PFTs
ACOI Board Review 2020

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NOW ROWAN SOM

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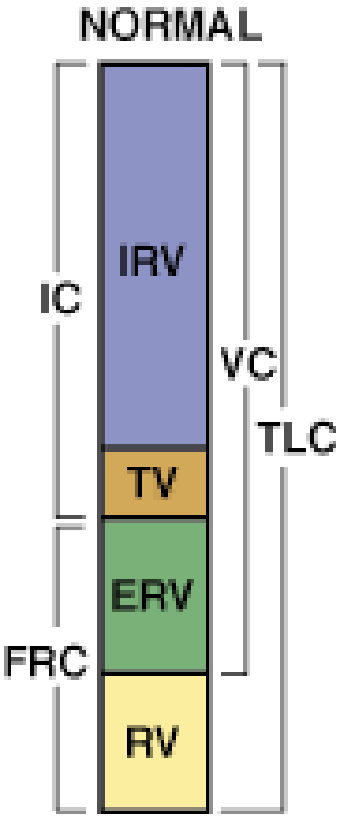
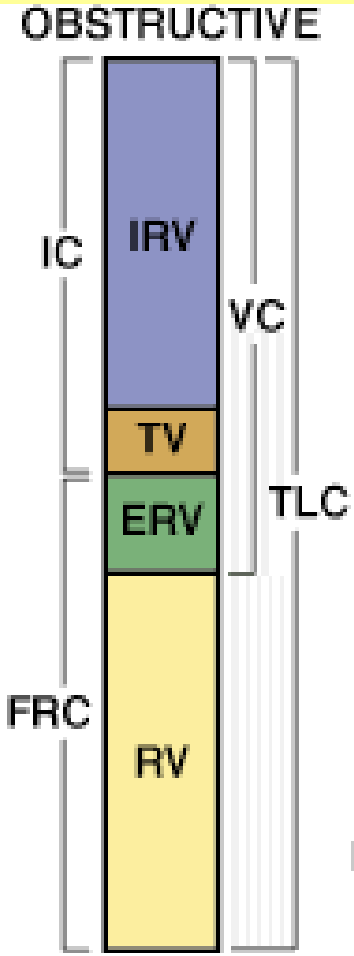
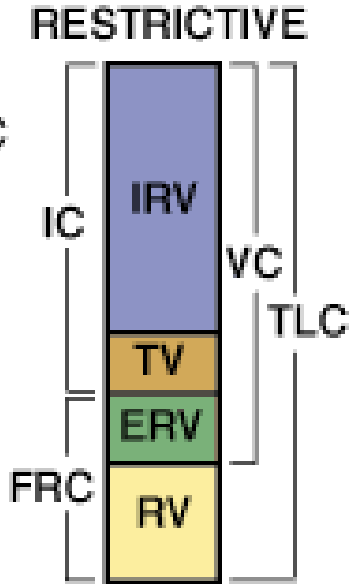
"Average" Lung Volumes

Lung Volumes

- **Tidal Volume**
  - 500 ml
- Inspiratory Reserve Volume
  - 3000 ml
- Expiratory Reserve Volume
  - 1000 ml
- **Residual Volume**
  - 1500 ml → ***NOT MEASURED by SPIROMETRY***







IC = Inspiratory Capacity	N or ↓	↓ or N
ERV = Expiratory Reserve Volume	↓ or N	↓ or N
IRV = Inspiratory Reserve Volume	N or ↓	↓ or N
RV = Residual Volume	↑	↓ or N
VC = Vital Capacity	N or ↓	↓
TV = Tidal Volume	N or ↑	↓ or N
FRC = Functional Reserve Volume	↑	↓ or N
TLC = Total Lung Capactly	↑	↓

In order to compute normal predicted values you need THREE things

- **Age** — **Lungs get smaller with age**
- **Gender** — **Men have bigger lungs**
- **Height** — **Tall people have bigger lungs**

- **Actually you need Air temp, Baro Pressure, and race too**

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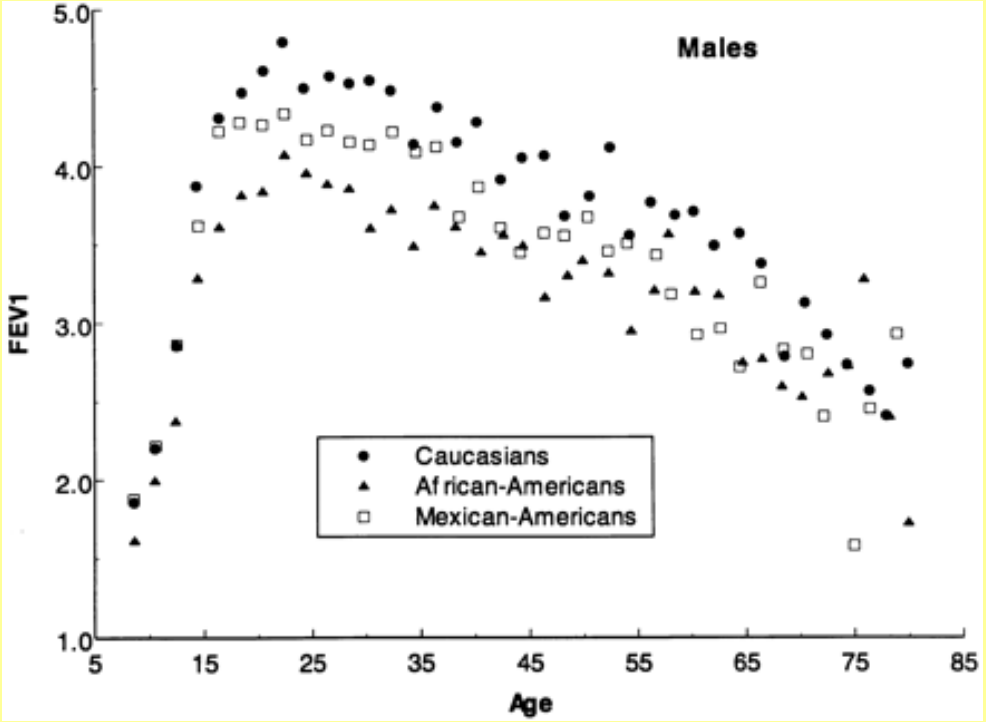
Prediction Equations



Hankinson JL et al.
Am. J. Respir Crit. Care Med.
Jan 1, 1999; 159(1):179-187

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Crapo RO, Morris AH, Clayton PD, and Nixon CR. Lung Volumes in Healthy Nonsmoking Adults. Bull. Europ. Physiopathol. Respir. 1982; 8:419-425.

FVC = 0.1524*Height(inches) - 0.0214*Age(years) - 4.6500 [Men]
FVC = 0.1247*Height(inches) - 0.0216*Age(years) - 3.5900 [Women]
FEV1 = 0.1052*Height(inches) - 0.0244*Age(years) - 2.1900 [Men]
FEV1 = 0.0869*Height(inches) - 0.0255*Age(years) - 1.5780 [Women]

FEV1% = Predicted FEV1 / Predicted FVC
RV = 0.0495*Height(inches) + 0.0246*Age(years) - 2.6830 [Men]
RV = 0.0251*Height(inches) + 0.0216*Age(years) - 0.9470 [Women]
TLC = 0.2019*Height(inches) + 0.0032*Age(years) - 7.333 [Men]
TLC = 0.1499*Height(inches) - 4.5370 [Women]

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To read spirometry you only really need THREE numbers

- **FVC predicted** — **80% or >**
- **FEV1 predicted** — **80% or >**
- **FEV1/FVC ratio** — **75% or greater**

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Data for spirometry can be presented in THREE ways

