

Midmark Spirometry Training for MD's and APP's

By

Dr Gail Brottman

Director, Pediatric Pulmonary Medicine

Hennepin County Medical Center

Why use spirometry?

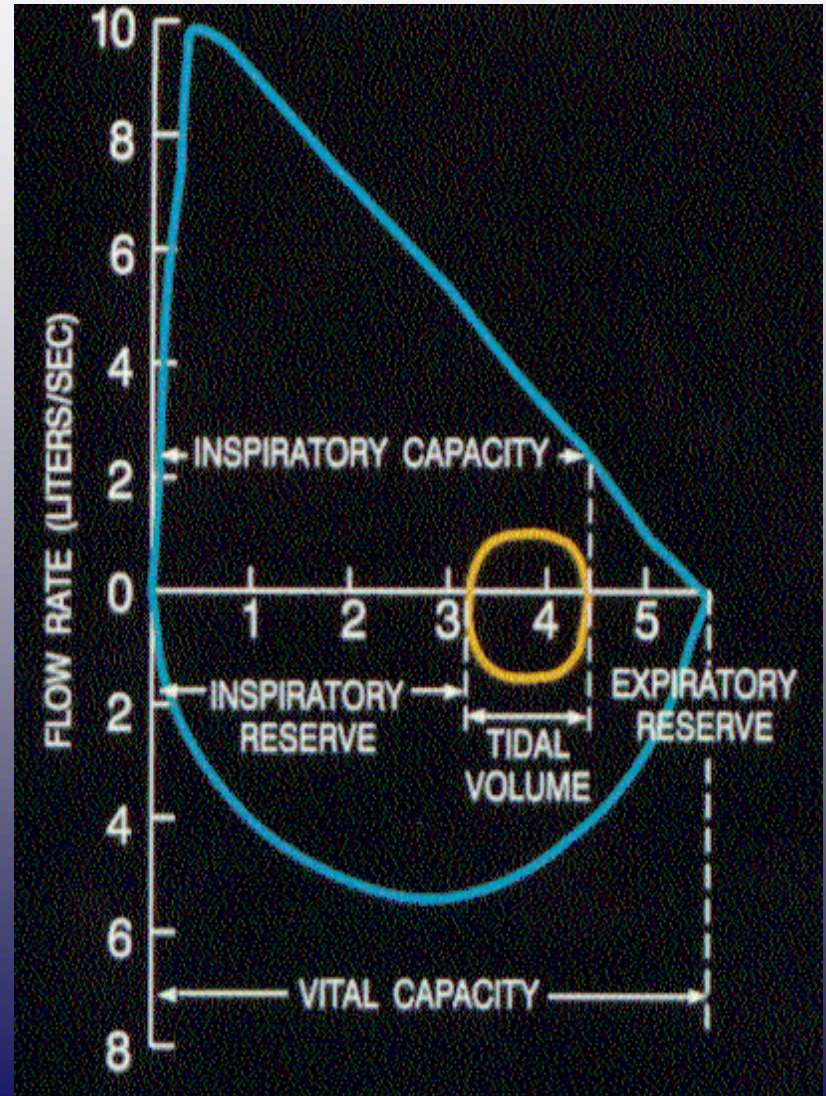
- Establish a diagnosis for patients with Chronic and/or recurrent pulmonary symptoms
- Help tailor therapy for patients with asthma / (COPD)
- Monitoring over time

Regular use of spirometry for established pulmonary patients

- 1. baseline establishment**
- 2. for ongoing objective assessment**
- 3. monitoring**

Spirometry (Flow Volume Loop)

- A Flow Volume Loop is simply a graph that represents how fast the air comes out of the patient
- Airflow rates are proportional to airway caliber.



A Quick Review...

To make a diagnosis of asthma:

Determine the presence of:

- Airflow obstruction is at least partially reversible
- Episodic symptoms of airflow obstruction or airway hyper-responsiveness are present
- Airway inflammation
- Alternative diagnoses are excluded

NHLBI recommends that spirometry tests be done:

- Initial assessment
- After treatment is initiated and symptoms and peak flow have stabilized to establish baseline
- Evaluating response to therapy
- Yearly thereafter

Contraindications to Spirometry

- Bronchospasm
- Pneumothorax
- Syncope
- Pregnant patients at risk of preterm labor
- Repetitive maneuvers may result in Hyperventilation

Testing Preparation:

- Daily Calibration. Follow the user manual for your equipment.
- Accurate height, age, sex, and weight are necessary for useable predicted values.
- Test adults **sitting*** children under 12 can stand. *Some adults will get very light headed during spirometry (Valsalva's Maneuver).

Satisfactory Start of Test

- Rapid rise time (PEF <120ms)
- No pause at TLC
- No cough in first second
- First second free of artifacts (pauses, stops, glitches, or breaks change in flows)
- No leaks

Enthusiastic Coaching.

