# Differentiating Asthma from COPD

*By Bernard Garbe, updated (2021) by Charlene Mhangami and Helen Venn.*

Whilst asthma and chronic obstructive pulmonary disease (COPD) are different diseases they cause similar symptoms, which can present a challenge in identifying which of the two diseases a patient is suffering from. A study by Tinkelman et al (2006) showed that among subjects with a spirometry-based study diagnosis of COPD, 121 (51.5%) reported a prior diagnosis of asthma without concurrent chronic bronchitis or emphysema (CBE) diagnosis, 89 (37.9%) reported a prior diagnosis of CBE, and 25 (10.6%) reported no prior diagnosis of obstructive lung disease.[i]

There are, however, some important distinctions between asthma and COPD. COPD causes chronic symptoms and narrowed airways which do not respond to treatment to open them up. In the case of asthma the constriction of the airways through inflammation tends to come and go and treatment to reduce inflammation and to open up the airways usually works well.

COPD is more likely than asthma to cause a chronic cough with phlegm and is rare before the age of 35 whilst asthma is common in under-35s. Disturbed sleep caused by breathlessness and wheeze is more likely in cases of asthma, as is a history of allergies, eczema, and hay fever. Differentiating between COPD and asthma requires a history of both symptoms and spirometry. The spirometry history should include post bronchodilator measurements, the degree of reversibility and, ideally, home monitoring which gives a history of diurnal variation.

Many patients have features of both COPD and asthma 'asthma-COPD overlap' (ACO) however these terms do not refer to a single disease entity. The clinical phenotypes in these patients are likely caused by a range of different underlying mechanisms.[ii]

## What are the definitions?

**Airflow Obstruction:** Both asthma and COPD are characterised by airflow obstruction. Airflow obstruction is defined as a reduced FEV1 and a reduced FEV1/FVC ratio, such that FEV1 is less than 80% of that predicted, and FEV1/FVC is less than 0.7[iii]

**Z Scores:** Z-scores can be useful for accurately defining the degree of airflow obstruction. A Z-score is a number that indicates how many standard deviations (SD) a spirometric measurement is from its predicted value. Z-scores are free from bias due to age, height, sex and ethnic group, and are therefore particularly useful in defining the lower and upper limits of normal. The FEV1/FVC (or FEV1/VC) must be below the LLN (z-score-1.645) to be classed as obstructive and severity grading is then based on FEV1 z-score.[iv]

**Asthma:** Asthma is a chronic respiratory disease usually associated with persistent airway hyperresponsiveness and chronic inflammation. It is characterized by variable symptoms of wheeze, shortness of breath, chest tightness and/or cough and by variable expiratory airflow limitation. Both symptoms and airflow limitation characteristically vary over time and in intensity. These variations are often triggered by factors such as exercise, allergen or irritant exposure, change in weather or viral respiratory infections.[v]

**COPD:** COPD is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and chronic airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors including abnormal lung development. Chronic inflammation causes structural changes, narrowing of the small airways and destruction of the lung parenchyma that leads to the loss of alveolar attachments to the small airways and decreases elastic lung recoil. In turn, these changes diminish the ability of the airways to remain open during expiration.[vi]

**Table 1: Main differences between COPD and asthma**

| History | COPD | Asthma |
|---|---|---|
| Age | Over 35 | Any age |
| Dyspnoea varies | A little | A lot |
| Onset of dyspnoea | Gradually | Sudden bouts |
| Dyspnoea at rest | Uncommon | Common |
| Smoking history | > 20 pack years | Variable |
| Wheezing as a child | Uncommon | Common |
| Productive cough | For many years | Associated attacks |
| Morning coughing fits | Common | Uncommon |
| Nocturnal cough wakes | Uncommon | Common |
| Family history | Uncommon | Usually |
| Atopy | Unusual | Often |
| Steroid responsiveness | Weak | Strong |
| Anticholinergic response | Usually good | Beta-agonists better |
| Beta-agonist response | Anticholinergics better | Very good |

***Note:*** *COPD is more likely to affect older people. The vast majority of sufferers are aged 70 to 85. COPD patients also tend to have frequent acute respiratory infections which can also accelerate the decline of FEV1.*