- **Volume time curve**
- **Flow-Volume loop**
- **Numerical data**

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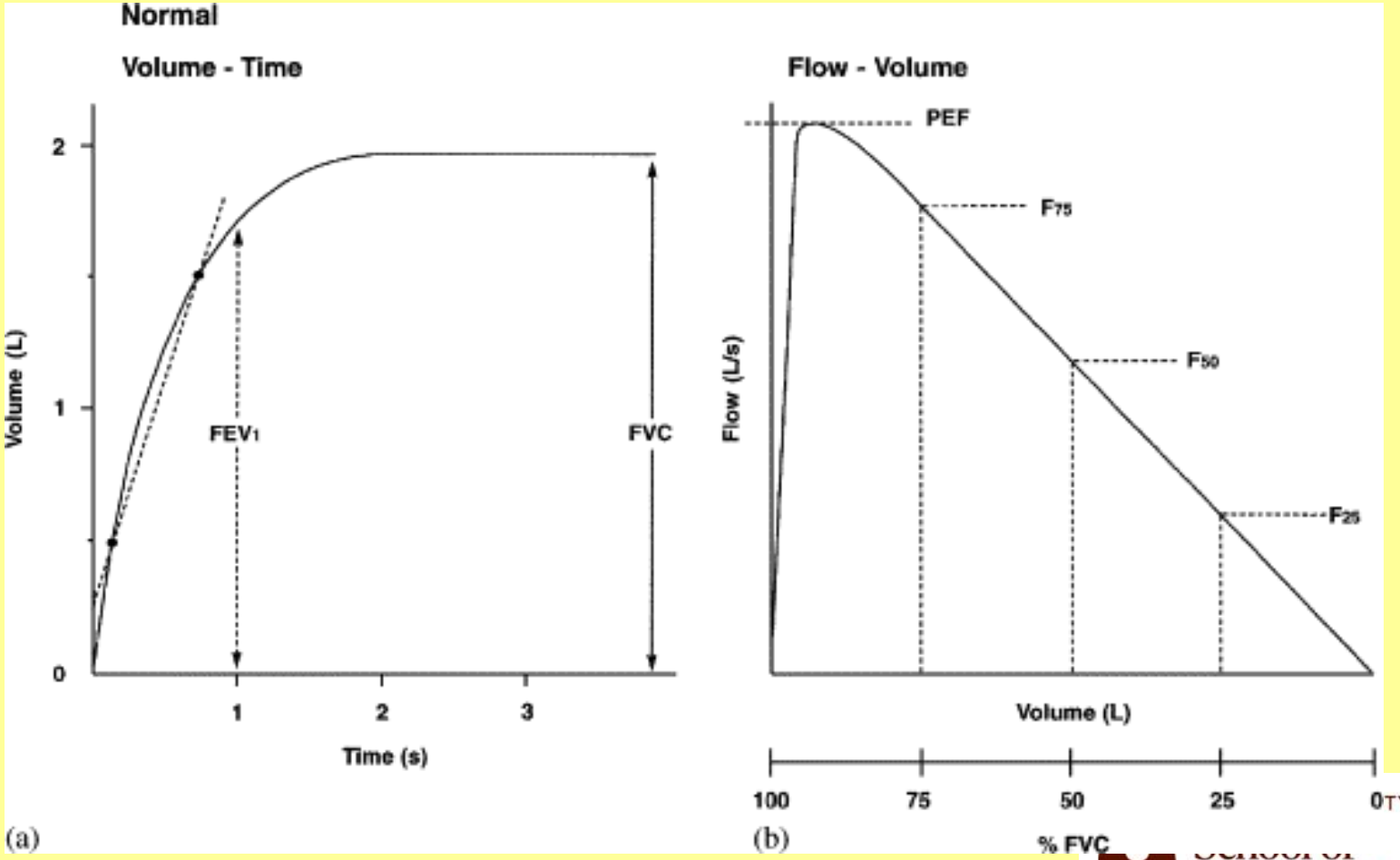
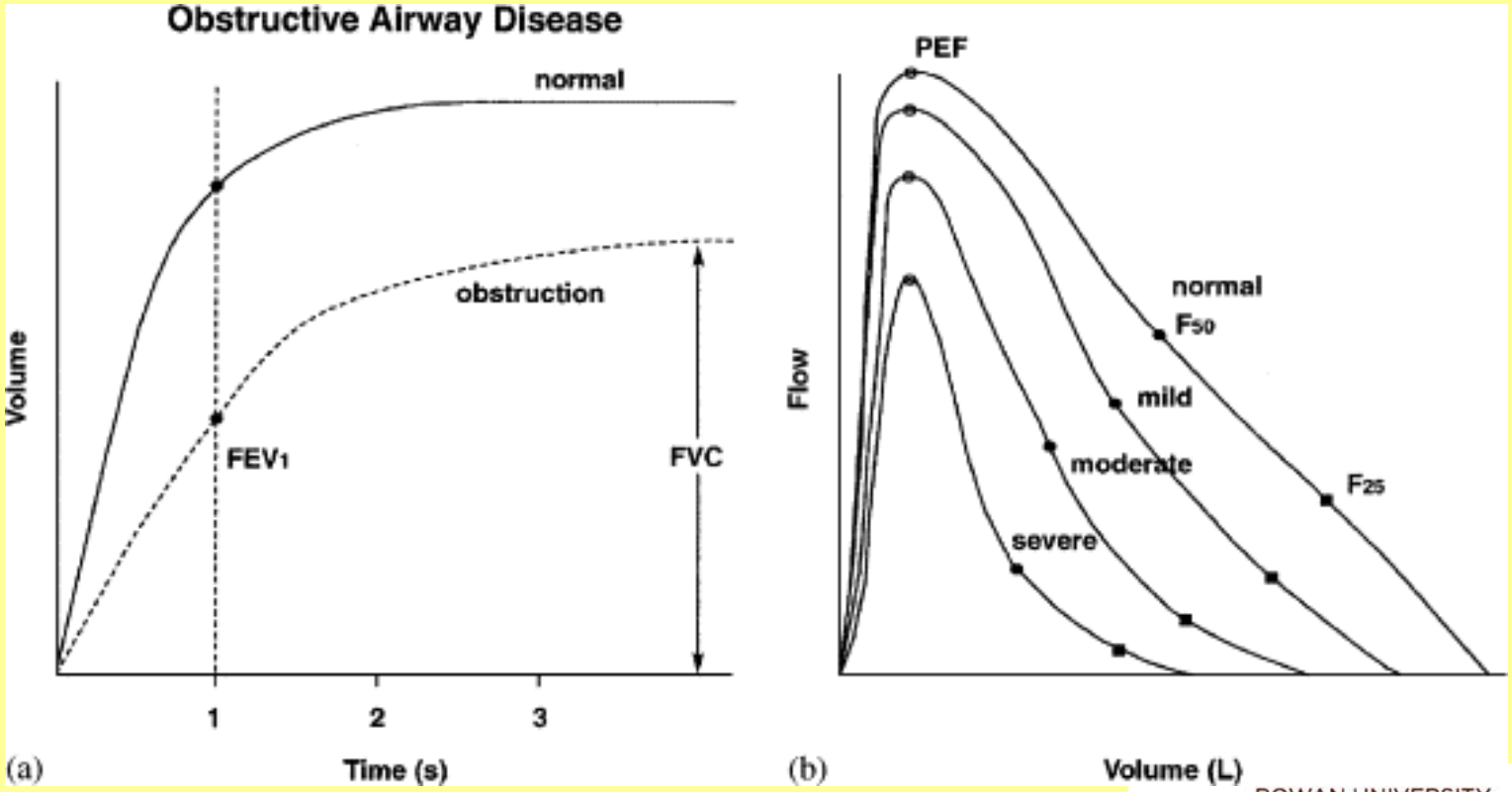
Normal VTC and FVL



Obstructed VTC and FVL



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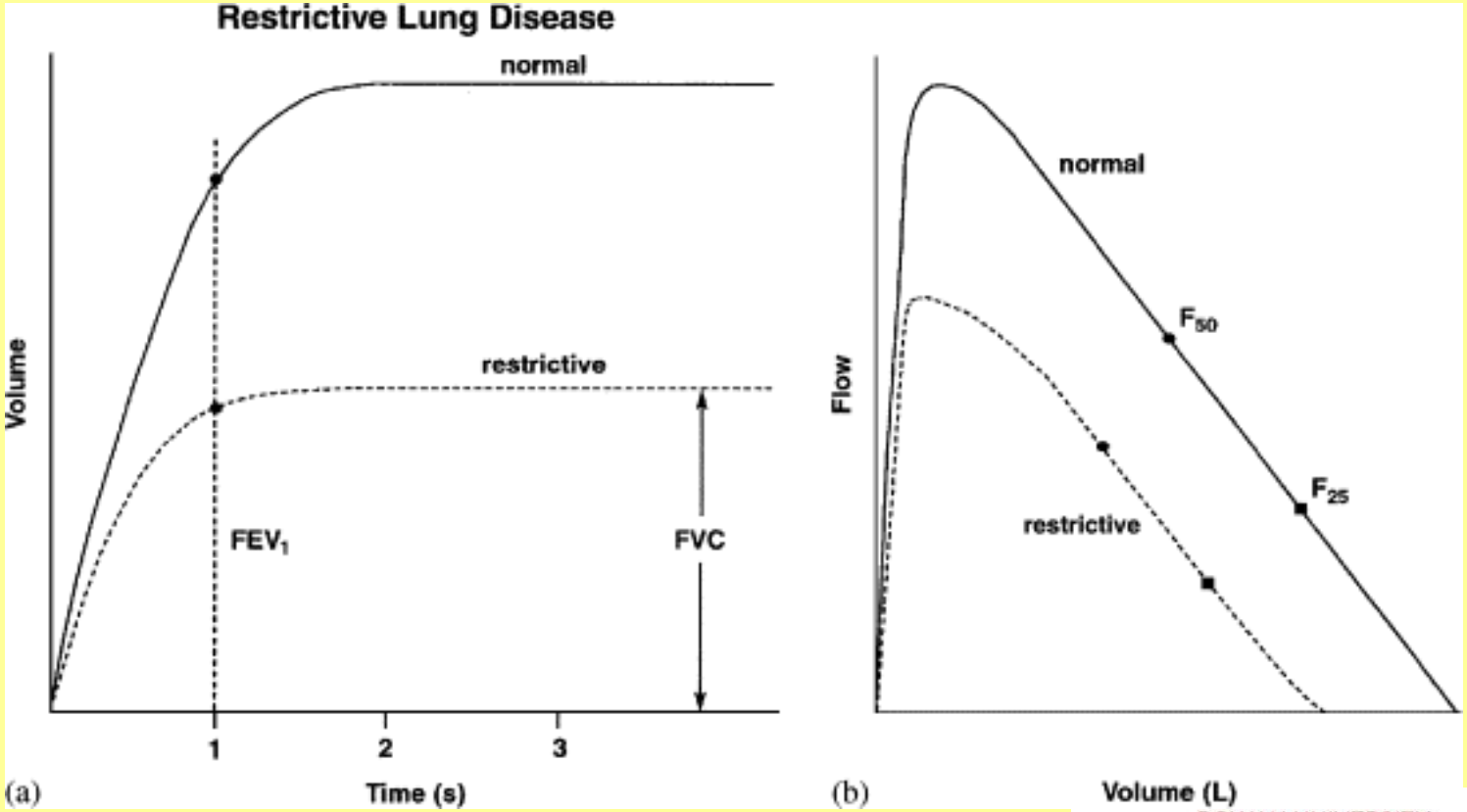
Restricted VTC and FVL



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Basic Spirometric Patterns

	OBSTRUCTIVE	RESTRICTIVE	MIXED
FEV1	↓	↓ or N	↓
FEVC	↓ or N	↓	↓
FEV1/FVC	↓	N or ↑	↓

*N = Normal

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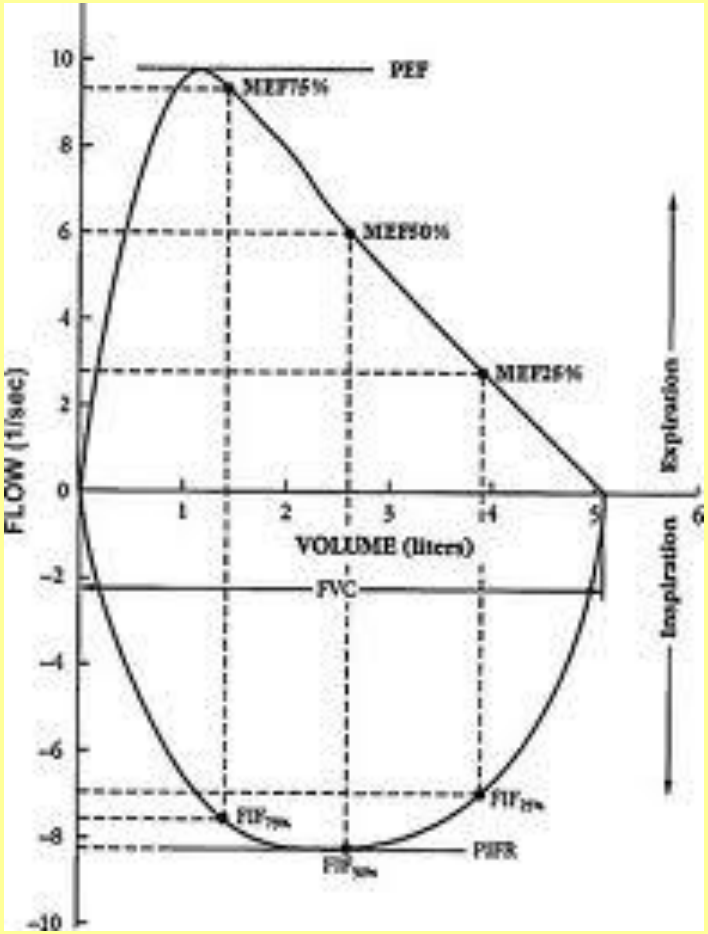
Normal Flow Volume Loop



