

Spirometry Guide Book

The following extracts are from the *Pocket Guide to Spirometry* – David Johns.

1. CALIBRATION AND QUALITY CONTROL

Accurate and reliable spirometry requires an ongoing program of preventative maintenance that includes regular cleaning and calibration (or validation) checks to ensure that the machine is operating correctly and consistently providing clinically useful results. Most electronic spirometers incorporate a specific calibration subroutine as part of the software, whereas volume-displacement spirometers often require the calibration to be done manually. All diagnostic spirometers must be capable of calibrated or having their calibration checked, and this should be done regularly. Be wary of claims by some manufacturers that their spirometer does not require calibration. Some models, however, have been shown to maintain their accuracy over the extended periods of heavy clinical use.

3 litre calibration syringe

From a practical point of view, the accuracy of a spirometer is checked using a certified 3 litre calibration syringe and the procedure is normally carried out via calibration subroutine. When the 3 litres is puffed into the spirometer is accurate if the recorded volume is between 2.895 and 3.105 litres ATPS.

Flow spirometers should also be checked weekly for linearity over the physiological range of flows (ideally 0-14L/s). A good test of linearity (and accuracy) is to deliver the 3 litres several times at different rates to cover a wide range of flows. If the spirometer is linear, the volume recorded by the spirometer will remain between 2.895 and 3.105 litres over the flow range (see Figure 3.2)

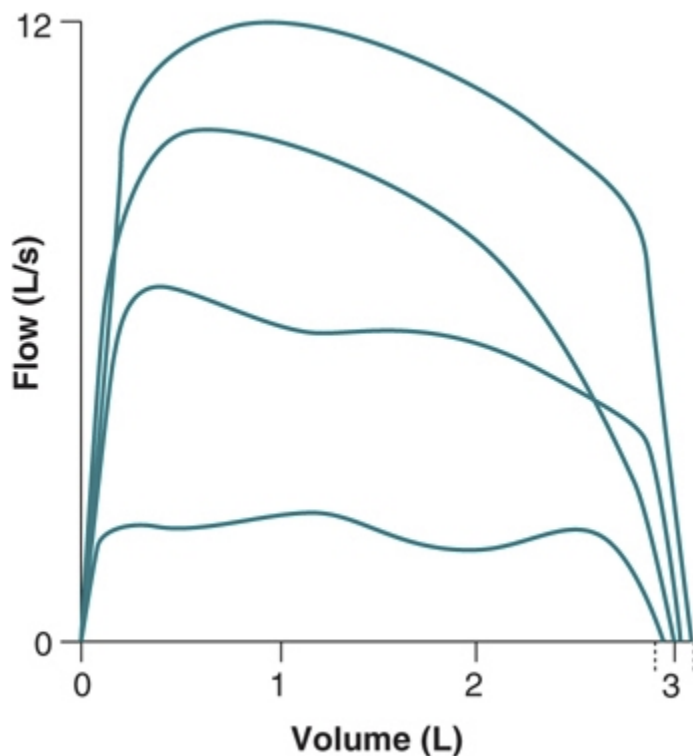


Figure 3.2 Checking the accuracy and linearity of the flow spirometer requires a 3 litre syringe to be emptied at several speeds. In this example, the spirometer is accurate over a wide flow range limits of 2.895 and 3.105 litres (indicated by the dotted lines) however, if the volume recorded falls outside these

limits then the spirometer is inaccurate and may be non-linear. Records of calibration checks, quality control and service history should be recorded in a logbook and kept with the equipment. It is important to remember that, as with any mechanical device, a calibration syringe should be checked for correct performance and accuracy periodically. Leaks can be checked easily but the accuracy of the syringe needs to be checked by the supplier or manufacturer.

Volume-displacement spirometers should be checked for volume linearity every 3 months by consecutive injections of 1-litre increments from a calibration syringe.

Leaks and timing accuracy

Volume-displacement spirometers should be checked daily for leaks by filling the spirometer and applying a weight to the spirometer bell (or by applying a constant pressure ≥ 3 cmH₂O or 0.3 kPa) with breathing hoses attached and plugged and observing any volume change. In practice, a volume change of less than 0.03 litres over a 60-second period is acceptable. If a kymograph is fitted, the *paper speed* should also be checked with a stopwatch every 3 months or immediately when an error is suspected. An error in accuracy of within 2% is acceptable.

Frequency

The frequency of performing checks will vary with the clinical setting (e.g. how often it is used) and the type of spirometer, and the need to adjust the calibration will depend on whether its accuracy is within acceptable limits. Table 3.1 provides the frequency of performing these checks as recommended by the ATS/ERS. Some spirometers are more stable than others. For example, in the absence of leak, volume-displacement spirometers such as the rolling seal usually maintain their accuracy for extended periods and the frequency of calibration may be weekly with daily checks for leaks/ However, flow spirometers generally require daily or twice-daily calibration checks. There are possible exceptions, for example, a popular ultrasonic spirometer has been shown to maintain accuracy over the extended periods of heavy clinical use (Walters et al. 2006; Skloot, Edwards & Enright 2019). All spirometers must be recalibrated (or their calibrations verified) after cleaning or disinfections, or if an unusual or unexpected result indicates a problem.

Table 3.1		Frequency of quality control
Test	Frequency	
Volume	Daily	
Leak	Daily	
Volume linearity	Every 3 months	
Flow linearity	Weekly	
Time	Every 3 months	

Source: Miller et al. (2005b).