One text book on Pulmonary Function testing suggested that:

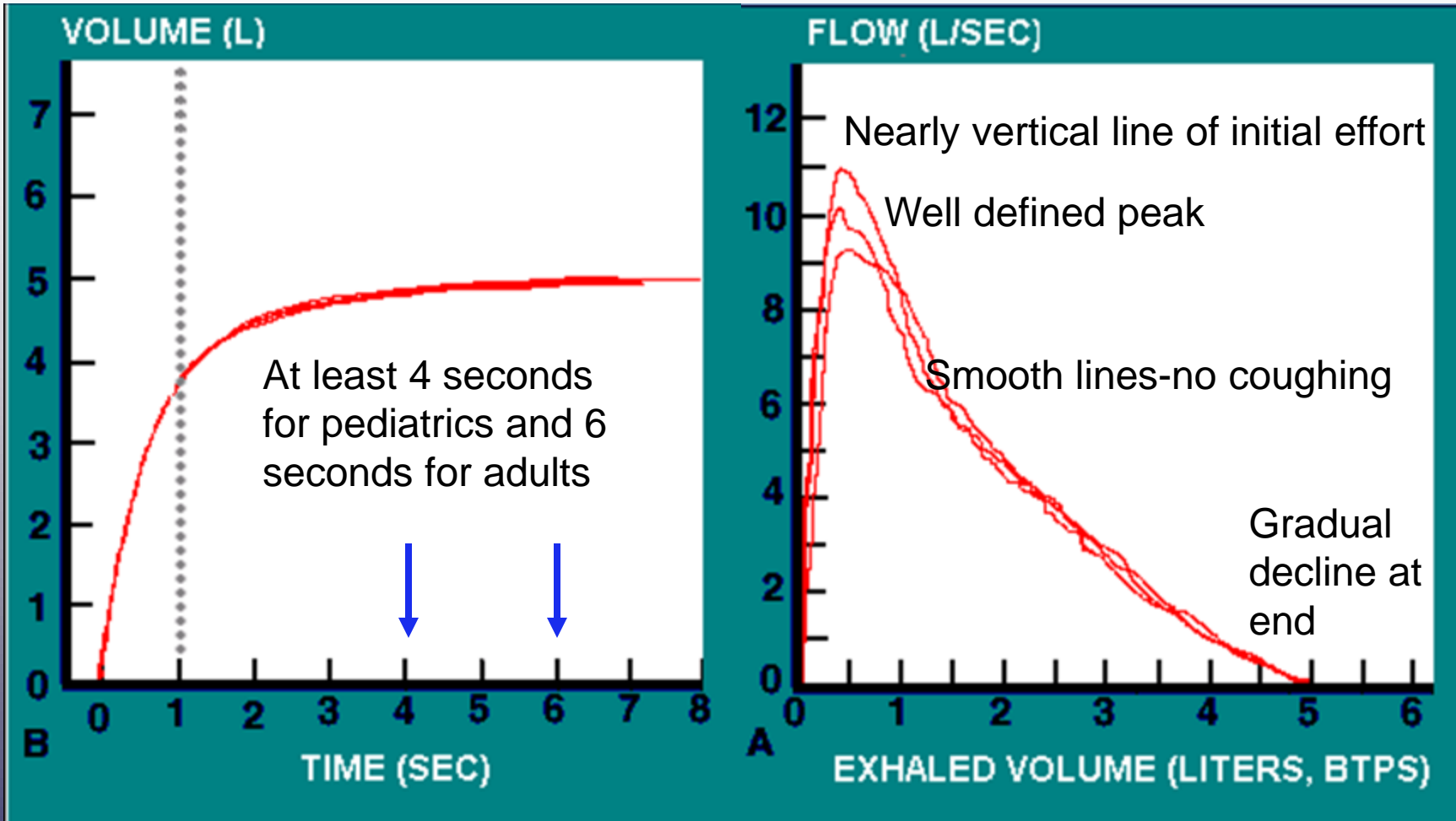
”if you are embarrassed by the fuss your making your probably doing a good job “

Use very simple language and lots of **positive reinforcement**: There is a learning curve for patients doing spirometry so lots of encouragement and positive reinforcement helps:

“That was a good job, but this time try to take even a bigger breath--- we need the very biggest breath you can take. Pack in as much air as you can. Then blow even harder, as hard as you can. When your running out of air at the end of your blow, try hard to squeeze every last bit of air out. “

