

Pulmonary Function Testing

Christopher H. Fanta, M.D.

Partners Asthma Center
Brigham and Women's Hospital
Harvard Medical School



Objectives

- Review the uses of spirometry, its proper performance, and its interpretation
- Distinguish obstructive and restrictive patterns on spirometry
- Identify an obstructive pattern on flow-volume curve
- Discuss peak flow measurements and their utility

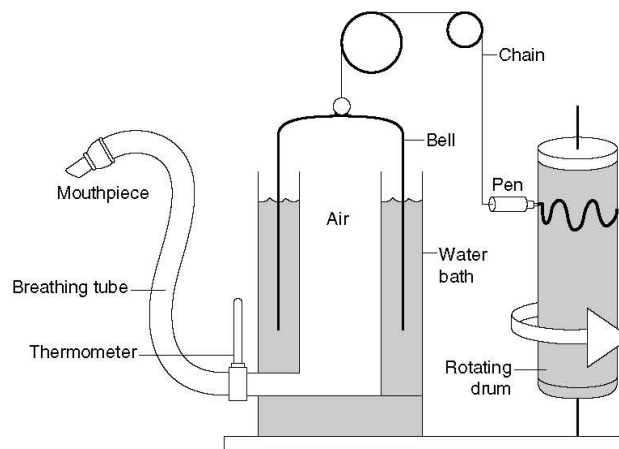


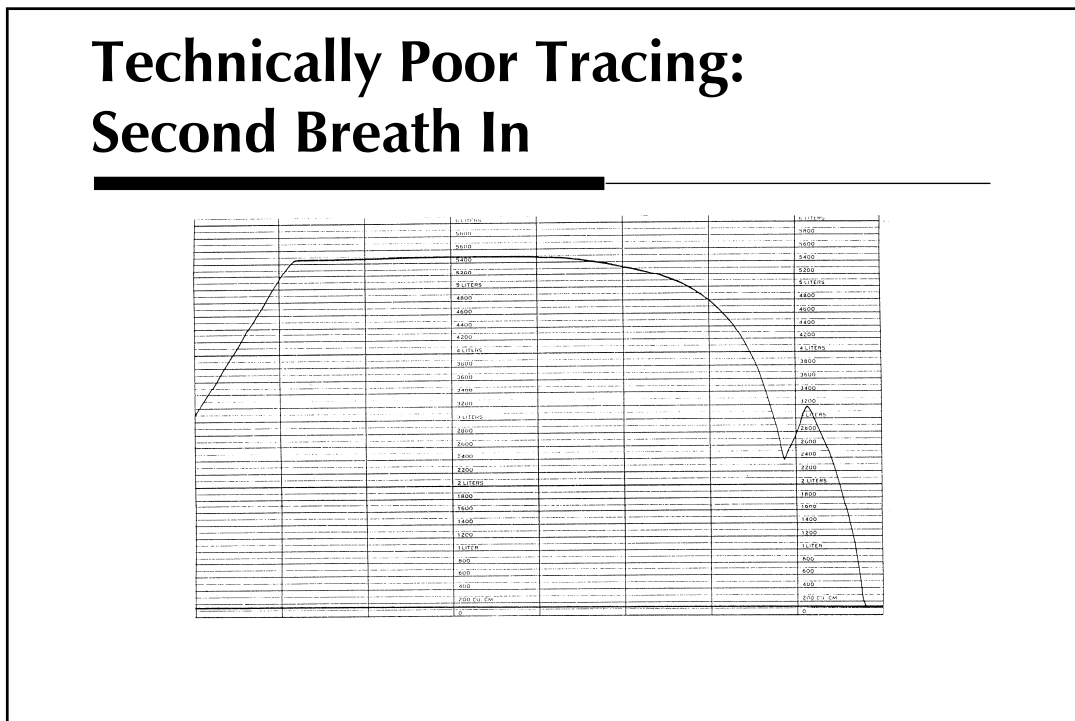
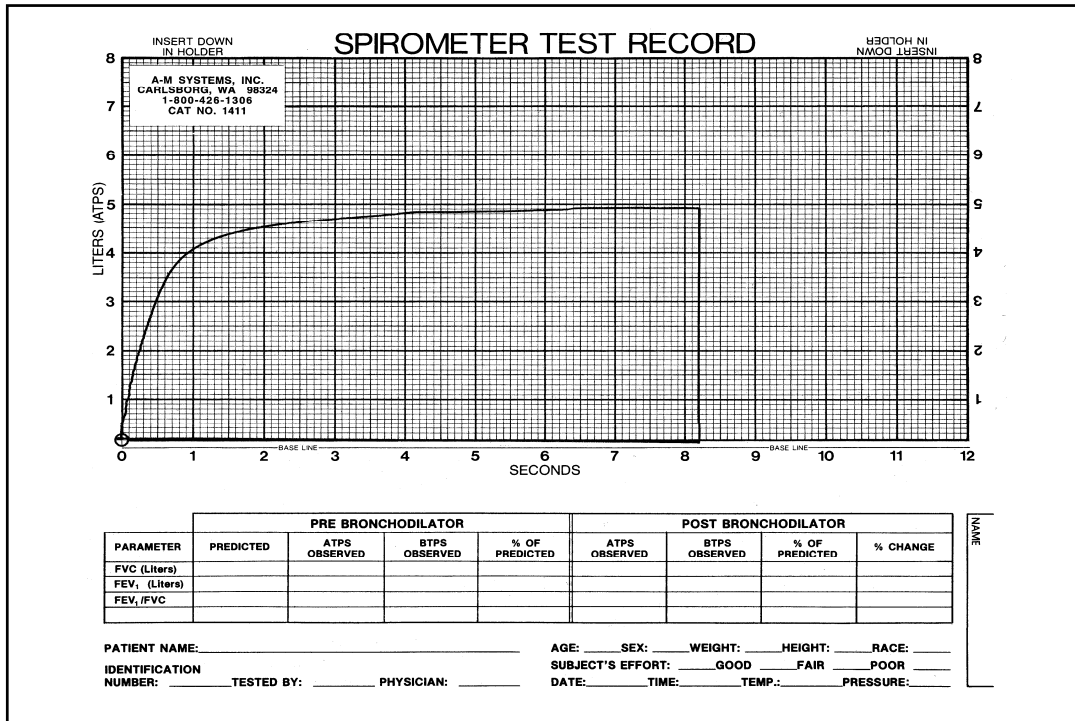
Role of Spirometry

