Standard Operating Procedure Template

Performance of Spirometry and bronchodilator response in Adults

Version 4 | June 2026

ARTP Standard Operating Procedure

Performance of Spirometry and Bronchodilator response in Adults.

Standard Operating Procedure	Performance of Spirometry and bronchodilator response in adults.
Undertaken By:	Qualified, trained practitioners registered with ARPT
Author(s)	ARTP Spirometry Committee
Date of Original Document	11 May 2023
Update(s)	Updated by ARTP Spirometry Committee in June 2026 Catherine Bridges June 2026
Current Version:	4
Review Date:	June 2028
Notes:	This document has been developed by the ARTP Spirometry Committee as a standardised template. It is designed for adaptation and implementation in workplaces utilising spirometry to ensure best practices and consistency in testing procedures.

Contents

1. Introduction

Spirometry is an essential diagnostic tool for assessing and monitoring respiratory diseases. This document, produced by the ARTP (Association for Respiratory Technology and Physiology), provides guidelines for the safe and effective performance of quality-assured spirometry. It is designed for implementation in any practice where spirometry is performed, ensuring consistency and accuracy in testing. This document should be used in conjunction with local protocols and adapted to the specific needs of each healthcare setting. This SOP has been edited to reflect the practice which is performed at Stamford Surgery.

2. Scope and Aims

This document provides a standardised procedure for conducting spirometry in primary health care setting. Its primary aim is to ensure the delivery of high-quality, acceptable, and repeatable spirometry results while maintaining patient safety. These guidelines are based on the recommendations from ARPT

3. Background

Spirometry is a critical tool used to support the diagnosis and management of lung diseases. It helps assess lung capacity, airflow, and the severity of impairment, but it should never be used in isolation for clinical decision-making. Results from spirometry should always be interpreted alongside other investigations and the clinician's overall assessment of the patient.

4. Desired Outcomes for this Spirometry Standard Operating Procedure (SOP)

Ensure that the spirometry procedure is performed in compliance with relevant legal, ethical, and professional standards, with appropriate documentation and reporting practices. This includes proper consent, confidentiality, and compliance with occupational health standards for workplace evaluations.

5. Indications

Spirometry is indicated for a variety of medical, surgical, and research purposes.

5.1 Medical Diagnosis and Management

Spirometry is a key tool in diagnosing, monitoring, and managing respiratory conditions. Its uses include:

- **Measuring the effects of disease on respiratory function:** Identifying impairments caused by conditions such as asthma, COPD, and restrictive lung diseases.

5.2 Consideration of Suboptimal Results

In some cases, patients may have difficulty producing optimal spirometry results. However, this does not mean that there is no usable clinical information within the test results. Those healthcare professionals performing spirometry should be aware of how to encourage patients to achieve the best results. They should include in the technical report any issues that occurred during testing and whether the tests meet acceptability and repeatability criteria according to the guidelines being used. They should also include any other information which the healthcare professional using the results in the patient's clinical pathway should be aware of. Those healthcare professionals responsible for using the spirometry results to make clinical decisions should be aware of how any technical issues may impact on the result.

It is the responsibility of the practitioner assess the accuracy of the results and use the patients clinical history with the collected results to make a decision about care.

6. Contraindications

The majority of contraindications for spirometry testing are relative and depend on balancing the potential risks with the clinical necessity of obtaining the results. While spirometry is considered safe, there are specific conditions that require caution due to the potential for complications. It is essential to assess each patient individually, considering their overall health status and the clinical need for the test. Certain pre-existing conditions may limit the ability to obtain optimal results. In such cases, the presence of suboptimal effort or external factors should be noted on the patient's report, ensuring that decisions, such as surgery refusals due to low lung function, are based on physiological limitations rather than impaired effort.

The categorisation of risk versus benefit may differ depending upon the setting in which spirometry is performed. Hospital settings may have a higher threshold due to the availability of immediate medical support in the event of complications, whereas community settings may adopt a lower risk approach. It is therefore essential that a local policy is in place outlining the absolute and relative contraindications in the specific setting, including an escalation policy if complications arise during testing.

Healthcare professionals performing spirometry are responsible for weighing the individual risk versus benefit of performing spirometry and for discussing the safest way to proceed in challenging cases.