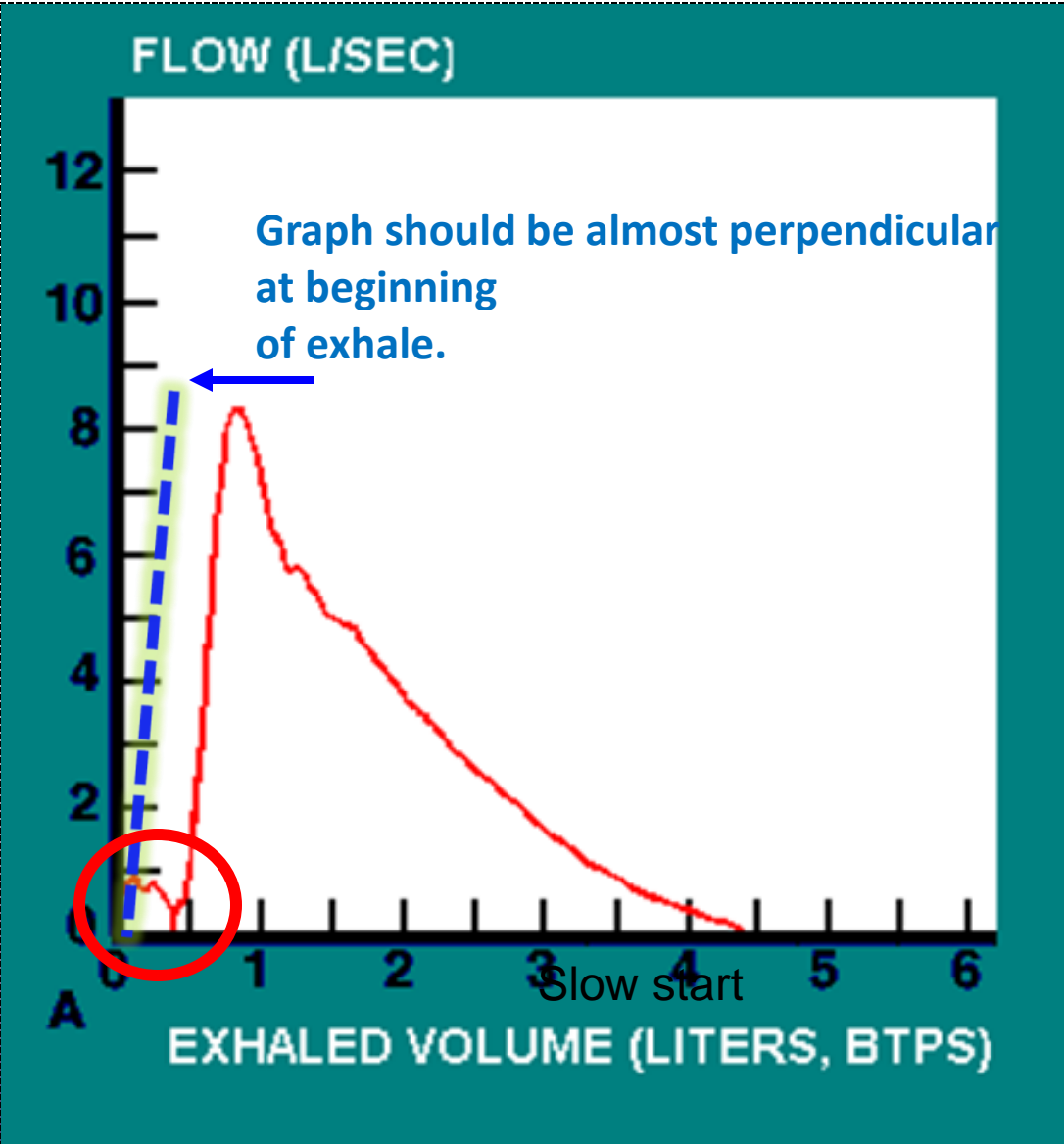
If the patient is very young, or if there is a language barrier -- demonstrate the maneuver, so they can get an idea of the effort you are

Examples of Reproducible and Acceptable Results Graphs



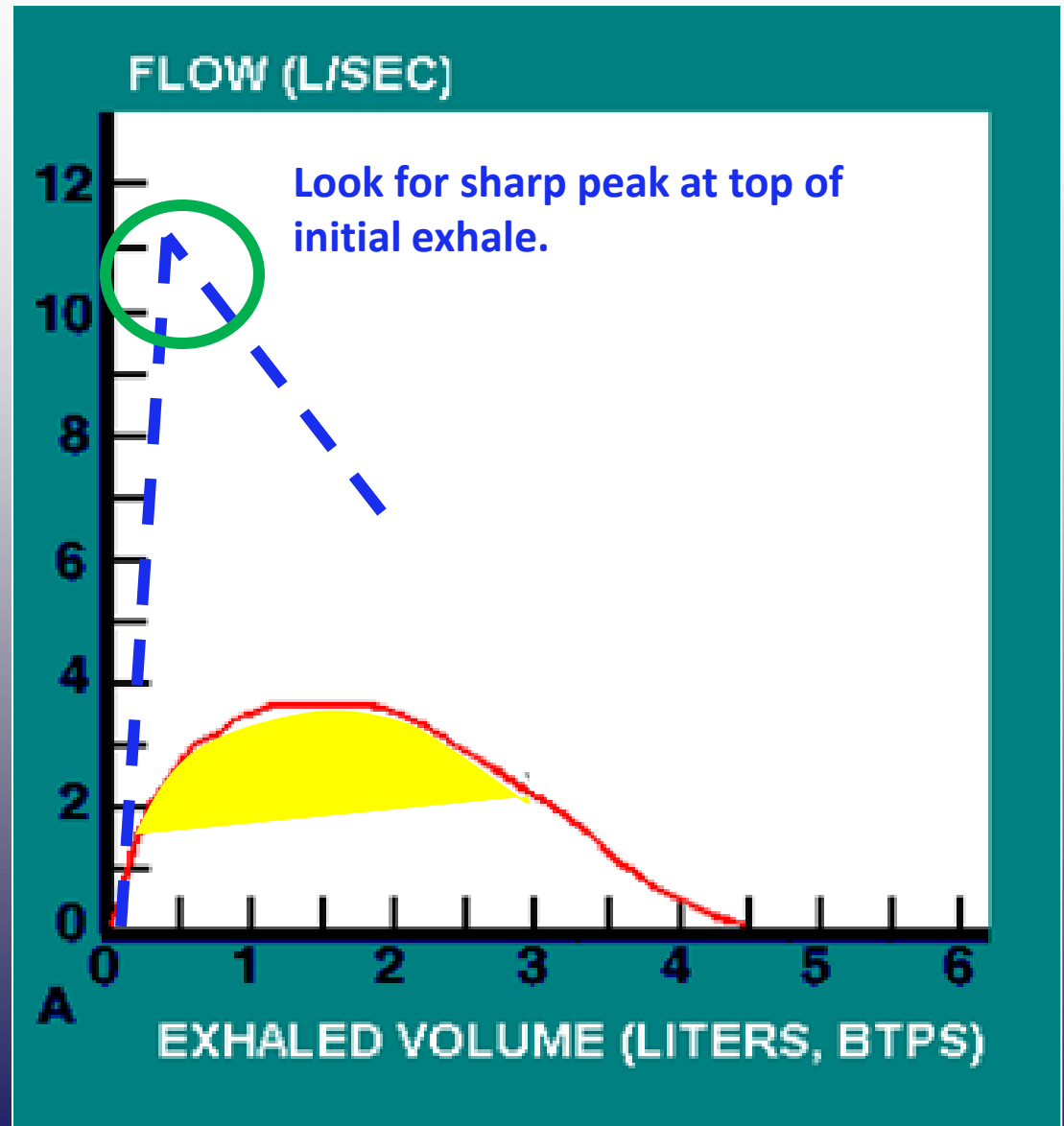
Unacceptable results:

#1. **Slow Start**



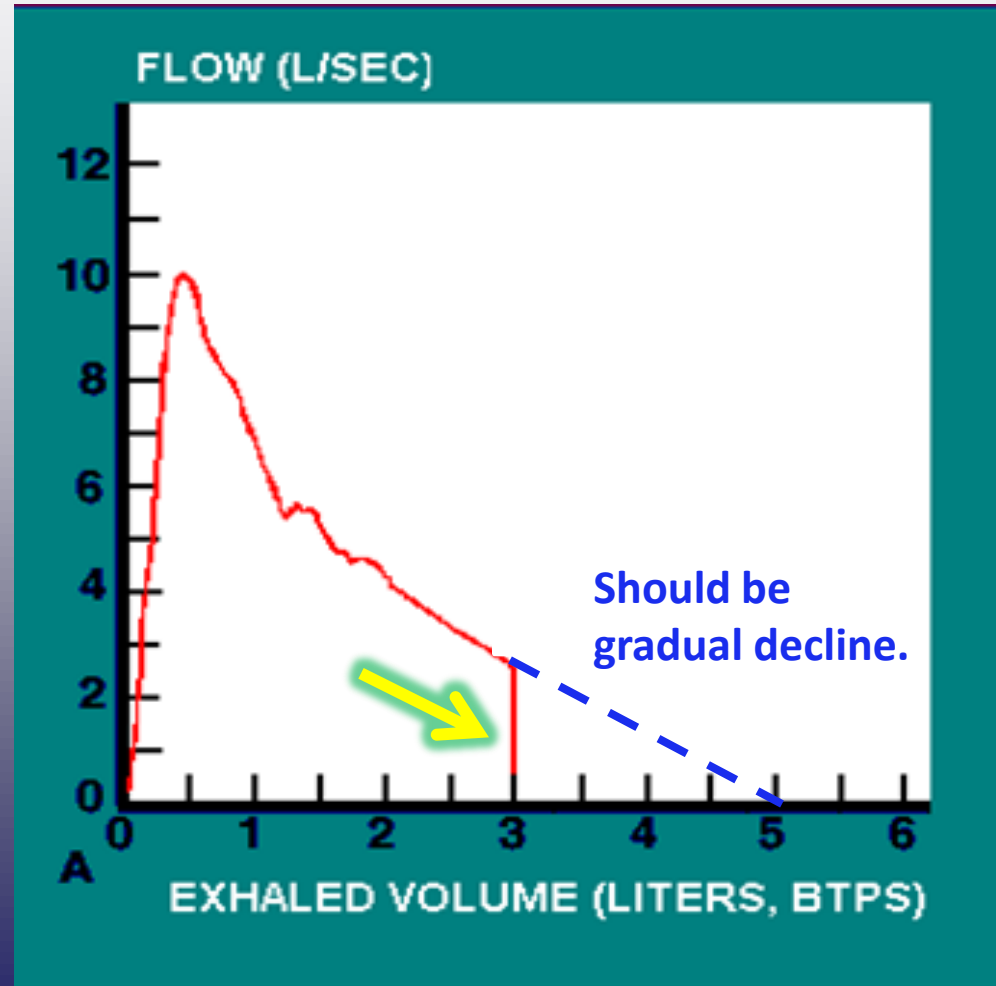
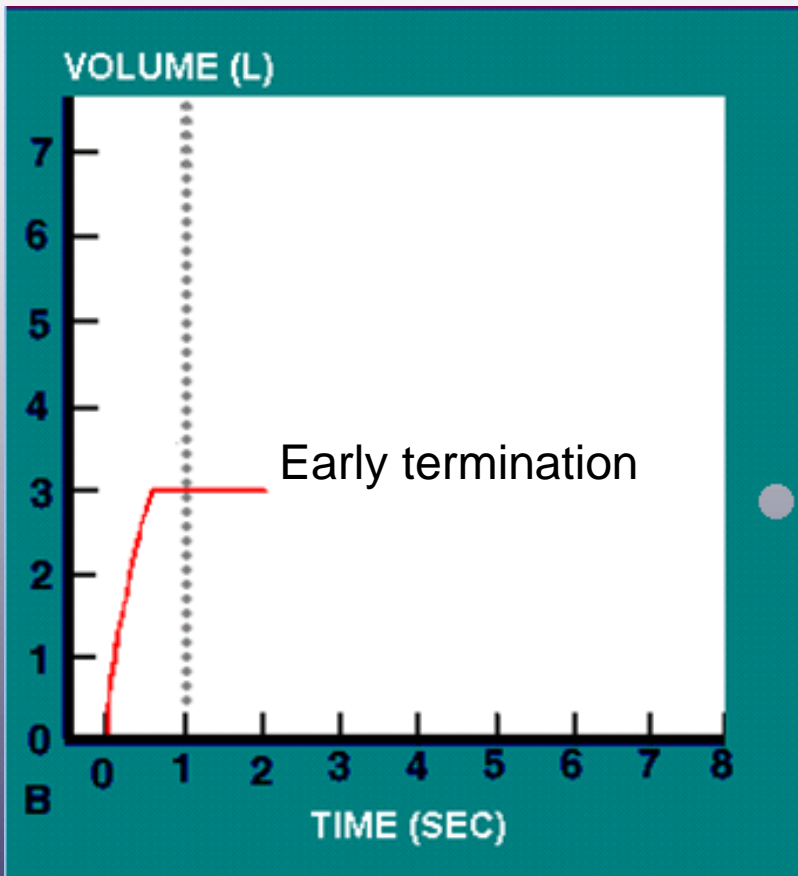
Unacceptable results:

#2. Rounded Peak



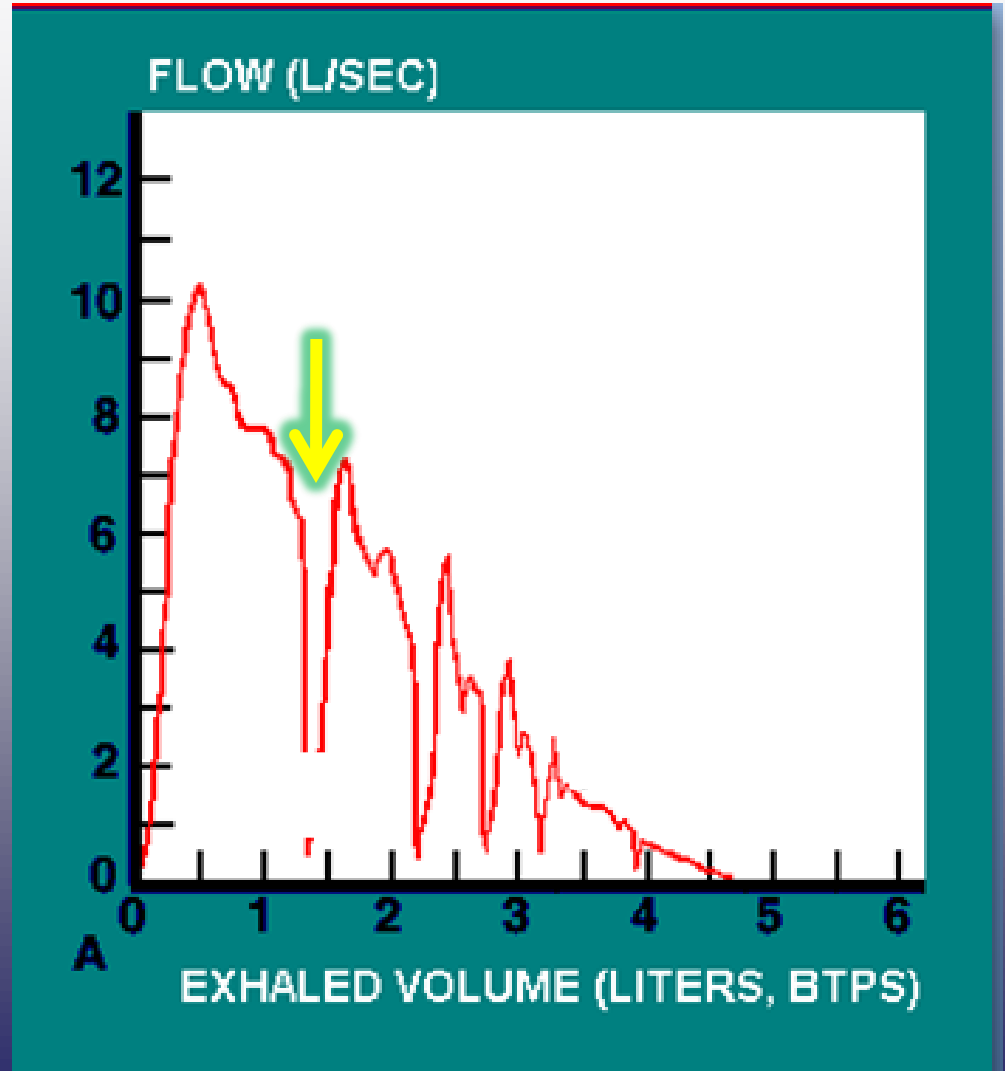
Unacceptable results:

#3. Early Termination

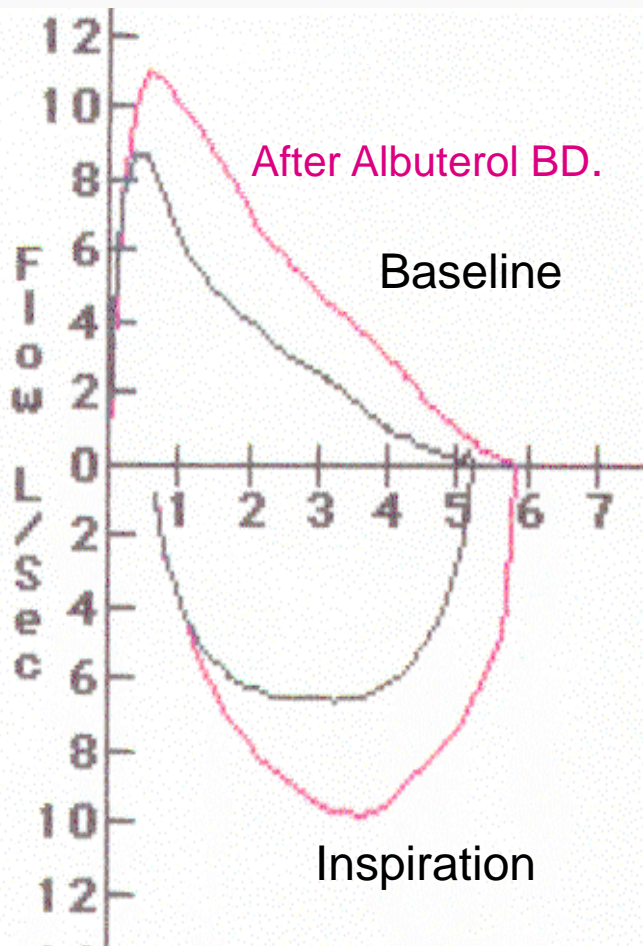


Unacceptable results:

#4. Coughing



This is Asthma



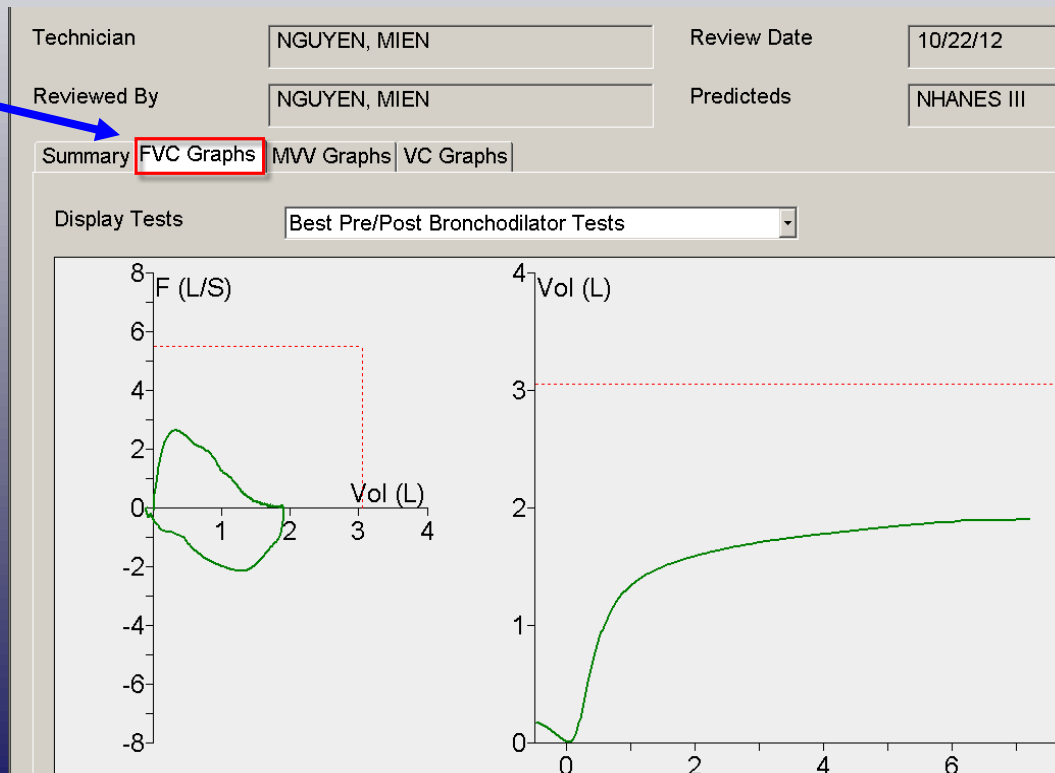
	<u>Baseline</u>		<u>Post BD</u>	
FVC	5.22	91%	5.88	103%
FEV1	3.73	78%	4.71	99%
FEV1/FVC	71%		80%	
FEFmax	8.80	101%	10.45	120%
FEF(25-75)	1.74	34%	4.18	83%

- Reversible Airflow Obstruction
- FEV1 increased 15% after bronchodilation

Spirometry Interpretation in Epic

Step 1: Check the loop for the 4 reproducibility and acceptability standards

- Nearly vertical line for initial effort
- No coughing
- No early termination
- Expiratory time at least 4 seconds for peds, 6 seconds for adults



If the results **do not** meet the standards, order pulmonary function tests in the pulmonary lab.

Spirometry Interpretation in Epic

Step 2: Abnormal results will show up in red on the “Summary” chart.



The primary evaluation result to consider is the FEV1/FVC ratio.

Summary | FVC Graphs | MVV Graphs | VC Graphs

	Units	Predicted	Pre Actual	Pre % Pred.
FVC	L	2.23	1.69	76 %
FEV1	L	2.02	1.11	55 %
FEV1/FVC	%	90 %	65 %	72 %
FEF25%	L/S	4.01	1.68	42 %
FEF50%	L/S	2.63	0.83	31 %
FEF75%	L/S	1.33	0.38	28 %
FEF25-75%	L/S	2.53	0.74	29 %
PFF	L/S	4.88	2.02	41 %

Normal FEV₁/FVC Ratios

8-19 years old	85%
20-39 years old	80%
40-59 years old	75%
60-80 years old	70%

Bronchial Dilatation Studies

- Albuterol 2 puffs (MDI) use a spacer!! Test the device! or 2.5mg/ml neb –
- If there is any question that the patient got an effective dose--give another puff.
- Wait 15 mins
- Pre testing must establish a solid baseline.
- Post test needs equivalent rapid rise time and equal or greater peak flows.

