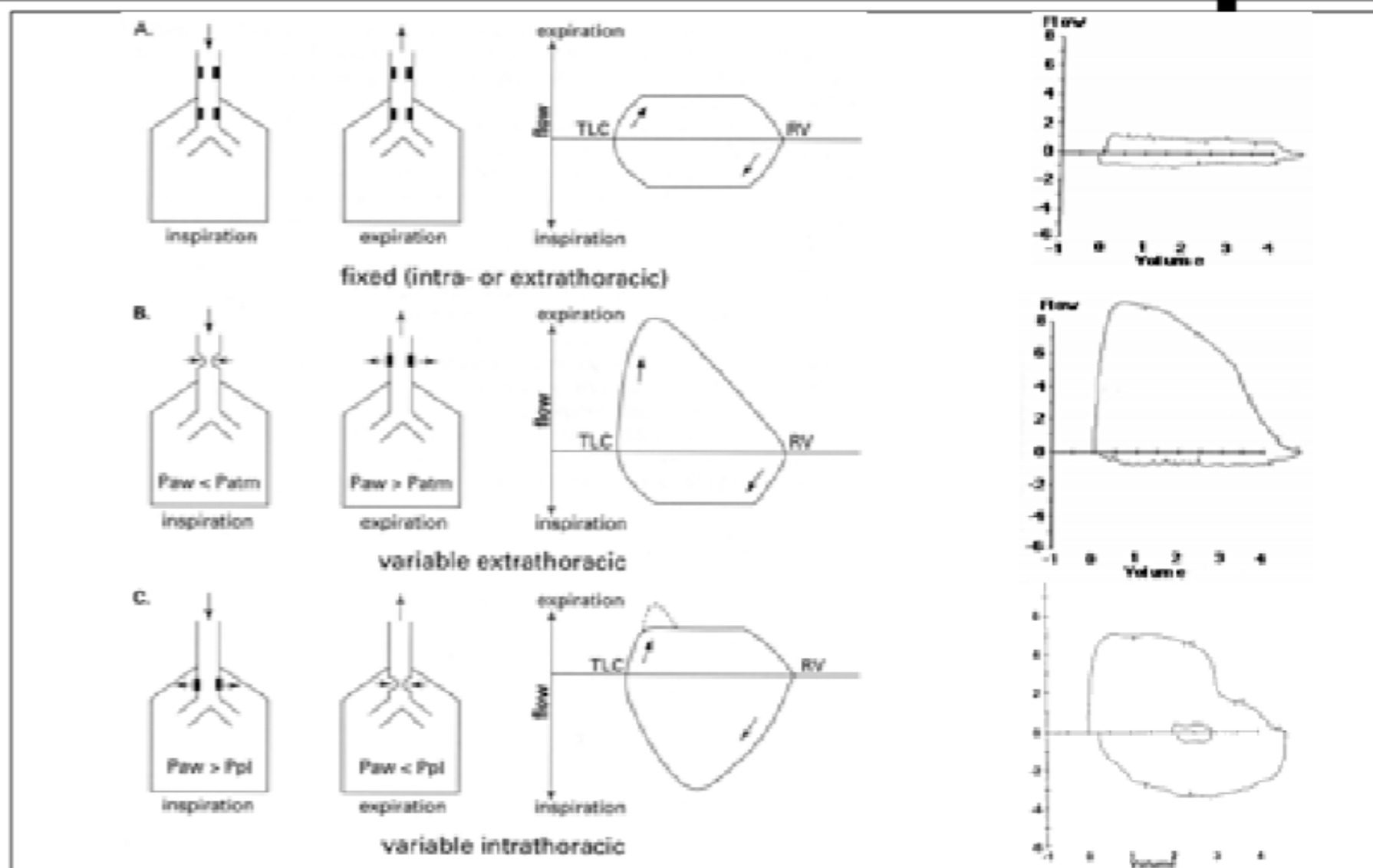
1.38*

Flow



- Normal spirometry
- Decreased peak flow
- Consistent with asthma
- No obstruction
- Tech notes: Patient with stridor during spirometry

