

Peak Expiratory Flow

The peak flow meter is a home-use device for people with asthma and is not adequate for routine asthma management by doctors.^{16 <LE IV>} *It is used to detect and measure any variation from a person's predetermined best peak flow and so indicate the presence and degree of airflow obstruction as an aid to self-management.*¹⁷

What is Peak Expiratory Flow (PEF)?

This is a measure of maximum expiratory flow occurring just after the start of a forced expiration from the point of maximum inspiration (total lung capacity). PEF is used to provide a measure of airway calibre or airflow. However, it is dependent not only on airway calibre, but on lung elastic recoil, patient effort and patient cooperation.

What are the limitations of PEF?

PEF has a significantly larger degree of variability than the gold standard for the measurement of airway calibre – FEV₁.^{18 <LE IV>} There is also a fairly wide normal range and PEF measurements do not necessarily parallel those of FEV₁. It is important to consider PEF data in conjunction with the patient's asthma symptoms. The readings are effort dependent and it is important that the user appreciates the need for maximal effort.

You should be aware that there can be a great degree of variability from meter to meter, even within the same brand. If peak flow is performed routinely, the same meter should be used.

When is PEF useful?

Many patients will not comply with a request to continuously monitor their PEF, but it can be useful in the management of some patients.

Short-term monitoring is useful following a recent diagnosis of asthma, a change in asthma treatment, or discharge from hospital. PEF readings may be recorded for 2-3 weeks when the patient is asymptomatic to:

- determine their personal best reading (for reference during acute exacerbations);
- examine their peak flow variability – a pre-bronchodilator day-to-day PEF variability greater than 15% suggests that the maintenance treatment is suboptimal and that medical review is advisable;
- assist with asthma management in patients who are poor perceivers of their asthma severity; and
- allow parents to assess the severity of their child's asthma.

PEF can be very useful in diagnosing **occupational asthma**, as you may not be able to demonstrate variability of airflow in the surgery.

PEF may be useful in some adults and children with **acute asthma**. If the personal best PEF is considered to be 100% lung function for that patient, the PEF during acute asthma may provide a useful measure in addition to the patient's clinical symptoms. This is particularly useful in patients who are poor perceivers of their asthma symptoms (see below).

A **written Asthma Action Plan** for your patients may be symptom based and/or PEF based. However, **peak flow measurements are not reliable for children under 6-7 years**. During acute attacks older children may not produce reliable measurements. In young people more attention should be given to asthma symptoms. Older patients may also have difficulty producing reliable measurements and often deliver very low peak flow.

Long-term regular PEF monitoring should be considered in persistent poor perceivers.^{19 <LE ID>}

Practical tips

How often is PEF measurement necessary?

In most situations a morning PEF measurement before bronchodilator is an adequate test and guide. If using PEF to validate patients' symptoms, or confirm a diagnosis of occupational asthma, more frequent measurements are required.

How can I identify poor perceivers?

These are patients who accept their chronic asthma symptoms as the norm, or do not recognise that they have symptoms. They live with undertreated asthma. This leads to poor quality of life and puts them at risk of severe attacks.

Check patients to see that they are aware of symptom improvement correlated with a bronchodilator response measured either during formal lung function tests or PEF monitoring. Encourage regular, long-term self-monitoring in patients who fail to recognise symptom improvement with a 15% increase in FEV₁.

How can I encourage PEF measurement in appropriate patients?

- Show your patients how to use a peak flow meter and chart their PEF. (Be wary of common techniques to obtain a higher result, such as bending over to blow into the meter or inserting the tongue into the mouthpiece.)
- Ask your patients to bring their own PEF meter to each consultation – this will ensure that home tests and tests taken in the surgery have comparable results. Check the chart at each visit.
- Discuss the benefits of PEF monitoring with your patients. Only ask the patient to continue if there is benefit – in all but poor perceivers, explain that the monitoring period will be short-term, but can be episodic to provide you with information at reviews.