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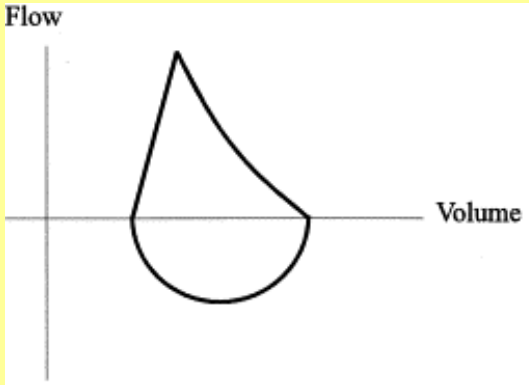
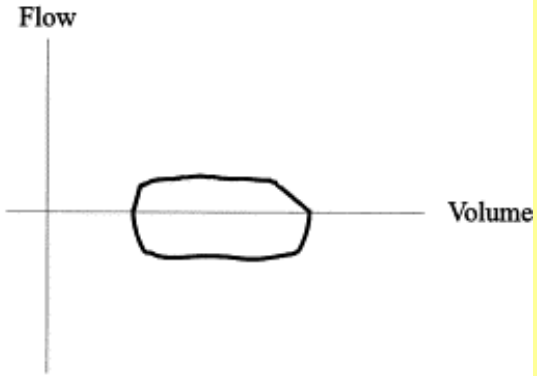
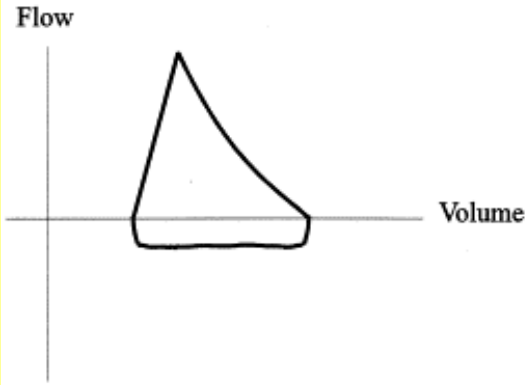


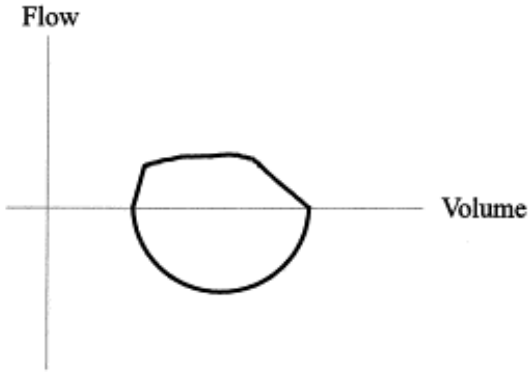
Normal Flow-Volume Loop



Fixed Large Airway Obstruction



Variable Extrathoracic Large Airway Obstruction



Variable Intrathoracic Large Airway Obstruction

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Cases

- Normal
- Restricted
- Obstructed
- Combined

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Patient 1

Gender: Female Room: Out-Pt

Age: 59 Race: Caucasian

Height(in): 58 Weight(lb): 183

Any Info: ASTHMA

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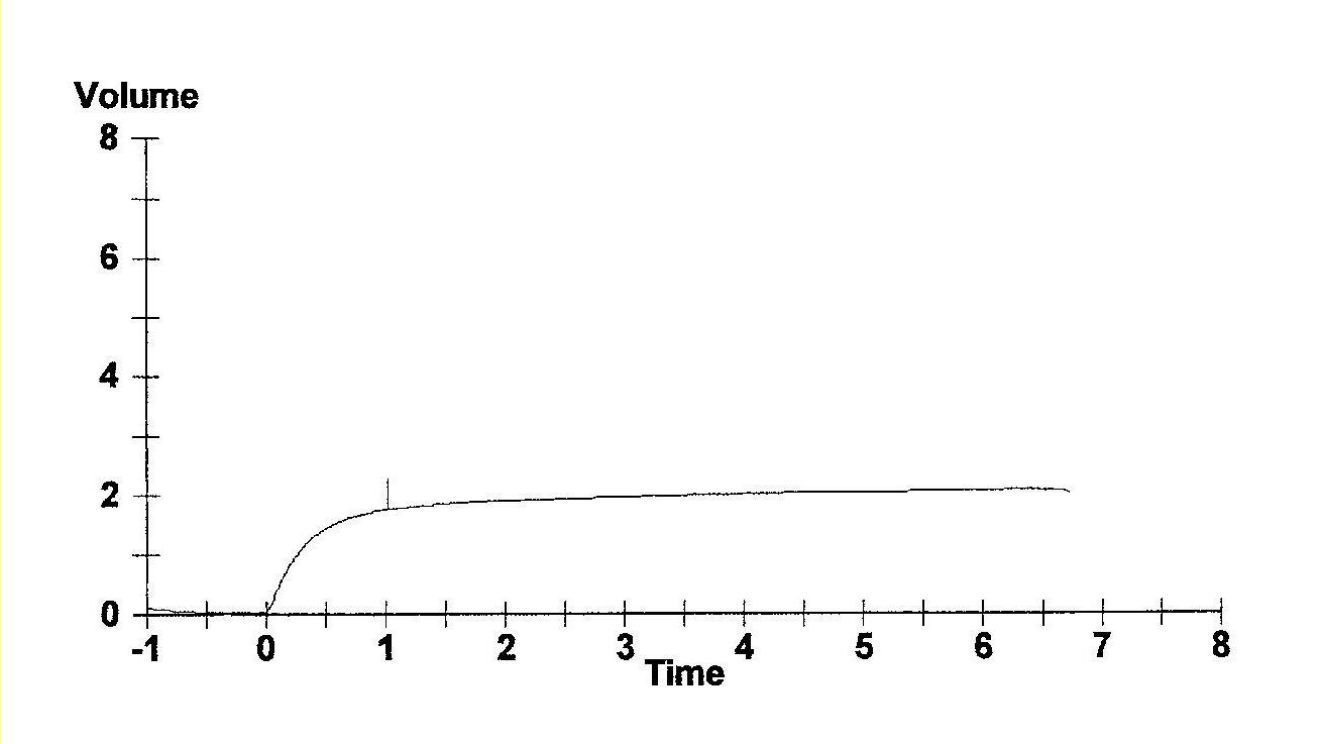
Patient 1



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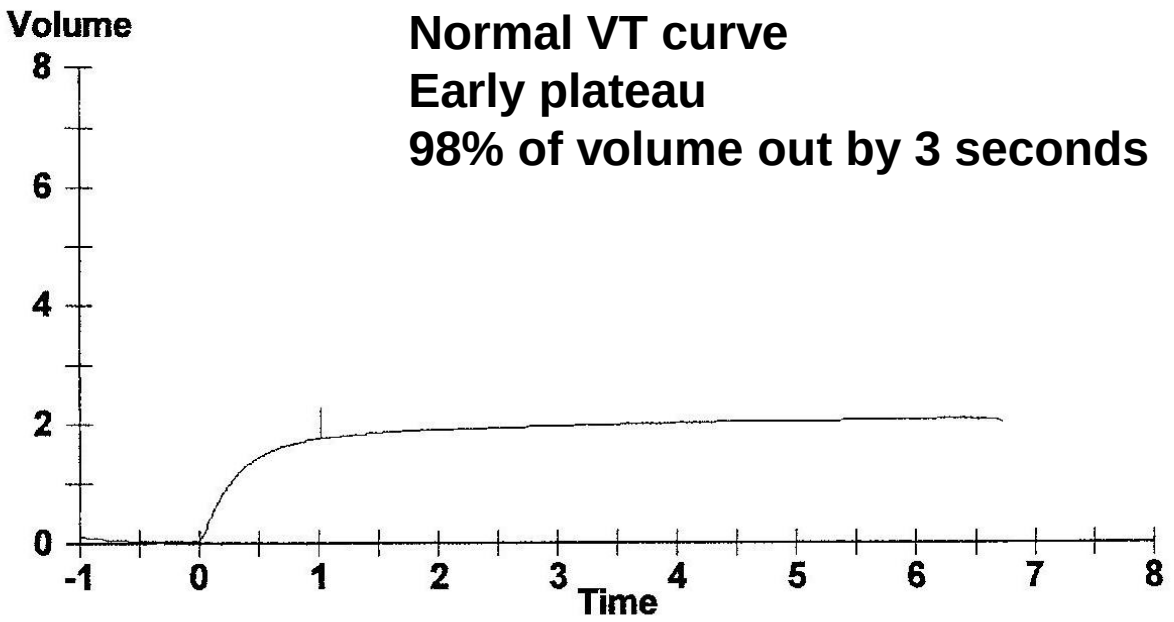
Patient 1



Normal VT curve
Early plateau
98% of volume out by 3 seconds

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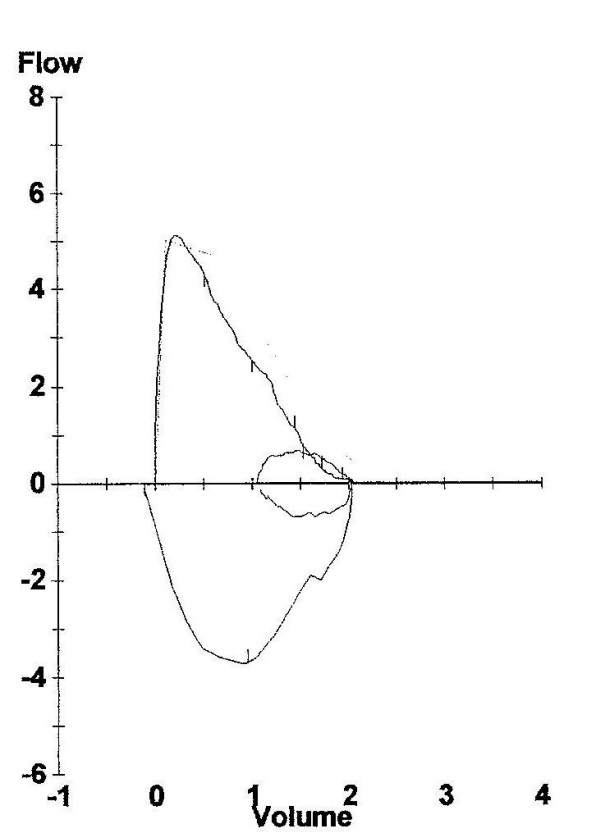
Patient 1