Useful resources include:

- Cooper, B.G (2011) An update on contraindications for lung function testing
- Graham et al., (2019). Standardization of spirometry: 2019 update. An official American Thoracic Society and European Respiratory Society technical statement
- Sylvester et al., (2020). ARTP statement on pulmonary function testing

Table 1: Recommended wait times before lung function testing

Contraindication	Absolute / Relative	Suggested timing until able to perform spirometry safely
Eye surgery	Relative	2-6 weeks
Unstable angina	Relative	Until stabilised
Stroke (CVA)	Relative	Minimum 1 month and clinically stable
Myocardial infarction (heart attack)	Relative	Minimum 1 month and clinically stable
Pulmonary embolism	Relative	Until treated and clinically stable (typically several weeks)
Thoracic surgery	Relative	4–6 weeks
Abdominal surgery	Relative	4–6 weeks
ENT	Relative	4–6 weeks
Resolved pneumothorax	Relative	6 weeks
Respiratory infection	Relative	4-6 weeks
Haemoptysis known cause	Relative	Until stabilised
Aneurysm	Relative	Specialist review
Current untreated pneumothorax	Absolute	Until fully resolved and medically cleared
Active haemoptysis unknown cause	Absolute	Until investigated and stabilised.
Intracranial surgery	Absolute	4-6 weeks or specialised clearance
Eye surgery	Absolute	4-6 weeks or specialised clearance
Unstable cardiovascular status	Absolute	Until stabilised and medically cleared

7. Infection Prevention

Spirometry itself is not an aerosol generating procedure. However, the forced expiratory manoeuvre can lead to coughing and the production of sputum, which generates aerosols in the form of droplets. As spirometry operators

and participants are required to be in close proximity, enhanced infection prevention and control is crucial, even with the use of bacterial/viral filters.

Although the risk of cross-infection during lung function testing is low, infection control remains a critical concern to ensure the safety of both patients and staff. The following infection control measures must be observed to minimise any potential risks.

7.1 Cleaning and Disinfection

After every patient the equipment and surfaces must be wiped down using the recommended wipes and documented that this has been done in the relevant file.
After every session the transducer must be sterilised with the recommended solution as per manufacturer's instructions. These are located in the spirometry file.

7.2 Use of Bacterial/Viral Filters

Single use bacterial filter mouthpiece are used on every patient for spirometry.
Single use infection control mouth pieces are used for the FENO machine, these mouth pieces have an infection control filter

7.3 Ventilation Considerations

A window is always open to allow adequate ventilation

8. Preparation for the Test Procedure

8.1 pre-appointment

8.1.1 Environment

Ensure that the testing area is free from drafts, extreme humidity, or sudden temperature changes, as these factors can impact on test results. The room should be quiet and private to set the patient at ease and to minimise distractions.

Before testing, the spirometry workstation area should be prepared by arranging all necessary equipment: stadiometer, weighing scales, spirometer, disposable mouthpieces, bacterial/viral filters, nose clips. Ensure the

spirometer is properly calibrated and that all required reusable consumables are available. Clear signage and instructions should be available in the testing area to guide both staff and patients through the process.

8.1.2 Equipment

- **Calibration and Verification:**
- **Calibration** establishes and adjusts a spirometer's accuracy to meet known standards, which usually requires factory maintenance and results in a formal certificate. This is done annually.
- **Calibration verification** is a routine daily check—usually performed by a clinician using a certified 3-L syringe—to confirm the device remains within acceptable accuracy limits (typically ± 3%) before testing. (BTS guidelines)
- Calibration should be carried out prior to every patient /session or after every 10thy patient. A certificated calibrated 3L syringe- this must have an accuracy of +15ml
- Results must be recorded
- **Physiological control:** Physiological control testing (often called biological control testing) in spirometry validates a spirometer's accuracy and stability over time by having a healthy staff member with no known respiratory diseases perform the test on themselves. Because spirometers can drift due to physical wear, contamination, or changes in environment, this process ensures device reliability. This is done randomly to check accuracy of the spirometer.