Levels of evidence

- I** Evidence obtained from a systematic review of all relevant randomised controlled trials
- II** Evidence obtained from at least one properly designed randomised controlled trial
- III-1** Evidence obtained from well-designed pseudo-randomised controlled trials (alternate allocation or some other method)
- III-2** Evidence obtained from comparative studies with concurrent controls and allocation not randomised (cohort studies), case-control studies, or interrupted time series with a control group
- III-3** Evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group
- IV** Evidence obtained from case series, either post-test or pre-test and post-test

These levels of evidence ratings have been adapted from US Preventive Services Task Force (1989) Guide to clinical preventive services: an assessment of the effectiveness of 169 interventions (ed M Fisher), Williams and Williams, Baltimore, Appendix A, p 388.

Source: NHMRC

A guide to the development, implementation and evaluation of clinical practice guidelines.

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Further information

The information in this paper is based on and reflects the information contained in the National *Asthma Council's Asthma Management Handbook 2002* and *Spirometry: The Measurement and Interpretation of Ventilatory Function in Clinical Practice*. Readers are recommended to consult these publications for further details on lung function testing in adults and children, including respiratory function tables.

National Asthma Council

The National Asthma Council website contains information and publications on asthma and has links to other asthma sites www.NationalAsthma.org.au

Asthma Foundations of Australia

For further information on asthma and patient materials, contact your local Asthma Foundation on **1800 645 130**, or visit their websites:

www.asthma.org.au www.asthmansw.org.au
www.asthmasa.org.au www.asthmawa.org.au
www.asthmatas.org.au www.asthmant.org.au
www.asthmaqld.org.au www.asthmaaustralia.org.au

Asthma www.health.gov.au/pq/asthma

HealthInsite www.healthinsite.gov.au

Australasian Society for Clinical Immunology and Allergy www.allergy.org.au

This series on Asthma Topics for Health Professionals comprises eight separate titles:

- Asthma and Allergy
- Asthma and Lung Function Tests**
- Asthma and Pain Relievers
- Asthma and Air Pollution
- Asthma and Complementary Therapies
- Asthma and Infant Bedding
- Asthma and Diet in Early Childhood
- Asthma and Wheezing in the First Years of Life

To access these documents log on to:

www.NationalAsthma.org.au or contact the Department of Health and Ageing on **1800 500 053**.

Asthma and Lung Function Tests

An information paper for health professionals

This publication is dedicated to the memory of Professor Ann Woolcock AO

The aim of this paper is to provide an up-to-date, evidence-based summary of the issues around lung function testing in asthma, including practical advice. A consumer brochure on this topic has also been developed. Both documents have been produced by the Australian Government Department of Health and Ageing in collaboration with the National Asthma Council.

Authors

Prof Richard Ruffin, Head of Medicine, The Queen Elizabeth Hospital, Adelaide University, SA

A/Prof John Wilson, Head of Cystic Fibrosis Unit, The Alfred Hospital, VIC

A/Prof Nick Freezer, Director of Respiratory Medicine, Monash Medical Centre, VIC

Dr Chris Brown, General Practitioner, QLD

Mr Marcus Weidinger, Consultant Pharmacist, WA

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Disclaimer

The information contained in this paper has been expert reviewed and represents the available published literature at the time of review. It is not intended to replace professional medical advice. Any questions regarding a medical diagnosis or treatment should be referred to a medical practitioner.



Spirometry

A spirometer is a device used to measure timed expired volumes, and from these it is possible to calculate how effectively and how quickly the lungs can be emptied. Two important measurements that are made are vital capacity (VC) and forced expired volume in one second (FEV₁). VC is the maximum volume of air that can be exhaled during either a forced (FVC) or a slow (VC) manoeuvre. FEV₁ is the volume expired in the first second of maximal expiration after a maximal inspiration and is one measure of airway calibre.¹

Why do spirometry?

Spirometry is used in medical practice to measure the degree of airflow obstruction compared to predicted normal. Accurate measurement of respiratory function is necessary to assess and manage asthma. Successive measurements before and after bronchodilator use allow you to:

- diagnose airflow obstruction;
- measure the degree of airflow obstruction and its variability;
- demonstrate the presence and reversibility of airflow obstruction to the patient;
- provide objective feedback to the patient about the presence and severity of asthma;
- determine if the patient can perceive or sense a change in airflow obstruction;
- monitor the effects of treatment; and
- accurately back-titrate preventive medication to determine the minimum effective dose.²

The diagnosis of asthma is confirmed by demonstrating the presence of variable airflow obstruction.