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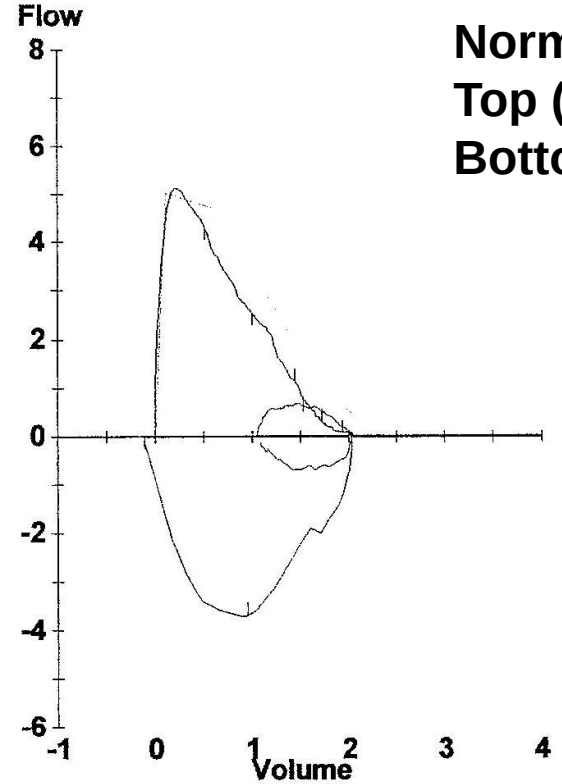
Patient 1



Normal FVL
Top (exp) looks like triangle
Bottom (inspir) looks like semi-circle

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Patient 1

F/V Parameters		BEST	PRE-RX %PRED	PRE-RX PRED
FVC	Liters	2.04	88	2.34
FEV1	Liters	1.72	89	1.94
FEV1/FVC	%	84		85
FEV3	Liters	1.94	89	2.17
FEV3/FVC	%	95		81
FEF25-75%	L/sec	2.09	96	2.18
PEF	L/sec	5.12	102	5.01
FEF25%	L/sec	4.28	91	4.72
FEF50%	L/sec	2.51	88	2.87
FEF75%	L/sec	0.74	84	0.88
PIF	L/sec	3.78		
FIF50%	L/sec	3.72		
SVC Parameters				
VC	Liters	2.16	92	2.34
ERV	Liters			
IC	Liters	2.05		

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Patient 1

FRC Parameters

FRC	Liters	1.37	81	1.68
TLC	Liters	3.41	92	3.70
FRC Time		1.0		
RV	Liters	1.26	93	1.35
RV/TLC%		37		37

DLCO/sb Parameters

DLCOsb/STPD	17.0	82	20.7
VA/BTPS	3.31		
DLCOsb/VA	5.12	130	3.94

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Patient 1

- Normal – no obstructive or restrictive defect

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Patient 2

Gender: Male Room: Out-Pt

Age: 57 Race: Caucasian

Height(in): 73 Weight(lb): 205

Any Info: PULM FIBROSIS

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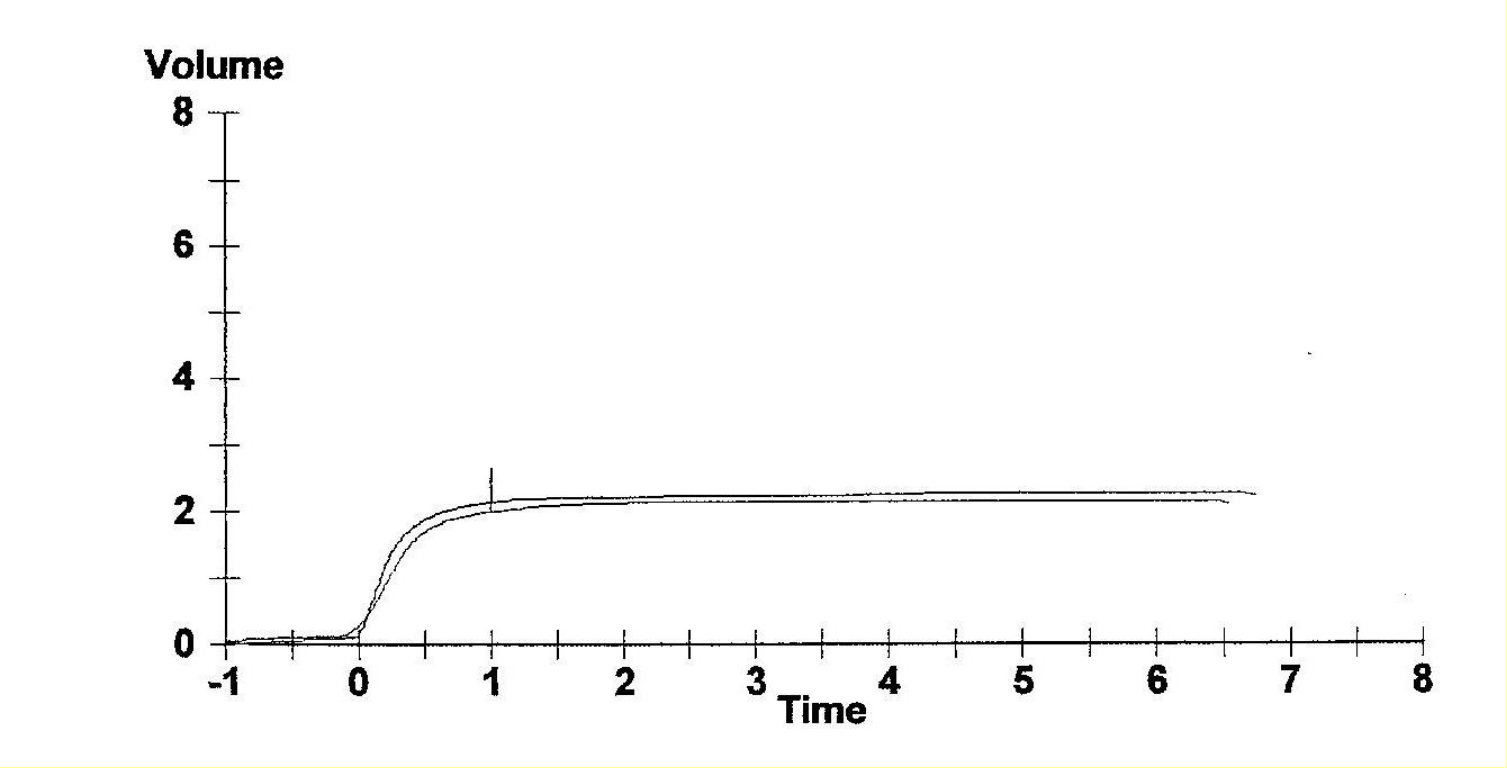
Patient 2



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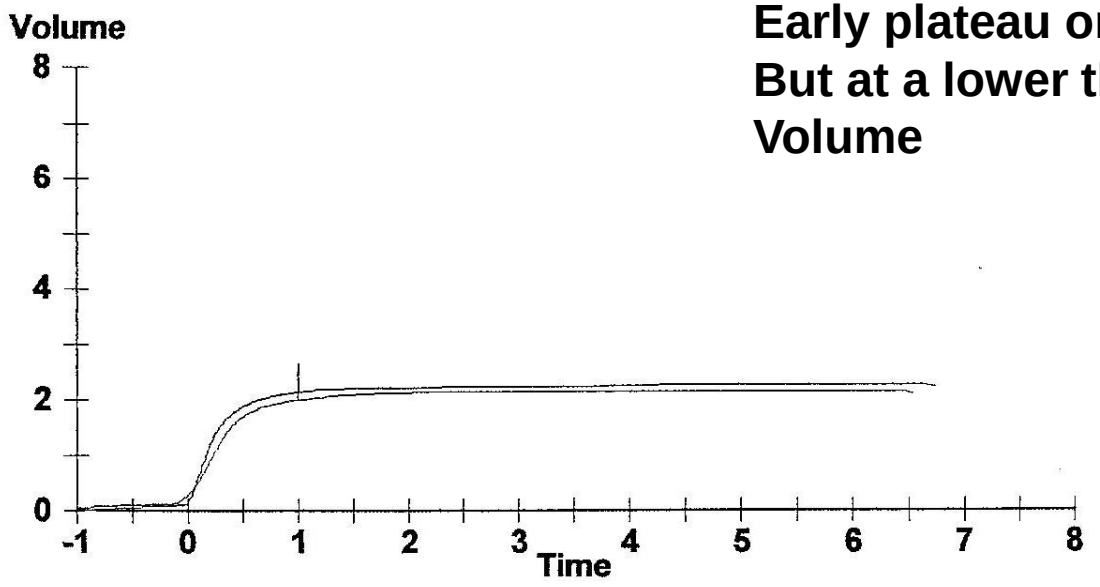
Patient 2