Flow-Volume Loop



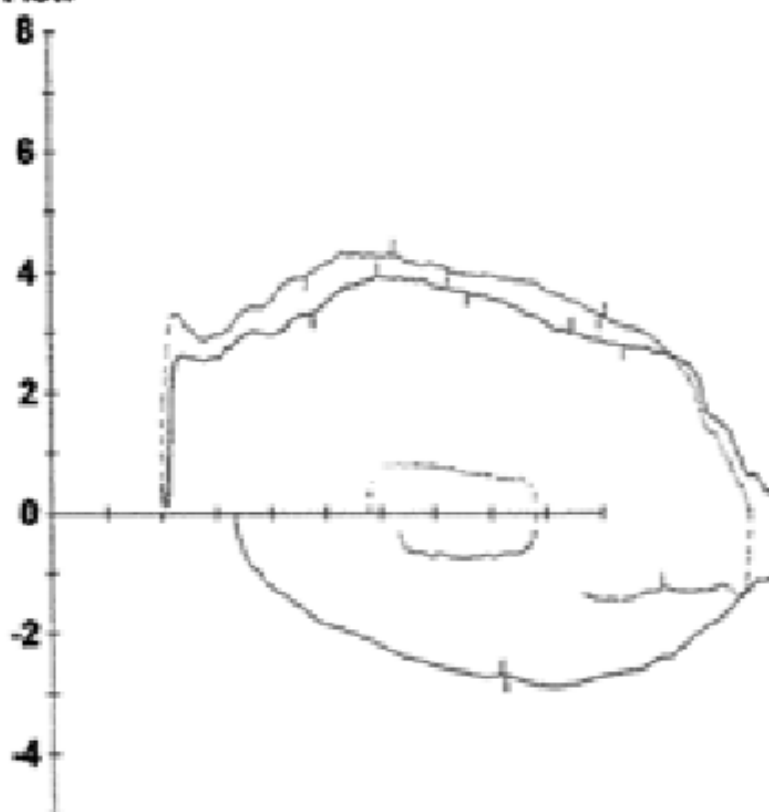
*SPIROMETRY

	PRED	ACTUAL	%PRED
Forced Vital Capacity (FVC;L)	4.78	4.63	97
Forced Exp. Vol. 1 (FEV1;L)	4.11	3.64	89
% FEV1/FVC	86.1%	78.6%	
Mid Exp. Flow (PEF25-75;L/sec)	4.63	3.50	76
Peak Flow (PF;L/sec)	9.59	5.07	53*

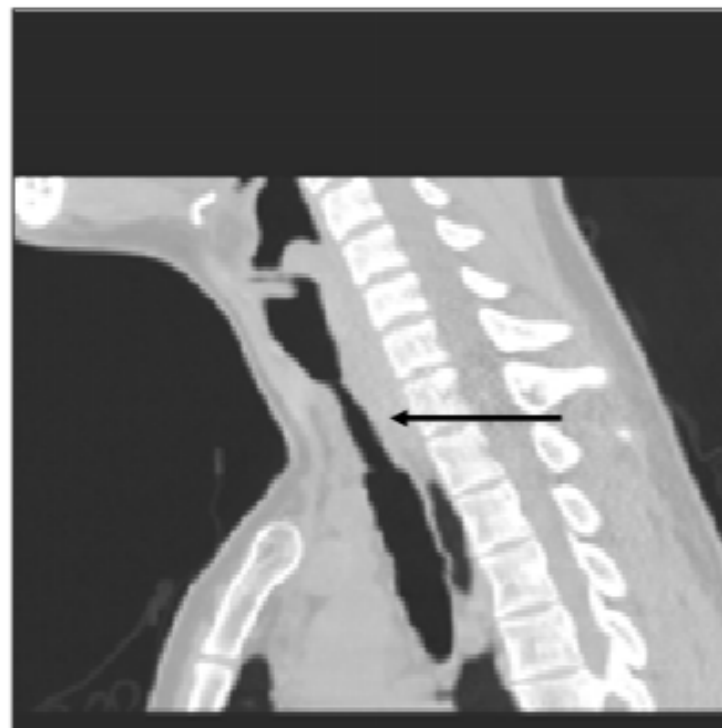
*INSPIRATORY LOOP

FEF50%/FIF50% (normal $\leq$ 1.0)	1.38*
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Flow