8.1.3 Patient

Patients must be adequately prepared for their spirometry appointment and provided with relevant instructions in advance. Compliance with these instructions should be confirmed prior to testing. Patients should be advised to avoid the following:

Table 2: Pre-testing considerations for spirometry

Advice	Time frame
Refrain from smoking	On the day of the test
Avoid eating a large meal	Before the test
Avoid vigorous exercise	Before the test
Avoid wearing tight clothing	On the day of the test
Avoid drinking alcohol	Before the test

Table 3: Recommended Washout Interval for Bronchodilator Medication
Table taken from ATS/ERS (2019) Standardization of Spirometry 2019 update.

Bronchodilator Medication	Withholding Time
Short-acting β2 agonist (e.g. albuterol/salbutamol)	4-6 hours
Short-acting muscarinic antagonist (e.g. ipratropium bromide)	12 hours
Long acting β2 agonist (e.g. formoterol or salmeterol)	24 hours
Ultra long acting β2 agonist (e.g. indacaterol, vilanterol, or olodaterol)	36 hours
Long-acting muscarinic antagonist	36-48 hours
Theophylline	24 -48 hours

Combination Inhalers

Inhaler	Components	Withhold
Symbicort	ICS + Formoterol	**24 hours**
Fostair	ICS + Formoterol	**24 hours**
Seretide	ICS + Salmeterol	**24 hours**
Relvar Ellipta	ICS + Ultra-LABA	**36 hours**
Anoro Ellipta	LAMA + Ultra-LABA	**48 hours**
Trelegy Ellipta	ICS + LAMA + Ultra-LABA	**48 hours**

Compliance with these instructions should be checked prior to testing and any deviation from this should be documented accordingly. Patients requested to perform spirometry without a pre-booked appointment, should have pre-test instructions reviewed to assess whether it would be appropriate to proceed with the test.

8.2 Preparation at the Appointment

- Patients should be greeted and invited through for testing.
- All staff involved with the patient should introduce themselves by name/role to the patient (and carer if appropriate).
- Measure patient's height, preferably standing height where possible standing height is not possible or in patients with thoracic deformities, arm span, ulnar length, or knee height should be considered as an alternative. Height should be recorded to the nearest 0.5cm.
- Weight should be measured – without outdoor clothing or shoes using calibrated scales and recorded to the nearest 0.1kg.
    - Ensure height, DOB, and birth sex are accurately recorded. Patients whose sex assigned at birth differs from their identified gender should be recorded as the sex they were assigned at birth.

9. Test Procedure

Explain the purpose and nature of the test to the patient.

Demonstrate the procedure to the patient and ask if they have any questions or concerns about the test. Address any doubts to ensure their comfort and understanding and reassure the patient that you will be there to guide them through the actual test, provide feedback, and ensure their safety throughout the procedure.

Obtain verbal consent and ensure the participant is comfortable:

- Sitting comfortably with both feet flat on the floor and in an upright posture.
- Loosen any tight clothing.
- Remove any loose dentures.
- Nose clip in place (use a new one for each participant).

9.1 Slow Vital Capacity (VC) as per ARTP guidelines

It is important to perform Slow Vital Capacity (SVC) manoeuvres, particularly in elderly patients and those with airflow obstruction.

-Patient is sitting comfortably

-A minimum of three acceptable VC manoeuvres must be obtained.

-Repeatability criteria are met when there is no more than 100mls ideally (and certainly no more than 150mls in the occasional highly variable patient) between each blow. Some spirometers will inform the user when this has been achieved.

-Verbally encourage patient to continue to exhale as long as possible l Observe both patient and the time volume curve as each VC is performed to ensure they: Breathe in to maximal inspiration, Do not obstruct the mouthpiece with their teeth or tongue.

-Ensure there are no leaks from the mouthpiece

-Remove false teeth if loose

-Usually this will be achieved within no more than four VC manoeuvres

- **If the patient is unable to achieve the quality criteria, record why this has not been possible. Another appointment may be required, or refer for specialist**

9.2 Forced Vital Capacity (FVC) as per ARTP guidelines

-Patient is sitting comfortably

- A minimum of three acceptable FVC manoeuvres must be obtained. -

- Repeatability criteria are met when there is no more than 100mls ideally (and certainly no more than 150mls in the occasional highly variable patient) between each blow. Some spirometers will inform the user when this has been achieved.