Early plateau on VTC
But at a lower than predicted Volume

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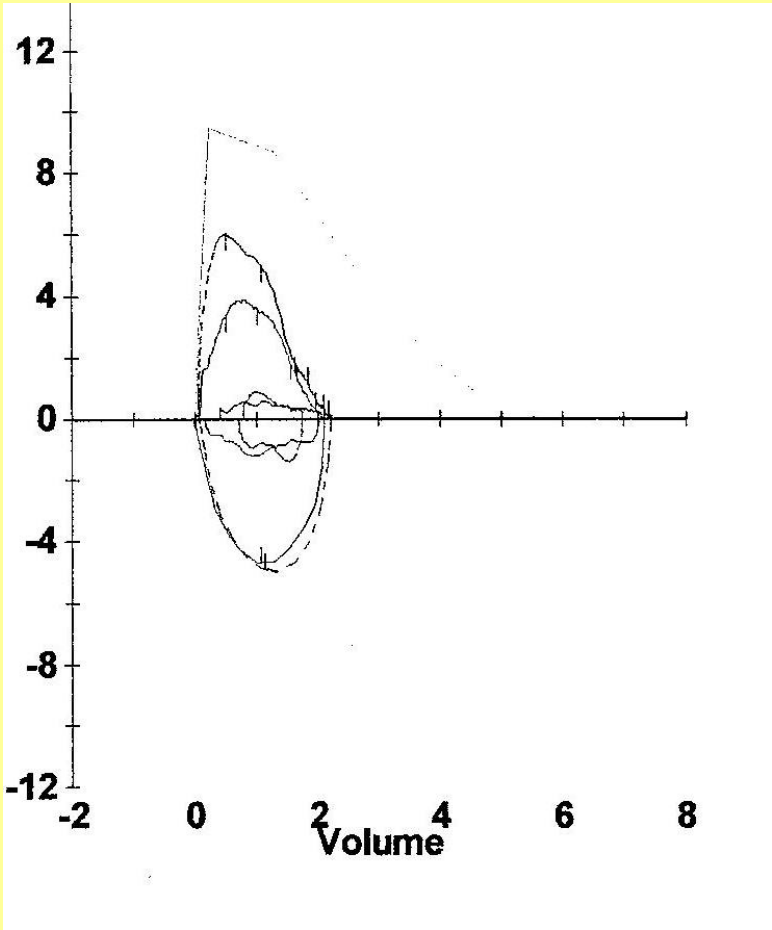
Patient 2



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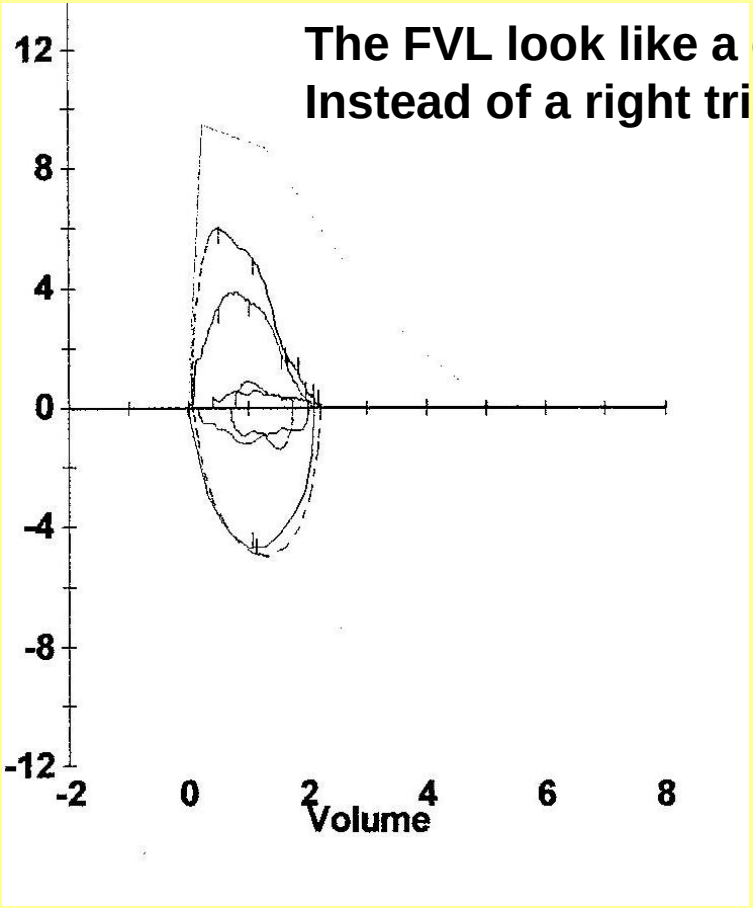
Patient 2



The FVL look like a cone
Instead of a right triangle

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Patient 2

F/V Parameters		BEST	PRE-RX %PRED
FVC	Liters	2.11	41
FEV1	Liters	1.96	48
FEV1/FVC	%	93	
FEV3	Liters	** 2.11	** 45
FEV3/FVC	%	100	
FEF25-75%	L/sec	3.17	77
PEF	L/sec	** 3.83	** 41
FEF25%	L/sec	3.29	38
FEF50%	L/sec	3.54	70
FEF75%	L/sec	1.72	89
PIF	L/sec	4.80	
FIF50%	L/sec	4.73	

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Patient 2

FRC Parameters

FRC	Liters	** 1.93	** 48	4.04
TLC	Liters	** 3.81	** 51	7.42
FRC Time		1.4		
RV	Liters	** 1.69	** 67	2.53
RV/TLC%		44		36

DLCO/sb Parameters

DLCOsb/STPD	** 7.6	** 28	26.9
VA/BTPS	3.43		
DLCOsb/VA	2.22	56	3.99

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Patient 2

- **A restrictive defect is present**
- **No obstructive defect**

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Patient 3

Gender: Female Room: Out-Pt

Age: 59 Race: Caucasian

Height(in): 63 Weight(lb): 143

Any Info: ILD,ASTHMA

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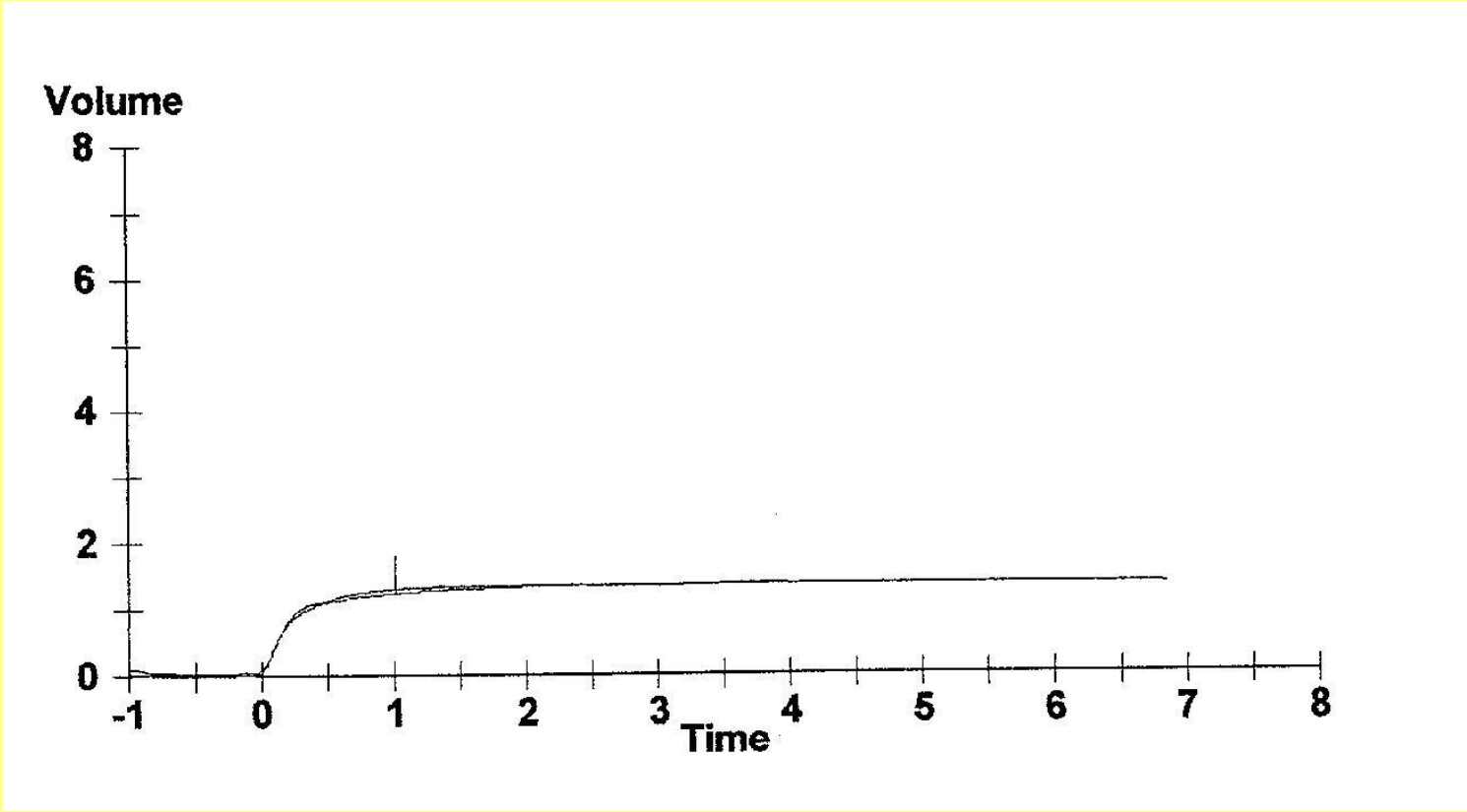
Patient 3



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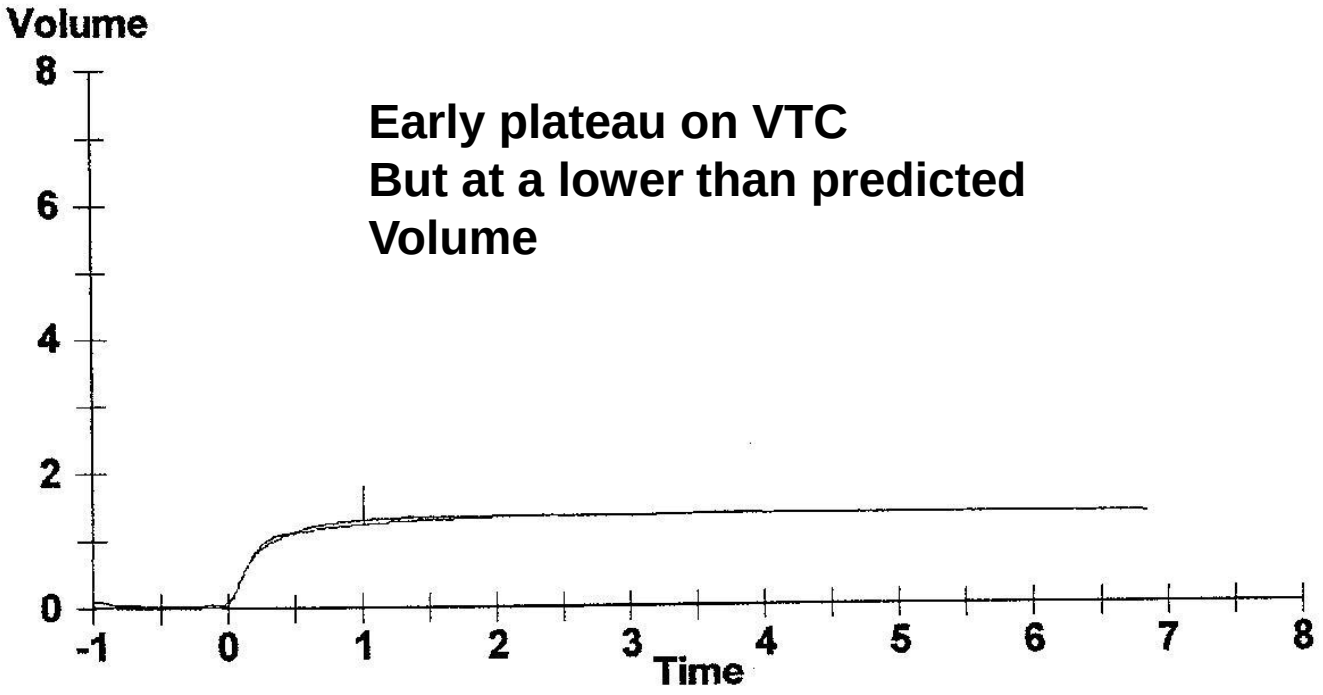
Patient 3