Fixed airway obstruction
Post-intubation tracheal
stenosis/stricture

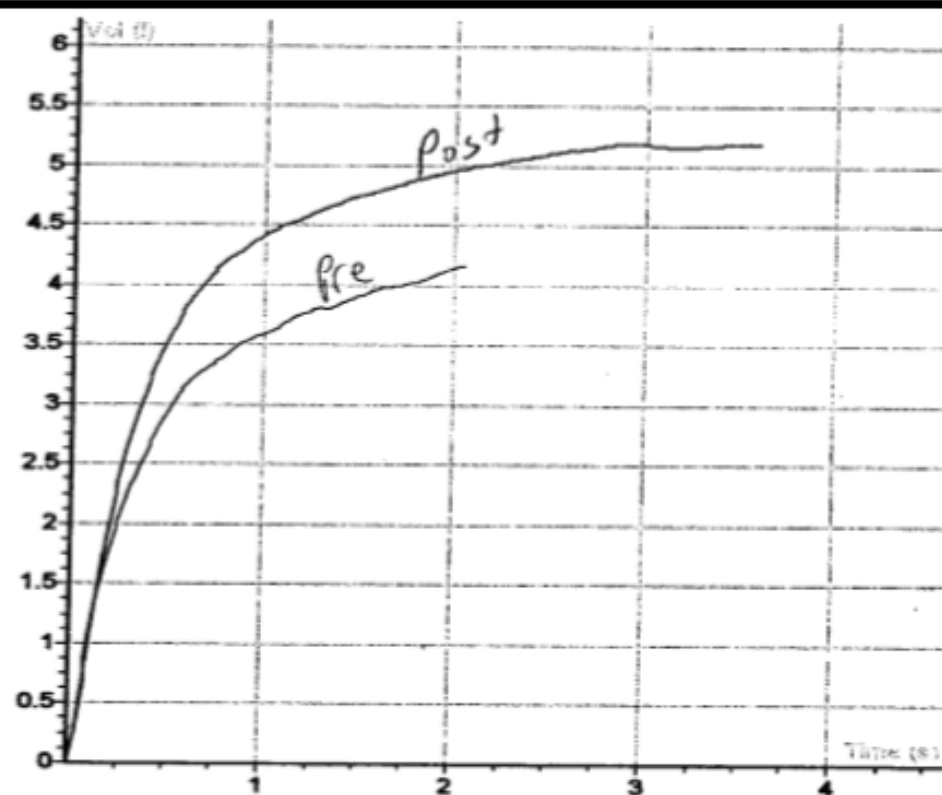
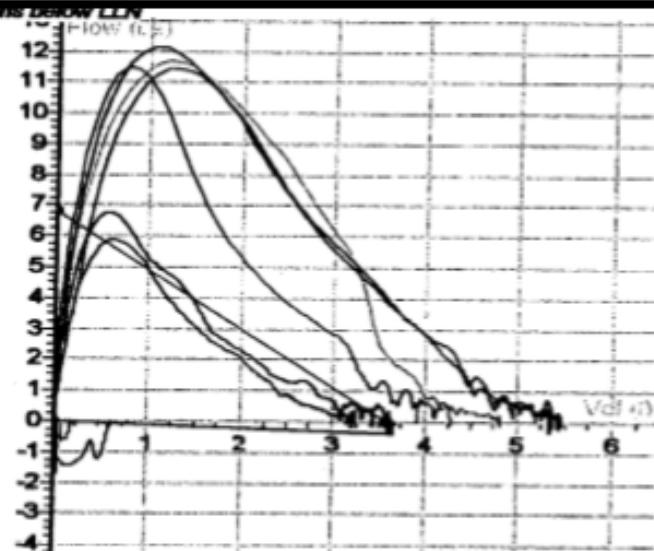


Case 12:

Parameter	Units	Pred	Best Effort		1. Post	%Pred	%Change
			2. Pre	%Pred			
FVC	(L)	3.58	4.26	119	5.46	152	128% (1.20)
FEV1	(L)	2.87	3.69	129	4.68	163	127% (0.99)
FEV1/FVC	(%)	81	87	107	86	106	99% (-1)
FEV6	(L)	3.50	4.26	122	5.46	156	128% (1.20)
PEF	(L/s)	6.82	11.49	169	11.46	168	100% (-0.03)
FEF25-75	(L/s)	2.90	4.47	154	5.48	189	123% (1.01)
ATS	-	-	No	-	No	-	-

Post Medication: Albuterol, 2.5mg/3ml

- 46 F with recent dx of asthma



Quality Messages:

Pre: 3-Blow out longer, 2-Blow out longer, 1-Blow out longer, 3-Blow out longer,

Post: 2-Blow out longer, 1-Blow out longer,

FEV1 Pre / Post Var:	855 ml (23 %)	/ 38 ml (1 %)
FVC Pre / Post Var:	643 ml (15 %)	/ 107 ml (2 %)

ATS Reproducibility:

Pre: NOT MET (< 3 acceptable efforts)

Post: NOT MET (< 3 acceptable efforts)

Test Comment:

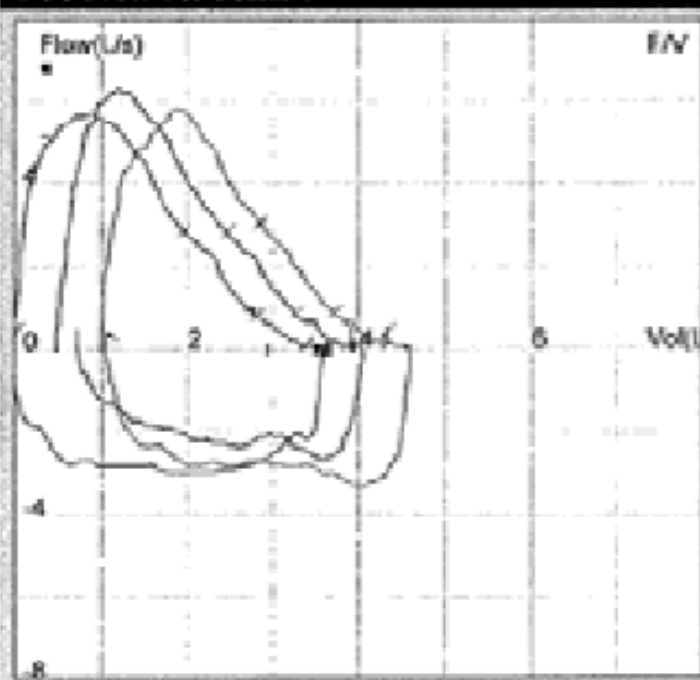
Calibrate Machine

- **Frequent checks with 3 liter syringe**
- **Biological control – no more than 5% variation in FVC and FEV1 per week.**

Results

Result	Pred	Best	%Pred	%Pred	%Pred		
FVC (L)	3.61	3.57	99%	3.55	98%	3.59	99%
FEV1 (L)	2.80	2.85	100%	2.84	98%	2.80	97%
FEV1/FVC	0.81	0.80	99%	0.80	99%	0.78	96%
FEF25-75% (L/s)	2.91	2.80	96%	2.77	95%	2.54	87%
PEFR (L/s)	6.85	5.71	83%	6.34	93%	5.85	85%
Vert %	---	2.99	---	3.29	---	3.79	---

FVC Flow vs. Volume



FVC Volume vs. Time

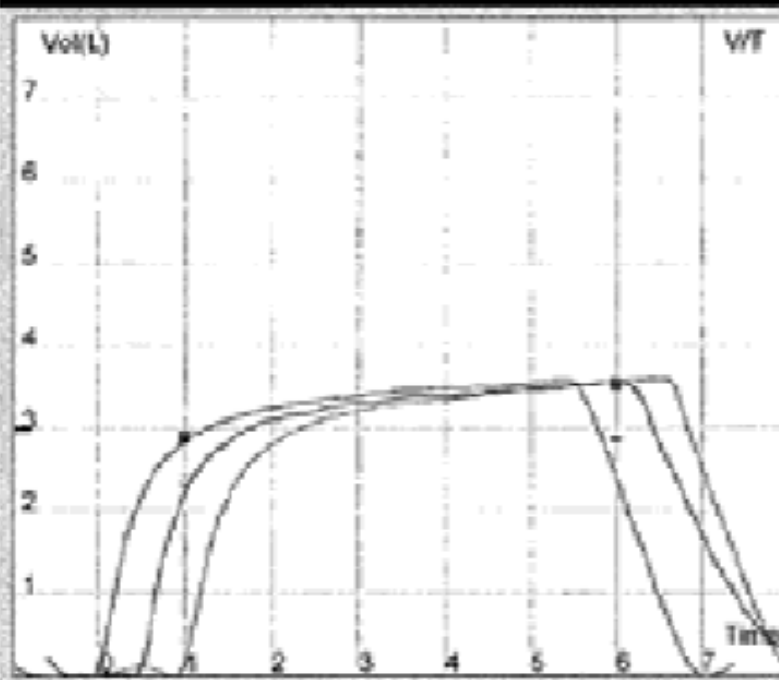


TABLE 2

Activities that should preferably be avoided prior to lung function testing

Smoking within at least 1 h of testing
Consuming alcohol within 4 h of testing
Performing vigorous exercise within 30 min of testing
Wearing clothing that substantially restricts full chest and abdominal expansion
Eating a large meal within 2 h of testing

- **No use of short acting bronchodilators for 4 hours prior to testing.**
- **Long acting β agonists or aminophylline should be held for 12 hours.**

Case 13

	PRED	ACTUAL	%PRED	
*SPIROMETRY				
Forced Vital Capacity (FVC;L)	3.25	2.93	90	
Forced Exp. Vol. 1 (FEV1;L)	2.83	2.33	82	
% FEV1/FVC	90.3%	79.5%		
Mid Exp. Flow (FEF25-75;L/sec)	3.44	2.26	66	
Peak Flow (PF;L/sec)	6.79	4.87	72*	
*INSPIRATORY LOOP				
FEF50%/FIF50% (normal<=1.0)	1.08*			
*LUNG VOLUMES Plethysmography				
Slow Vital Capacity (SVC;L)	3.25	2.93	90	
Exp. Reserve Volume (ERV;L)	1.33	1.11	83	
Thoracic Gas Volume (TGV;L)	2.48	2.40	97	
Residual Volume (RV;L)	1.15	1.29	112	
Total lung Capacity (TLC;L)	4.60	4.22	92	
%RV/TLC	25.2	30.6		
*DIFFUSING CAPACITY				
			Hb CORR/%PRED	
Diff. Cap. (DLCO;ml/min/mm Hg)	24.3	13.5	56*	16.4 67*
Single breath TLC (VA; L)	4.57	3.81	83	
DLCO/VA	5.12	3.54	69*	4.30 84
*OXIMETRY/OTHER STUDIES Predict. Actual				
%SaO2(Rest, O2 = 2 L/min)	>93%	96		
%SaO2(6' walk, room air)	>93%	77*		
6' Walk Distance (ft)	>1200	1459		
Dyspnea(Borg Scale 6'walk)	Rest: .0	Max: 3.0		
Heart rate (6' walk, b/min)	Rest: 84	Max: 160		

