

Pulmonary Function Testing in Asthma

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Conflicts of Interest

None.

Importance of Making Measurements of Lung Function to Assess Asthma Control

ORIGINAL ARTICLE

Active Albuterol or Placebo, Sham Acupuncture, or No Intervention in Asthma

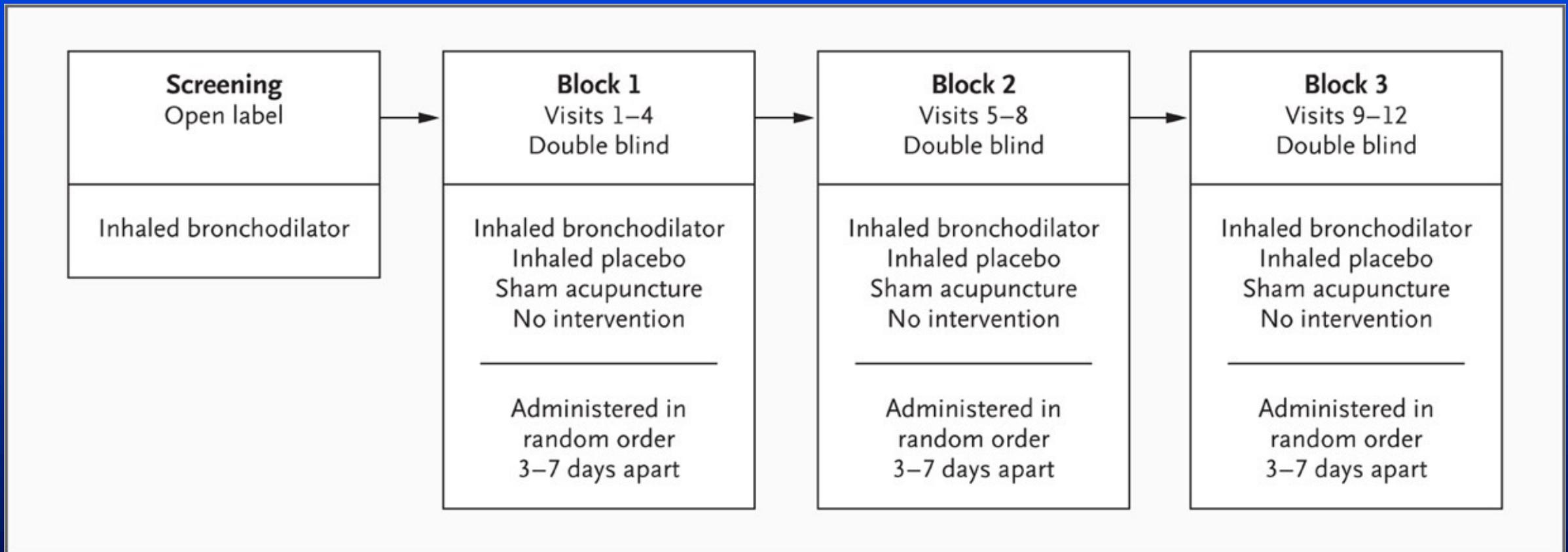
Michael E. Wechsler, M.D., John M. Kelley, Ph.D., Ingrid O.E. Boyd, M.P.H., Stefanie Dutile, B.S., Gautham Marigowda, M.B., Irving Kirsch, Ph.D., Elliot Israel, M.D., and Ted J. Kaptchuk

[full/10.1056/NEJMoa2105215?query=recirc_top_ri...](https://doi.org/10.1056/NEJMoa2105215?query=recirc_top_ri...)

Wechsler, ME, et al. *New Engl J Med* 2011; 365:119-26.