Biological controls

In order to detect changes in overall spirometer performance, the ventilator function of one or more subjects with stable respiratory function should be measured and recorded regularly as part of an ongoing quality control program. In surgery, testing yourself (if you have stable lung function) on your spirometer every week is a practical way of monitoring quality control. Generally, a variation of more than 5% in FEV1 or FVC should alert you to a problem and the need to have your instrument properly

checked and serviced. A practical approach is to measure the spirometry of the subject 10 times over a period of two to three weeks. From the results, calculate the mean and standard deviation for both FEV₁ and FVC. From these calculate the 95% confidence interval (mean \pm 1.96 standard deviation). Any value for FEV₁ or FVC that subsequently falls outside these limits should alert you to the possibility that the spirometer has become inaccurate. The easiest way to handle serial data of this type is to plot it as Levy-Jennings diagram, as shown in Figure 3.3. Remember that testing a normal subject does not negate the need to calibrate (or to check the calibration of) the instrument regularly using a certified 3 litre syringe.

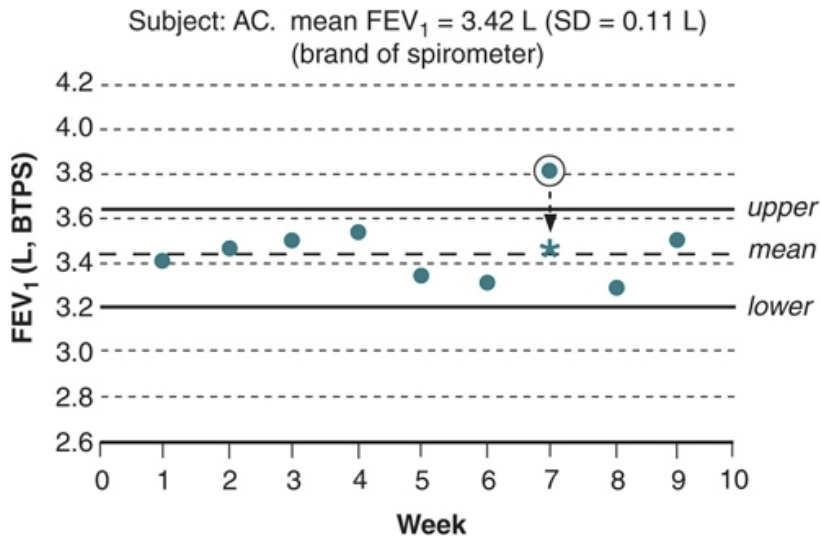


Figure 3.3 Plotting serial results from a normal control subject allows ‘out of control’ values to be identified easily. The upper and lower limits were calculated from the mean \pm 1.96 x standard deviation (see text). Here the FEV₁ at week 7 is outside the expected range and alerts you to a potential problem. In this example, recalibration of the spirometer with a 3 litre syringe brings the FEV₁ back into the acceptable range (asterisk)

BTPS correction

It should be noted that if the accuracy of the spirometer is checked with a 3 litre syringe while the spirometer is in ‘patient’ rather than ‘calibration’ mode (if available), the volume recorded will usually be higher than the expected accuracy range of 2.895 to 3.105 litres. This is because in the patient-testing mode the spirometer will apply the BTPS correction factor (and possibly other factors, for example, correction for gas viscosity). For a computerised volume-displacement spirometer, the recorded volume will be about 3.3 litres if the room temperature is 20°C.

When a volume-displacement spirometer is moved into a cooler or hotter environment, it is important to allow time for it to reach the new temperature and to measure it, otherwise the BTPS correction factor (see Appendix B) will be incorrect. Similarly, the calibration syringe needs to be at the same temperature as the spirometer and for this reason it is usually stored with the spirometer.

Mechanical peak flow meters can generally be expected to wear out after about 12 to 24 months of heavy use, although there is a little published data to support this. However, a volume-displacement spirometer will usually last many years if properly maintained and serviced.

2. FACTORS TO CONSIDER WHEN CHOOSING A SPIROMETER

Factors governing the choice of spirometer for use in a doctor's surgery include (Burton, Johns & Swanney 2005):

- ease of use
- provision of easy-to-read-real-time graphic display of manoeuvre
- provision of immediate quality feedback concerning the acceptability of blows. Including repeatability
- provision to interface with clinical software packages
- provision of customizable final spirometer report
- provision to print the final report
- price and running costs
- reliability and ease of maintenance
- training, servicing and repair of the spirometer provided by the supplier
- ability to trial the spirometer in your setting before the purchase
- provision of disposable sensor or a breathing circuit that can be easily cleaned and disinfected
- provision of appropriate normal reference values with lower limits of normal
- robustness
- provision of comprehensive manual describing its operation, maintenance and calibration
- calibration requirements
- conforms to accepted spirometry performance standards (Appendix A)
- complies with electrical safety standards

A summary of the specifications and features of spirometers on the market in Australia and New Zealand is provided in the *Spirometers Users' and Buyers' Guide* (Burton, Johns & Swanney 2005) available at www.nationalasthma.org.au

Faced with the wide variety of spirometers available today, general practitioners have to choose an instrument suitable for use in their own surgery. If possible, trial the spirometer before buying to ensure it meets *your* specific needs.