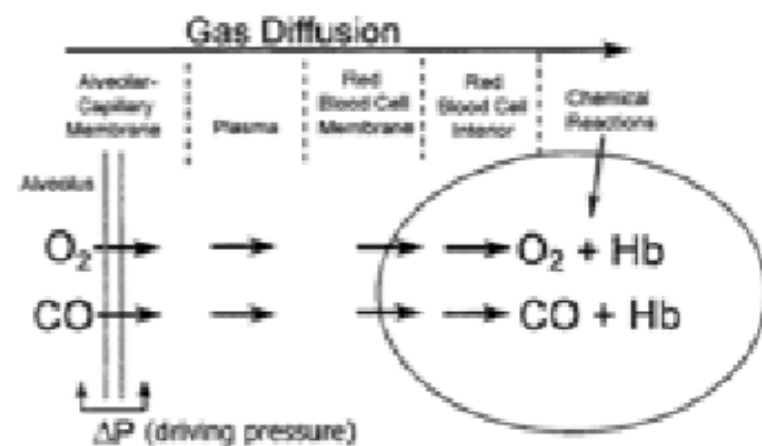
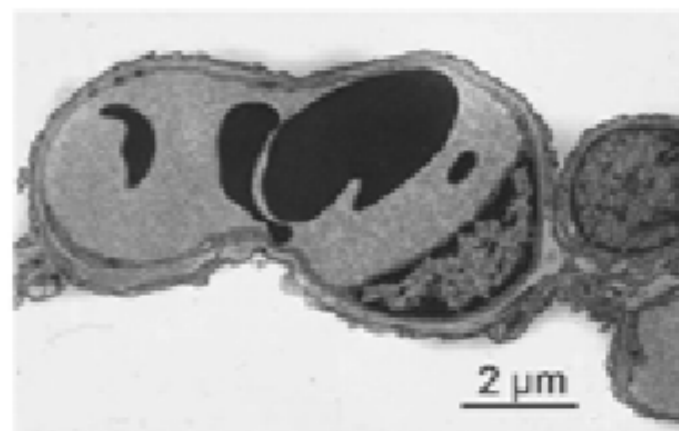
- 26yo AAF with progressive SOB/DOE
- Ht 61in, wt 100 lbs
- BMI=19
- Hgb=11.3
- 7 PY tob hx

	PRED	ACTUAL	%PRED	
*SPIROMETRY				
Forced Vital Capacity (FVC:L)	3.25	2.93	90	
Forced Exp. Vol. 1 (FEV1:L)	2.83	2.33	82	
% FEV1/FVC	90.3%	79.5%		
Mid Exp. Flow (FEF25-75:L/sec)	3.44	2.26	66	
Peak Flow (PF:L/sec)	6.79	4.87	72*	
*INSPIRATORY LOOP				
FEF50%/FIF50% (normal<=1.0)	1.08*			
*LUNG VOLUMES Plethysmography				
Slow Vital Capacity (SVC:L)	3.25	2.93	90	
Exp. Reserve Volume (ERV:L)	1.33	1.11	83	
Thoracic Gas Volume (TCV:L)	2.48	2.40	97	
Residual Volume (RV:L)	1.15	1.29	112	
Total Lung Capacity (TLC:L)	4.60	4.22	92	
RV/TLC	25.2	30.6		
*DIFFUSING CAPACITY				
			Hb CORR/%PRED	
Diff. Cap. (DLCO:ml/min/mm Hg)	24.3	13.5	56*	16.4 67*
Single breath TLC (VAB: L)	4.57	3.81	83	
DLCO/VA	5.12	3.54	69*	4.30 84
*OXIMETRY/OTHER STUDIES Predict. Actual				
%SaO2(Rest, room air)	>93%		96	
%SaO2(6' walk, room air)	>93%	77*		
6' Walk Distance (ft)	>1200	1459		
Dyspnea(Borg Scale 6'walk)	Rest: .0	Max: 3.0		
Heart rate (6' walk, b/min)	Rest: 84	Max: 160		