- Distinguish normal vs abnormal
- Distinguish obstructive vs. restrictive pattern (or both)
- Assess severity of the abnormality
- In obstructive abnormalities, assess for reversibility of the obstruction
- Monitor for changes over time

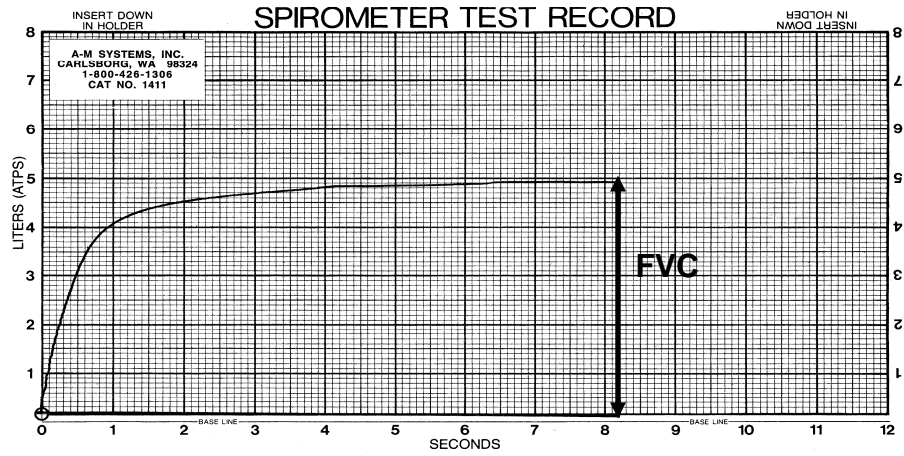
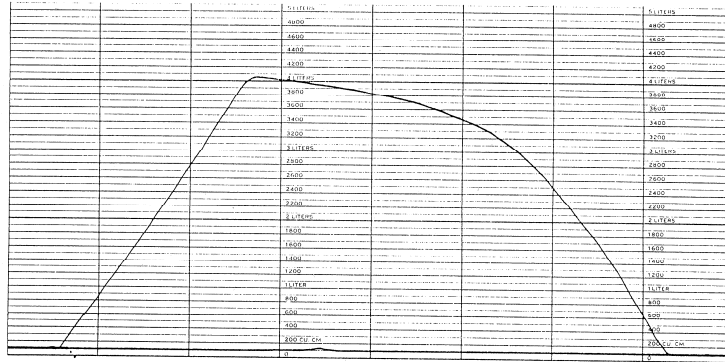