SUMMARY

All spirometers are regarded as diagnostic instruments and should meet or exceed relevant ATS/ERS equipment standards. Spirometers must be capable of being calibrated, or at least having their calibration checked, to ensure their ongoing accuracy. A certified 3 litre syringe is recommended for calibrating spirometers, and this should be done regularly, and the results recorded. To assess overall spirometer, it is recommended that biological controls be included in the spirometer's quality assurance program with the results recorded in the table and Levy-Jennings plot. When purchasing a spirometer, it is important that it meets or exceeds minimum performance criteria.

3. ACCEPTABILITY AND REPEATABILITY

Table 4.1	Acceptability and repeatability criteria
Each individual test is acceptable if it meets the following criteria:	
Start of test criteria (apply to each test)	
<ul style="list-style-type: none"> • There was no evidence of hesitation • The test was performed with a rapid start (i.e. the extrapolated volume is less than 5% or 0.15L, whichever is greater). • The PEF has a sharp rise (flow-volume). 	
End of test criteria (apply to each test)	
<ul style="list-style-type: none"> • Expiration continued until there was no change in volume (<0.025 L) for ≥ 1 second, and the patient had blown for ≤ 3 seconds (children aged < 10 years) or for ≤ 6 seconds (subjects aged ≥ 10 years) • However, the patient or person conducting the test can terminate the blow if the patient cannot or should not continue.) 	
Other criteria (apply to each test)	
<ul style="list-style-type: none"> • The patient followed instructions • A continuous maximal expiratory manoeuvre throughout the rest (i.e. no stops and starts) was achieved was initiated from full inspiration. • There were no leaks. • No cough (note FEV1 may be valid if cough occurs after the first second). • No glottis closure (Valsalva). • No obstruction of the mouthpiece (e.e. by the tongue or teeth)> • No premature termination (note FEV1 may be valid if this occurs after the first second). • No evidence that the patient took an additional breath during the expiratory manoeuvre. 	
Repeatability criteria	
<ul style="list-style-type: none"> • Obtain three acceptable tests (i.e. each tests should meet the above acceptability criteria). • The two largest values for FEV1 should agree to within 0.15 litre. • The two largest values for FVC should agree to within 0.15 litre. • Repeat the test if these repeatability criteria are not met. 	
Result to report	
<ul style="list-style-type: none"> • FEV1 – report the largest value. • FVC – report the largest value. • PEF – report the largest value. • FEV6 – report the largest value. • FEF25/75% – report the value obtained from the test with highest sum of FEV1 + FVC. 	

At least three technically acceptable manoeuvres should be obtained which meet the ATS/ERS acceptability and repeatability criteria given in Table 4.1 . It is important that the acceptability criteria be applied and unacceptable tests discarded before assessing repeatability, as the latter is used to determine whether additional tests from the three acceptable ones already obtained are required. These criteria (together with a properly maintained and calibrated spirometer) help to ensure the quality of your results, which is essential when comparing results with predicted values and quantifying change over time. Tests that do not fully meet the acceptability criteria may still be clinically useful. For example, FEV 1 may still be valid if cough or premature termination of the blow occurs after the first

second. The report should state when the results are obtained from manoeuvres that do not meet acceptability and repeatability criteria.

Summary

Acceptable spirometry requires close cooperation between the patient and the operator in the performance of maximal breathing manoeuvres. Clear and concise instructions with constant encouragement from the operator are essential to obtain accurate and reproducible results. This is especially challenging in young children. At least three technically acceptable tests should be obtained and the FEV₁ and FVC in two of the three tests should vary by less than 0.15 litres. The highest FEV₁ and FVC (even if from separate blows) are reported. The quoted FEF_{25–75%} should be calculated from the single blow with the highest sum of FEV₁ plus FVC. A range of patient- and instrument-related problems can affect the results but most of these can be easily identified and avoided.

4. HOW TO DO SPIROMETRY AND THE COMMON PROBLEMS

To ensure an acceptable result, the FVC manoeuvre must be performed with maximum effort immediately following a maximum inspiration; it should have a rapid start and the spirogram or flow-volume curve should be a smooth continuous curve throughout the manoeuvre. The test can be tiring for the elderly or breathless patient, so sufficient time for recovery should be allowed between repeat tests. It is important that the operator is properly trained before attempting to measure spirometry.

There are two breathing circuits commonly used when performing spirometry: closed- and open-circuit methods (Figure 4.1). The *open-circuit* method is used when the subject inspires fully before going onto the mouthpiece to perform the forced manoeuvre. The *closed-circuit* method requires the subject to first breathe tidally on the mouthpiece and then to inspire fully from the spirometer before performing the forced manoeuvre. The latter method has the advantage that subject's inspired volume can be measured and is displayed, which can help to verify that the subject has inspired fully prior to performing the forced manoeuvre, and also has the advantage of being able to compare tidal with maximal breathing.

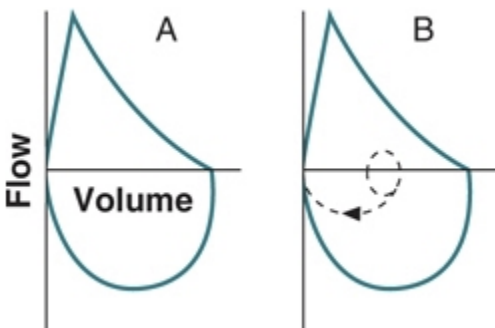


Figure 4.1 Open and closed circuit. The flow-volume loop performed by the open-circuit (A) and closed-circuit (B) methods (see text). When correctly performed the results for both methods are the same. However, the closed-circuit method has the advantage that tidal breathing can be displayed and it is easier to verify that the subject had fully inspired before commencing the forced expiratory manoeuvre. Only the closed-circuit methods allows IC to be measured.