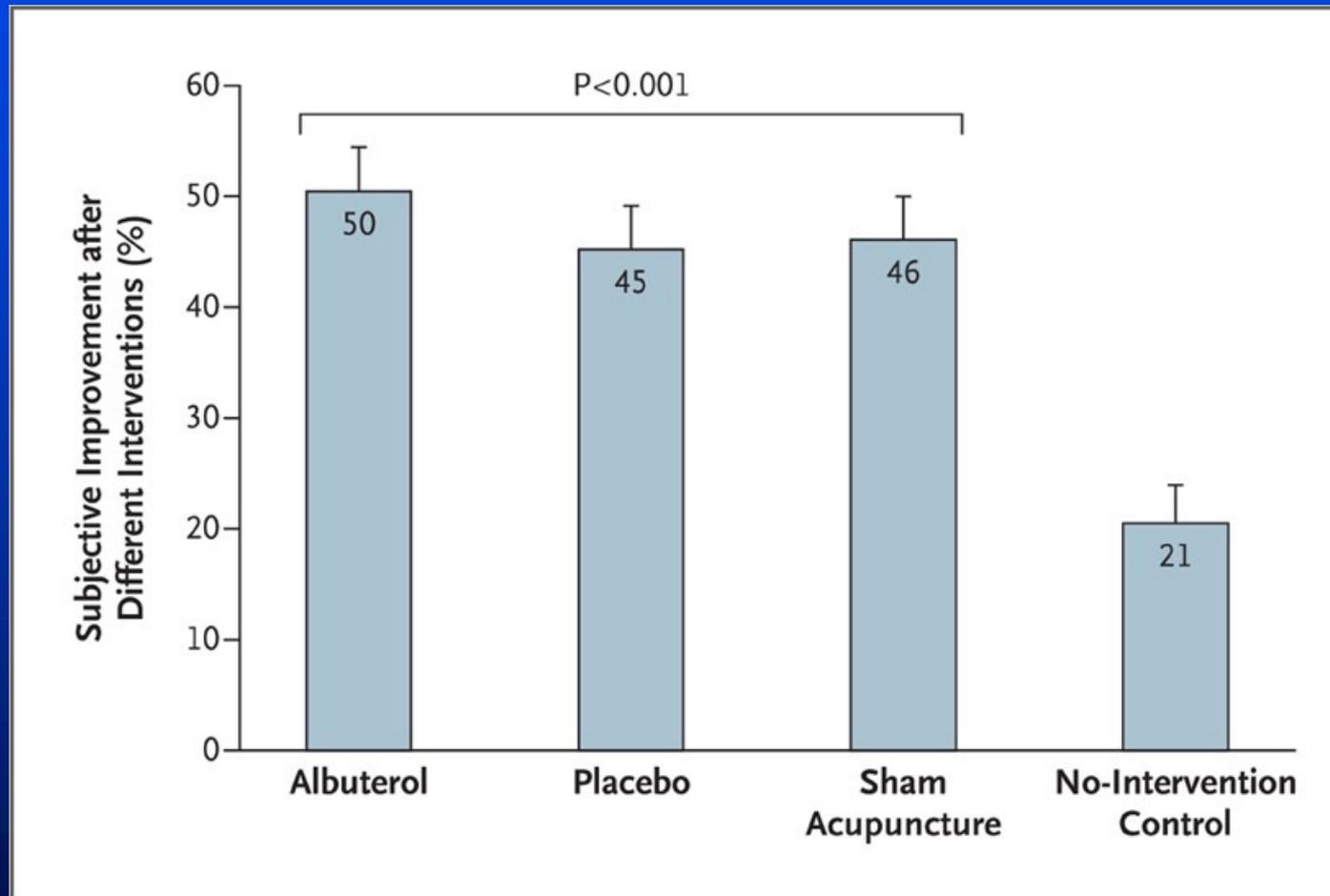


Study Design



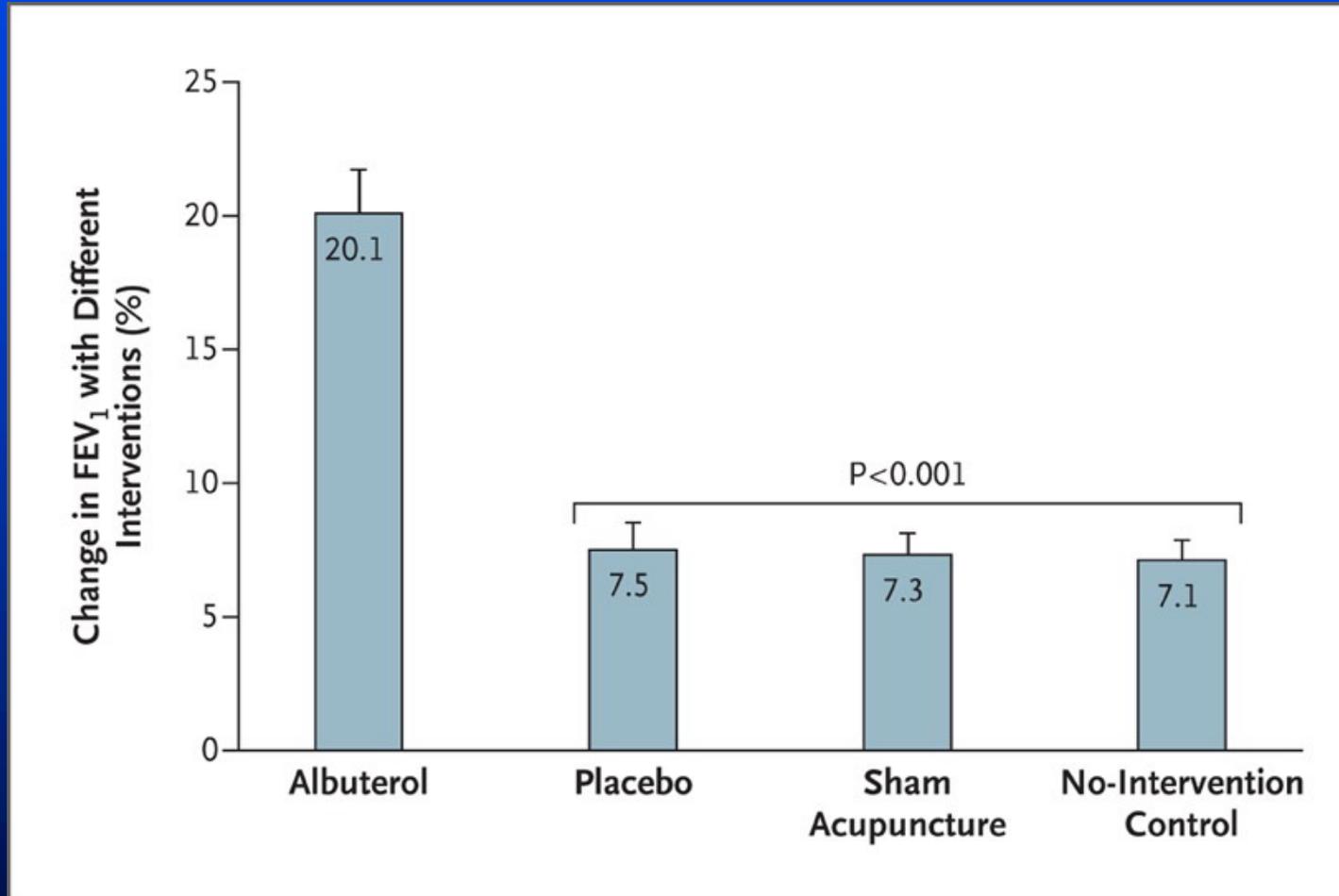
Wechsler, ME, et al. *New Engl J Med* 2011; 365:119-26.

Outcome: Symptomatic Improvement



Wechsler, ME, et al. *New Engl J Med* 2011; 365:119-26.

Outcome: Objective Improvement



Wechsler, ME, et al. *New Engl J Med* 2011; 365:119-26.