Spirograph





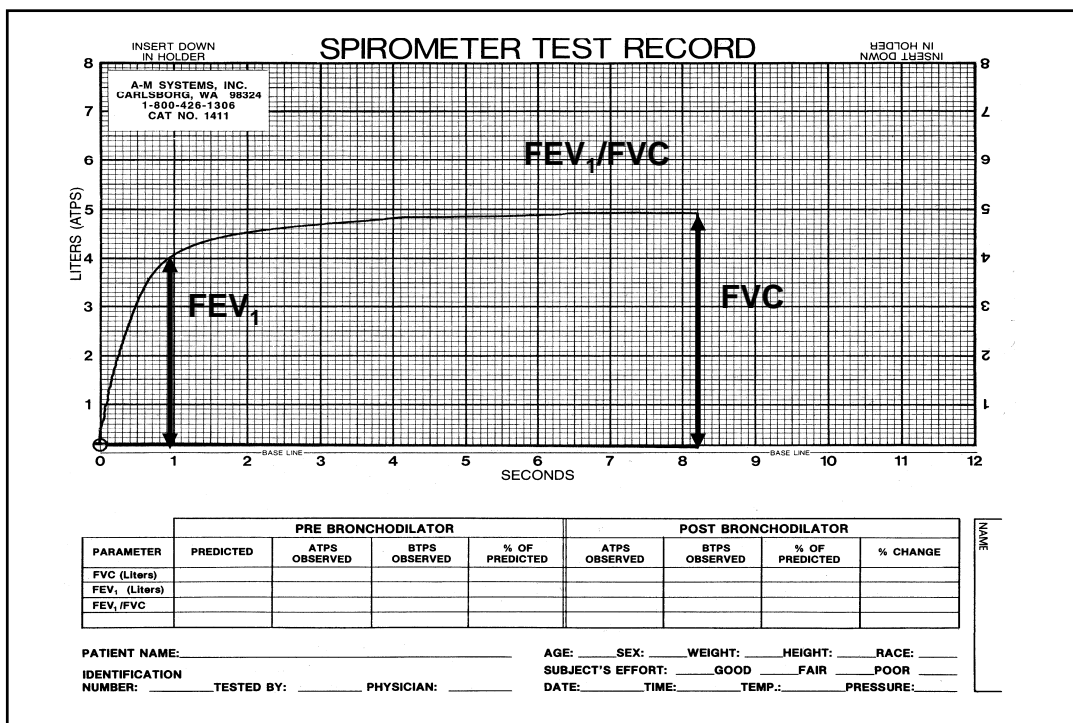
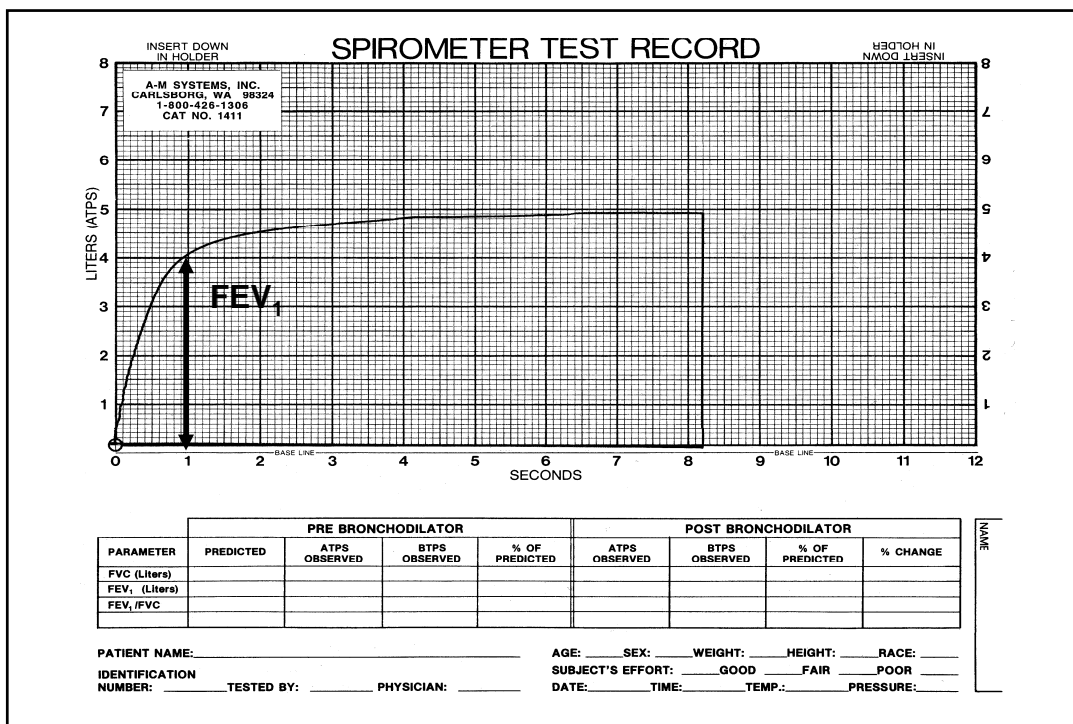
Technically Poor Tracing: Incomplete Exhalation (<6 sec.)