To achieve good results, carefully to explain to the patient the procedure (to be clear and precise) and what is being measured. Also ensure that he or she is sitting upright with feet firmly on the floor (the safest and most comfortable position; although standing and sitting a similar result in adults, in children in the VC is usually greater in the standing position). A nose clip must be worn when measuring IC and inspiratory VC and when performing a slow VC manoeuvre and is recommended when performing a forced (FVC) manoeuvre. A nose clip is not needed when measuring PEF. Do not use a chair with wheels. Remember that verbal encouragement/coaching throughout the test is essential.

Open-circuit spirometry

Demonstrate the manoeuvre to the patient. Apply a nose clip to the patient's nose (this is recommended, but not essential) and urge to the patient to:

- Breathe in fully (the subject should inspire rapidly until absolutely full)
- Seal his or her lips around the mouthpiece and *immediately blast* the air out as fast and as far as possible until the lungs are *completely* empty (the patient should remain upright)
- Breathe in again as forcibly and fully as possible (not all spirometers will measure inspiration).

Obtain at least three acceptable tests and *then* apply the repeatability criteria (Table 4.1, p.6).

The measurement of IC using open-circuit spirometry involves switching the patient into this circuit at the end of quiet expiration (i.e. FRC) and measuring the maximum volume that can be inspired (i.e. to TLC)

Closed-circuit spirometry

Demonstrate the manoeuvre to the patient. Apply a nose clip to the patient's nose (this is recommended, but not essential) and urge to the patient to:

- Seal his or her lips around the mouthpiece
- Breathe tidally for 2 to 4 breaths – usually until a stable FRC is recorded
- Breathe in fully (the subject should inspire rapidly as fast and as far as possible until the absolutely full) and *immediately blast* the air out as fast as far as possible until the lungs are completely empty (the patient should remain upright)
- Breathe in again as forcibly and fully as possible (not all spirometers will measure inspiration).

Obtain at least three acceptable tests and then apply *then* repeatability criteria (Table 4.1, p.6).

Closed-circuit spirometry facilitates the measurement of IC by affording the operator the capacity to scrutinise the stability of FRC during tidal breathing before asking the patient to inspire fully. Volume-displacement spirometers must contain a volume of air at the start of the manoeuvre that is greater than the patient's IC so that a full inspiratory breath can be measured.

Flow spirometers, provided they have the software to integrate inspiratory as well as expiratory flow, are usually more suitable as they do not require the patient to breathe in from an air reservoir.

Essentials of both open- and closed-circuit spirometry

For both methods, the *essentials* are:

- Maximal inspiration
- A good seal between the lips and mouthpiece
- Very rigorous effort right from the start of the manoeuvre, continuing until *absolutely* no more air can be exhaled
- Rapid start
- The patient avoiding coughing, tongue occlusion, glottis closure, premature termination of the blow, etc. (see below)
- The patient not leaning forward during the test.

See also Table 4.1 (on p.6).

The operator should be confident that the patient has followed the instructions. Note that failure to initially fill the lungs is a very common cause of poor quality spirometry

Because the initial part of the expiration and all of the inspiration is effort-dependent, it is essential to achieve maximum patient effort in the performance of spirometry. Demonstrating to the patient the vigour and effort required is perhaps the best way to achieve this.

If only PEF is being measured, the patient need only exhale for a couple of seconds.

Remember that, particularly in patients with airflow obstructions, it may take the patient many seconds to fully exhale. It is also important to recognise those patients whose efforts are submaximal. There is no substitute for careful explanation and demonstration – demonstrating the manoeuvre to the patient will overcome 90% of problems encountered and can be critical in achieving satisfactory results.

Observation and encouragement of the patient's performance are also crucial. Be sure to examine the spirogram (or flow-volume curve) for acceptability and repeatability (see below) and, if your spirometer doesn't do this for you, to correct the measurements to BTPS conditions.

5. MEASUREMENTS IN YOUNG CHILDREN

The measurement of spirometry in young children is a particular challenge and usually limited to those 4-5 years of age and older. It is important to present the child with non-threatening environment, to minimise interruptions, to capture the child's imagination and to make spirometry fun. The instructions must be kept short and simple. Use body language and voice intonations to reinforce your instructions. Use very simple and understandable words and phrases such as 'blow like a big wolf' or 'blow the biggest mountain' and point to the flow-volume loop on the screen. Avoid words like 'inhale' and 'maximum' as a child may never have experienced these. As with adults, it usually helps to demonstrate the test. Children who are unable to perform satisfactory spirometry on their first visit often perform the test correctly at the next visit.