Objective Measurements in Asthma

- Peak expiratory flow
- Spirometry
- Exhaled nitric oxide concentration

Peak Flow Meters

Useful:

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



WOMEN

Age	Height				
	55"	60"	65"	70"	75"
20	390	423	460	496	529
25	385	418	454	490	523
30	380	413	448	483	516
35	375	408	442	476	509
40	370	402	436	470	502
45	365	397	430	464	495
50	360	391	424	457	488
55	355	386	418	451	482
60	350	380	412	445	475
65	345	375	406	439	468
70	340	369	400	432	461

MEN

Age	Height				
	60"	65"	70"	75"	80"
20	554	602	649	693	740
25	543	590	636	679	725
30	532	577	622	664	710
35	521	565	609	651	695
40	509	552	596	636	680
45	498	540	583	622	665
50	486	527	569	607	649
55	475	515	556	593	634
60	463	502	542	578	618
65	452	490	529	564	603
70	440	477	515	550	587

PEAK FLOW VALUES IN LITERS/MINUTE

Peak Flow Monitoring

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

Advantages of Peak Flow Monitoring

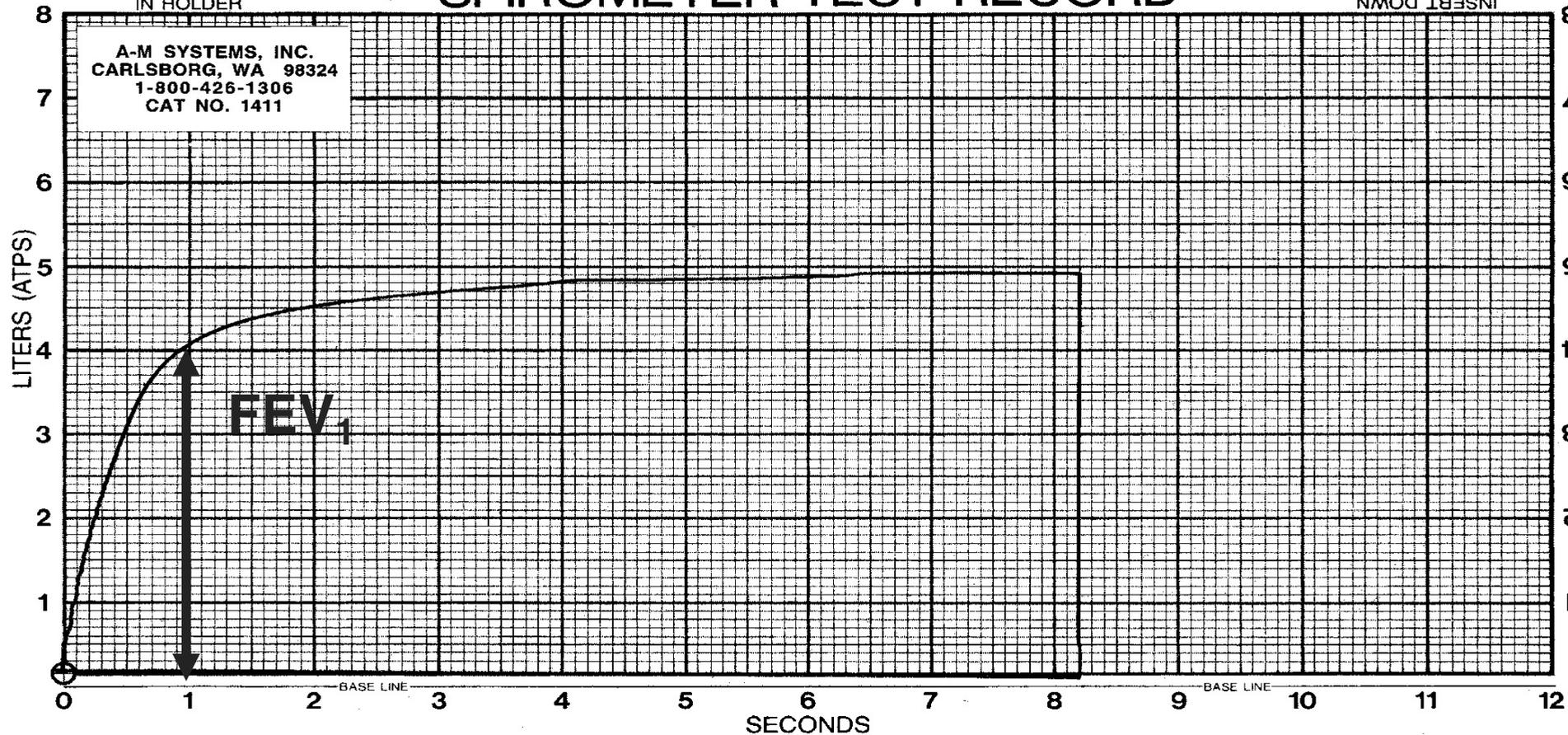
- Low cost
- Widely available
- Limited expiratory effort compared to spirometry

