



Spirometry

= a simple diagnostic breathing test which can differentiate many symptoms of breathlessness.

What are the indications for Spirometry?

- **To evaluate respiratory symptoms and signs.**
- **To assess disease severity or response to treatment.**
- **Pre-operative risk assessment.**
- **To screen high risk subjects.**
- **Early detection of disease.**
- **To assess eligibility for some medications.**

Who should not be tested?

- **Acutely ill people or with nausea, vomiting or pain.**
- **People with known or suspected lung infections.**
- **People with pneumothorax or haemoptasis.**
- **People with an AAA or recent thoracic, abdominal or eye surgery.**
- **People who have had a recent MI (<6 weeks ago).**
- **People with uncontrolled hypertension or history of haemorrhagic cerebrovascular event.**



**What does spirometry
measure?**



1. FVC = Forced vital capacity.

The maximal volume of air exhaled using maximal effort following maximal inhalation.



**2. FEV1 = Forced expiratory volume
in 1 second.**

**The volume of air forcefully exhaled
in the first second.**

3. FEV₁/FVC ratio (FEV₁%)

= % of volume exhaled in the first second.

Normal subjects can forcibly exhale 80 % of a maximal breath in the first second.

**4. PEF = Peak expiratory flow
(L/sec or L/min).**

**The fastest part of the forced
exhalation in the first 10
milliseconds.**



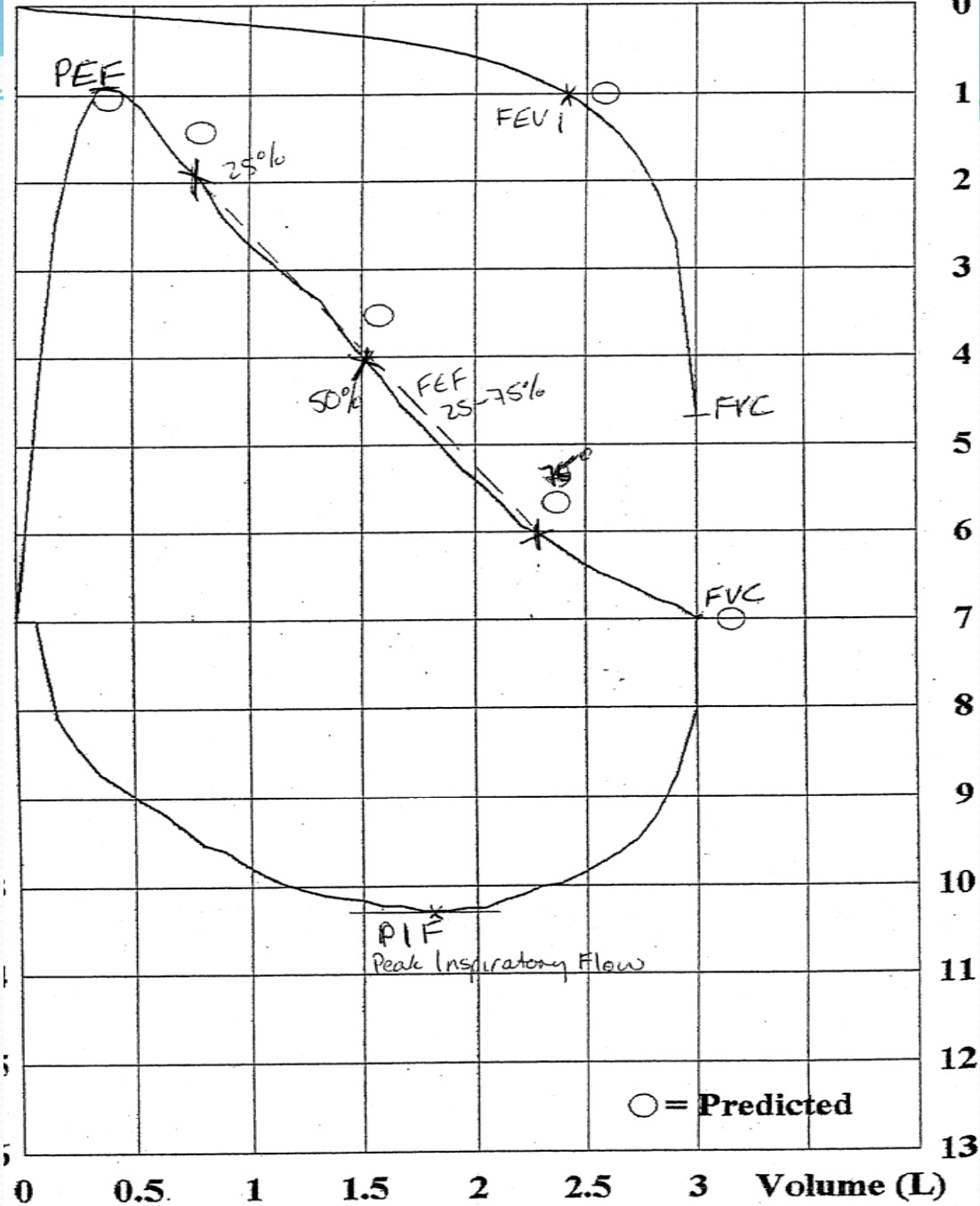
5. VC or SVC =

The amount of air that can be exhaled slowly after a maximal inhalation.



