

SPIROMETRY IMPLEMENTATION QUICK GLANCE GUIDE

Spirometry: A measure of airflow (how fast) and volume (how much)

Forced Vital Capacity (FVC): The volume delivered during an expiration made as forcefully and completely as possible starting from full inspiration.

Forced Expiratory Volume in the first second (FEV₁): The volume delivered in the first second of a FVC maneuver.

Obstruction is defined as FEV₁/FVC ratio below the lower limits of normal. The rule of thumb is if FEV₁/FVC is down 10 or more from the predicted value.

Restriction: Spirometry with a low FVC (less than the LLN) suggests restriction. Further testing is needed to confirm.

Spirometry must establish a solid baseline meeting the American Thoracic Society (ATS) criteria for acceptability and repeatability. Use Global Lung Initiative (GLI-2012) predictive ranges when available. GLI-2012 has a grading system range of A-F, spectrometry tests with grades of A-C are clinically useful.

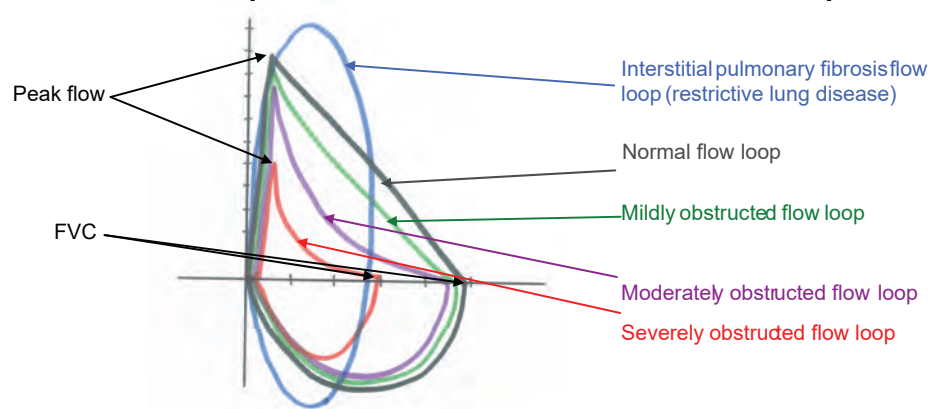
Contraindications of spirometry:

- ✓ Recent surgery
- ✓ Within one month of myocardial infarction
- ✓ Recent pneumothorax
- ✓ Unable to understand directions
- ✓ Inability to seal mouthpiece

Refer to a specialist, if patient:

1. Has **severe** obstruction
2. Shows a **restrictive pattern**
3. Does **not respond to medications**

Examples of obstructed and restricted flow loops

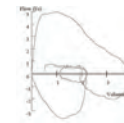


Examples of Unacceptable Spirometry Tests:

Slow start of test



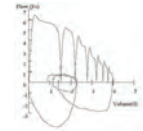
Rounded peak



Early termination



Cough in first second



Repeatability Criteria from ATS: ATS requires three acceptable maneuvers where the difference between the two largest FVC and FEV₁ values must be within 150 ml of each other for patients over 6 years old and 100ml for patients 6 years old and under.

Coaching Patients through Spirometry:

Instruct patient to breathe normally. When the patient is ready, have them take their deepest breath and blow as hard as they can, for as long as they can. There is a learning curve for spirometry. Use positive reinforcement to build on the patient's successes. For example, "that was good. This time, take an even deeper breath." Demonstrating the maneuver can be helpful.

Testing for Bronchodilator Responsiveness (Formerly Reversibility): Give patient 4 puffs of bronchodilator with a valved-holding chamber or a standard nebulized dose. Wait 10-15 minutes after last dose to perform post-bronchodilator maneuver. If the patient cannot perform acceptable baseline maneuvers or there is no evidence of airflow obstruction, do NOT give a bronchodilator.

