Spirometry is a method for measuring the speed and volume of airflow and is seen as the “gold standard” of testing lung function (Levy et al, 2009). This article is the first in a two-part series. It describes the definitions of lung function measurements, how to perform spirometry testing, which patients are suitable for the test, and which type of spirometer to use.

Patient selection
The most common reason for undertaking spirometry is to help diagnose COPD, asthma and pulmonary fibrosis. It is also used to assess disease progression in these conditions, as well as in cystic fibrosis and bronchiectasis. Spirometry testing should be used for patients presenting with undiagnosed respiratory symptoms, such as dyspnoea, wheeze and cough. It should also be used for those with suspected COPD, a smoking history and: chronic cough; breathlessness on exertion; daily wheezing; or a history of winter chest infections.

Spirometry should also be used to monitor patients who have COPD, asthma or other chronic respiratory conditions (Levy et al, 2009). Patients with the following conditions are not suitable for spirometry testing:
- Known or suspected respiratory infection;
- Haemoptysis of unknown origin;
- Pneumothorax;
- Myocardial infarction in the previous month;
- Uncontrolled hypertension or pulmonary embolism;
- History of haemorrhagic cerebrovascular event;
- Recent thoracic, abdominal or eye surgery;
- Nausea, vomiting or pain;
- Confusion or dementia;
- Recent middle-ear infection.

Patients with these conditions may be tested using spirometry if a health review shows it is appropriate, but only after discussion with a clinician who is experienced in spirometry (Levy et al, 2009).

How to perform spirometry
Before performing spirometry, the patient’s condition should be stable and patients must sit for spirometry testing. They should not have had a chest infection for at least six weeks. Features of the spirometer are outlined in Box 1.

Preparing the patient
Before a spirometry test, patients should be advised to avoid smoking, alcohol, strenuous exercise or a heavy meal. They should wear loose-fitting clothing, ensure they arrive in good time for the test, and have not had a chest infection for at least six weeks. Features of the spirometer are outlined in Box 1.

Keywords:
Spirometry/Lung function/
COPD/asthma

In this article...
- How to decide if a patient is suitable for spirometry testing
- Definitions of lung function measurements
- How to perform a spirometry test and which device to use

5 key points
1. Spirometry testing is most commonly used to help diagnose COPD, asthma and pulmonary fibrosis.
2. Spirometry testing should be used for patients with undiagnosed respiratory symptoms and for those with a history of smoking and suspected COPD.
3. Spirometry testing is contraindicated in some conditions.
4. Before a test, patients should avoid smoking, alcohol, strenuous exercise or a heavy meal.
5. Good technique is essential to ensure optimal results.

The mean flow between FEF25 and FEF75 is often the first parameter to decline in respiratory disease.
BOX 2. LUNG FUNCTION MEASUREMENTS RECORDED WITH A SPIROMETER

- FVC: The volume of air, measured in litres that can be forcibly expelled from the lungs following maximal inspiration. Patients should aim for an expiration lasting a minimum of six seconds.
- FEV₁: This is the speed of air forcibly expelled from the lungs in the first second from maximal inspiration.
- FEV₁/FVC ratio (FEV₁%): The percentage of the FVC expired in the first second of maximal forced expiration following full inspiration.

The practitioner should explain the forced expiratory manoeuvre. This involves:
- Inhaling as deeply as possible;
- Sealing the lips around the mouth-piece;
- Blowing out as hard and fast as possible until all the air has been expelled from the lungs.

Performing spirometry

Measurements recorded using a spirometer are outlined in Box 2.

Before performing the test, the practitioner should:
- Prepare the spirometer according to manufacturer’s instructions;
- Ensure the patient is sitting upright. This is recommended for optimal lung expansion;
- Use nose clips or ask the patient to pinch their nose if relaxed vital capacity is recorded. If a relaxed manoeuvre is being undertaken, the test should be performed first. This involves inhaling deeply and breathing out gently to full expiration. This measurement is usually only performed for those patients with conditions that cause severe obstruction. (See part 2 for interpretation of results.)

During all spirometry testing, the practitioner should encourage the patient to keep blowing for at least six seconds during expiration. They should also observe the patient to check for inadequate inspiration or expiration.

The procedure should be carried out three times for all measurements to give three consistent volume–time curves. The best two curves should be within 100ml or 5% of each other (Fig 1).

Poor readings due to technique error can occur; these are outlined in Box 3.

The results of lung function measurements are presented as a volume/time graph, or spirogram (Fig 2), a flow/volume graph (Fig 3), or flow volume loop (Fig 4) (Miller et al, 2005).

Reversibility testing

Post-bronchodilator spirometry should be measured to confirm a diagnosis of COPD and help differentiate between asthma and COPD.

The patient’s condition should be stable before carrying out bronchodilator reversibility testing, and the patient should stop short-acting bronchodilators six hours before the test. Long-acting bronchodilators should be stopped 12 hours before testing, and theophylline stopped 24 hours before (The Scottish Intercollegiate Guidelines Network/British Thoracic Society, 2009). A baseline spirometry test is then performed before a bronchodilator is administered. This is usually 400mcg salbutamol delivered by a metered dose inhaler and spacer device (Pearce, 2011). The spirometry test is then repeated after 15 minutes and the difference calculated using the reversibility formula (Box 4).

Further assessment can be carried out using steroid reversibility testing. According to the National Institute for Health and Clinical Excellence (2010), this involves performing a baseline spirometry test, administering a two-week course of 30–40mg of daily prednisolone, repeating the spirometry test and calculating the difference using the reversibility formula.

Training

Misleading results from poorly performed spirometry can lead to inappropriate diagnosis and treatment. The practitioner should attend a recognised training programme, followed by a period of supervision while administering spirometry; regular quality audits of performance should also be carried out (NICE, 2010).

Respiratory training organisations provide spirometry courses and most COPD training courses include spirometry education. Spirometry manufacturers provide training for using their equipment.

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% change (>20% positive)

Post FEV₁ - pre FEV₁ x 100 = % change

preFEV₁

ml change (>400ml is positive)

Post FEV₁ - pre FEV₁ x 1000 = ml change

References


