Your essential guide to spirometry

What is spirometry?

Spirometry is used to measure lung volumes and air flow. Alongside clinical assessment, it is an essential tool used in the diagnosis, assessment and monitoring of Chronic Obstructive Pulmonary Disease (COPD)[1], may contribute to the diagnosis of asthma and detect restrictive respiratory conditions.[2]

Who should undertake spirometry?

Poorly performed spirometry is misleading and potentially harmful. Spirometry should only be undertaken by healthcare professionals who are trained and certified as competent (certificated) in performing and/or interpreting the tests.[3,4,5] Regular updates and quality audits are fundamental to ensuring the quality of spirometry testing.

Association for Respiratory Technology & Physiology
http://www.artp.org.uk/

Association for Respiratory Technology & Physiology
Breathing Inspiration and Quality into Respiratory Healthcare

The ARTP spirometry certification is now the recognised competency assessment qualifications for all practitioners performing spirometry. The courses are based on the competency assessment framework, "Quality Assured Spirometry" which sets out the minimum competency standards for healthcare professionals performing spirometry

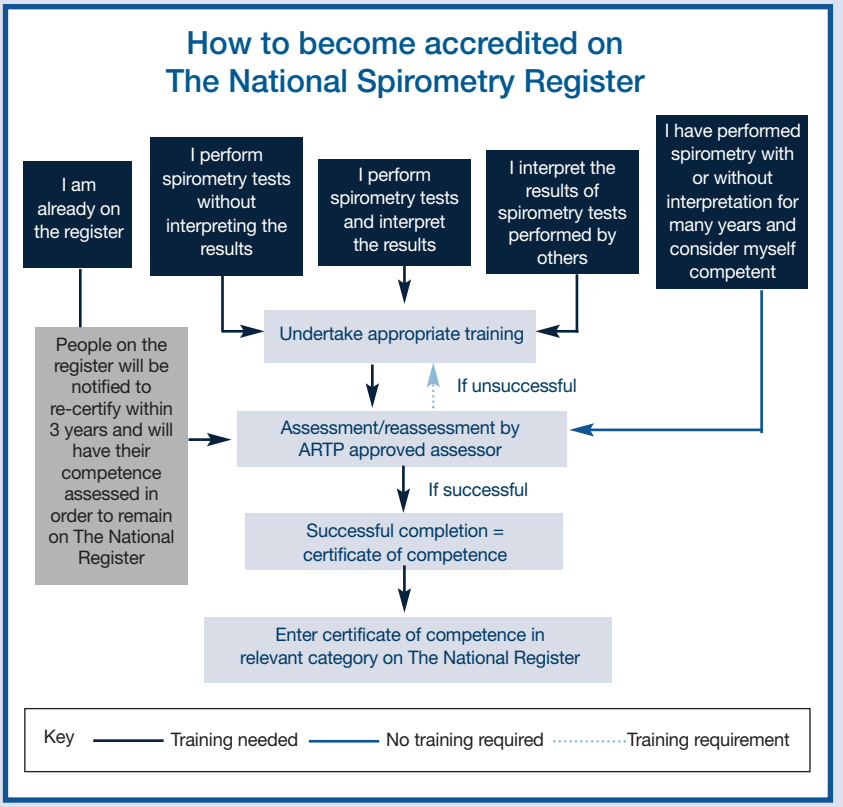
Institute for Clinical Science and Technology
https://www.clinicalscience.org.uk/5-steps-to-the-artp-register/

The Institute of Clinical Science & Technology

A primarily online course, endorsed by PCRS, as appropriate and relevant to primary care healthcare professionals. The course is administered by the Institute of Clinical Science and Technology (ICST), the ARTP's training partner. ICST also host the certification process and the National Spirometry Register. The online course is supported by a half day practical skills workshop for the Full and Foundation levels run by ARTP accredited trainer/assessors.

Diagnostic Spirometry: National Register of certified professionals and operators

1. The National Register (https://artp-register.org.uk/) is the list of practitioners and operators who have demonstrated their competence in spirometry. A National Register will enable transparency within the NHS and to the public about the competence of healthcare professionals to perform and/or interpret spirometry. This list already exists and many healthcare professionals are already on it after undertaking training in recent years.
2. The National Register is not mandatory. However PCRS believes having a national certification programme and register represents the best way to ensure quality and consistency. We expect that introducing the scheme will raise the quality of diagnosis of respiratory disease because it will ensure that all practitioners involved in spirometry have their skills assessed and are certified as competent.
3. The Care Quality Commission (CQC) has indicated that they will check on the quality of spirometry by looking at whether practices are delivering spirometry in line with the standards document. They will take into account whether they are on the National Register in assessing their competence.



CQC expects practices to be able to demonstrate

- How they ensure spirometry equipment is cleaned and maintained according to the manufacturer's guidance (KLOE S3 – reliable systems, processes and practices).
- That all staff who perform spirometry tests or interpret results are competent (KLOE E3 - staff skills, knowledge and experience). They can demonstrate this if the staff are on the National Register.