6. BACK-EXTRAPOLATION

Back-extrapolation is a procedure applied to the volume versus time curve to determine the appropriate time zero from which all timed volumes (e.g. FEV₁) are calculated. The derived time zero is the point on the time axis where exhalation would have started assuming 'instantaneous' flow acceleration (i.e. the patient's maximal flow is projected back to the volume axis). The procedure minimises errors in the measurement of FEV₁ if the expiratory manoeuvre was not performed rapidly from the very start. Back-extrapolation is quite simple. To calculate time zero, draw a line through the steepest portion of the volume-time curve and extend it back to the time axis. This point is taken as time zero (Figure 4.2). From this construction the 'extrapolated volume' can be calculated as shown in Figure 4.2. For an acceptably rapid start to the blow, the ATS/ERS requires that the extrapolated volume should be less than 5% FVC or 0.15 litres, whichever is greater. An extrapolated volume higher than this indicates that the blow was not initiated sufficiently rapidly and should be repeated.

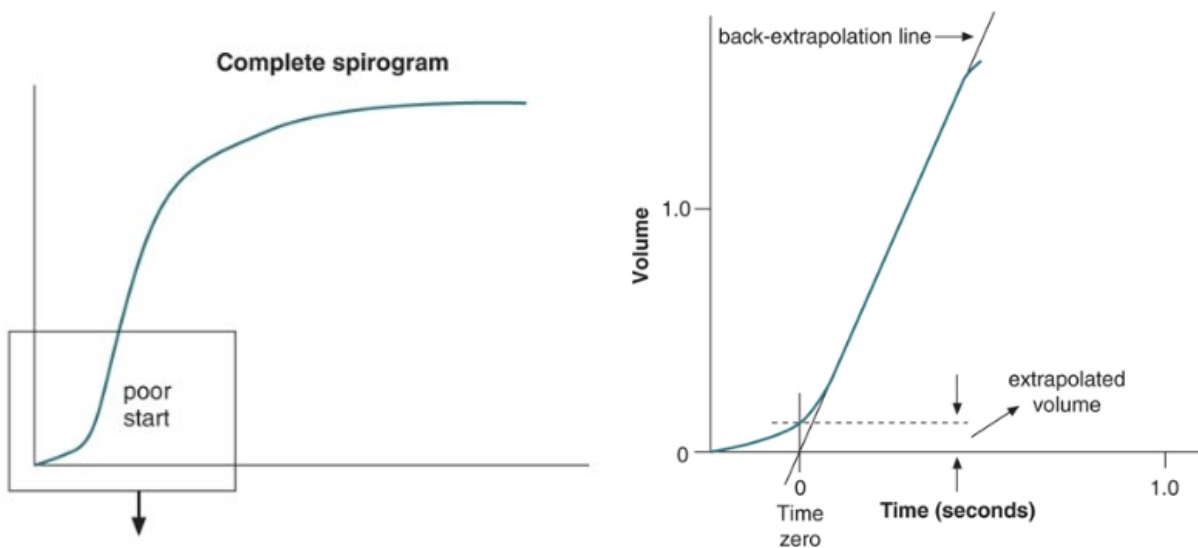


Figure 4.2 The back-extrapolation procedure to determine time zero and the extrapolated volume.

The back-extrapolation procedure is performed by hand with manual spirometers; however, in practice this is often only done when the spirogram shows an obvious slow start (i.e. measurable extrapolated volume). Computerised spirometers that meet ATS/ERS equipment standards (Miller et al. 2005b) will perform this procedure automatically, and many will provide immediate feedback if the extrapolated volume exceeds acceptable limits (i.e. 5% FVC or 0.15 litres, whichever is greater).

7. PATIENT-RELATED PROBLEMS

It is useful to learn how to recognise inadequacies in the performance of spirometry and the recordings as these can greatly affect the accuracy, repeatability and hence interpretation of the results. Figures 4.3 and Figures 4.4 show some problematic examples compared with well-performed manoeuvres, illustrated for both the expiratory spirogram and the flow-volume loop respectively.

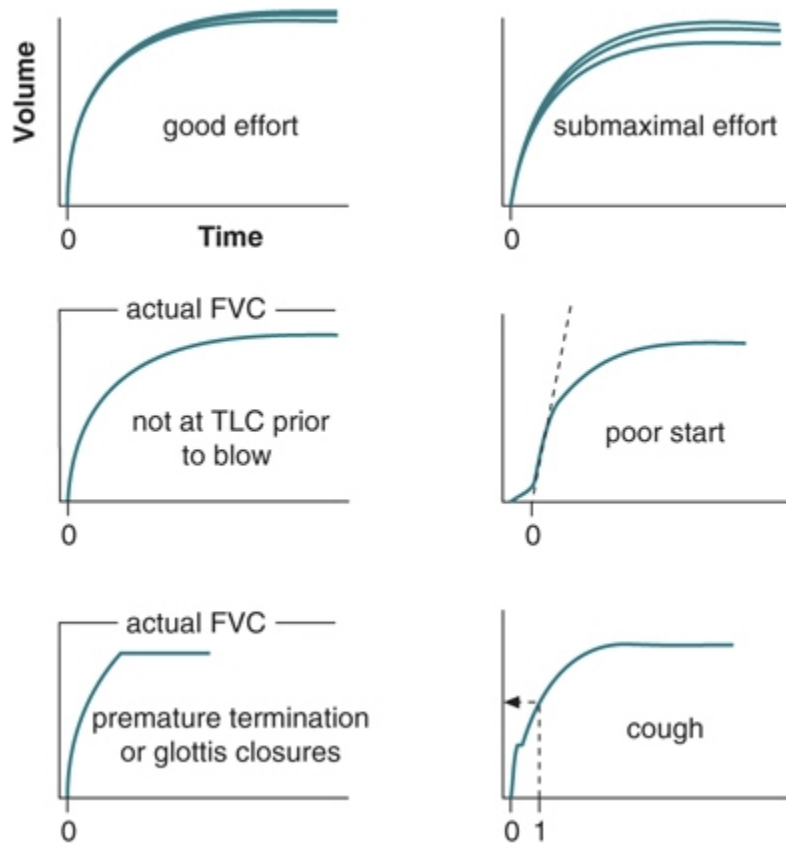


Figure 4.3 Common problems in the performance of spirometry are shown on these expiratory spiograms.