6. FEF 25 – 75%.

**= Forced expiratory flow between 25%
and 75% of the lung volume.**



How are normal values established?

Normal values depend on:

- Height.
- Age.
- Gender.
- Ethnicity.

Values within 15% of predicted are considered normal.

What are the criteria for an acceptable test?


- Satisfactory effort.
- No artifact e.g. cough .
- Minimum of 6 seconds exhalation.
- At least three acceptable maneuvers.
- Largest FVC should be within 100ml of the next.
- Largest FEV1 should be within 100ml of the next.

Common Problems

- **Not blowing hard enough.**
- **Leaks between lips and mouthpiece.**
- **Didn't take a complete breath in.**
- **Hesitation before blowing out.**
- **Cough.**
- **Glottic closure.**
- **Obstruction of the mouthpiece by the tongue.**
- **Vocalisation during the test.**
- **Poor posture.**

How do you do it?

- **Patient sitting upright in a chair with feet flat on the ground, arms uncrossed.**
- **Well ventilated room.**
- **New filter or mouthpiece.**
- **Tester to the side of the patient.**

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- **SVC first – rapid flow through airways may cause bronchospasm.**
 - **Let the subject try the mouthpiece first.**
 - **Explain the test clearly in simple terms – it is to test how much air you have in your lungs and how fast you can blow it out.**
 - **Always be positive, i.e. ‘testing how good your lungs are’.**
 - **Lead the subject through the test.**

Slow Vital Capacity

Measures how much air you can blow out of your lungs.

Keep instructions short and direct:


- **Take a big breath in.**
- **Put the mouthpiece in your mouth.**
- **Blow out steadily.**
- **Keep going.**
- **Keep going.**
- **Keep going.**

Keep urging patient until you are satisfied there is no more flow.

Forced Vital Capacity

Measures how fast you can move air through your lungs.

- **Take a big breath in.**
- **Put the tube in your mouth.**
- **BLOW out as FAST as you can.**
- **Keep going.**
- **Keep going.**
- **Keep going. (Try for at least 6 seconds)**

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- **Repeat each test at least three times until you have three reproducible results.**
 - **Ensure the subject has performed the test to the best of their physical ability.**
 - **Remember – they will blow as hard as you tell them to, so encourage them to do the best possible test.**



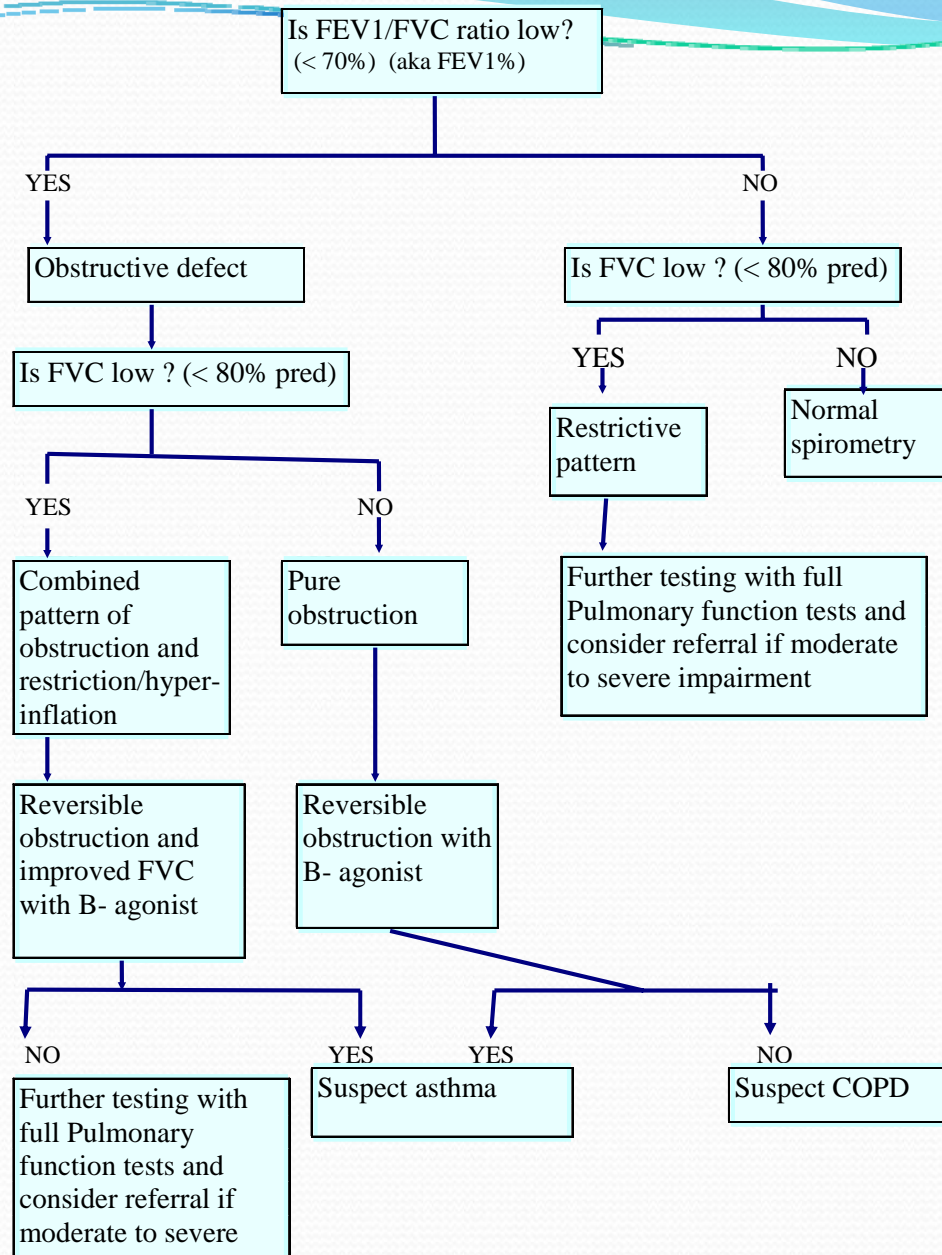
Bronchodilator response should be measured through post- bronchodilator tests.