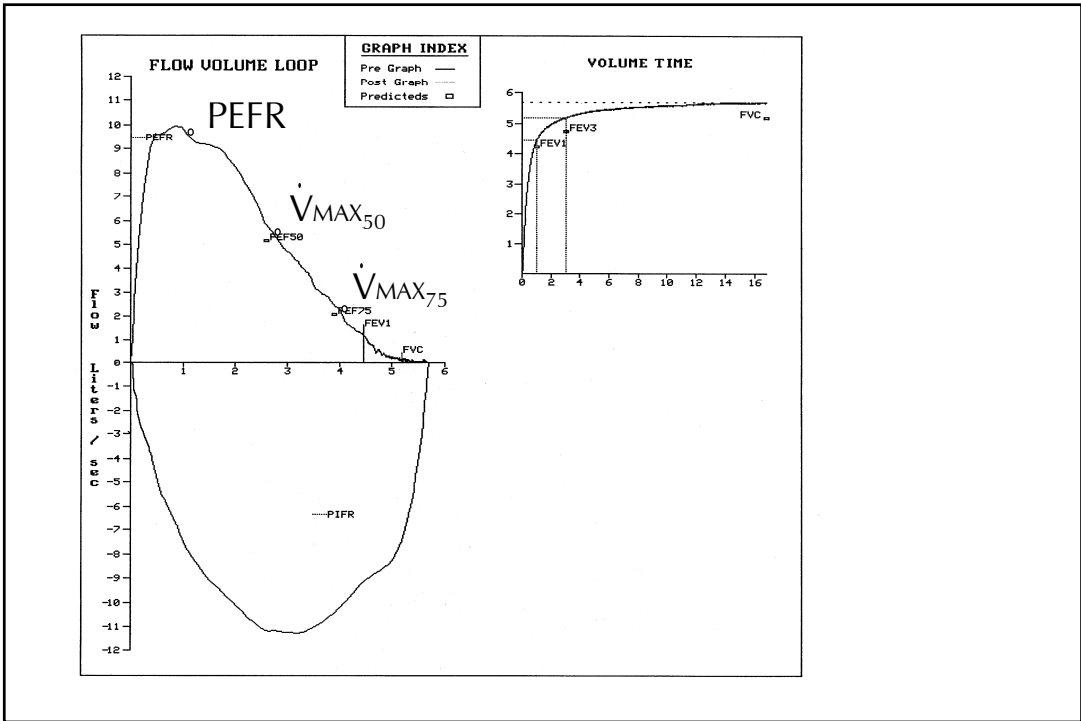
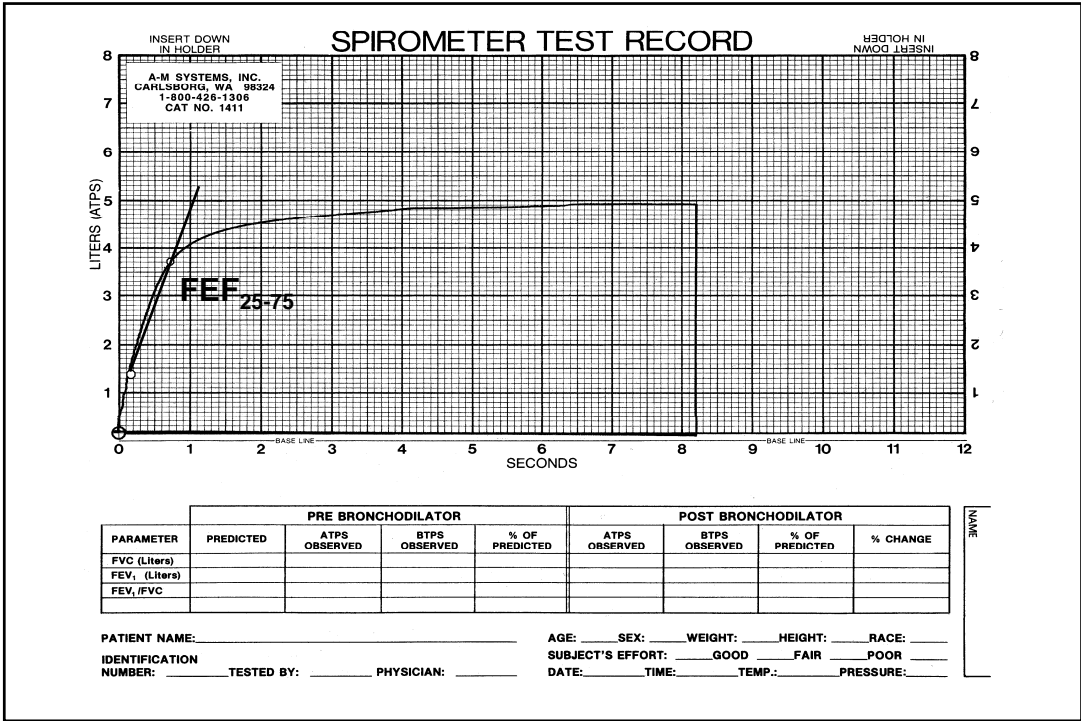