Spirometry is the method of choice, as the measurement of peak expiratory flow (PEF) with conventional peak flow meters has significant limitations.^{3, 4, <LE IV> 5 <LE IV>}

Most adults, and children over 7 years of age can perform spirometry.³

Best practice guidelines recommend that all doctors managing asthma should have access to and use a spirometer to assess, diagnose and monitor airway disease.

How useful is spirometry in the management of asthma? Current evidence.

There appear to be no published studies conducted specifically to examine the outcomes of measuring spirometry in patients with asthma. However, in a study of patients with acute asthma in an Emergency Department, physicians were found to underestimate the degree of airflow limitation based purely on clinical examination and subsequent knowledge of spirometry results directly altered management in 20.4% of patients.^{6 <LE IV>} In asthma, there are often large disparities between symptoms, measurement of spirometry and PEF variability. Therefore it is important to measure spirometric function in these patients.^{7 <LE IV>}

Modified from: King, Gregory and Johns, David P. The use of spirometry in the management of asthma. A paper prepared for the Australian Government Department of Health and Ageing's General Practice Spirometry Sub-group, October 2002.

How do I get the best results?

Explain clearly what the test involves and demonstrate the correct technique to the patient. It is important to ensure a good seal around the mouthpiece, and ensure that the patient's posture is correct, i.e. they are seated upright. Explain that maximum inspiration, followed by maximum forced expiration until no more can be exhaled (or for at least 6 seconds if possible, but in children 3 seconds is usually sufficient) is required.³

Expiration must be rapid and complete with maximum effort maintained during expiration. Repeat three times to ensure the best result is obtained, with a minute's rest between. The aim is to obtain three reproducible (FVC within 200 ml) and acceptable (good start, maintenance of forced expiration, no cough) measurements. The best FEV₁ and FVC result from any of these curves is recorded. No more than eight attempts should be undertaken as more are unlikely to be successful due to patient fatigue.³

Repeat spirometry about 10 minutes after giving a bronchodilator via a large volume spacer. A spacer is more efficient than a metered dose inhaler and it gives you the opportunity to explain the use and benefits of a spacer.^{3, 8, <LE III-2> 9 <LE III-2>}

An increase in FEV₁ of at least 200 ml and 15% is significant. Values should be expressed as absolute figures and also as a percentage of predicted based on the patient's age, height, weight and sex.³

The absence of reversible airflow obstruction does not exclude the diagnosis of asthma. Repeated measurements, perhaps combined with home measurement of PEF, are sometimes necessary to document the presence of asthma.³

Practical tips

How often is it necessary?

Patients with moderate asthma should be seen at least twice a year.^{10 <LE D>} Their FEV₁ should be measured during every review appointment. Spirometry gives you an objective measure of a patient's lung function and may identify a decline in asthma control before symptoms develop.^{11 <LE IV>, 12 <LE IV>} This is particularly useful when the dose of asthma medication is being back-titrated. Patients with severe asthma need to be seen more frequently.^{10 <LE D>}

How can I do it cost-effectively, and within a normal consultation?

As soon as you become aware in a consultation that the visit concerns asthma and that spirometry is appropriate, the pre-bronchodilator spirometry can be done even before finishing the history. Give the bronchodilator, and use this opportunity to check technique. After completing history-taking, examination and beginning to outline a management plan, enough time should have elapsed for a post-bronchodilator spirometry to be done. The consultation time is not unduly extended.¹³

The time between pre- and post-bronchodilator tests can be used to complete the written Asthma Action Plan, or to provide other asthma education in a longer consultation. Salbutamol works very quickly and valid results are obtained if the interval is about 10 minutes.¹³

Other suggestions:

- Do the pre-bronchodilator spirometry, history and exam, send the patient out, get the next patient in and when finished with that patient, get the first patient back in. Do the post-bronchodilator spirometry and then consider the management plan for the patient.
- Get your practice nurse to do the spirometry, then do the consultation following this.
- Send the patient to your local respiratory lab or pathology service for testing prior to your consultation. A respiratory laboratory will accurately calibrate their equipment each day and will also interpret the results for you.
- Send the patient away and get them to return specifically for spirometry.
- See if the local hospital physiotherapy department or asthma educators are prepared to perform spirometry on request.¹³

There is a rebate for pre- and post-bronchodilator spirometry: MBS Item No. 11506. The results should be documented in the patient's medical record and it is also helpful to attach the print-out.