How to join the register

There are several different routes you can take in order to join the National Register. The most suitable route for you depends on whether you need training or consider yourself competent at performing and/or interpreting spirometry, or whether you are already on the register and are applying for re-certification.

For more information visit
https://www.clinicalscience.org.uk/5-steps-to-the-artp-register/

PCRS has produced a series of Frequently Asked Questions about the register – see https://www.pcrs-uk.org/spirometry-assessment-certification-and-national-register-faqs

What are the training options?

1. The Association of Respiratory Technology and Physiology (ARTP) spirometry course (http://www.clinicalscience.org.uk/5-steps-to-the-artp-register/step-two-the-course/), developed in conjunction with PCRS, is a blended learning programme which comprises online training, and a half day practical skills workshop. PCRS has endorsed this course and recommends it as appropriate and relevant to primary care practice. The course is administered by the Institute of Clinical Science and Technology (ICST), the ARTP's training partner.

2. The training can be undertaken at 3 levels
    1. **Full** – both performing and interpretation
    2. **Foundation** – performing only
    3. **Interpretation** – interpreting only

3. There is an online element for all three levels, and a half day practical skills workshop for Full and Foundation, but not for Interpretation only. The workshops will be run by individuals who are ARTP accredited trainer/assessors. These may be respiratory physiologists, specialist respiratory nurses, primary care nurses/nurse practitioners, physiotherapists, or GPs.

4. The costs of the ARTP training are:
    1. **Full certificate** (blended/online) – £500
    2. **Foundation certificate** (blended/online) – £500
    3. **Interpretation certificate** (online only) – £450

    This cost includes assessment and entry onto the register.
    You can see a full table of costs at https://www.clinicalscience.org.uk/artp-spirometry-programme-purchasing/.

5. There are still other training options in spirometry from other individuals and organisations which provide training. All of them should be aiming to prepare healthcare professionals to deliver spirometry to the standard set out in the NHSE document 'A guide to performing quality assured diagnostic spirometry', and to be successful when they undergo assessment to join the National register. PCRS supports the availability of a range of training routes. If you choose an independent training provider, you will still need to sign up to be assessed for certification by ARTP, in order to join the National register.

    If you choose to receive training from independent training providers, you will need to find out the cost from them.

6. If CCGs or other groups are planning to train groups of healthcare professionals, there may be special arrangements for group training from training providers. Consult with individual training providers.

7. If your practice is providing spirometry in-house, it will probably be the practice that funds your training. If you are involved in a spirometry service that your CCG or other organisation is running, it is likely that they will fund you. In some instances, quality improvement money has been used – either from local budgets or Sustainability Transformation Partnerships (STPs) or national funds.

Recertification

1. If you are already on the National register, you will be called to undergo reassessment and recertification every three years.
2. You may choose to have some refresher training at this point, or you may wish simply to register for recertification without training.
3. The costs of recertification are:
    1. Re-certification (Full) – £150
    2. Re-certification (Foundation) – £150
    3. Re-certification (Interpretation) – £150
4. For more details, see https://www.clinicalscience.org.uk/spirometry-re-certification/

Types of spirometry testing[4]

- **Baseline testing** Used to investigate lung function where diagnosis has not been established.
- **Post-bronchodilator testing**
  - **Investigative**: To diagnose obstructive conditions where baseline spirometry shows an obstructive pattern
  - **Monitoring**: To monitor clinical progress in diagnosed asthma and COPD
- **Reversibility testing** May help to differentiate asthma from COPD.

What equipment is required to conduct spirometry?[4,6]

- Spirometer (must meet ISO standard 26783).
  - Small hand-held meters which provide digital readings (but no visual display) are a cheap option which may be useful as a screening tool to identify people with abnormal readings who should be assessed by full diagnostic spirometry[5]
- One-way disposable mouthpieces and nose clips
- Bacterial and viral filters (selected patients with any risk of infection)
- Accurate height measures – calibrated according to manufacturer's instructions
- Short-acting bronchodilators for reversibility testing and suitable means for delivery (volumatic/nebuliser)

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Calibration, verification and maintenance of spirometry equipment[3-6]

Verification of spirometry test equipment should be performed using a certificated 3 litre syringe and following the manufacturer's recommended procedures. For a device to be within calibration limits it must read +/- 3% of true.[4]

Verification should be verified prior to each clinic/session or after every 10th patient (whichever comes first).

A calibration log should be maintained.

Spirometers should be cleaned and service/maintenance processes carried out regularly according to the manufacturer's instructions and in line with local and national guidance for infection control and equipment maintenance.