Under instruction from a doctor, give 2 puffs of a rapid acting bronchodilator, through a spacer, 1 puff at a time, with a minute wait between puffs.

**Wait 10 – 15 minutes For salbutamol,
30 minutes for ipratropium.**

Repeat FVC tests.

Diagnostic flow diagram



DIAGNOSIS

Normal lung function:

- **Subject's volumes and flow rates will be within 15% of the predicted values for people of their age, gender, ethnicity and height.**

Obstructive Airways disease

- **Affects the lumen of the airways.**
- **Early presentation usually with normal volumes with reduced flow rates and reduced FEV1.**
- **Volumes may be lower in later presentation as RV increases.**



Can be due to:

- **Excess mucus production.**
- **Inflammation.**
- **Bronchospasm.**
- **Bronchoconstriction.**
- **Airways collapse.**

Severity of Obstruction

FEV1:

Mild..... 60 – 80% of predicted.

Moderate...40 - 60% of predicted.

Severe.....<40 % of predicted.

Restrictive Airways disease

- **Affects the lung tissue or the capacity of the lungs to expand and hold predicted volumes of air.**
- **Presents as reduced volumes and normal flow rates.**



Can be due to:

- **Fibrosis.**
- **Scarring.**
- **Physical deformity.**
- **Some connective tissue diseases.**
- **Lobectomy.**

Severity of restriction

FVC:

Mild.....65 - 80% predicted.

Moderate.....50 - 65% predicted.

Severe.....< 50% predicted.

Combined Ventilatory Disorder

- Exhibits features of both an obstructive and a restrictive disorder.
- Example Cystic fibrosis causes both excess mucus production and damage to lung tissue.



Significant inhaled bronchodilator response

FEV₁...12% and/or 200 ml increase.

FVC.....12% and/or 200 ml increase.



Peak Flow vs Spirometry

PEF is useful in asthma where there is a good correlation between FEV1 and PEF.

In COPD airways collapse is variable and PEF is not sensitive enough to detect small treatment changes.

Infection Control

- **Filters are recommended to prevent cross infection.**
- **If this is not practicable, then a NEW disposable mouthpiece must be used for each patient.**
- **If a filter is not used, any part of the equipment the patient breathes through must be cleaned between patients.**



Quality Control

Quality control checks should be carried out regularly to ensure the equipment is functioning correctly.

One of the simplest effective ways to do this is by “biological control”.

Biological control

Each person using the equipment must be familiar with their own readings:

- **Perform 10 tests on themselves.**
- **Take the average of the FEV1 and the average VC.**
- **Work out the standard deviation.**
- **Multiply by 2.**
- **Subtract this from the average – this is the minimum.**
- **Add the same number to the average – this is the maximum.**

Biological control

- **Each day, perform spirometry on yourself.**
- **Your result should be between the two values.**
- **If it is not, there may be a problem with the accuracy of the spirometer, contact your supplier.**

Quality Control

- **Your spirometer should have its calibration checked at least annually.**
- **Some drug companies offer this service.**
- **Contact your local Respiratory Department or Biomedical Department and ask if they can help.**

Quality Assurance

- **Make sure your quality control procedures are carried out regularly.**
- **Make sure you keep records of your quality control.**