- Normal spirometry
- Normal lung volumes
- Low diffusing capacity
- Significant desaturation with normal walk distance
- DDx:
 - Pulm HTN
 - Early ILD

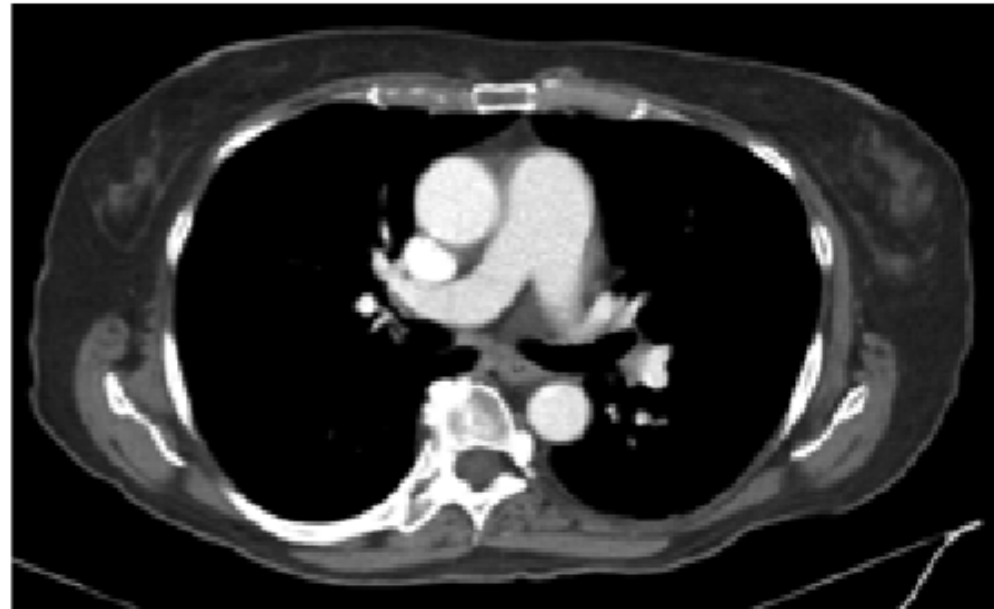
Diffusing Capacity

- Capacity of the lungs to exchange gas across the alveolar-capillary interface
- Most common technique based on CO uptake
- Function of
 - Flow delivery of CO to alveoli
 - Mixing and diffusion of CO to airways and alveoli
 - Transfer of CO across gas/liquid interface
 - Mixing and diffusion of CO in the lung parenchyma/capillary plasma
 - Diffusion across RBC membrane
 - Chemical reaction with Hgb



Echocardiogram:

- **The right ventricular systolic pressure is calculated at 49 mmHg. There is evidence of moderate pulmonary**
- **Right Ventricle: The right ventricle is slightly dilated. The right ventricular global systolic function is mildly reduced.**



Case 15

Test Date:10-09-2008 Age:52 Ht:70.0 in Wt:176 lbs
Gender: male Race:Caucasian Hb:18.1 g/dl BMI:25.2 kg/m2
[redacted] Smoke Hx (Pk Yrs):
Diagnosis:Multiple myeloma
[redacted]

	PRED	ACTUAL	%PRED	
*SPIROMETRY				
Forced Vital Capacity (FVC;L)	5.01	3.25	65*	
Forced Exp. Vol. 1 (FEV1;L)	3.87	2.08	54*	
% FEV1/VC	77.3%	62.3%	*	
Mid Exp. Flow (FEF25-75;L/sec)	3.37	1.13	34*	
Peak Flow (PF;L/sec)	9.73	5.06	52*	
*INSPIRATORY LOOP				
FEF50%/FIF50% (normal<=1.0)				.41
*LUNG VOLUMES Plethysmography				
Slow Vital Capacity (SVC;L)	5.01	3.34	67*	
Exp. Reserve Volume (ERV;L)	1.49	1.05	70	
Thoracic Gas Volume (TGV;L)	3.57	3.53	99	
Residual Volume (RV;L)	2.08	2.49	120	
Total Lung Capacity (TLC;L)	6.97	5.83	84	
%RV/TLC	30.1	42.7*		
*DIFFUSING CAPACITY				
Diff. Cap. (DLCO;ml/min/mm Hg)	30.3	12.5	41*	Hb CORR/%PRED
Single breath TLC (VA; L)	6.82	4.78	70*	7.6 25*
DLCO/VA	4.50	2.62	58*	1.59 35*

Case 16

Test Date: 08-31-2009 Age: 26 Ht: 56 in Wt: 78 lbs
 Gender: female Race: Caucasian Hb: 11.4 g/dl BMI: 17.5 kg/m2
 94 Smoke Hx (Pk Yrs):
 Diagnosis: DOE, Dyspnea on Exertion
 Denise Owens