Early plateau on VTC
But at a lower than predicted Volume

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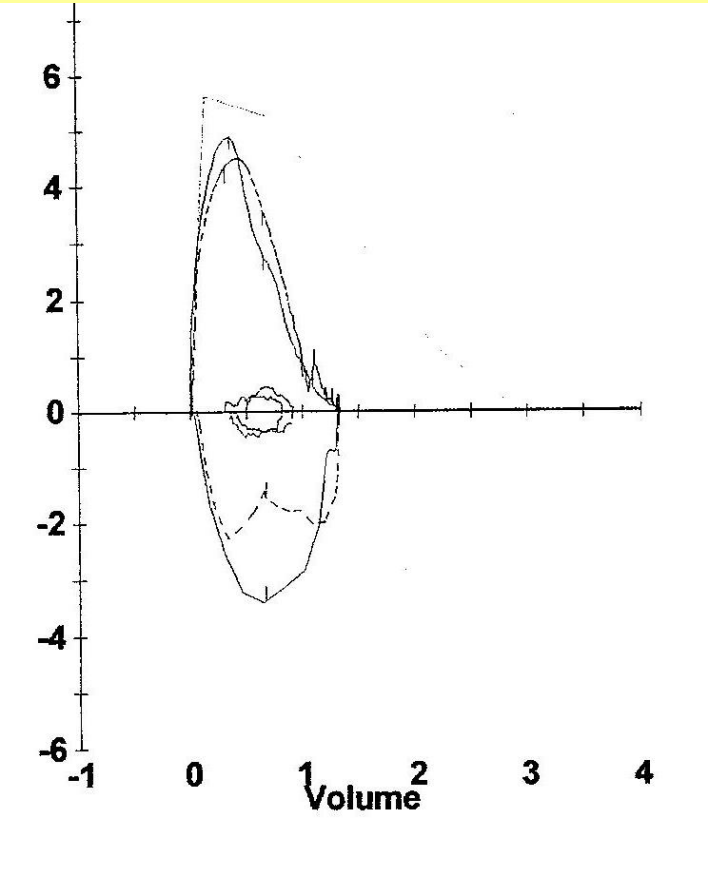
Patient 3



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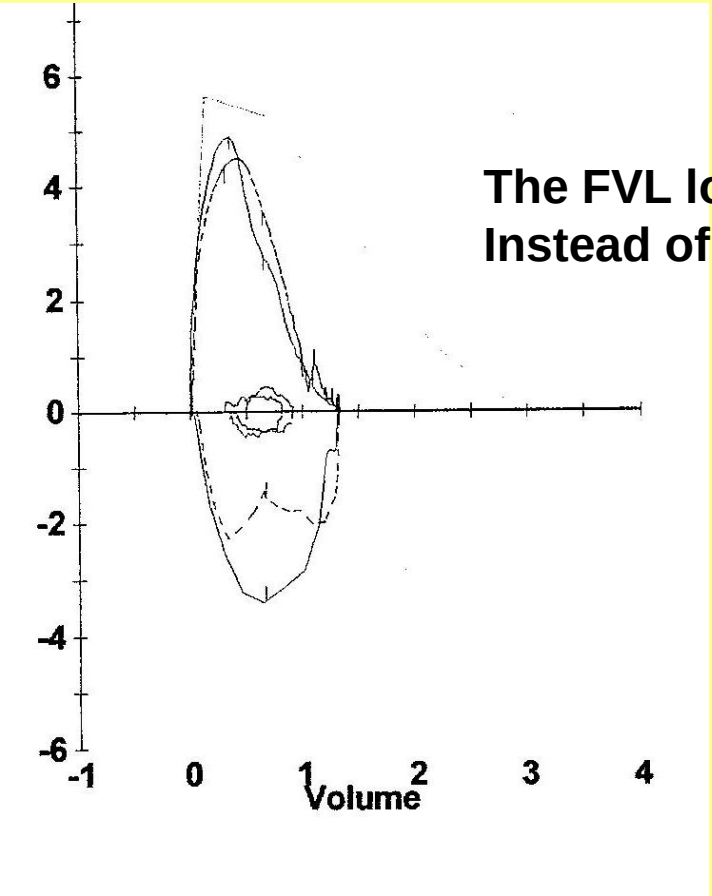
Patient 3



The FVL look like a cone
Instead of a right triangle

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Patient 3

F/V Parameters		BEST	%PRED	PRE-RX
FVC	Liters	1.34	46	
FEV1	Liters	1.22	51	
FEV1/FVC	%	91		
FEV3	Liters	** 1.34	** 51	
FEV3/FVC	%	100		
FEF25-75%	L/sec	2.30	89	
PEF	L/sec	4.90	87	
FEF25%	L/sec	4.85	92	
FEF50%	L/sec	2.76	84	
FEF75%	L/sec	0.84	76	
PIF	L/sec	3.43		
FIF50%	L/sec	3.40		

SVC Parameters				
VC	Liters	1.34	46	
ERV	Liters	0.11		
IC	Liters	0.88		

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Patient 3

FRC Parameters

FRC	Liters	** 1.20	** 45
TLC	Liters	** 2.08	** 44
FRC Time		1.1	
RV	Liters	** 0.74	** 42
RV/TLC%		36	

DLCO/sb Parameters

DLCOsb/STPD	** 8.3	** 42
VA/BTPS	1.77	
DLCOsb/VA	4.68	119

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Patient 3

- **A restrictive defect is noted**
- **No obstruction is present**

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Patient 4

Gender: Male Room: Out-Pt

Age: 68 Race: Caucasian

Height(in): 72 Weight(lb): 214

Any Info: COPD

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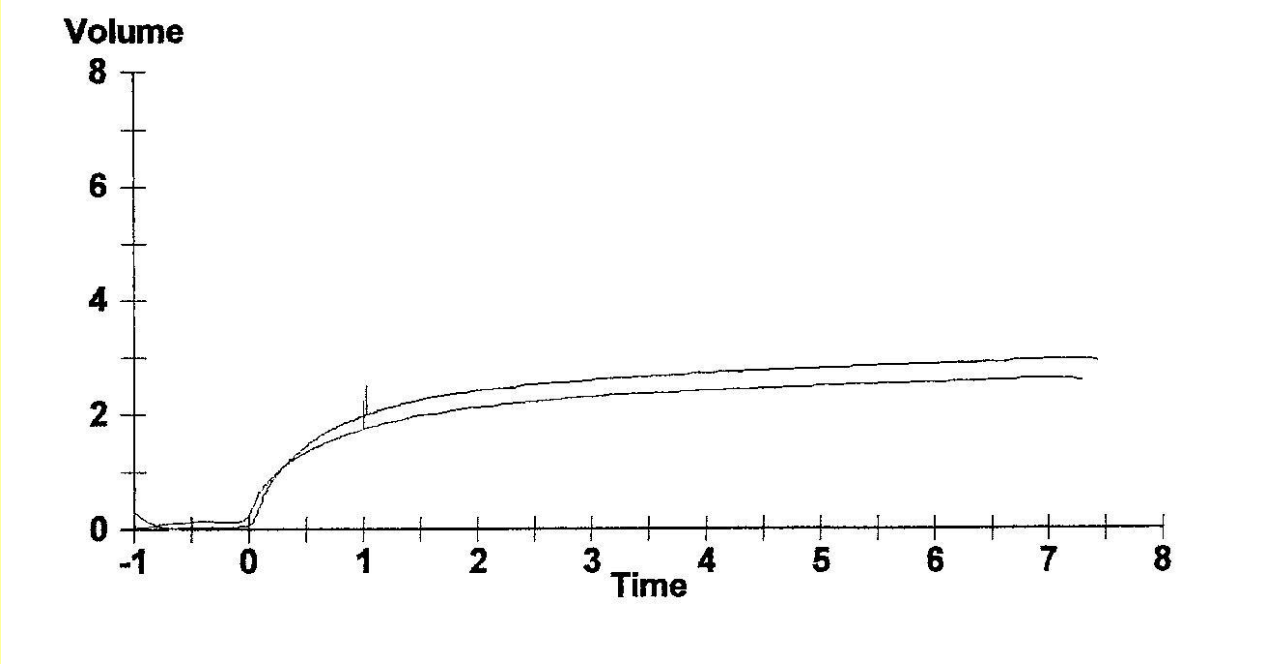
Patient 4