SPIROMETER TEST RECORD

INSERT DOWN
IN HOLDER

INSERT DOWN
IN HOLDER

A-M SYSTEMS, INC.
CARLSBORG, WA 98324
1-800-426-1306
CAT NO. 1411



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								

NAME: _____

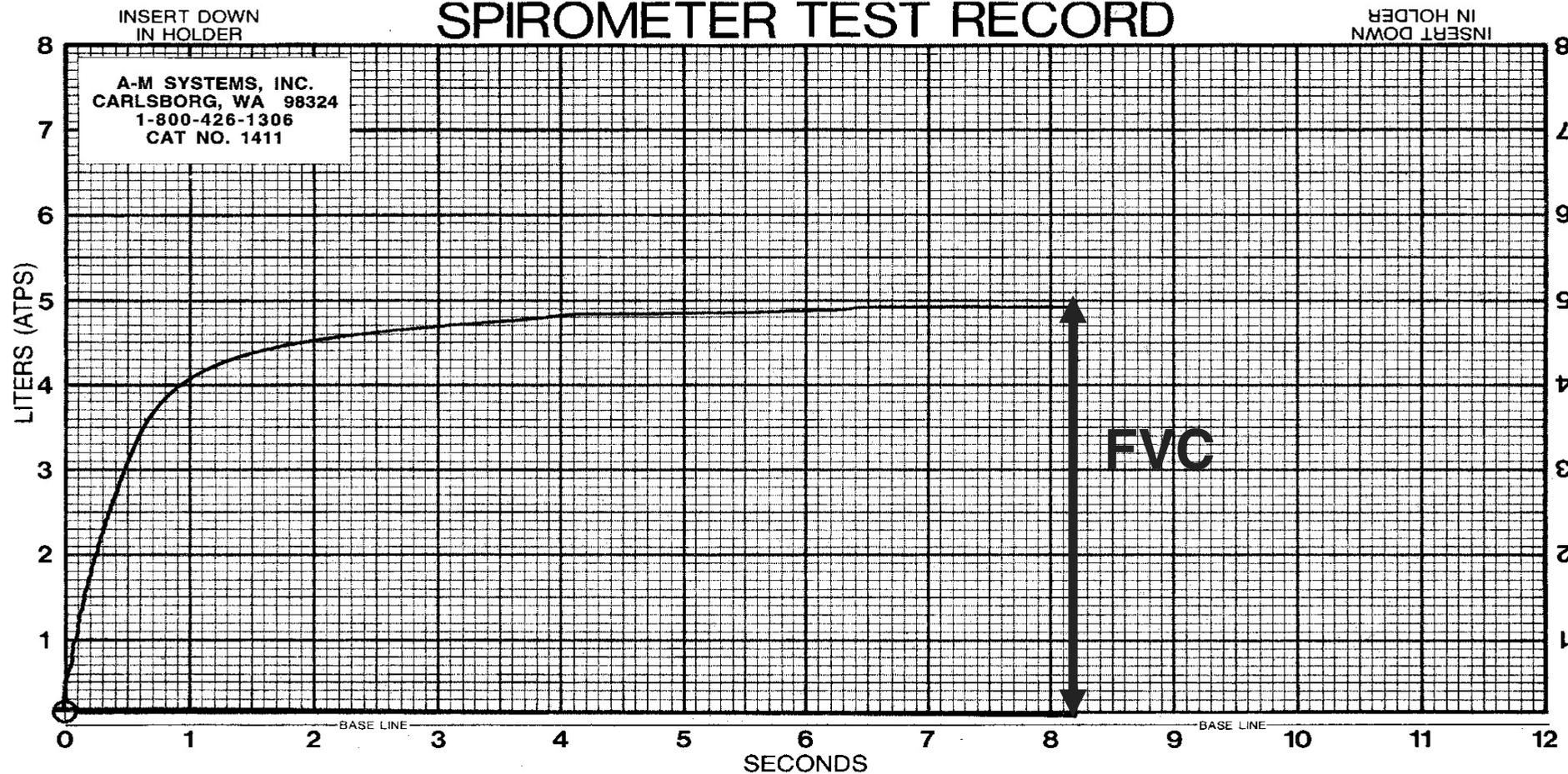
PATIENT NAME: _____

AGE: _____ SEX: _____ WEIGHT: _____ HEIGHT: _____ RACE: _____

IDENTIFICATION NUMBER: _____ TESTED BY: _____ PHYSICIAN: _____

SUBJECT'S EFFORT: _____ GOOD _____ FAIR _____ POOR _____
DATE: _____ TIME: _____ TEMP.: _____ PRESSURE: _____

SPIROMETER TEST RECORD



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

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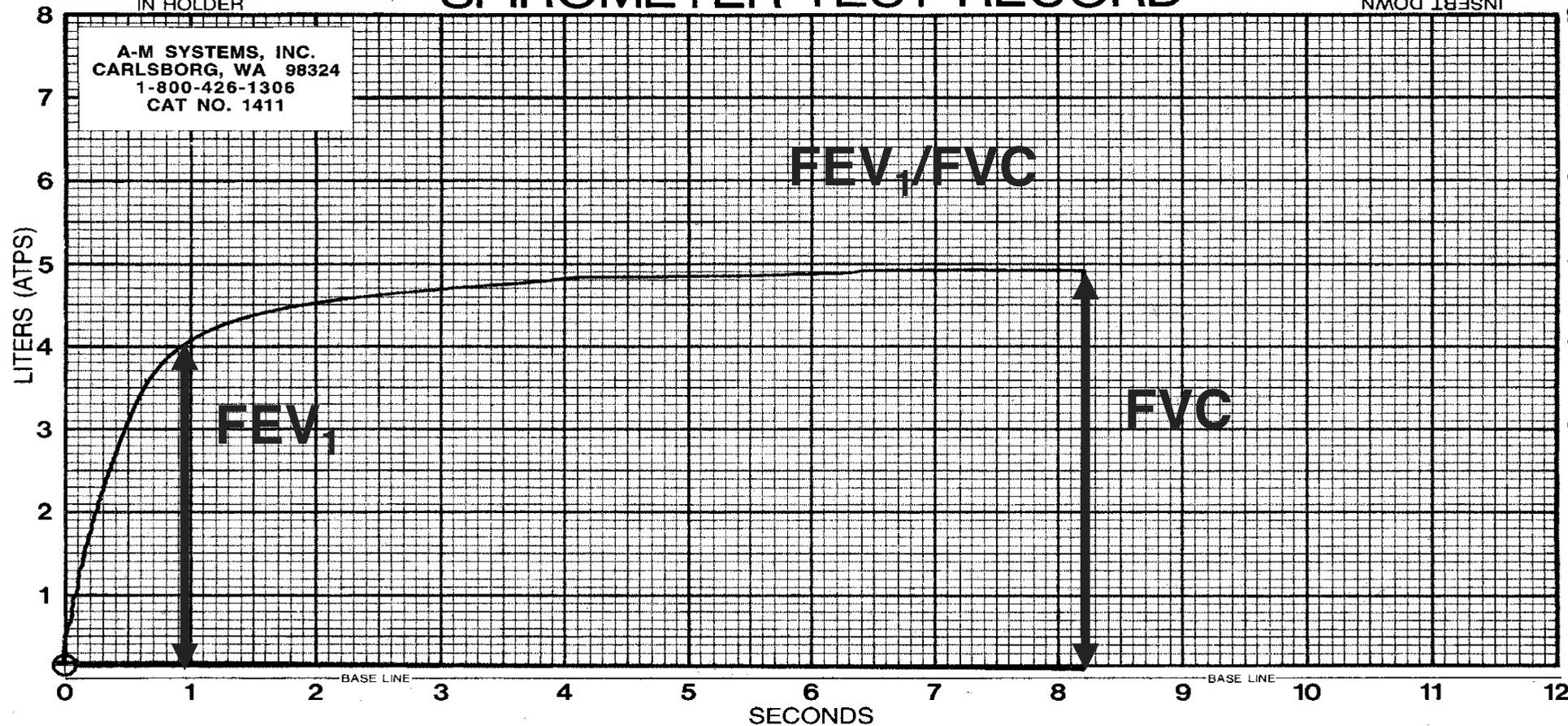
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FEV ₁ /FVC								