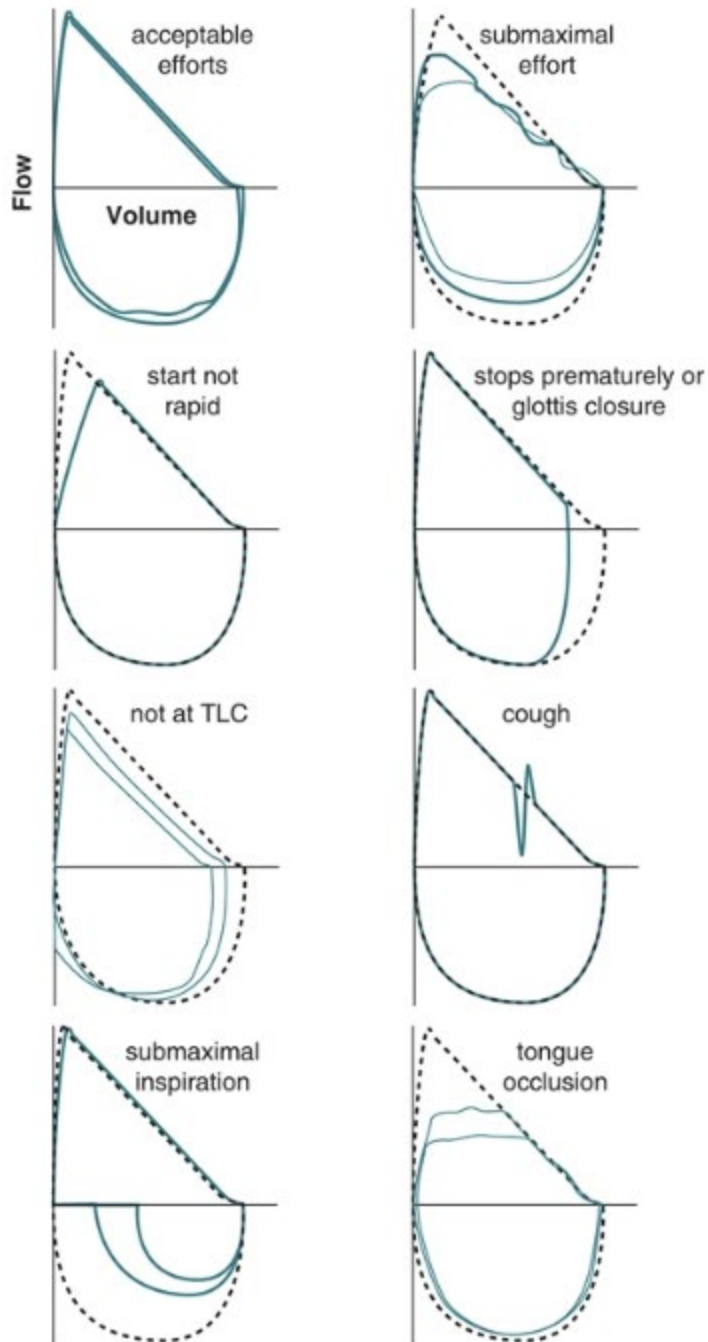


Figure 4.4 Common problems in the performance of spirometry are shown in these flow-volume loops. The dotted flow-volume loop represents the acceptable maximal effort.

As stated, optimum patient performance is crucial to obtaining valid spirometry. The patient must understand fully that the manoeuvre must be performed with maximal effort. If the test is performed correctly, the results from repeat blows will usually be reproducible (i.e. FEV₁ and FVC to within 0.15 litres). The most common patient-related problems when performing the FVC manoeuvre are:

- submaximal effort
- leaks between the lips and mouthpiece
- incomplete inspiration or expiration (prior to or during the forced manoeuvre)
- hesitation at the start of the expiration
- cough (particularly within the first second of expiration)
- glottis closure causing an abrupt reduction in flow or straight sections (rather than a smooth curve) in the spirogram
- obstruction of the mouthpiece by the tongue or teeth (false or otherwise)
- vocalisation during the forced manoeuvre
- poor posture.

These problems can largely be avoided by giving the patient clear instructions with vigorous verbal reinforcement throughout the test. Demonstration of the procedure will also help prevent many of these problems, remembering that all effort-dependent measurements will be variable in patients who are uncooperative or deliberately trying to produce low values.

Failure to empty the lungs completely (premature termination) is very common, resulting in an underestimation of both FVC and exaggerated evidence of airflow obstruction (overestimated FEV₁/FVC ratio). To avoid this, active encouragement right to the end of the blow is essential. The FVC can be greatly overestimated (and FEV₁/FVC underestimated) if the patient manages to take an extra breath through the nose during the expiratory manoeuvre (see Figure 4.5).