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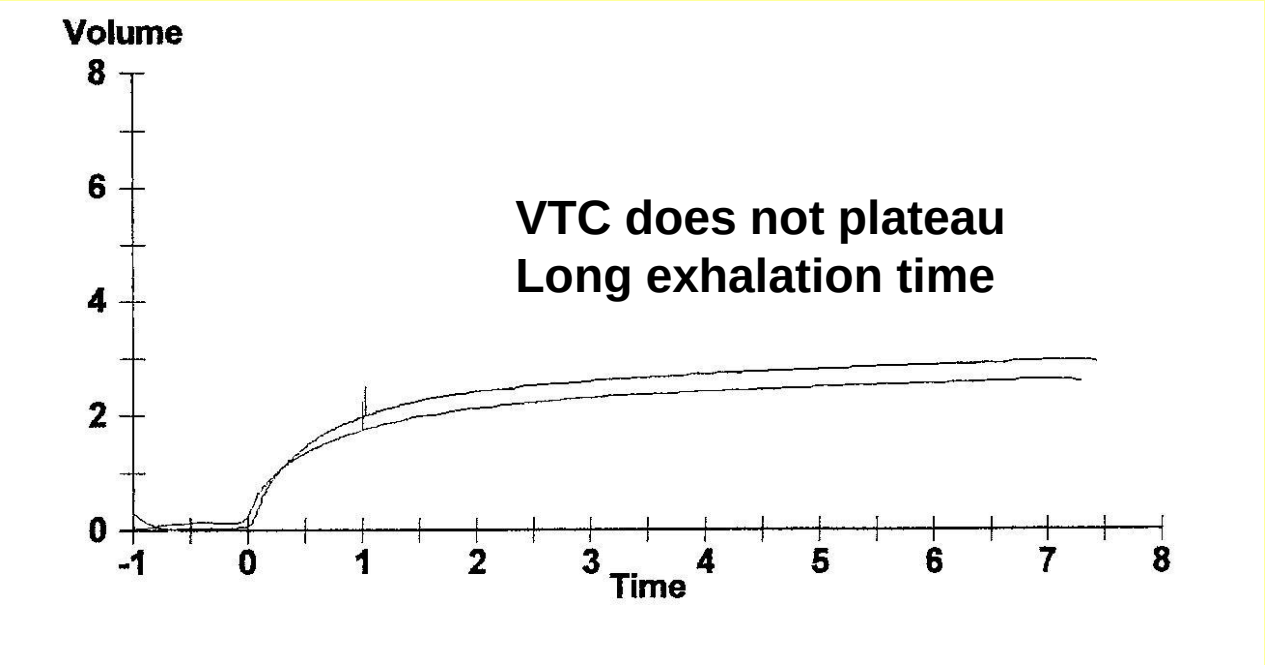
Patient 4



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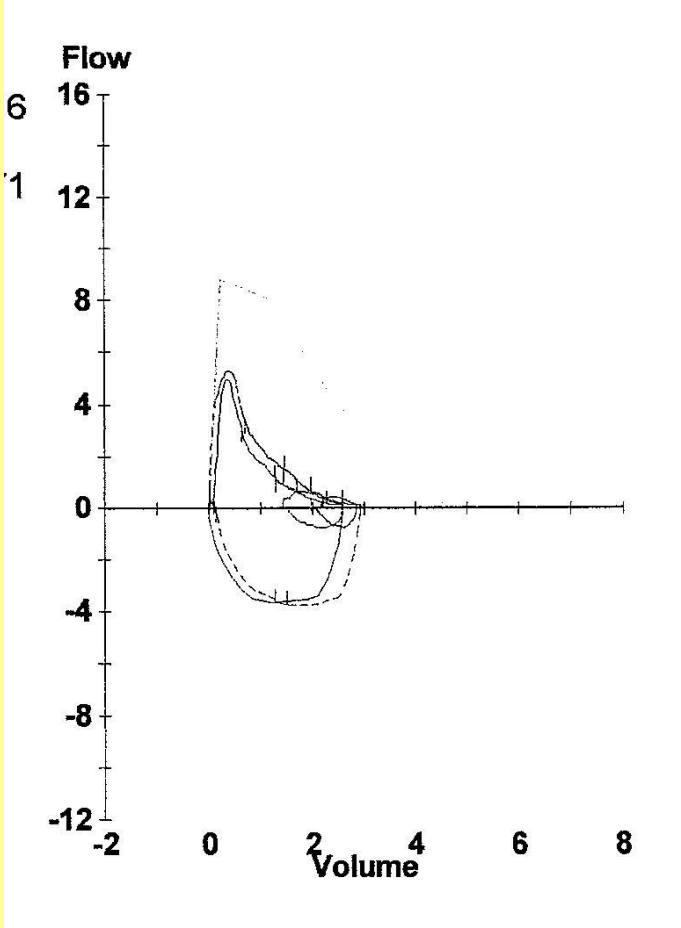
Patient 4



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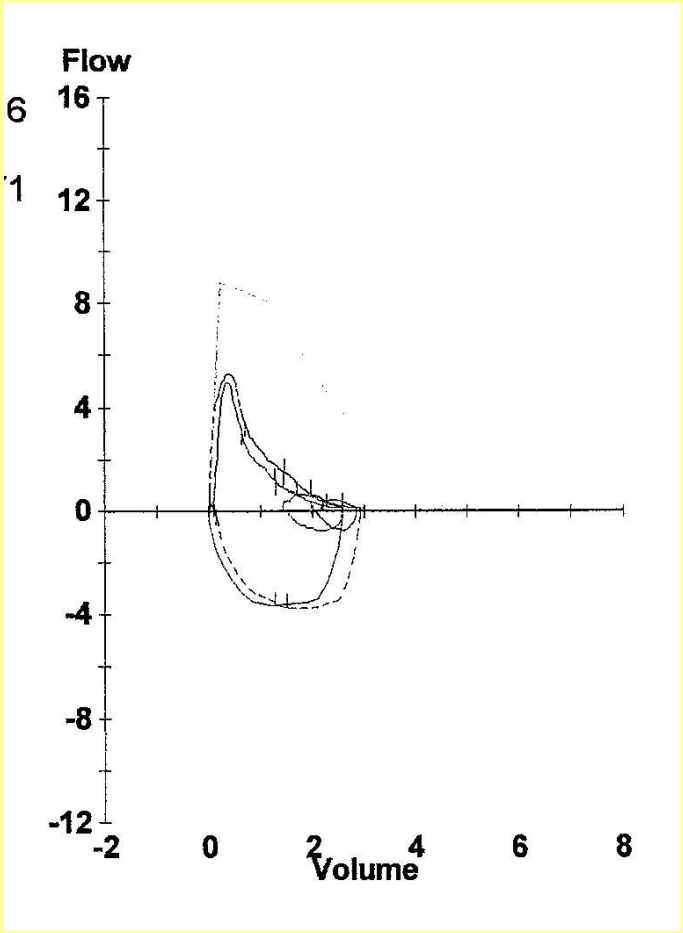
Patient 4



The line between PEF
And RV becomes concave
Instead of straight
Indicates airflow obstruction

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Patient 4

F/V Parameters		BEST	PRE-RX %PRED
FVC	Liters	2.60	56
FEV1	Liters	1.69	46
FEV1/FVC	%	65	
FEV3	Liters	** 2.27	** 55
FEV3/FVC	%	87	
FEF25-75%	L/sec	0.94	26
PEF	L/sec	4.97	56
FEF25%	L/sec	3.06	38
FEF50%	L/sec	** 1.11	** 25
FEF75%	L/sec	0.35	22
PIF	L/sec	3.81	
FIF50%	L/sec	3.70	

SVC Parameters			
VC	Liters	2.61	56
ERV	Liters		
IC	Liters	2.88	

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Patient 4

FRC Parameters

FRC	Liters	3.58	94	3.79
TLC	Liters	6.46	92	7.02
FRC Time		2.0		
RV	Liters	** 3.85	** 145	2.65
RV/TLC%		** 60		40

DLCO/sb Parameters

DLCOsb/STPD	18.9	77	24.6
VA/BTPS	4.97		
DLCOsb/VA	3.82	103	3.71

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Patient 4

- A mild obstructive defect is noted.
- No restriction is identified by TLC
- TLC is used rather than FVC to determine restriction

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Patient 5

Gender: Female Room: Out-Pt

Age: 57 Race: Caucasian

Height(in): 65 Weight(lb): 100

Any Info: COPD

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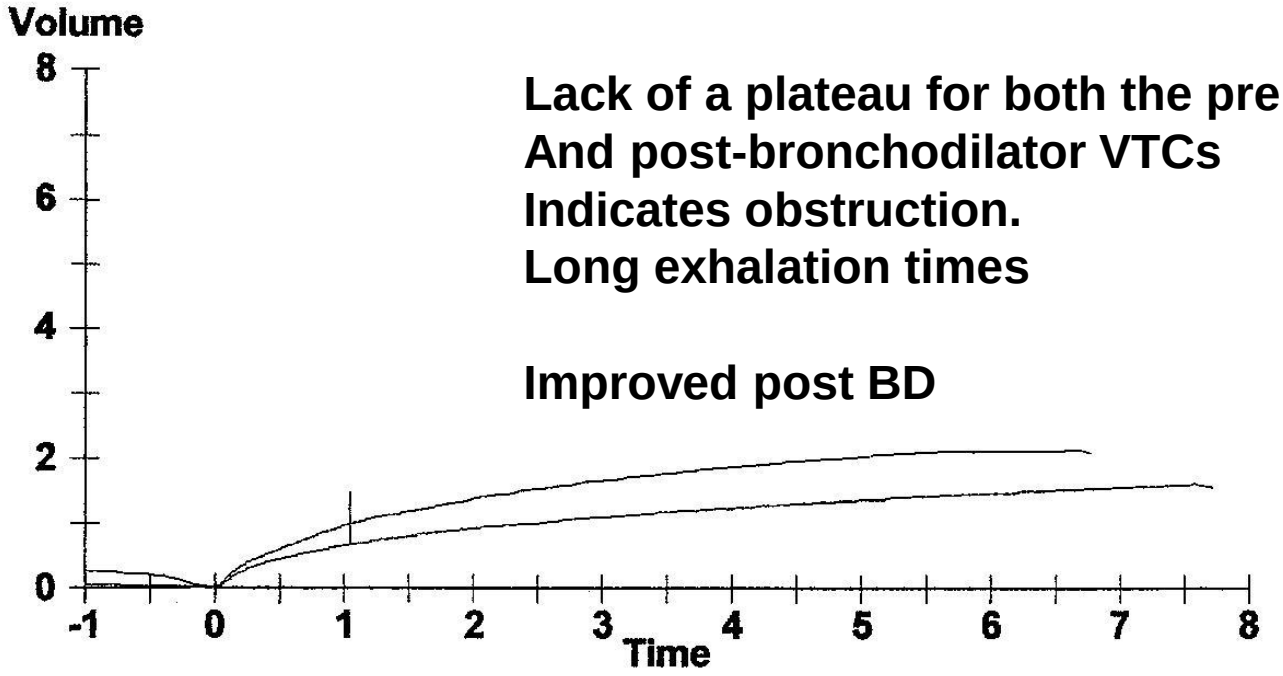
Patient 5



Lack of a plateau for both the pre And post-bronchodilator VTCs Indicates obstruction.
Long exhalation times