PARAMETER	PRE BRONCHODILATOR				POST BRONCHODILATOR			
	PREDICTED	ATPS OBSERVED	BTPS OBSERVED	% OF PREDICTED	ATPS OBSERVED	BTPS OBSERVED	% OF PREDICTED	% CHANGE
FVC (Liters)								
FEV ₁ (Liters)								
FEV ₁ /FVC								

PATIENT NAME: _____ AGE: _____ SEX: _____ WEIGHT: _____ HEIGHT: _____ RACE: _____
 IDENTIFICATION NUMBER: _____ TESTED BY: _____ PHYSICIAN: _____ SUBJECT'S EFFORT: _____ GOOD _____ FAIR _____ POOR _____
 DATE: _____ TIME: _____ TEMP.: _____ PRESSURE: _____

NAME





My Numeric Spirometry Results

- FVC = 5.70 L
- FEV₁ = 4.45 L
- FEV₁/FVC = 0.78
- FEF₂₅₋₇₅ = 3.99 L/sec



Defining Normal Values

- Average normal predicted values are based on age, height, and gender
- There are racial differences in average normal values
- Defining normal ranges around the predicted average



Defining the Normal Range of Values

Normal ranges around the predicted average:

- Most widely used method:
 - FEV_1 and FVC $\geq 80\%$ ($100\% \pm 20\%$)
 - $FEV_1/FVC \geq 95\%$
- 95% confidence intervals (\geq lower limit of normal)



Normal Spirometry

Spirometry (BTPS)

		<i>Predicted Range</i>			
		<u>Actual</u>	<u>% Pred</u>	<u>Mean</u>	<u>95% CI</u>
FVC	(Lts)	5.70	109	5.19	4.14
FEV_1	(Lts)	4.45	105	4.22	3.35
FEV_1/FVC	(%)	78	98	79	71
FEF_{25-75}	(L/s)	3.99	93	4.29	
PEFR	(L/s)	9.98	105	9.48	
FET	(Secs)	16.81			



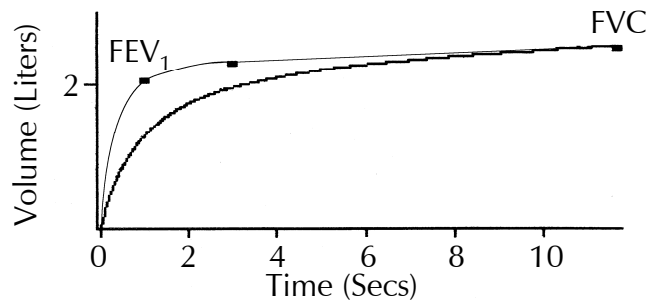
Normal Spirometry

Spirometry (BTPS)

		<u>Actual</u>	<u>% Pred</u>	<u>Predicted Range</u>	
				<u>Mean</u>	<u>95% CI</u>
FVC	(Lts)	5.70	109	5.19	4.14
FEV ₁	(Lts)	4.45	105	4.22	3.35
FEV ₁ /FVC	(%)	78	98	79	71
FEF ₂₅₋₇₅	(L/s)	3.99	93	4.29	
PEFR	(L/s)	9.98	105	9.48	
FET	(Secs)	16.81			



Spirometry in Obstructive Defect



Moderate Obstructive Defect

Spirometry (BTPS)

		Actual	% Pred	<i>Predicted Range</i>	
				Mean	95% CI
FVC	(Lts)	2.53	100	2.51	1.7
FEV ₁	(Lts)	1.31	63	2.05	1.41
FEV ₁ /FVC	(%)	51	63	80	71
FEF ₂₅₋₇₅	(L/s)	0.55	25	2.16	
PEFR	(L/s)	3.67	75	4.85	
FET	(Secs)	11.67			