Calibration should be carried out as per manufacturer's instructions or if there is a discrepancy of more than 3% during verification

What measurements are undertaken using spirometry?[3]

- **Relaxed or slow vital capacity (VC)**
  The volume of air that can be slowly expelled from the lung from maximal inspiration to maximum expiration
- **Forced vital capacity (FVC)**
  The volume of air that can be forcibly expelled from the lung from maximal inspiration to maximum expiration
- **Forced Expiratory Volume in 1 second (FEV_1)**
  The volume of air that can be forcibly expelled from maximum inspiration in the first second
- **FEV_1/FVC ratio**
  The FEV_1/FVC ratio is the FEV_1 expressed as a percentage of the FVC (or VC if that is greater). i.e. the proportion of the vital capacity exhaled in the first second. It distinguishes between a reduced FEV_1 due to restrictive lung volume and that due to obstruction. Obstruction is defined as an FEV_1/FVC ratio less than 70%
- **Forced Expiratory Volume in 6 seconds (FEV_6)**
  The volume of air that can be forcibly expelled from maximum inspiration in six seconds. This measurement is sometimes used as an alternative for FVC. Similarly FEV_1/FEV_6 is sometimes used instead of FEV_1/FVC.

Abnormal spirometry is divided into restrictive and obstructive ventilatory patterns.

- Restrictive patterns appear in conditions where the lung volume is reduced e.g. interstitial lung diseases, scoliosis. The FVC and FEV_1 are reduced proportionately
- Obstructive patterns appear when the airways are obstructed e.g. due to asthma or COPD. The FEV_1 is reduced more than the FVC

Predicted normal values can be calculated and depend on age, sex, height, mass and ethnicity. FEV_1 is often expressed as a percentage of the predicted value for any person of similar age sex, and height with adjustments for ethnic origin. FEV_1 %predicted is used to classify the severity of COPD. National and international guidelines use the levels of FEV_1 <80%, <50% or <30% predicted to define moderate, severe or very severe disease.

Common errors in spirometry testing[4]

- **Poor seal around mouthpiece**
- **Hesitation or false start**
- **Early termination of exhalation: a 'short blow' which has not achieved the full FVC**
- **Poor intake of breath**
- **Poor forced expiratory effort**
- **Cough during procedure**
- **Incorrect data entered into the spirometer prior to testing**
- **Spirometer not calibrated and verified**

Contraindications to spirometry testing[3-6]

Absolute

- Active infection e.g. AFB positive TB until treated for 2 weeks
- Conditions that may cause serious consequences to health if aggravated by forced expiration e.g. dissecting/unstable aortic aneurysm, pneumothorax, recent surgery (abdominal, thoracic, neurosurgery, eye surgery)

Relative

- Suspected respiratory infection in the last 4-6 weeks requiring antibiotics or steroids
- Undiagnosed chest symptoms e.g. haemoptysis
- Any condition which may be aggravated by forced expiration e.g. prior pneumothorax, history of myocardial infarction, stroke or embolism in the last 3 months, previous thoracic, abdominal or eye surgery
- Perforated ear drum
- Acute disorders such as nausea and vomiting
- Confusion, communication problems

Adjusting Caucasian reference values to other ethnic groups

The BTS/ARTP guidelines suggest that for Japanese, Polynesian, Indian, Pakistani and African patients, and those of African descent, reference values multiplied by a factor of 0.90 should be used[6]

The guidance provided here has been adapted from the following resources and publications:-

1. National Institute for Health and Care Excellence. Management of chronic obstructive pulmonary disease (COPD) in adults in primary and secondary care (partial update) 2010 http://www.nice.org.uk/CG101
2. BTS/SIGN British guideline on the management of asthma - https://www.brit-thoracic.org.uk/standards-of-care/guidelines/btssign-british-guideline-on-the-management-of-asthma/ Last accessed 25/03/2019
3. Spirometry PCRS-UK opinion Sheet Number 1, version 5. 2012. Available at https://www.pcrs-uk.org/resource/Opinion-sheets/spirometry-opinion-sheet
4. A guide to performing quality assured diagnostic spirometry. 2013 Primary Care Commissioning. Available at http://www.pcc-cic.org.uk/article/guide-quality-assured-diagnostic-spirometry
5. Mark L Levy, Philip H Quanjer, Booker Rachel, Brendan G Cooper, Stephen Holmes & Iain R Small. Diagnostic Spirometry in Primary Care: Proposed standards for general practice compliant with American Thoracic Society and European Respiratory Society recommendations. A Primary Care Respiratory Society UK (PCRS-UK) document, in association with the Association for Respiratory Technology & Physiology (ARTP) and Education for Health. *Prim Care Respir J.*2009;18:130–147. http://dx.doi.org/10.4104/pcrj.2009.00054
6. Guidelines for the measurement of respiratory function. Recommendations of the British Thoracic Society and the Association of Respiratory Technicians and Physiologists. Respir Med 1994; 88: 165–194

Further Information for Patients
http://patient.info/health/spirometry-leaflet
http://www.artp.org.uk/en/patient/lung-function-tests/pretest-info.cfm

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