Spirometry Interpretation in Epic

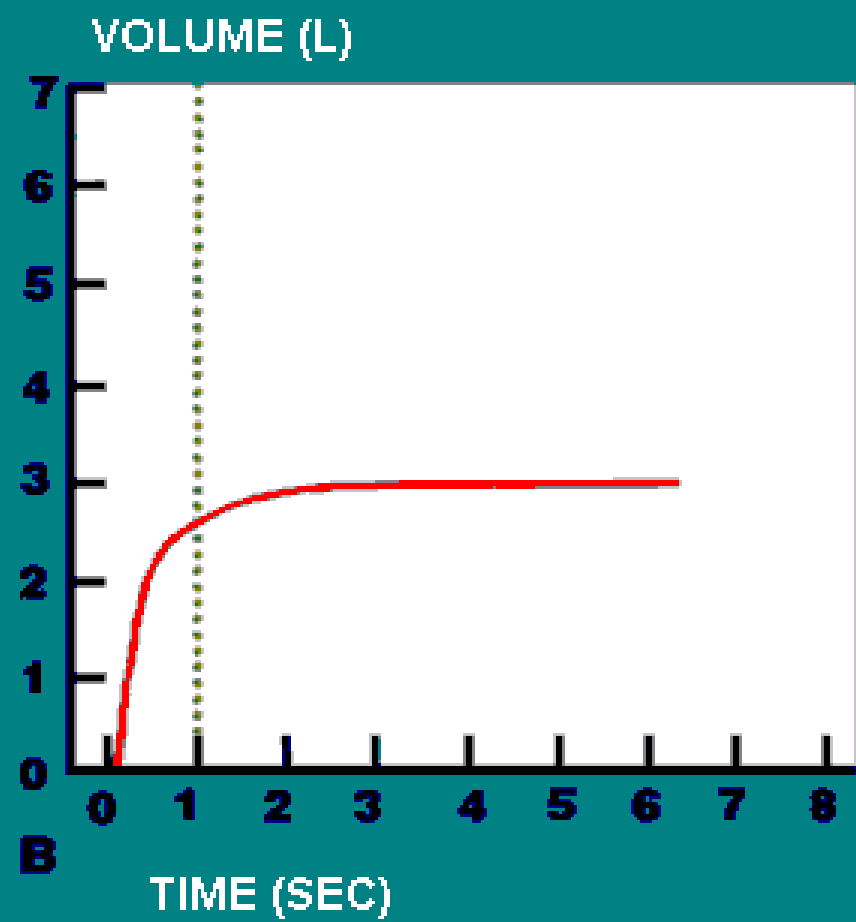
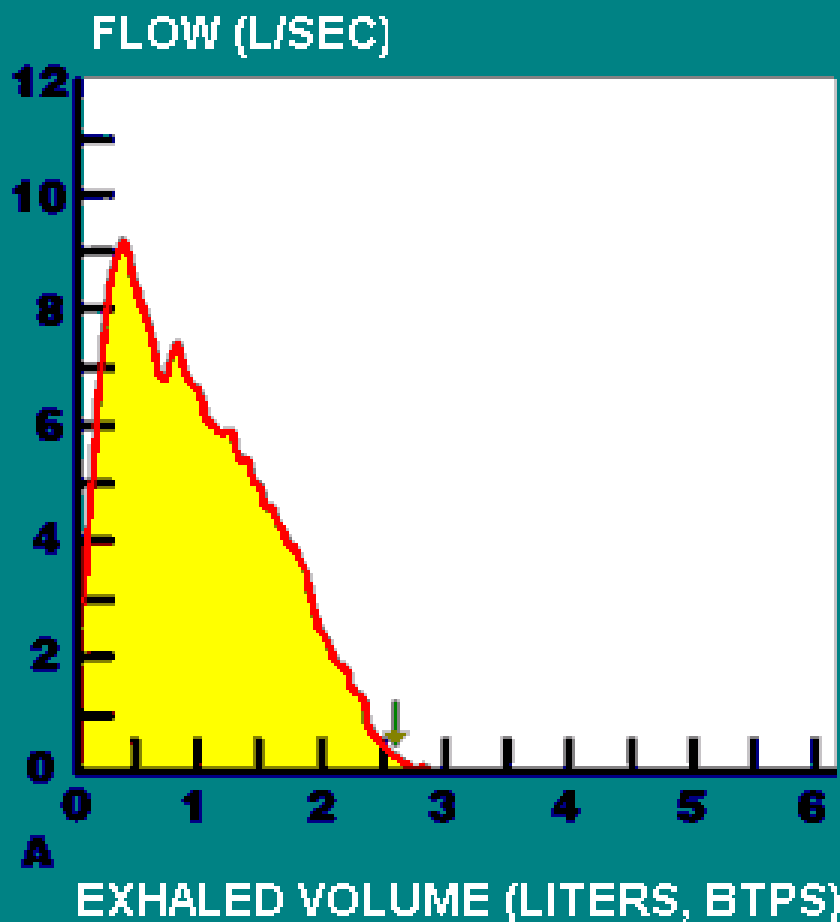
If a post bronchodilator test has been ordered, the results will show up next to the pre bronchodilator results.