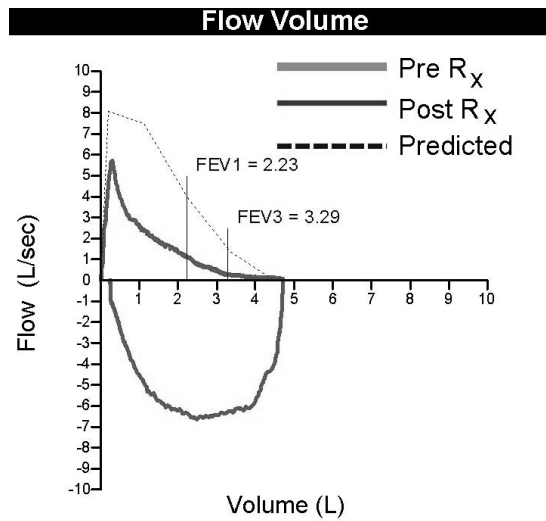


Definition of Obstructive Abnormality

- Reduced FEV₁/FVC ⇒ obstructive defect
- Normal or increased FEV₁/FVC ⇒ no obstruction



Flow-Volume Curve in Obstructive Abnormality



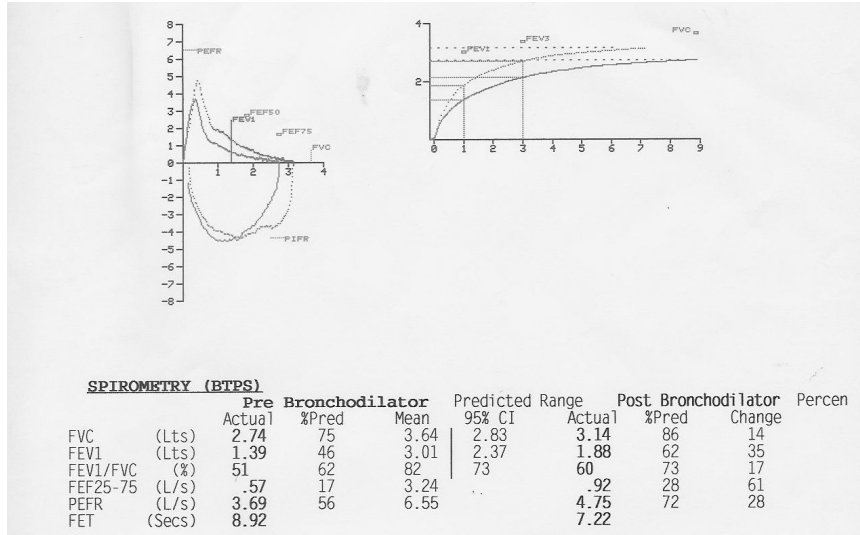
Bronchodilator Response

Significant improvement:

- 12% increase in FEV₁, and
- 200 cc increase in FEV₁



Significant Bronchodilator Response

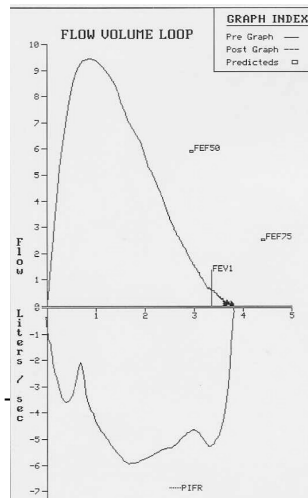


Moderate Restrictive Defect

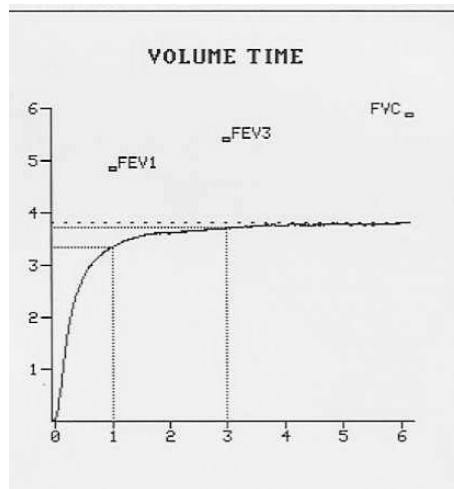
Spirometry (BTPS)

		<u>Actual</u>	<u>% Pred</u>	<u>Predicted Range</u>	
				<u>Mean</u>	<u>95% CI</u>
FVC	(Lts)	3.82	64	5.88	4.83
FEV ₁	(Lts)	3.36	69	4.85	3.99
FEV ₁ /FVC	(%)	88	108	81	73
FEF ₂₅₋₇₅	(L/s)	4.6	91	5.02	
PEFR	(L/s)	9.43	91	10.28	
FET	(Secs)	6.15			