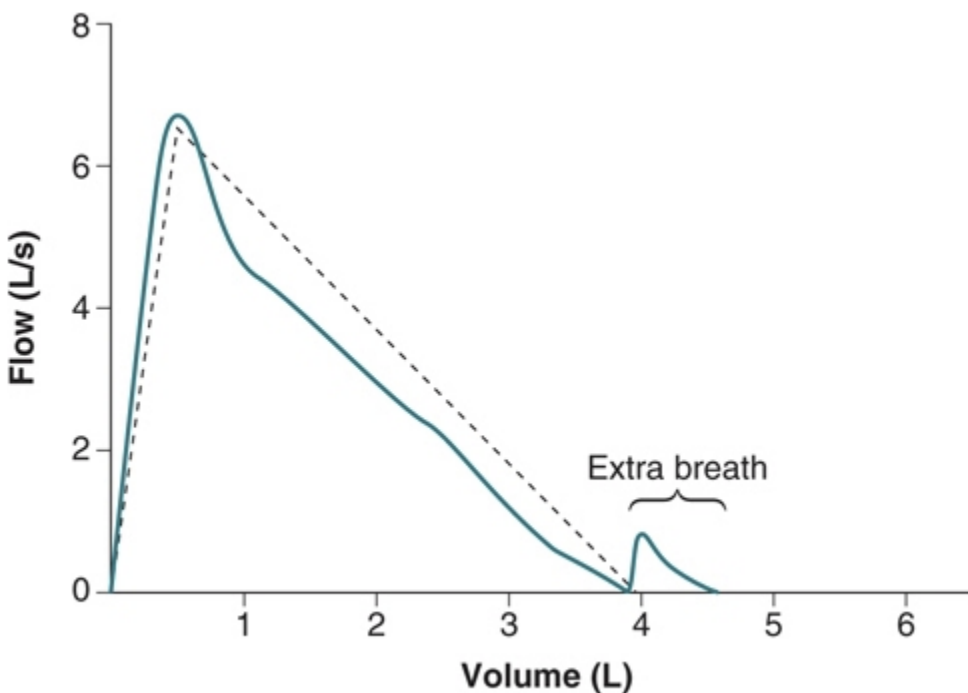


Figure 4.5 Example of a patient taking an extra breath through the nose towards the end of the expiration. The FVC is overestimated and FEV₁/FVC underestimated. The dotted line is the predicted curve.

Glottis closure should be suspected if flow ceases or falls abruptly during the test rather than being a continuous smooth curve. Recordings in which cough, particularly if this occurs within the first second (it may affect the FEV₁), or hesitation at the start has occurred should be rejected. Vocalisation during the test will reduce flows and must be discouraged; performing the manoeuvre with the neck extended often helps.

Chest pain, abdominal problems, fear of incontinence or even just lack of confidence or embarrassment may reduce patient effort. Nose clips are recommended but are not essential when performing forced manoeuvres. Discourage the patient from leaning forward during testing; it may be helpful to tape a target to the opposite wall.

Modifying the cardboard mouthpiece, as shown below in Figure 4.6, can generally prevent obstruction of the mouthpiece by the tongue. The end of the mouthpiece is cut or shaped at an angle of about 60° to its length and used with the sloped side upward, preventing obstruction by the tongue. Alternatively, the problem can be reduced significantly by instructing the subject to place the mouthpiece well into the mouth and to bite it lightly.

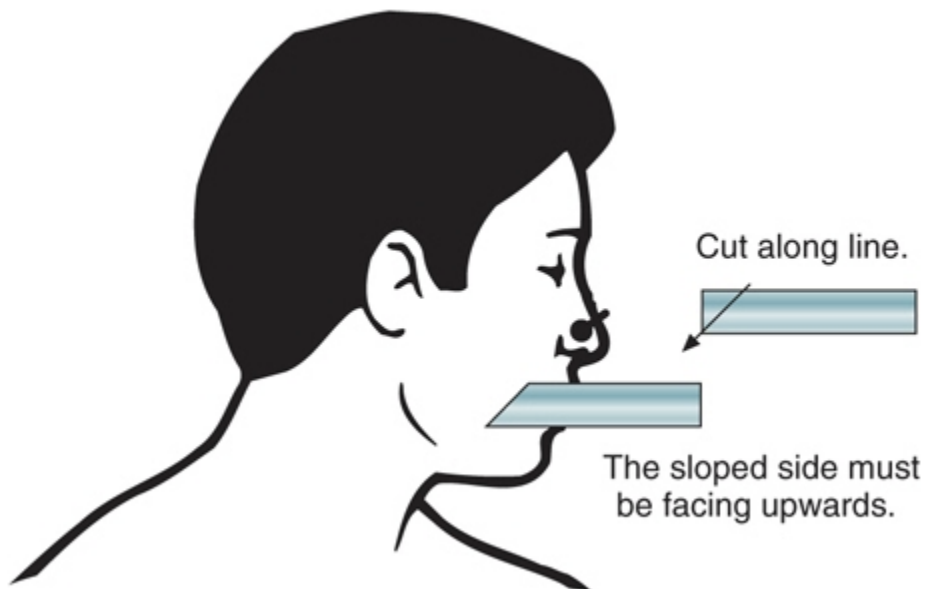


Figure 4.6 Most mouthpieces can be modified as shown to eliminate occlusion of the mouthpiece by the tongue. Note that the sloped face of the mouthpiece must be positioned as shown.