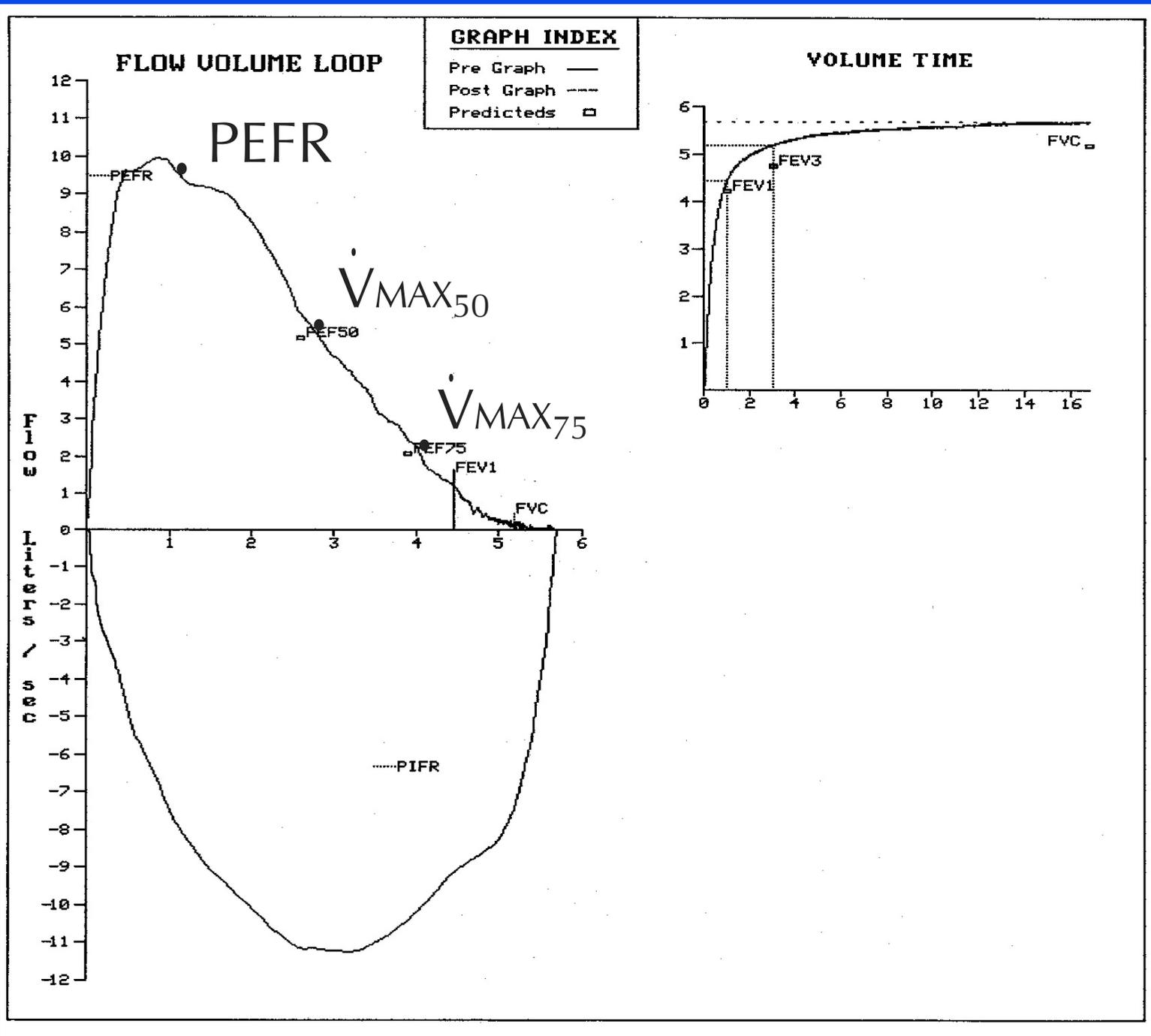
NAME

PATIENT NAME: _____

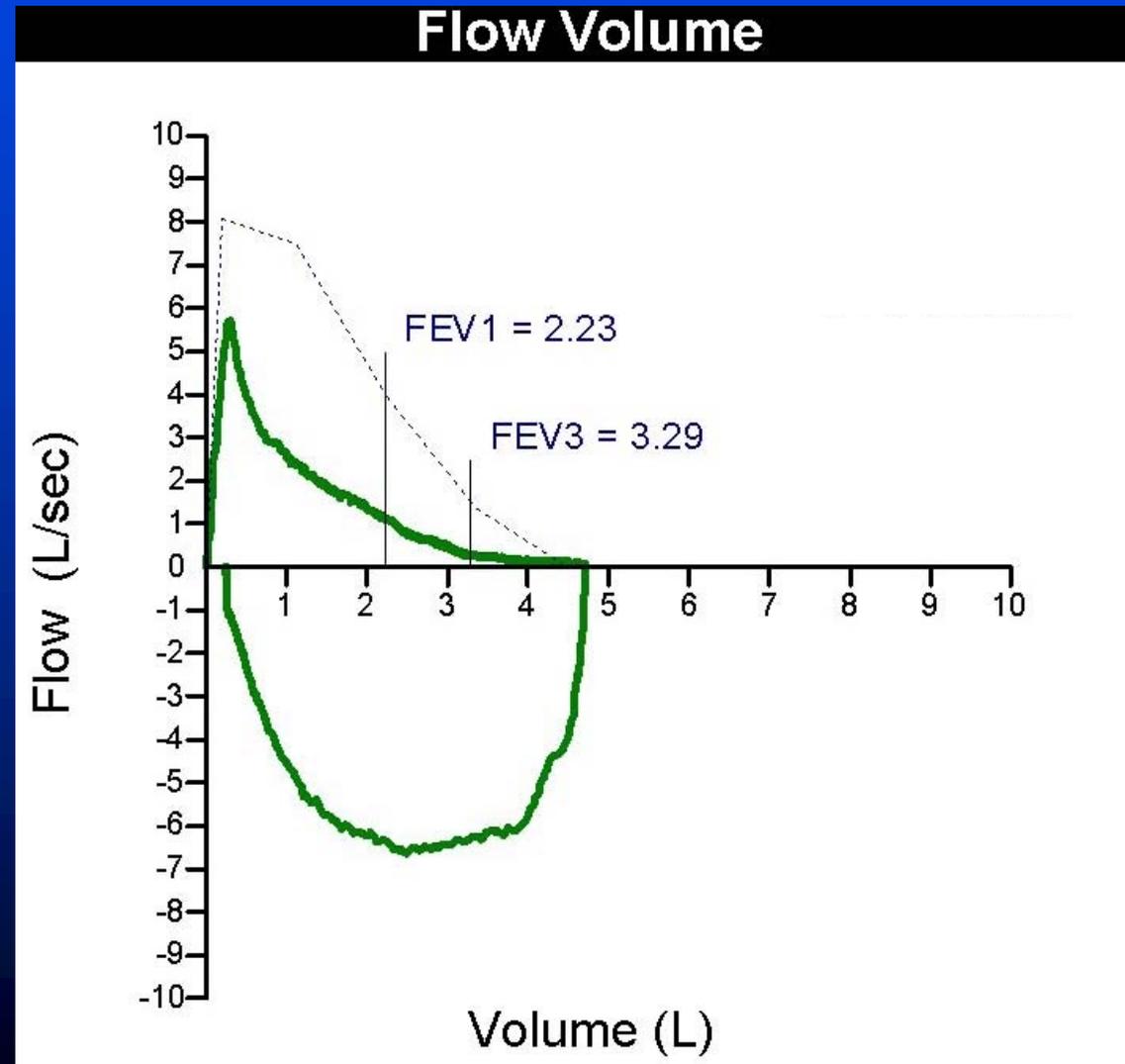
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