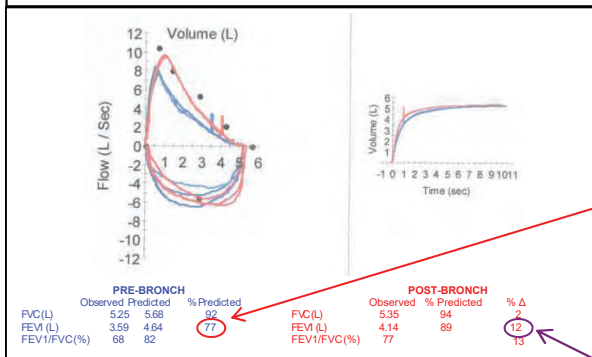
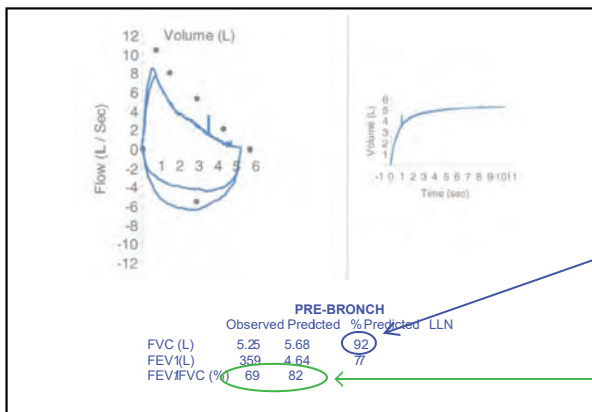
References:

1. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease. Updated 2024. <https://goldcopd.org/2024-gold-report/>
2. National Heart, Lung and Blood Institute National Asthma Education and Prevention Program. Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. Asthma Management Guidelines: Focused Updates 2020. <https://www.nhlbi.nih.gov/health-topics/asthma-management-guidelines-2020-updates>
3. Quanjer, PH, et al. 2012. Multi Ethnic Reference Values for Spirometry for the 3-95 Year Age Range: the global lung function 2012 equations. Eur Respir J 40(6): 1324-1343.
4. Graham BL. 2019. Standardization of Spirometry 2019 Update. An official American Thoracic Society and European Respiratory Society Technical Statement. <https://doi.org/10.1164/rccm.201908-1590ST>

SPIROMETRY INTERPRETATION

ASTHMA

COPD



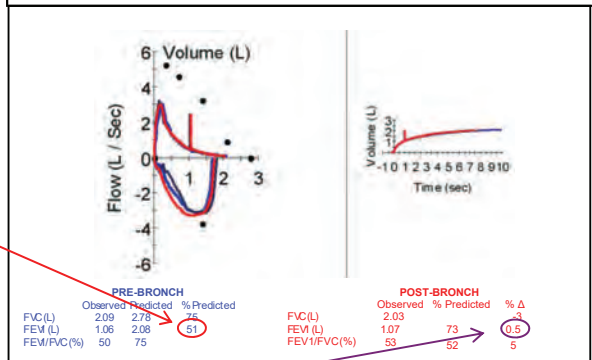
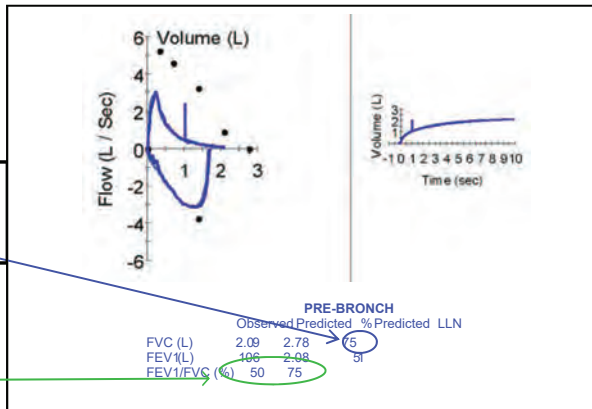
Is this a good test?
Are acceptability and repeatability criteria met?