	Units	Predicted	Pre Actual	Pre % Pred	Post Actual	Post % Pred.	% Change
FVC	L	5.82	4.19	72 %	3.00	52 %	-29 %
FEV1	L	4.72	1.86	39 %	2.33	49 %	26 %
FEV1/FVC	%	82 %	44 %	54 %	78 %	95 %	34 %
FEF25-75%	L/S	4.66	1.18	25 %	2.14	46 %	81 %
PEF(L/M)	L/Min	642.7	135.8	21 %	326.9	51 %	141 %
PIF	L/S						
Exp. Time	Sec.		3.60		6.18		72 %
MVV	L/Min						
VC	L	5.82					

Spirometry Criteria for Asthma

- Airflow obstruction before therapy
 - $FEV_1 < 80\%$ of predicted
 - FEV1/FVC ratio $< 80\%$, or below lower limit of normal
- Reversibility
 - Improvement of $\geq 12\%$ in FEV_1 and/or ≥ 200 ml after treatment



MODERATE RESTRICTION



Restrictive Disease

- FVC and FEV_1 are decreased proportionally
- Flow-volume curve is truncated without scooping
- $FEV_1/FVC \geq 80\%$

Discussing Spirometry Results with Patients

- Explain how the results will affect the patient's asthma management
 - Importance of trigger avoidance
 - Medication changes, if any
- Explain that spirometry results are not permanent
- Stress that effective asthma management can lead to less severe disease

Interpretation of Tests

- Configuration of flow-volume curve
 - Look at the shape and contour of the loop
- Look at the forced expiratory time (FET)
 - Is it > 4 sec for kids and > 6 sec for adults?
- Relationship between FVC, FEV_1 , $FEV_{25-75\%}$
- Response to inhaled bronchodilators

Viewing Spirometry results in Epic

Results show under *both*:

Chart Review >Procedures tab AND
Results Review >Pulmonary Function section.

Chart Review >Procedures > Spirometry Screening

The screenshot displays the Epic Chart Review interface. On the left is a navigation menu with 'Chart Review' circled in red. The main area has a blue header 'Chart Review' and a toolbar with 'Filters', 'Preview', 'Refresh', 'Select All', and 'Dese'. Below the toolbar are tabs for 'Encounters', 'Lab', 'Imaging', 'Cardiology', and 'Procedures', with 'Procedures' circled in red. The main content area shows '3 records loaded', 'all records loaded', and 'No filters applied'. A table below lists records with columns for 'Date' and 'Procedure'. The first row, dated '01/09/2013', has 'SPIROMETRY SCREENING' circled in red. The second row, dated '01/07/2013', has 'SDC APNEA PROTOCOL'.

Date	Procedure
01/09/2013	SPIROMETRY SCREENING
01/07/2013	SDC APNEA PROTOCOL

Viewing Spirometry results in Epic

Results Review > *Pulmonary Function* > Spirometry > Spirometry screening

The screenshot displays the Epic EMR interface. On the left is a vertical navigation menu with the following items: Care Everywhere, Flowsheets, Results Review (circled in red), Allergies, History, Problem List, Demographics, Letters, Identity Manager, Media Manager, Medications, Synopsis, and Clinical Encounters. The main content area shows a tree view of 'ALL TOPICS' with the following structure: LABORATORY RESULTS (expanded), RADIOLOGY (expanded), and PULMONARY FUNCTION (expanded). Under LABORATORY RESULTS, the following sub-topics are listed: GASES/OXIMETRY, CHEMISTRY, HEMATOLOGY, COAGULATION, CARDIAC MARKERS, LIVER STUDIES, ENDOCRINES - HORMONES, DRUGS OF ABUSE, and BLOOD BANK. Under RADIOLOGY, the following sub-topics are listed: GENERAL RADIOLOGY, RADIOLOGY/ECHO, and ECHO REPORT. Under PULMONARY FUNCTION, the following sub-topics are listed: PREGNANCY LABS, PRENATAL LABS, PREECLAMPSIA LABS, and SPIROMETRY (highlighted in grey). On the right side of the interface, there is a header area with the date '1/9/2013' and the number '1109'. Below this is a table with two rows: 'SPIROMETRY' and 'SPIROMETRY SCREENING'. The 'SPIROMETRY SCREENING' row has a paperclip icon next to it. A blue arrow points from the text 'Click on paper clip to open results page' to this icon.

1/9/2013 1109	
SPIROMETRY	
SPIROMETRY SCREENING	

Click on paper clip to open results page

Viewing Spirometry results in Epic

Results

SPIROMETRY SCREENING (Order

Result Information

Status	Provider Status
Final result (1/10/2013 11:20 AM)	Open

The initial patient effort results are entered by the MA/RN/RT doing the test

Entry Date

1/10/2013

Result Impression

Good pt efforts.Moderate airflow obstruction.
Nguyen, Mien, RT, 1/10/2013 11:20 AM

Results

[Spirometry on 1/10/2013 11:20 AM by Nguyen, Mien, RT : Pre: 4 FVC.](#)

Click here to get to graphs and results chart

Result History

[SPIROMETRY SCREENING on 1/10/13.](#)

Spirometry

Reviewed by List

Optional Midmark Spirometry Instruction sheet

to print this page to take with you- ctrl+p, click current slide, then OK

To view Midmark spirometry results: inpatient chart in Epic:

Click on :

Chart Review > Procedures > Spirometry screening

OR

Results review > Pulmonary Function > Spirometry > Spirometry screening
paperclip

On results page, click on blue link under blue results section.

Click on FVC graphs tab to review loop on graph for reproducibility and acceptability.

Click on Summary tab to review numerical test values.