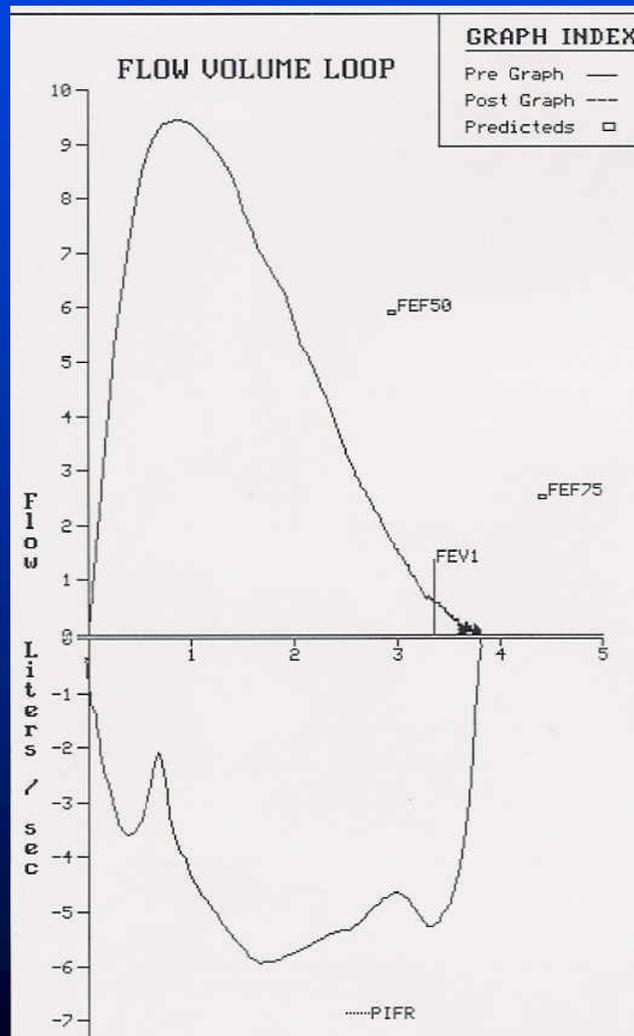
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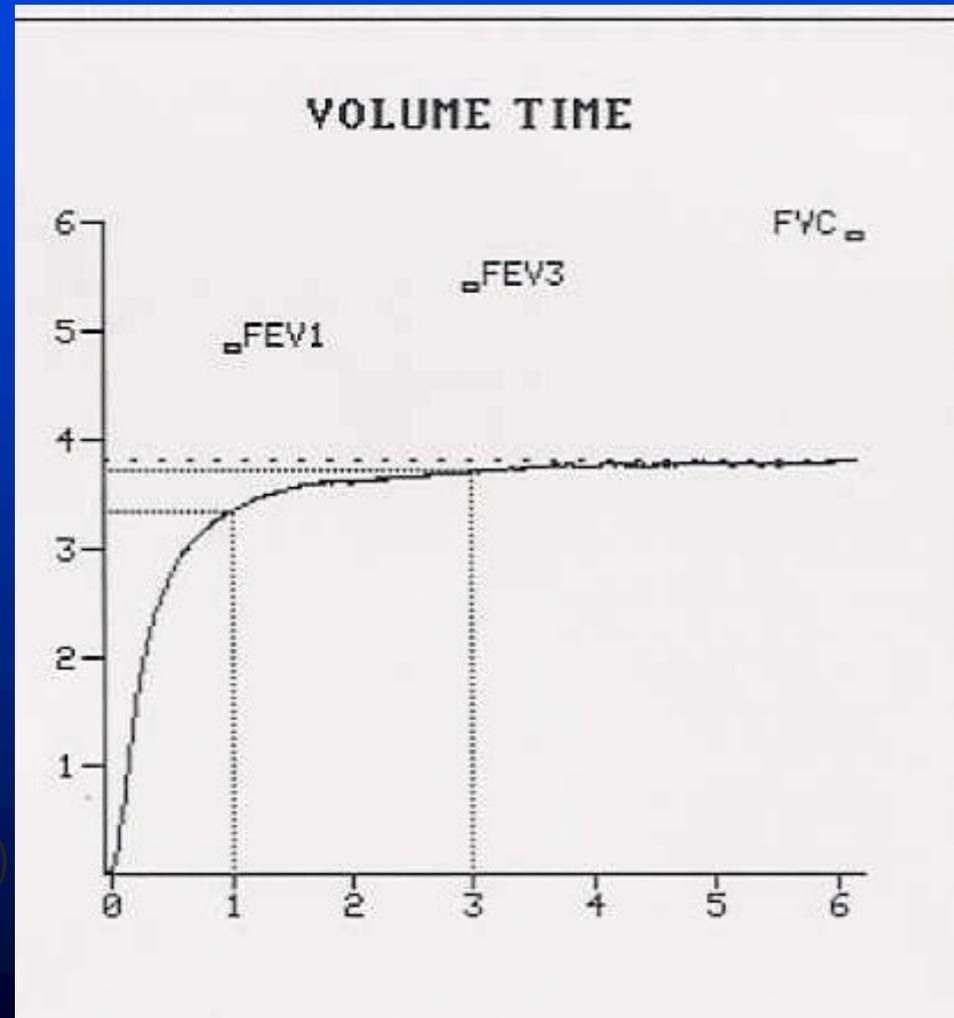
Flow-Volume Curve in Obstructive Abnormality