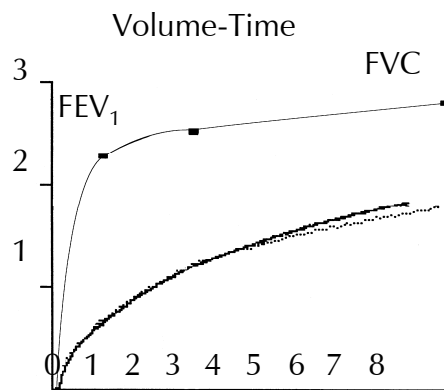
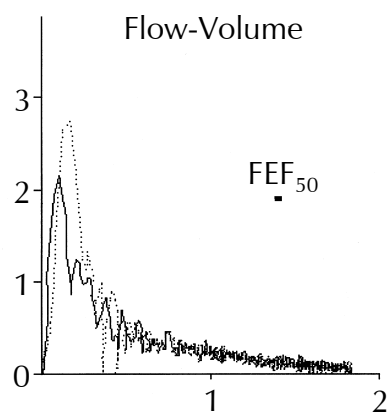
Spirometry and Flow-Volume Curve in Restrictive Defect



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Spirometry and Flow-Volume Curve In Severe Obstruction



Severe Obstructive Defect

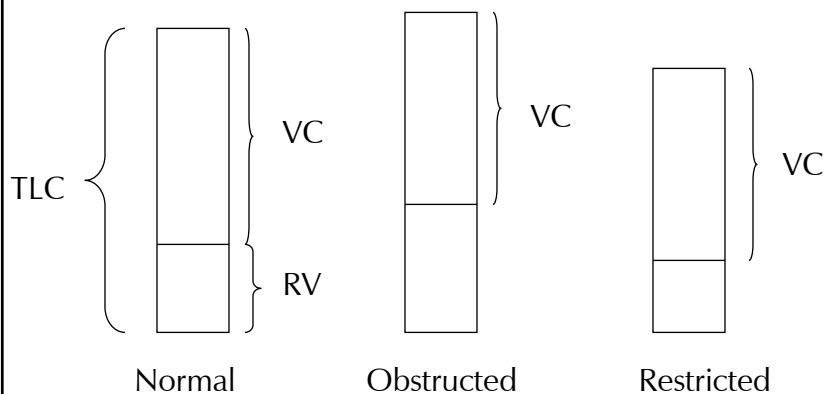
Spirometry (BTPS)

		Pre -bronchodilator		<i>Predicted Range</i>	
		<u>Actual</u>	<u>% Pred</u>	<u>Mean</u>	<u>95% CI</u>
FVC	(Lts)	1.84	65	2.80	1.98
FEV ₁	(Lts)	0.66	28	2.28	1.63
FEV ₁ /FVC	(%)	36	45	80	71
FEF ₂₅₋₇₅	(L/s)	0.26	10	2.39	
PEFR	(L/s)	2.16	39	5.51	
FET	(Secs)	7.76			



Severe Obstructive Defect

Lung Volumes



Peak Flow Meters

Useful:

- To diagnose asthma
- to assess asthma severity
- when symptoms change
- when medications are changed
- during an asthma attack



PARTNERS
A

Peak Flow Monitoring

- Measure 3 times and record the *best* value
- Establish your personal best
- For daily monitoring, check your PEF before your daily medications
- Daily monitoring not necessary
- Analogy: using a thermometer to quantify the severity of a fever

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A

Conclusions

- The key measurements on spirometry are the FVC, FEV₁, and FEV₁/FVC.
- An obstructive pattern on spirometry is identified by a reduced FEV₁/FVC and by the scooped appearance of the flow-volume curve.



Conclusions (cont.)

- A significant bronchodilator response involves a 12% increase in FEV₁ (and at least 200 cc increase in FEV₁).
- Peak flow measurements cannot distinguish obstructive vs. restrictive abnormalities; but in persons with established obstructive disease, they can be useful to monitor changes in lung function.



Case Example

- A 52-year old man presents with a chief complaint of dyspnea on exertion.
- He smoked a pack of cigarettes/day for 30 years, quitting five years ago. He has had gradually increasing shortness of breath with exertion over the past six months, to the point of breathlessness on climbing one flight of stairs. He is comfortable at rest, including sleeping on one pillow.