Check FVC. If greater than the lower limits of normal (LLN), restriction can be ruled out. If less than LLN, further testing is needed to differentiate restriction from obstruction with air-trapping.

What is the observed ratio (FEV1/FVC) compared to predicted?
If below LLN = airflow obstruction
Rule of thumb, down 10 or greater = airflow obstruction

ATS/ERS* Degree of severity of obstruction based on FEV1 % predicted

Degree of severity	FEV1 % predicted
Mild	>70
Moderate	60-69
Moderately severe	50-59
Severe	35-49
Very severe	<35



Consistent with asthma diagnosis?

Bronchodilator response (BDR)?
As of 2022, BDR is defined as $\frac{\text{Actual Post FEV}_1 - \text{Actual Pre FEV}_1}{\text{Predicted FEV}_1} \times 100$
Change of >10% is considered a significant BDR

Airflow obstruction that is not significantly responsive does NOT rule out asthma. To help differentiate COPD from asthma with airflow remodeling/fixated obstruction, further testing is needed; e.g., DL₁CO₁, chest x-ray, or chest CT.

		Asthma Severity			
		Intermittent	Mild	Moderate	Severe
5-11 years		Normal FEV ₁ between exacerbations FEV ₁ > 80% predicted FEV ₁ /FVC > 85%	FEV ₁ > 80% predicted FEV ₁ /FVC > 80%	FEV ₁ = 60-80% predicted FEV ₁ /FVC = 75-80%	FEV ₁ < 60% predicted FEV ₁ /FVC < 75%
	Normal FEV ₁ /FVC: 8-19 yr 85% 20-39 yr 80% 40-59 yr 75% 60-80 yr 70%	Normal FEV ₁ between exacerbations FEV ₁ > 80% predicted FEV ₁ /FVC normal	FEV ₁ > 80% predicted FEV ₁ /FVC normal	FEV ₁ 60-80% predicted FEV ₁ /FVC reduced 5%	FEV ₁ < 60% predicted FEV ₁ /FVC reduced > 5%

COPD Severity			
Stage I: mild	Stage II: moderate	Stage III: severe	Stage IV: very severe
FEV ₁ /FVC < 70% FEV ₁ > 80% predicted	FEV ₁ /FVC < 70% FEV ₁ 50-80% predicted	FEV ₁ /FVC < 70% FEV ₁ 30-50% predicted	FEV ₁ /FVC < 70% FEV ₁ < 30% predicted or FEV ₁ < 50% predicted plus chronic respiratory failure

Sample asthma interpretation: The FEV₁/FVC ratio below the lower limits of normal is consistent with airflow obstruction. The FEV₁ being 77% of predicted suggests a mild airflow obstruction based on the 2005 ATS/ERS guide for severity of obstruction. The post bronchodilator study reveals a significant BDR with a change of 12%. This finding is consistent with a diagnosis of asthma although clinical correlation is needed to confirm. Based on the 2020 Focused Guidelines Update for asthma severity, this 28 year old male with a baseline FEV₁ of 77% of predicted has moderate persistent asthma. Treatment should begin with Step 3 or 4 therapy.

Sample COPD Interpretation: The FEV₁/FVC ratio being below the lower limits of normal is consistent with airflow obstruction. A post bronchodilator FEV₁/FVC ratio below 70% is consistent with COPD. The FEV₁ of 51% of predicted suggests a moderately-severe airflow obstruction based on the 2024 GOLD guidelines for severity of obstruction. There was no significant BDR to albuterol. Further testing revealed a diffusion capacity of 50% of predicted. The lateral chest x-ray showed signs of hyperinflation and flattened diaphragm and the chest CT had classic changes seen in emphysema. Based on GOLD, this 74 year old female has Stage II moderate COPD. Treatment should be based on the CAT score, mMRC score and exacerbation history.