Spirometry and Flow-Volume Curve in Restrictive Defect



3
ters)



Disadvantages of Spirometry

- Cost of equipment
- Skilled coaching required during testing; more time consuming
- Interpretation more complex than for peak flow
- Consequently, less available

Spirometry vs Peak Flow

- Shortcomings of peak flow measurement:
 - Cannot distinguish obstructive vs restrictive
 - No graphic assessment of expiratory effort
 - Peak flow meters cannot be calibrated

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Spirometry vs Peak Flow

- Shortcomings of peak flow measurement:
 - Cannot distinguish obstructive vs restrictive
 - No graphic assessment of expiratory effort
 - Peak flow meters cannot be calibrated
 - **May overestimate expiratory flow**

FEV₁ vs PEFr



Brigham & Women's Hospital
Pulmonary Function Laboratory
 Medical Director: Victor Pinto-Plata, M.D.
 75 Francis Street
 Boston, MA 02115

Date of Test: 1/9/2013
 Date/Time of Change: 1/9/2013
 Date/Time of Report: 1/10/2013 01:01 PM
 Temp: 24°C
 Pressure: 763mmHg
 BTPS: 1.080

Phone: (617) 732-7424
 Name: Charles K. Mann MRN: 03686540 Sex: M DOB: 10/22/1934 Age: 78 Race: W
 Ht: 68 in (173 cm) Wt: 150 lb (68.0 Kg) BMI: 22.8 Kg/mt² Diagnosis: 1: Dyspnea/respiratory abnormality, unspecif
 Location: Center for Chest Disease 2:
 Therapist: AD034 Attending: Christopher H. Fanta, M.D. Referring: David M. Systrom, M.D.

ATS compliant tests are indicated by a ✓ : FVC ✓ FRC DLCO Raw

Spirometry (BTPS)		Predicted Range		Pre Bronchodilator	
		Mean	95%	Actual	% Pred
FEV ₁	L	3.07	2.23	1.35	44
FVC	L	4.06	2.94	2.77	68
FEV ₁ / FVC	%	76	68	49	64
FEV ₆	L	3.54	2.68	2.42	68
FEV ₁ / FEV ₆	%	77	68	56	73
FEF ₂₅₋₇₅	L/s	2.70	1.03	0.42	16
PEFR	L/s	7.06	4.87	6.98	99
FET	sec	---	---	10.10	---
MVV	L/m	112.1	55.3	---	---