I'm not confident with interpretation – is there an easy way?

A full guide is available in *Spirometry: The Measurement and Interpretation of Respiratory Function in Clinical Practice* (Pierce & Johns, National Asthma Campaign, 1995). The interpretation table on p. 22 (see Figure 1 below) makes it simple. The publication can be downloaded from the NAC website: www.NationalAsthma.org.au

A respiratory laboratory can also perform the test accurately and interpret the results for you.

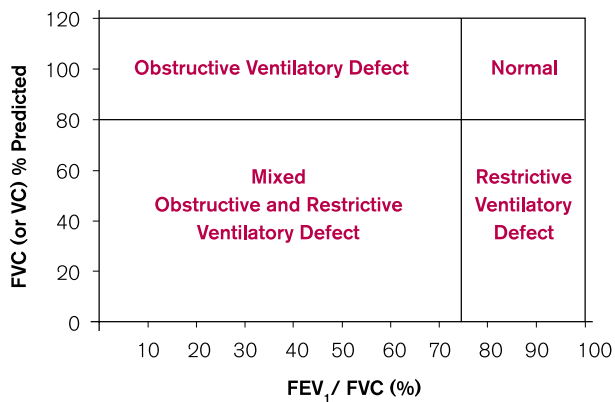


Figure 1 Interpretation of spirometry as a function of VC (or FVC) as predicted and the FEV₁/FVC% ratio. The vertical line represents the patients' predicted FEV₁/FVC% (varies with age and sex) and the horizontal line is an estimate of the lower limit of normal for VC or FVC.¹

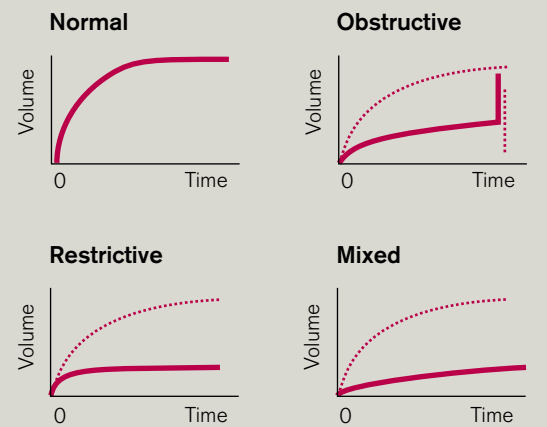
What should I look for when choosing a spirometer?

There are now spirometers to fit every practice and pocket, from small, hand-held computerised models to full-size, traditional bellows spirometers. All reputable brands give good results.

- Ensure that the spirometer provides a graphic display and is calibrated at regular intervals. Your local hospital's respiratory laboratory may assist you with calibration.
- Infection control is also very important. Disposable mouthpieces are recommended.
- A list of suppliers can be found in the spirometry publication detailed above.

You would not consider managing hypertension without a sphygmomanometer, or diabetes without a glucometer – accurate and objective assessment and management of asthma is not possible without a spirometer.^{3,12,14 <LE IV>}

Normal and abnormal spirometry: A guide



Guidelines for infection control

Cleaning

Before sterilisation or disinfection **all equipment must be thoroughly cleaned.** The manufacturers' recommendation for cleaning specific equipment must be adhered to at all times.¹⁵

Semi-critical items

It is recommended that disposable mouthpieces are used where ever possible. Where not possible, an alcohol solution should be used on the mouthpiece. This should be a 70% solution of ethyl or isopropyl alcohol in which the items are fully immersed for twenty minutes.¹⁵

Non-critical items

The literature states that tubes are seldom contaminated with pathogens and there is no evidence that any organisms re-emerge at the mouthpiece or have been involved in infection transmission. It is recommended that tubing be cleaned daily to remove particulate matter and moisture. Other items or equipment coming in contact with intact skin require cleaning between patients. It is important to rinse the equipment with tap water, to remove all traces of detergent and disinfectant, and air dry as soon as possible after rinsing.¹⁵