**Table 2: Differentiating COPD and asthma with Spirometry**

| Spirometry | COPD | Asthma |
|---|---|---|
| VC | Reduced | Nearly normal |
| FEV1 | Reduced | Reduced in attack |
| FVC (or FEV6) | Reduced | Nearly normal |
| FEV1 Ratio (of VC/FVC/FEV6) | Reduced anytime | Reduced in attack |
| FEV1 as % of predicted (or SDS*) | <LLN | Reduced in attack |
| Bronchodilator reversibility | A little | Marked if in attack |
| Serial spirometry | Progressive deterioration | Constant or erratic |
| Home monitoring | Use for alerts | Use for variability |
| Peak Flow measurement | Not useful | Use for variability |
| Peak Inspiratory Flow measurement | Not useful | Not useful |

** SDS = Standard Deviation Score. In comparing your test subject to a 'normal population' using SDS or LLN (Lower Limit of Normality) is preferred to percent of predicted because the latter gives false negatives for younger people and false positives for older people.*

## Serial Spirometry

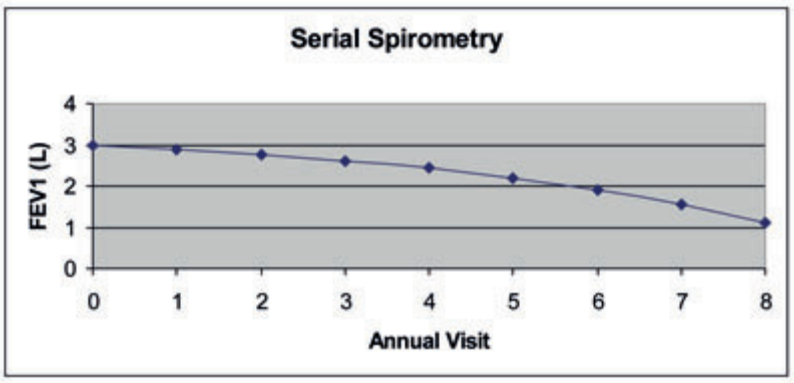
The most important objective measurement of all in lung disease management is serial spirometry. Taking a single lung function measurement may or may not yield useful information. But comparing that spirometry test data, particularly the FEV1, with data from the previous few years yields invaluable, yet simple, information.

As a normal growing child, it is obvious that the lung function values will rise according to the individual's growth centiles. After achieving adulthood, and a period of a few years without change in values, every normal person will have a gradual decline lung function. In disease this pattern may radically change.

In older people, the rate of decline of a COPD sufferer can be two or three times the FEV1 decline in normal people. Medical intervention can bring this back to a normal rate of decline, but not back to the level of a normal person. For this reason, early detection is crucial. It is very possible to detect this accelerated rate of decline even when the patient is in 'normal range'. An accelerated rate of decline detected by serial spirometry is abnormal, no matter if the patient still has 'good' lung function values.[vii]

A serial spirometry plot like the one pictured here is typical of uncontrolled COPD, such as a sufferer who keeps smoking.[viii]

Serial spirometry is impossible without spirometry quality control. Without consistently accurate measurements, the serial data will be useless, or worse, misleading. Operator training and quality control are both key to maintaining spirometry quality.




*Graphic: Example of typical serial spirometry plot in uncontrolled COPD*

## Spirometry Quality Control

**Spirometer accuracy:** Verifying the calibration of a spirometer is a is a two minute check to be completed immediately prior to starting an asthma or COPD clinic and is as simple as setting the device to 'calibration verification' mode (or 'accuracy check' in older models) then following the routine on the device to pump air through using a 3L syringe. If all is well the device will measure 3L ±3%. It is important not to confuse 'calibration' with 'calibration verification'. Calibration of a spirometer is a certification of traceability to international measurement standards which may or may not involve adjustment prior to certification, whereas calibration verification is a routine check to be completed by clinics. Many modern spirometers do not require routine calibration post manufacture.

**Test acceptability & usability:** Acceptability of a spirometry session is assessed against a set of criteria to determine whether a maximal effort was achieved and acceptable FEV1 and/or FVC measurements were obtained. However, in some cases, maneuvers that do not meet all of the criteria may be the best that the patient is able to do on that occasion, and although the FEV1 and/or FVC measurements are not technically acceptable, they may be clinically useful (i.e., "usable").

