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]

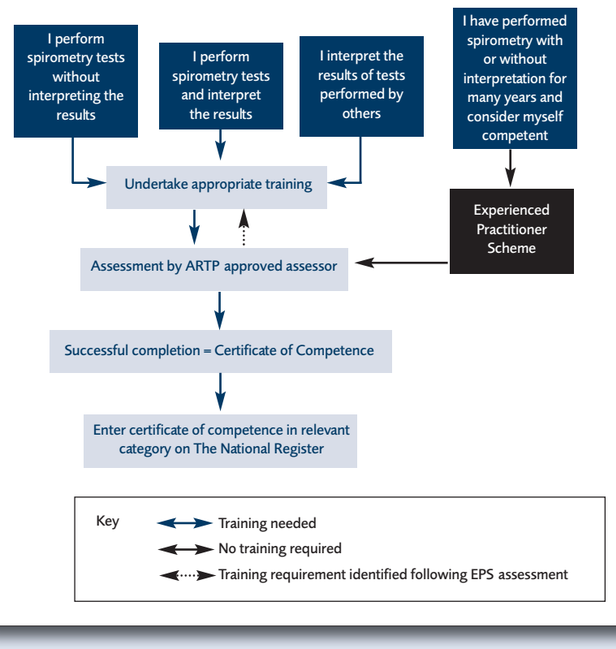
Diagnostic Spirometry: National Register of certified professionals and operators

As part of a phased introductory process starting in April 2017 all healthcare practitioners in England will be required to demonstrate that they are competent to perform and/or interpret spirometry and join a register of certified practitioners. The new scheme sets out how healthcare professionals performing and/or interpreting diagnostic spirometry should be trained, assessed and certified.

The key principles of the National register are:-

- Diagnostic spirometry must meet the Association for Respiratory Technology and Physiology (ARTP) standards
- Education and training must be flexible and accessible
- Assessment and verification process must include recognition of prior experience and competence

How to become accredited on the National Spirometry Register



The register has three levels of competency assessment

- **Foundation**: those who have been assessed as competent to perform safe, accurate and reliable spirometry tests without interpretation
- **Full**: those who have been assessed as competent to perform and interpret spirometry in terms of physiological changes
- **Interpretation Only**: those who have been assessed as competent in interpretation only

THE CERTIFICATION SCHEME TO RAISE STANDARDS OF SPIROMETRY FOR RESPIRATORY DIAGNOSIS:

- Recognises the distinct and separate skills of performing spirometry, interpreting spirometry and diagnosing respiratory conditions where spirometry results form part of the whole picture.
- Enables practitioners who are experienced and confident in either performing and/or assessing spirometry and consider themselves competent to be assessed and certified through an experienced practitioner scheme.
- Supports practitioners who are less confident about their skills to access the appropriate training.
- Recognises that providing a good diagnostic spirometry service may take different forms in different places and is not prescriptive about the setting in which spirometry takes place.
- Will be phased in gradually up to March 2021.

FURTHER INFORMATION
https://www.pcc-cic.org.uk/article/quality-assured-diagnostic-spirometry
http://www.artp.org.uk/en/spirometry/spiro-register/

What measurements are undertaken using spirometry?[3]

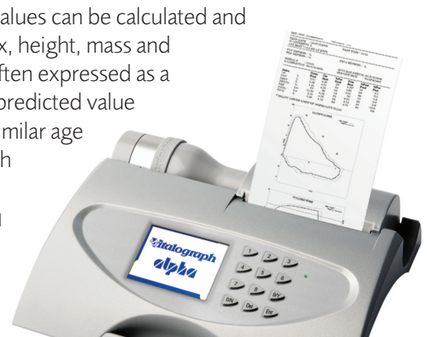
- **Relaxed or slow vital capacity (VC)**
  The volume of air that can be slowly expelled from the lung from maximal inspiration to maximum expiration
- **Forced vital capacity (FVC)**
  The volume of air that can be forcibly expelled from the lung from maximal inspiration to maximum expiration
- **Forced 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.



Who should undertake spirometry?

Poorly performed spirometry is meaningless. Spirometry should only be undertaken by healthcare professionals who are trained and competent (accredited) in performing (and ideally, interpreting) the tests.[3,4,5] Regular updates and quality audits are fundamental to ensuring the quality of spirometry testing.

Accredited training courses include:-

Institution	Course
http://www.artp.org.uk/ Association for Respiratory Technology & Physiology	The ARTP with the British Thoracic Society (BTS) offer a variety of training methods and an accreditation system to ensure acceptable standards of spirometry testing and interpretation.
https://www.educationforhealth.org/ Education for Health	Education for Health have a range of Spirometry courses written by experts, including workshops for those who simply need to feel more confident recording accurate measurements. The spirometry modules are developed with the Association of Respiratory Technology & Physiology (ARTP) and supported by the British Thoracic Society (BTS).

Types of spirometry testing[4]

- **Baseline testing** Used to investigate lung function where diagnosis has not been established.
- **Post-bronchodilator testing**
  - o **Investigative**: To diagnose obstructive conditions where baseline spirometry shows an obstructive pattern
  - o **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).
  - o 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]

Calibration 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] Calibration 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.

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

COMMON ERRORS IN SPIROMETRY TESTING[6]

- **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**

Adjusting Caucasian reference values to other ethnic groups. To apply these, multiply the FEV_1 and FVC by the factors below[6]

Population	FEV_1	FVC
Hong Kong Chinese	1.0	1.0
Japanese American	0.89	-
Polynesian	0.9	0.9
North Indian and Pakistani	0.9	0.9
South Indian, African	0.87	0.87

The guidance provided on this wall chart 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. British Thoracic Society – Scottish Intercollegiate Guideline Network. British Guideline on the Management of Asthma. *Thorax* 2008;**63**(Suppl 4): 1-121 Last Update October 2014. Available from https://www.brit-thoracic.org.uk/guidelines-and-quality-standards/asthma-guideline/
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. Spirometry in COPD Protocol. Primary Care Respiratory Society UK 2010. Available at https://www.pcrs-uk.org/resource/Nurse-tools/pcrs-uk-protocol-spirometry-copd-pdf

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

http://www.pcrs-uk.org