FEV₁ vs PEFR



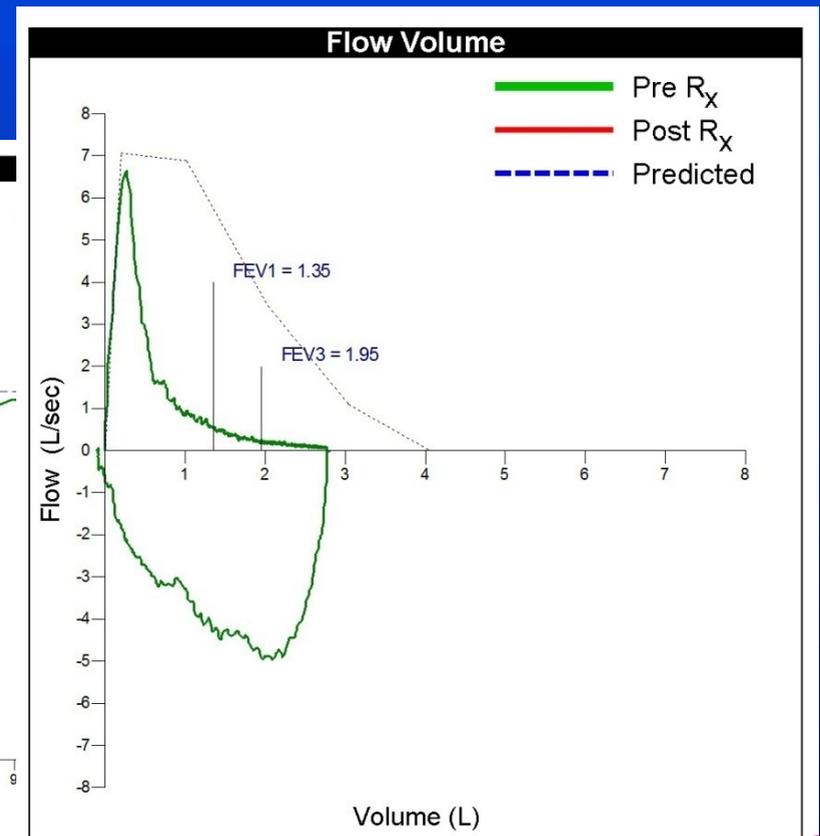
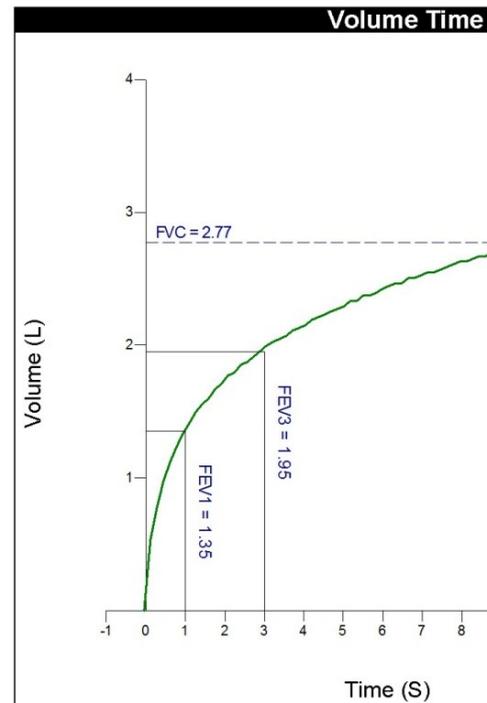
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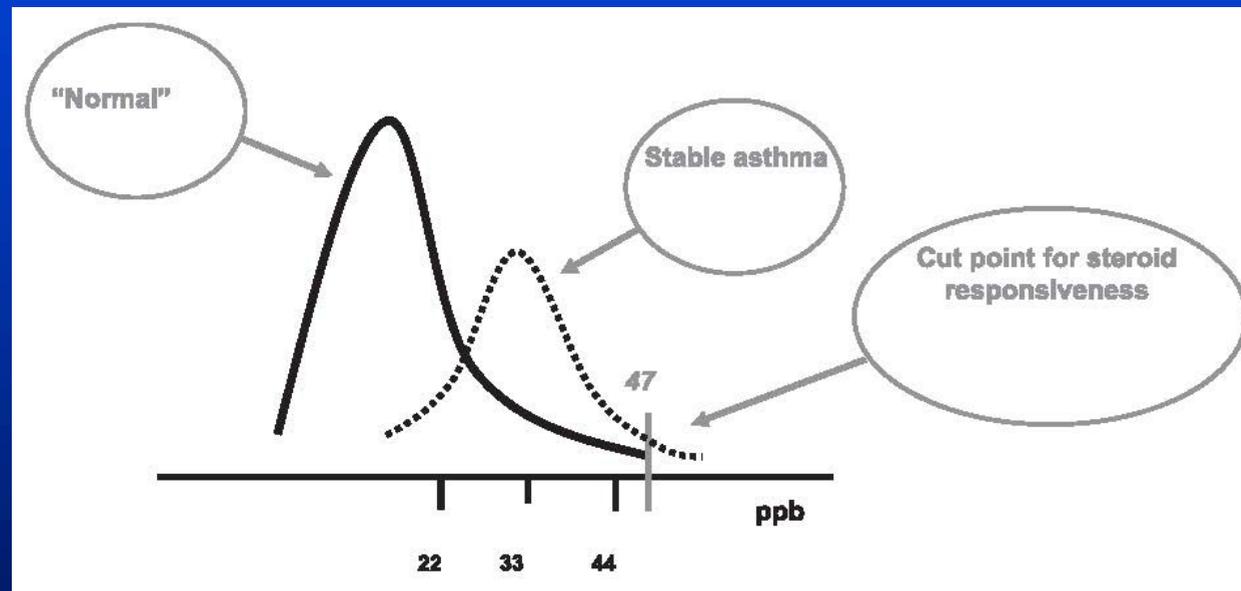
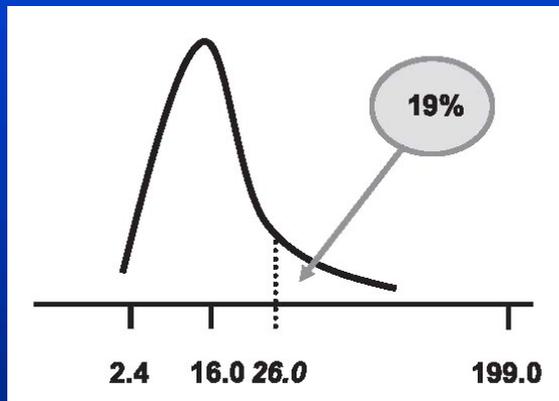


Measurement of Nitric Oxide in Exhaled Breath As Marker of Eosinophilic Inflammation



Nitrogen oxide analyzer

Cut-Off Values for FE_{NO}



Dweik RA, et al. An Official ATS Clinical Practice Guideline. *AJRCCM* 2011; 184:602-15.

Cut-Off Values for FE_{NO}

Normal: <25 ppb

Indeterminate: 25 – 50 ppb

High: >50 ppb

Modifiers:

Atopy (↑)

Cigarette smoking (↓)

Corticosteroid therapy (↓)

Case Example

- 58-year-old radiologist with persistent cough for 3 weeks.
- History of mild intermittent wheezing for last 8 years, worse when returning home to Cambridge at the end of the summer.
- 3 cats and a dog at home.
- Other history: oral allergy syndrome; no sensitivity to the cold.

Case Example (cont.)

- Normal exam, clear including chest exam.
- Spirometry with borderline mild airflow obstruction.

Case Example (cont.)

- Normal exam, clear including chest exam.
- Spirometry with borderline mild airflow obstruction.

Exhaled nitric oxide = 202 ppb.

Take Home Points

- Patient-reported symptoms are important in asthma but are subject to influences other than breathing capacity.
- Measurements of lung function are important in assessing asthma control.
- Spirometry provides more detailed information about lung function than peak flow alone, but it is more difficult to perform and more costly.
- Any measurement is better than none!