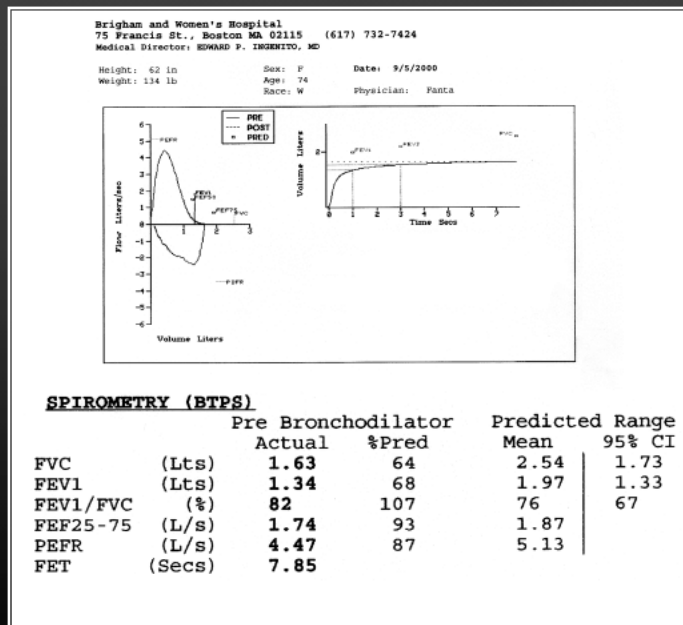
Case Example (cont.)

- On examination, he is morbidly obese with a normal cardiopulmonary exam.
- His chest X-ray is normal.



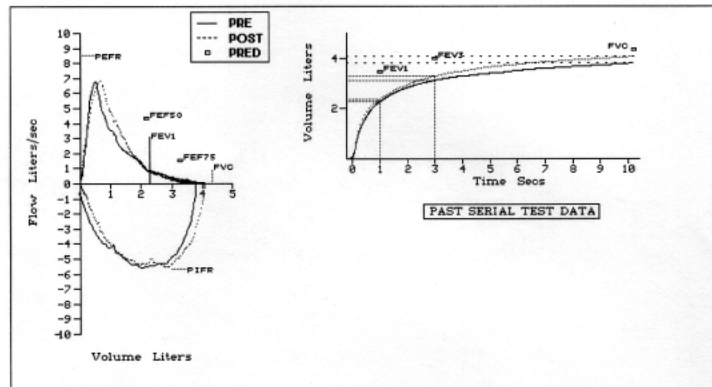
Question #1

- With the above history and the following pulmonary function test results, which is the most likely diagnosis?



Question #2

- With the same history and the following pulmonary function test results, which is the most likely diagnosis?



SPIROMETRY (BTPS)

		Pre Bronchodilator		Predicted Range		Post Bronchodilator		Percent Change
		Actual	%Pred	Mean	95% CI	Actual	%Pred	
FVC	(Lts)	3.8	87	4.35	3.3	4.08	93	7
FEV1	(Lts)	2.29	65	3.47	2.61	2.39	68	4
FEV1/FVC	(%)	60	76	78	70	59	75	-1
FEF25-75	(L/s)	1.13	32	3.49		1.03	29	-8
PEFR	(L/s)	6.8	79	8.52		6.87	80	1
PET	(Secs)	10.17				10.28		

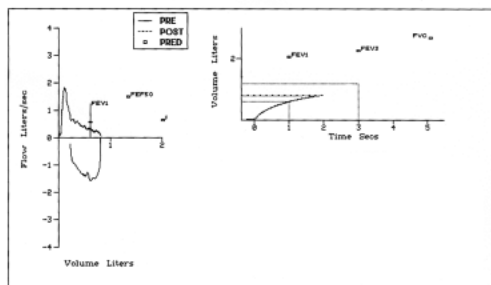
Question #3

- With the same history and the following pulmonary function test results, which is the most likely diagnosis?



Brigham and Women's Hospital
 75 Francis St., Boston MA 02115 (617) 732-7424
 Medical Director: EDWARD P. INGENITO, MD

Height: 64 in Sex: F Date: 9/6/2000
 Weight: 141 lb Age: 78
 Race: W Physician: Panta



SPIROMETRY (BTPS)

		Pre Bronchodilator		Predicted Range	
		Actual	%Pred	Mean	95% CI
FVC	(Lts)	.82	30	2.68	1.87
FEV1	(Lts)	.61	29	2.05	1.41
FEV1/FVC	(%)	75	101	74	65
FEF25-75	(L/s)	.48	26	1.84	
PEFR	(L/s)	1.84	34	5.28	
FET	(Secs)	1.98			

Case Example

- A 24 year-old college student without prior history of allergies or asthma complains of cough and loud wheezing.
- You confirm inspiratory and expiratory wheezes on physical exam.
- Spirometry/flow-volume results are shown on the next slide.