- Encourage maximum effort at the start of each blow, verbally encouraging patient to continue to exhale to achieve maximal effort

- Observe the patient as each FVC is performed to ensure they: n Breathe in to maximal inspiration

- Do not obstruct the mouthpiece with their teeth or tongue. Ensure there are no leaks from the mouthpiece

- Remove false teeth if loose

- Observe the flow/volume curve as each FVC manoeuvre is being performed to identify: Slow starts, Early stops, Variability in flow within manoeuvre

- Ensure the patient exhales fully and that this is demonstrated on the graph showing a time/volume plateau.

- Do not perform more than eight FVC manoeuvres in one session.

- **If the patient is unable to achieve these standards - record why this has not been possible, arrange a further appointment to repeat the test if appropriate, or refer for specialist assessment**

9.3 Bronchodilator response

A bronchodilator response may be performed if there is a question regarding the diagnosis and if the following conditions are met:

- Patient is able to perform technically acceptable and repeatable baseline spirometry.
- Patient has withheld inhalers as instructed; otherwise, true baseline will not be established.

- If the patient is unable to withhold their inhalers, baseline spirometry only should be performed with appropriate comments reported.
- Depending on the clinical question, if a patient has taken inhalers prior to testing and the spirometry demonstrates airflow obstruction, this can provide enough information to aid the diagnosis/management plan.

- A bronchodilator should be administered according to local protocol. A prescription for the type, dose and mode of delivery will be required from a registered prescriber.
- 400mcg of salbutamol should be administered via a spacer chamber. This needs to be prescribed for the patient. If being administered by someone who is not a prescriber, then a PSD needs to be provided. One puff at a time should be given with tidal breathing.
- The patient is asked to wait in the waiting from for 15 minutes.
- The patient should be advised that there maybe some side effects to the drug such as heart rate increase or feeling shaky.

Post bronchodilator testing should be performed as per baseline. It is recommended that slow vital capacity is performed pre and post bronchodilator as this can help identify any improvement in early airway closure/gas trapping.

10. Overcoming Challenges to Testing

Table 5: Outlining challenges during testing and how to manage these challenges

Challenge	Steps to overcome the challenge
Participant wants to stop testing early	Explain reasons why you are testing. Listen to their reasons for wanting to stop. Allow them to rest. Encourage the participant to continue. Alternatively reschedule or discontinue testing.
Slow start	Re-explain, re-demonstrate. Show the participant on the flow/volume graph how you are looking for a tall, pointed peak.
Early termination	Re-explain and re-demonstrate. Show them what is the required on the flow/volume and volume time graphs. Encourage to continue blowing during testing until told to stop.
Poor mouth seal	Watch the participant carefully. Stop the blow if air leakage is noticed. Re-explain and re-demonstrate. Consider alternative mouthpiece.
Language barriers	Ensure interpreter is available for test. Exercise patience. Use extra body language and non-verbal cues to communicate.

Persistent coughing	Rest. Give participant water and tissues. Encourage participant to cough to clear as much phlegm as possible before next blow.
Variable effort	Show the participant the flow volume and volume time curves to demonstrate how their changing techniques are giving different results; explain that you want every blow to look identical.
Obstruction of the mouthpiece with the tongue	Tell participant to place the mouthpiece on top of the tongue or keep the tongue on the bottom of the mouth out of the way of airflow.
Bending	Tell the participant to stay upright.

11. Reporting Results

Volumes are expressed in litres (L) and are reported at body temperature and pressure saturated with water vapour (BTPS). Most spirometers will automatically convert results from ambient temperature and pressure, saturated (ATPS) to BTPS.

The following measurements will be recorded for each of the spirometry readings. Both the absolute value, and the value relative to predicted should be included in the report.