**Table 3: Summary of Acceptability, Usability, and Repeatability Criteria for $FEV_1$ and FVC (from ATS/ERS, 2019).**[ix]

| | Required for Acceptability | | Required for Usability | |
|---|---|---|---|---|
| **Acceptability and Usability Criterion** | **$FEV_1$** | **FVC** | **$FEV_1$** | **FVC** |
| Must have BEV ≤5% of FVC or 0.100 L, whichever is greater | Yes | Yes | Yes | Yes |
| Must have no evidence of a faulty zero-flow setting | Yes | Yes | Yes | Yes |
| Must have no cough in the first second of expiration* | Yes | No | Yes | No |
| Must have no glottic closure in the first second of expiration* | Yes | Yes | Yes | Yes |
| Must have no glottic closure after 1s of expiration | No | Yes | No | No |
| Must achieve one of these three EOFE indicators: | No | Yes | No | No |
| 1. Expiratory plateau (≤0.025 L in the last 1s of expiration) | | | | |
| 2. Expiratory time ≥15 s | | | | |
| 3. FVC is within the repeatability tolerance of or is greater than the largest prior observed FVC† | | | | |
| Must have no evidence of obstructed mouthpiece or spirometer | Yes | Yes | No | No |
| Must have no evidence of a leak | Yes | Yes | No | No |
| If the maximal inspiration after EOFE is greater than FVC, then FIVC − FVC must be ≤0.100 L or 5% of FVC, whichever is greater‡ | Yes | Yes | No | No |
| Repeatability criteria (applied to acceptable FVC and FEV1 values) | | | | |
| Age >6 yr: The difference between the two largest FVC values must be ≤0.150 L, and the difference between the two largest FEV1 values must be ≤0.150 L | | | | |
| Age ≤6 yr: The difference between the two largest FVC values must be ≤0.100 L or 10% of the highest value, whichever is greater, and the difference between the two largest FEV1 values must be ≤0.100 L or 10% of the highest value, whichever is greater | | | | |
| Definition of abbreviations: BEV = back-extrapolated volume; EOFE = end of forced expiration; FEV0.75 = forced expiratory volume in the first 0.75 seconds; FIVC = forced inspiratory VC.<br>The grading system (Table 10) will inform the interpreter if values are reported from usable maneuvers not meeting all acceptability criteria.<br>*For children aged 6 years or younger, must have at least 0.75 seconds of expiration without glottic closure or cough for acceptable or usable measurement of FEV0.75.<br>†Occurs when the patient cannot expire long enough to achieve a plateau (e.g., children with high elastic recoil or patients with restrictive lung disease) or when the patient inspires or comes off the mouthpiece before a plateau. For within-maneuver acceptability, the FVC must be greater than or within the repeatability tolerance of the largest FVC observed before this maneuver within the current prebronchodilator or the current post-bronchodilator testing set.<br>‡Although the performance of a maximal forced inspiration is strongly recommended, its absence does not preclude a maneuver from being judged acceptable, unless extrathoracic obstruction is specifically being investigated. | | | | |

**Repeatability:** The goal of spirometry testing is to achieve a minimum of three technically acceptable FEV1 and three technically acceptable FVC measurements. Note that acceptable FEV1 and acceptable FVC measurements are not necessarily from the same maneuver. The operator must ensure that sufficient time is allowed between maneuvers for the patient to sufficiently recover and agree to perform another maximal maneuver. FVC repeatability is achieved when the difference between the largest and the next largest FVC is ≤0.150 L for patients older than 6 years of age[x] and ≤0.100 L or 10% of largest FVC, whichever is greater, for those aged 6 years or younger[xi,xii]. For FEV1 repeatability, the difference between the largest and the next largest FEV1 is ≤0.150 L for those older than 6 years of age and ≤0.100 L or 10% of the largest FEV1, whichever is greater, for those aged 6 years or younger. If these criteria are not met in three maneuvers, additional trials must be attempted, up to eight maneuvers in adults, although more may be done in children.[xiii]

Training & Over-reading: None of the above can be achieved without proper training. The use of over-reading for ECG interpretation is widely used, but over-reading spirometry reports is relatively new in primary care. New technology and centralization of spirometry clinics is making automation of over-reading possible and modern spirometry software includes quality and acceptability as standard.

## Home Monitoring

Home monitoring of lung disease is important to alert the patient of exacerbations and for providing invaluable objective data to the practitioner. Additionally, the patient may be given an 'action plan' for helping them to manage their condition or to know when to seek medical intervention. According to BTS/SIGN[xiv], written personalised asthma action plans (PAAPs) "are crucial components of effective self-management education" and "All people with asthma (and/or their parents or carers) should be offered self-management education, which should include a written personalised asthma action plan and be supported by regular professional review."

The use of mechanical peak flow meters may not be adequate for lung diseases other than asthma.[xv]

Today accurate and inexpensive home monitors are available which record FEV1 and even FEV6 as well as having the facility to set a personalised action plan for the patient. For PEF measurement in asthmatics, inexpensive electronic home monitors can also be used which avoids the need for paper records and misleading 'false reporting'.

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