8. INSTRUMENT RELATED PROBLEMS

These depend largely on the type of spirometer used but generally the most common problems are:

- leaks in the spirometer, breathing hose and hose connections, and timing inaccuracies (in volume-displacement spirometers)
- rips and tears in the flowhead connector tube and clogged sensor (in flow spirometers)
- calibration, accuracy, signal drift and linearity (in flow spirometers).

Standards recommend checking the calibration at least daily with a calibrated syringe; a simple self-test of the spirometer is an additional, useful daily check that the instrument is functioning correctly. Other faults may require repair by the manufacturer or distributor.

When using the volume-displacement spirometer that has a limited time axis (e.g. the Vitalograph spirometer), it is very important to continue to record expired volume until the patient's lungs are empty and not to discontinue once the chart carrier stops moving, otherwise you will underestimate FVC and overestimate the FEV₁/FVC ratio. When using a volume-displacement spirometer that utilises a rotating drum (kymograph) to move the recording paper, it is important to allow the paper to reach the correct speed before the patient begins to blow. Therefore, switch on the kymograph a second or two before the patient blows.

9. PERFORMING SPIROMETRY IN THE BUSY CLINICAL PRACTICE

There is no doubt that spirometry is time-consuming, requiring about 20 minutes to perform, document and interpret pre- and post-bronchodilator measurements. This, together with the cost of purchasing and maintaining a spirometer, are arguments often put by general practitioners for not including spirometry as part of their general practice consultations.

There are a number of ways to make testing more cost-effective (Fardy 2001):

- Perform pre-bronchodilator spirometry as soon as you have determined that your patient's problems may be related to asthma or COPD. Administer a bronchodilator and then complete the history-taking and clinical examination. By the time you have done this, sufficient time (10 minutes or more) will have passed for the post-bronchodilator blows to be done. With the results of spirometry now available, you will be better equipped to discuss the diagnosis, outlook and management plan with your patient. This strategy adds only about 10 minutes to your consultation but adds a lot of information that will be of immediate value and provide baseline measurements for future comparison (e.g. effectiveness of treatment).
- Your practice nurse can measure the patient's spirometry for you, provided he or she has completed a comprehensive training course in spirometry.

10. COMPLICATIONS AND CONTRAINDICATIONS

Spirometry is generally a safe, non-invasive procedure. However, it does require maximal effort and subject cooperation, which may result in transient breathlessness, oxygen desaturation, syncope, chest pain and cough. The forced manoeuvre can also induce bronchospasm in patients with poorly controlled asthma. There are a number of clinical circumstances in which the generation of a high positive intra-thoracic pressure and its transmission to vascular, abdominal and other body compartments may be detrimental and thus spirometry is best avoided. The measurement of spirometry is thus normally delayed following:

- recent eye surgery
- recent thoracic and abdominal surgery
- aneurysms (e.g. cerebral, abdominal)

- unstable cardiac function
- haemoptysis of unknown cause (i.e. infection risk)
- pneumothorax
- chest and abdominal pain
- nausea and diarrhoea.

11. CHOOSING THE APPROPRIATE TEST

It is important to recognise likely clinical situations and to choose the appropriate test for each. For example:

- For patients with respiratory symptoms such as dyspnoea, wheeze, chronic cough and sputum production and exercise intolerance, spirometry and DLCO are indicated to diagnose and differentiate diseases causing ventilatory abnormality of obstructive or restrictive type.
- In patients with COPD, spirometry is indicated to follow the progression of the disease, response to interventions and so on.
- For the diagnosis of asthma, obtain spirometry before and after the administration of a bronchodilator, looking for an obstructive pattern with significant improvement. It is usually necessary to repeat spirometry at follow-up visits in asthma and other lung conditions where change can occur over short periods of time.
- In patients suspected of having asthma but in whom baseline spirometry is normal, it may be appropriate to confirm the diagnosis by measuring airway reactivity by provocation testing, with measurement of spirometry before and after provocation by exercise or by inhalation of methacholine or mannitol.
- To identify asthma triggers or treatment responses over long periods of time, regular PEF monitoring by the asthmatic patient is more reliable than a symptom diary alone.
- If upper airway obstruction is suspected, flow-volume loop with particular emphasis on inspiration is the best test.
- To assess the risk of postoperative complications in the elderly and respiratory compromised, particularly if undergoing abdominal or thoracic surgery, the FEV₁, FVC and FEV₁/FVC ratio are the most useful indices. If an obstructive ventilatory defect is present, the anaesthetist would like to know whether there was improvement after administration of a bronchodilator.
- To assess smoking-related damage, evidence of airflow obstruction should be sought systematically using spirometry. This information may be helpful in convincing smokers to give up the habit.

Serial spirometric measurements are useful to quantify severity and to follow the progression and response to therapy of respiratory diseases such as COPD, asthma and interstitial lung disease. Here measures such as FEV₁ and FVC may be helpful in asthma, but in COPD measurement of IC as an index of functional hyperinflation also has clinical utility and better correlation with functional outcomes (O'Donnell 2000). Although detailed studies are needed to better establish the magnitude of a clinically meaningful change, an increase of about 10% in dynamic IC with exercise may be considered a clinically significant improvement. Such increases correlate with dyspnoea scores and exercise endurance time.