Improved post BD

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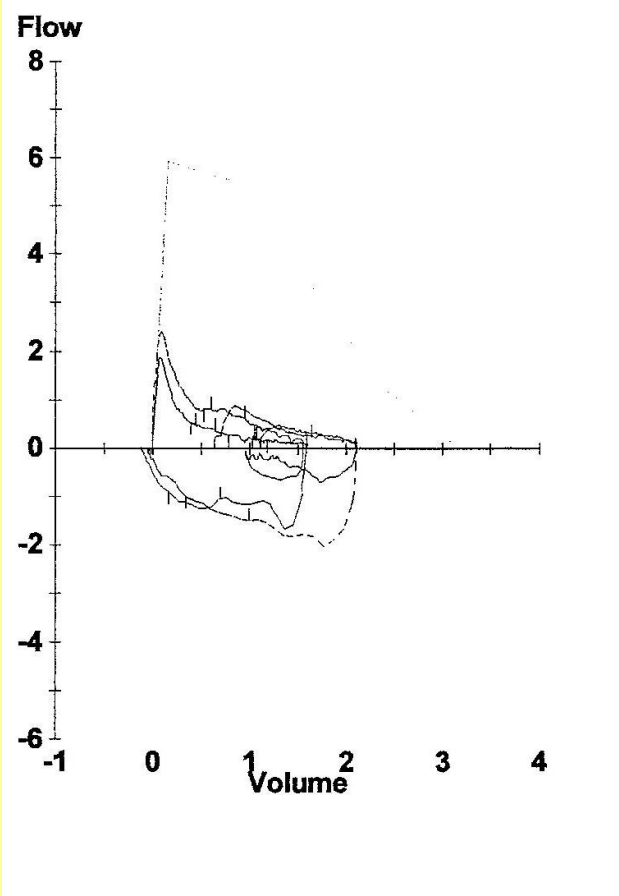
Patient 5



The line between PEF And RV becomes concave
Instead of straight
Indicates airflow obstruction.

Improved post BD

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Patient 5

F/V Parameters		BEST	PRE-RX %PRED
FVC	Liters	1.58	50
FEV1	Liters	0.65	25
FEV1/FVC	%	41	
FEV3	Liters	** 1.08	** 38
FEV3/FVC	%	68	
FEF25-75%	L/sec	0.24	9
PEF	L/sec	** 1.88	** 32
FEF25%	L/sec	0.52	9
FEF50%	L/sec	** 0.26	** 7
FEF75%	L/sec	0.15	12
PIF	L/sec	1.70	
FIF50%	L/sec	1.08	

SVC Parameters			
VC	Liters	2.10	66
ERV	Liters	0.29	
IC	Liters	1.81	

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Patient 5

RX	POST-RX		
PRED	BEST	% PRED	% Chg
3.17	2.12	67	34
2.57	0.96	37	48
83	45		
2.84	1.65	58	52
86	78		
2.78	0.45	16	90
5.93	** 2.40	** 40	28
5.53	0.79	14	51
3.49	** 0.45	** 13	77
1.24	0.26	21	78
	2.06		21
	1.51		40

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Patient 5

FRC Parameters

FRC	Liters	3.42	105	3.27
TLC	Liters	5.23	102	5.12
FRC Time		2.1		
RV	Liters	** 3.13	** 165	1.90
RV/TLC%		** 60		37

DLCO/sb Parameters

DLCOsb/STPD	12.5	75	16.7
VA/BTPS	3.14		
DLCOsb/VA	3.99	100	3.99

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Patient 5

- Severe obstructive defect with significant improvement after bronchodilator treatment
- Air trapping is present
- No restriction is noted

Patient 6

Gender: Male Room: Out-Pt

Age: 62 Race: Caucasian

Height(in): 65 Weight(lb): 221

Any Info: COPD

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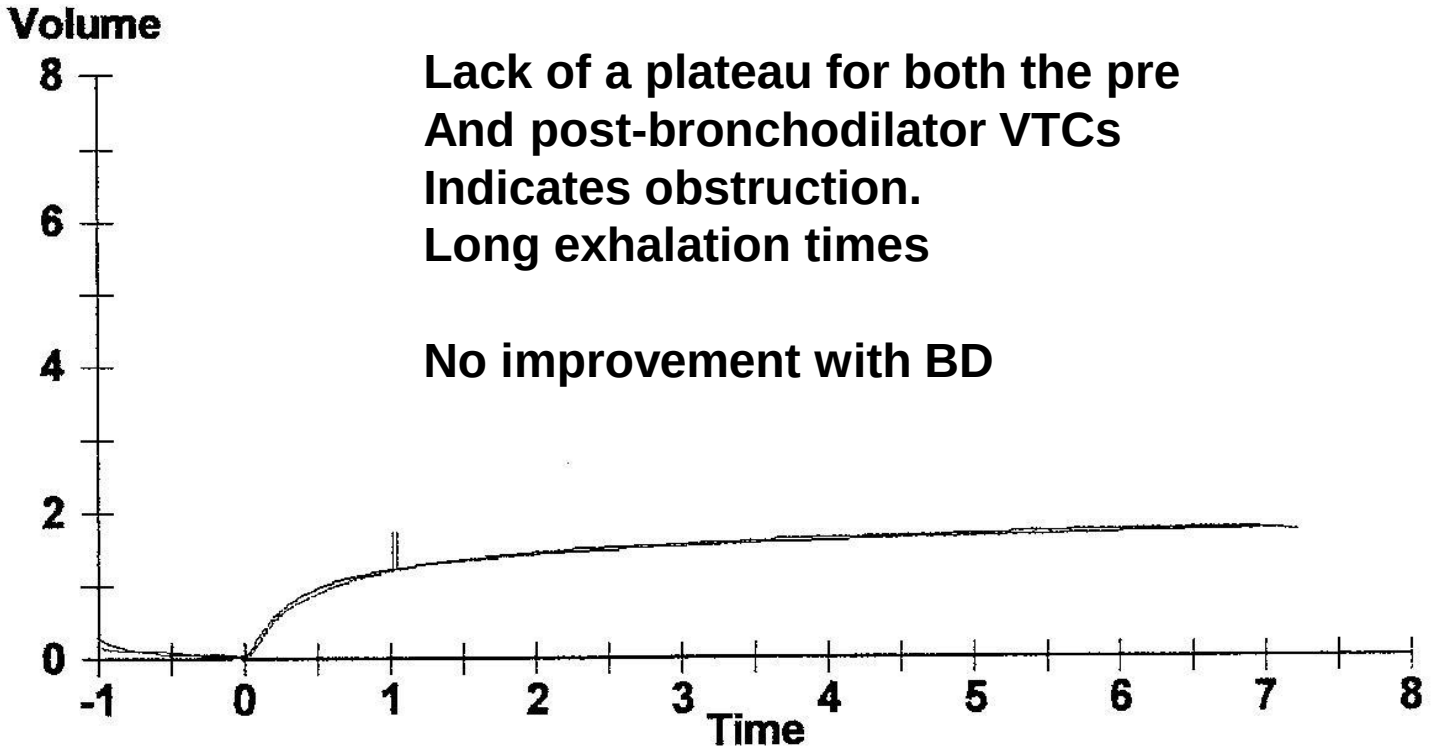
Patient 6



Lack of a plateau for both the pre
And post-bronchodilator VTCs
Indicates obstruction.
Long exhalation times

No improvement with BD

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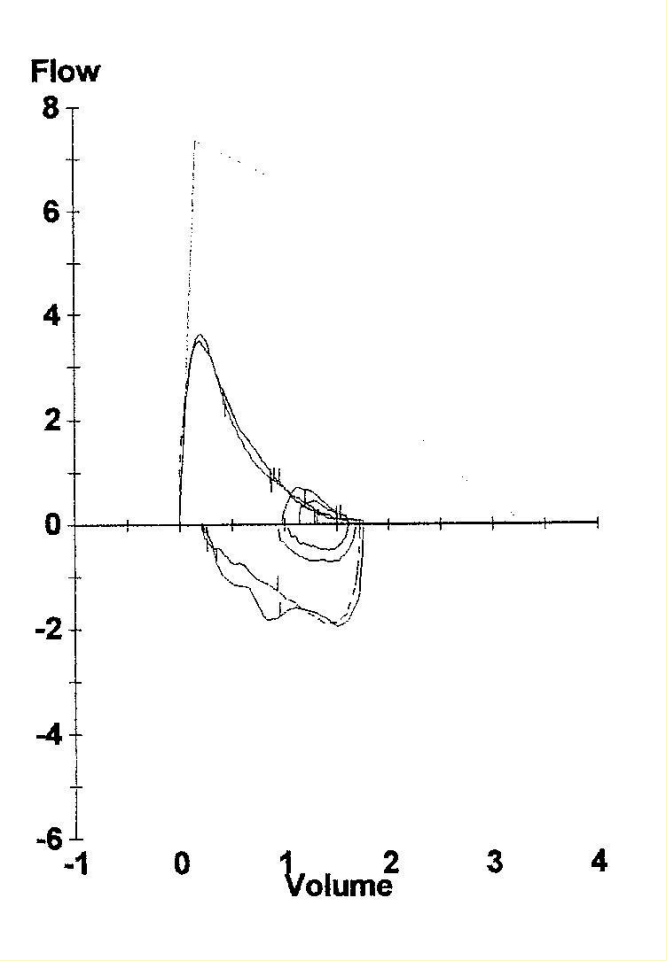
Patient 6



The line between PEF And RV becomes concave Instead of straight Indicates airflow obstruction.

Not improved post BD

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Patient 6

F/V Parameters		BEST	%PRED	PRE-RX
FVC	Liters	1.76	53	
FEV1	Liters	1.19	45	
FEV1/FVC	%	68		
FEV3	Liters	1.54	47	
FEV3/FVC	%	87		
FEF25-75%	L/sec	0.70	25	
PEF	L/sec	3.62	49	
FEF25%	L/sec	2.31	34	
FEF50%	L/sec	0.86	25	
FEF75%	L/sec	0.24	20	
PIF	L/sec	1.99		
FIF50%	L/sec	1.76		

SVC Parameters				
VC	Liters	1.76	53	
ERV	Liters			
IC	Liters	1.61		

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FRC Parameters

FRC	Liters	2.41	93	2.58
TLC	Liters	** 4.02	** 74	5.44
FRC Time		1.2		
RV	Liters	2.26	109	2.06
RV/TLC%		** 56		38

DLCO/sb Parameters

DLCOsb/STPD	** 15.2	** 63	24.0
VA/BTPS	3.21		
DLCOsb/VA	4.74	123	3.86

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Patient 6

- **Combined obstructive and restrictive defect**