• 26 yo WF
 with dyspnea

• PMHx of
 cystinosis

	PRED	ACTUAL	%PRED	
*SPIROMETRY				
Forced Vital Capacity (FVC;L)	2.07	1.16	40*	
Forced Exp. Vol. 1 (FEV1;L)	2.53	1.13	45*	
% FEV1/VC	85.3%	97.4%		
Mid Exp. Flow (FEF25-75;L/sec)	3.15	1.74	55*	
Peak Flow (PF;L/sec)	5.0	1.97	34*	
*INSPIRATORY LOOP				
FEF50%/FIF50% (normal<=1.0)			1.35*	
*LUNG VOLUMES Plethysmography				
Slow Vital Capacity (SVC;L)	2.07	1.16	40*	
Exp. Reserve Volume (ERV;L)	1.12	0.34	30	
Thoracic Gas Volume (TGV;L)	2.02	1.86	92	
Residual Volume (RV;L)	0.9	1.52	169	
Total Lung Capacity (TLC;L)	3.86	2.68	69*	
RV/TLC	25.2	56.7*		
*RESPIRATORY MECHANICS				
Max Insp Press (MIP; cm H2O)	-91	-23	25*	
Max Exp. Press. (MEP;cm H2O)	156	9	6*	
*DIFFUSING CAPACITY				
Diff. Cap. (DLCO;ml/min/mm Hg)	22.3	6.9	31*	Hb CORR/%PRED
Single breath TLC (VA; L)	3.75	1.61	43*	9.7 43*
DLCO/VA	5.35	4.29	80	6.02 113
*OXIMETRY/OTHER STUDIES Predict. Actual				
%SaO2(Rest, room air)	>93%	100		
%SaO2(6' walk, room air)	>93%	98		
6' Walk Distance (ft)	>1200	1138*		
Dyspnea(Borg Scale 6"walk)	Rest: 1	Max: 5		
Leg Fatigue (Borg Scale 6' walk)	Rest: 0	Max: 5		
Heart rate (6' walk, b/min)	Rest: 98	Max: 146		

Test Date: 10-09-2008

Gender: male

Age: 52

Race: Caucasian

Smoke Hx (Pk Yrs):

Height: 70.0 in

Hb: 6.9 g/dl

Weight: 176 lbs

BMI: 25.2 kg/m2

Diagnosis: Multiple myeloma

Predicted Values from NHANES III

	PRED	ACTUAL	%PRED
SPIROMETRY			
Forced Vital Capacity (FVC; L)	5.01	3.25	65 *
Forced Exp. Vol. 1 (FEV1; L)	3.87	2.08	54 *
% FEV1 / VC	77.3 %	62.3 %	*
Mid Exp. Flow (FEF25-75; L/sec)	3.37	1.13	34 *
Peak Flow (PF; L/sec)	9.73	5.06	52 *

INSPIRATORY LOOP

FEF50% / FIF50% <=1.0 .41

LUNG VOLUMES *Plethysmography Method*

Slow Vital Capacity (SVC; L)	5.01	3.34	67 *
Exp. Reserve Volume (ERV; L)	1.49	1.05	70
Thoracic Gas Volume (TGV; L)	3.57	3.53	99
Residual Volume (RV; L)	2.08	2.49	120
Total Lung Capacity (TLC; L)	6.97	5.83	84
%RV/TLC	30.1	42.7	*

DIFFUSING CAPACITY

Diffusing Capacity (DLCO; ml/min/mm Hg)	30.3	12.5	41 *
Single breath TLC (VA; L)	6.82	4.78	70 *
DLCO/VA	4.50	2.62	58 *

Hb CORR

23.3

% PRED

77

4.87

108

Test Date: 08-31-2006 Age: 26 Ht: 56 in Wt: 70 lbs
 Gender: female Race: Caucasian Hb: 11.4 g/dl BMI: 17.5 kg/m²
 [Redacted] Smoke Hx (Pk Yrs):
 Diagnosis: DM2, Dyspnea on Exertion
 [Redacted]