Table 6: Values reported from spirometry

Measurement
FVC (L)
FEV_1 (L)

FEV_1/FVC
PEF (either L/min or L/s)
VC

For clarity, the terminology used for reporting/interpreting by ARTP is outlined below:

- Technical report: Were acceptability and repeatability criteria met? Information on medication taken, smoking history, any issues during testing – **This should be done by the person doing the test.**
- Clinical report: Does spirometry show normal/obstructive/restrictive pattern? If abnormal, grade severity of abnormality (i.e. mild, moderate, severe, very severe). If pre and post, was there a significant response to a bronchodilator? – This **can be done by the person supervising the test or the person performing clinical interpretation, depending on job role**
- Clinical interpretation: How does the pattern, alongside the patient examination, history, and other investigations (e.g. imaging) support the diagnosis and/or management plan for the patient? – This **should be considered by a person with clinical responsibility for managing the patient pathway**
- The patient should be informed of the diagnosis/findings and treatment started if appropriate as per national guidelines.
- Follow up in 8 weeks to assess effectiveness of treatment.

THE GUIDELINES FOR TESTING PEADIATRICS (<16 years)

N/B – protocol is the same as adults however for positive reversibility see below-

Children **≥12% increase in FEV_1 from baseline**

Adults **≥12% AND ≥200 mL increase in FEV_1**

It is recommended that a technical report is written for each test, by the healthcare professional who performed the test. Sometimes the causes of different errors/deviations from normal can only be known by the person in the room at the time of testing, so it is important that any factors that may affect clinical reporting or interpretation of the results are documented.

Clinical reporting and clinical interpretation should always consider the technical comments and the patient demographics as these will impact on how much value to place on the numbers. Consideration of the shape of the flow volume loop should always be done prior to reviewing any numerical values as this will identify the nature of

the disease pathology (normal/obstructive/restrictive). In most cases, the numbers will then just confirm what has already been identified.

There are multiple different guidelines for using spirometry in the diagnosis and management of specific conditions. These are also updated as new evidence becomes known. There should be clear local policies in place for which guidelines are used in the specific setting, and these should be reviewed regularly. Each guideline has limitations, so these should be acknowledged. It should also be emphasised that spirometry alone cannot diagnose any specific condition and should always be interpreted in light of the patient's history, examination, and other test results. Ultimate responsibility for how the spirometry results are used in the patient's diagnosis, treatment and management lies with the referring healthcare professional.

13. References

American Thoracic Society/European Respiratory Society (ATS/ERS). (2022). *Lung Function Interpretation Standards*. American Journal of Respiratory and Critical Care Medicine, 205(1), 144–157.

ARTP Position Statement: Race-neutral Spirometry Reference Values (2025) *https://www.artp.org.uk/_userfiles/pages/files/news/gliglobalartpstatement2025.pdf*

ARTP Standard: Respiratory and Sleep Physiology Diagnostic Reporting (2025) *https://www.artp.org.uk/_userfiles/pages/files/standards/standard/artp_respiratory_and_sleep_physiology_diagnostic_reporting_standard_v1.pdf*

Cooper BG. An update on contraindications for lung function testing. Thorax. 2011 Aug;66(8):714-23. doi: 10.1136/thx.2010.139881. Epub 2010 Jul 29. PMID: 20671309.

Davis, B.E., Blais, C.M., & Cockcroft, D.W. (2018). Methacholine challenge testing: Comparative pharmacology. *Journal of Asthma and Allergy*, 11, 89-99.

Graham, B.L., Steenbruggen, I., Miller, M.R., Barjaktarevic, I.Z., Cooper, B.G., Hall, G.L., Hallstrand, T.S., Kaminsky, D.A., McCarthy, K., McCormack, M.C., & Oropez, C.E. (2019). Standardization of spirometry: 2019 update. An official American Thoracic Society and European Respiratory Society technical statement. *American Journal of Respiratory and Critical Care Medicine*, 200(8), e70-e88.

Sylvester, K.P., Clayton, N., Cliff, I., Hepple, M., Kendrick, A., Kirkby, J., Miller, M., Moore, A., Rafferty, G.F., O'Reilly, L., & Shakespeare, J. (2020). ARTP statement on pulmonary function testing: 2020. *BMJ Open Respiratory Research*, 7(1), e000575.

ARTP c/o Executive Business Support
Unit E1, City Wharf, Davidson Road,
Lichfield, Staffordshire, WS14 9DZ

Tel: 01543 442141
E-mail: ***spirometry@artp.org.uk***