	PRED	ACTUAL	APRED
*SPIROMETRY			
Forced Vital Capacity (FVC:L)	2.07	1.16	40*
Forced Exp. Vol. 1 (FEV1:L)	2.53	1.13	45*
% FEV1/VC	85.3%	97.4%	
Mid Exp. Flow (FEF25-75:L/sec)	3.15	1.74	55*
Peak Flow (FFrL/sec)	5.0	1.97	34*
*INSPIRATORY LOOP			
FEF50%/VIF50% (normal<1.0)			1.35*
*LUNG VOLUMES PLETHYMOGRAPHY			
Slow Vital Capacity (SVC:L)	2.07	1.16	40*
Exp. Reserve Volume (ERV:L)	1.12	0.34	30
Thoracic Gas Volume (TVV:L)	2.02	1.86	92
Residual Volume (RV:L)	0.9	1.52	169
Total Lung Capacity (TLC:L)	3.86	2.68	69*
RV/TLC	25.2	56.7*	
*RESPIRATORY MECHANICS			
Max Insp Press (MIR) cm H ₂ O	-91	-23	75*
Max Exp. Press. (MEP) cm H ₂ O	156	9	6*
*DIFFUSING CAPACITY			
Diff. Cap. (DLCO=vol/min/mm Hg)	22.3	4.9	10*
Single breath TLC (VA: L)	3.75	1.61	43*
DLCO/VA	5.95	4.29	80
			6.02 113
*CHEMISTRY/OTHER STUDIES Predict. Actual			
%SaO ₂ (Rest, room air)	>93%	100	
%SaO ₂ (6' walk, room air)	>93%	90	
6' Walk Distance (ft)	>1200	1100*	
Dyspnea(Borg Scale 4'walk)	Rest: 1	Max: 5	
Leg Fatigue (Borg Scale 4' walk)	Rest: 0	Max: 5	
Heart rate (6' walk, b/min)	Rest: 98	Max: 146	

- 26 yo WF with dyspnea
- PFTS:
 - Restriction
 - Reduced DLCO but normal when adjusted for lung volumes
 - No desaturation when walking
 - Reduced maximum inspiratory pressure
- Dx: Dyspnea secondary to muscle weakness

Case 17

Test Date:04-28-2008

Last Test:12-07-2007 Age:55 Ht:64.0 in Wt:182 lbs

Gender: male Race:Caucasian Hb: None BMI:31.2 kg/m2

Smoke Hx (Pk Yrs):

Diagnosis:DOE, Dyspnea on Exertion

	PRED	ACTUAL	%PRED
*SPIROMETRY			
Forced Vital Capacity (FVC:L)	3.95	3.39	86
Forced Exp. Vol. 1 (FEV1:L)	3.04	2.08	68*
% FEV1/VC	76.7%	56.8%	*
Mid Exp. Flow (FEF25-75:L/sec)	2.69	.80	30*
Peak Flow (PF:L/sec)	8.26	6.77	82
*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC:L)	3.95	3.66	93
Exp. Reserve Volume (ERV:L)	1.07	.06	6
Thoracic Gas Volume (TGV:L)	2.88	2.62	91
Residual Volume (RV:L)	1.81	2.56	141*
Total Lung Capacity (TLC:L)	5.77	6.22	108
%RV/TLC	31.1	41.2*	
*DIFFUSING CAPACITY			
			Hb CORR/%PRED
Diff. Cap. (DLCO:ml/min/mm Hg)	27.1	35.2	130*
Single breath TLC (VA: L)	5.66	5.56	98
DLCO/VA	4.75	6.33	133*

- 55yo WM with long standing asthma

Test Date:04-28-2008

Last Test:12-07-2007 Age:55 Ht:64.0 in Wt:182 lbs

Gender: male Race:Caucasian Hb: None BMI:31.2 kg/m2

Smoke Ex (Pk Yrs):

Diagnosis:DOE, Dyspnea on Exertion

	FRED	ACTUAL	%FRED
*SPIROMETRY			
Forced Vital Capacity (FVC:L)	3.95	3.39	86
Forced Exp. Vol. 1 (FEV1:L)	3.04	2.08	68*
% FEV1/VC	76.7%	56.8%	*
Mid Exp. Flow (FEF25-75:L/sec)	2.69	.80	30*
Peak Flow (PF:L/sec)	8.26	6.77	82
*LUNG VOLUMES Plethysmography			
Slow Vital Capacity (SVC:L)	3.95	3.66	93
Exp. Reserve Volume (ERV:L)	1.07	.06	6
Thoracic Gas Volume (TGV:L)	2.88	2.62	91
Residual Volume (RV:L)	1.81	2.56	141*
Total Lung Capacity (TLC:L)	5.77	6.22	108
%RV/TLC	31.1	41.2*	
*DIFFUSING CAPACITY			
			Hb CORR/%FRED
Diff. Cap. (DLCO:ml/min/mm Hg)	27.1	35.2	130*
Single breath TLC (VA: L)	5.66	5.56	98
DLCO/VA	4.75	6.33	133*

- **PFTS:**
 - ✓ **Obstruction by spirometry**
 - ✓ **Increased RV c/w air trapping**
 - ✓ **Increased DLCO**
- **Asthma**
- **Obesity**
- **Polycythemia, cardiac shunts, alveolar hemorrhage**

