Peak flow monitoring and microspirometry as aids to respiratory diagnosis in primary care

Introduction

The common chronic respiratory disorders diagnosed in primary care—asthma and chronic obstructive pulmonary disease (COPD)—are both characterised by airway obstruction. In asthma, this varies markedly with time and treatment, while in COPD, the airway obstruction is typically fixed and permanent. Some people have fixed obstruction with some degree of reversibility—the so-called asthma COPD overlap syndrome (ACOS).

Diagnosis involves careful history-taking and examination before moving on to physiological testing, being careful to keep in mind other respiratory and non-respiratory diagnoses that may cause breathlessness or cough. The pattern of symptoms over time and their response to treatment are also important, and earlier diagnoses should be re-interrogated if necessary. Always review an initial diagnosis and consider referral to a specialist if the response to treatment is poor or there are atypical features. Chronic sputum production, for example, is highly unusual in asthma and even in COPD should prompt consideration of bronchiectasis. Get a chest X-ray at the time of any new diagnosis of COPD, and if a suspected asthma case also has any atypical features.

Peak flow charting and microspirometry are inexpensive, easy-to-use, and provide useful information when assessing respiratory symptoms. They are, however, generally undervalued in guidelines and underused in primary care. The COVID pandemic, of course, made us question the safety of aerosol-producing tests such as spirometry, microspirometry, and peak flow testing. The use of spirometry, in particular, has plummeted. Recent evidence shows us that full spirometry is nowhere near returning to pre-pandemic levels, and the need to urgently resume services was highlighted in the UK's Health Service Journal in March 2023.[1]

With access to more formal respiratory function testing taking time to recover, it is still essential that when diagnosing asthma and COPD, we should always seek objective physiological confirmation of our diagnosis. This is where PEFR and microspirometry can be helpful.

Because of the potential to generate aerosols that can carry infection, many practitioners have, during the course of the pandemic, developed processes and methods for remote teaching of technique and assessment of results, both made eminently possible by the rapid advances seen in both the availability and the use of digital technologies. Video tutorials on using peak flow meters and microspirometers abound online, and patients can be directed to these; some practitioners have made their own for their patients.

This article will cover the use of peak flow monitoring and microspirometry in primary care as aids to the objective demonstration of airway obstruction, reversible or otherwise.

Images of a traditional peak flow meter (adult and mini) and a digital peak flow meter

Peak Flow Monitoring

The great advantages of peak flow measurement in asthma diagnosis are the low cost and ready availability of the equipment, as well as the ease with which peak flow measurement and periods of peak flow monitoring can be repeated. Measurements can and should start at once if a patient presents with acute symptoms. Demonstrating to yourself and a patient during an acute airway event that a peak flow reading can dramatically change with treatment can be very powerful in engaging future use of the peak flow meter and providing confidence in any diagnosis of reversible airway disease.

Repeated measurements and charting of peak expiratory flow have long been used for the diagnosis of asthma. Like many long-established and simple aids to diagnosis, the published evidence base for its use is surprisingly sparse. The latest NICE asthma guideline[2] cites a generally low and variable sensitivity, but it has a specificity of up to 0.99 in adults and 0.80 in children for peak flow monitoring in the diagnosis of asthma. This high specificity value does mean that if you have clear evidence of peak flow variability, you can be confident in this test for ruling asthma in as a diagnosis.

We know that sensitivity (the ability of a normal peak expiratory flow rate (PEFR) chart to rule out asthma) also improves if the monitoring is repeated, particularly if it can be recorded during times when people are experiencing symptoms.

Who should do this?

Setting up peak flow monitoring with a patient suspected of having asthma requires the healthcare professional to have the skills and the time to do it. Just like the correct use of an inhaler, teaching the correct use of a peak flow meter is not like falling off a log, and a surprising number of healthcare professionals don't know how to do it. Learn! It is not rocket science, either. Explaining and teaching effective peak flow monitoring does take a bit of time, but attention to correct diagnosis at the outset saves a great deal of time down the line. If there is not time to do the job at the first consultation, arrange for a review as soon as possible to go over it more thoroughly, but always get at least one peak flow and give them a meter and a chart before starting any treatment.

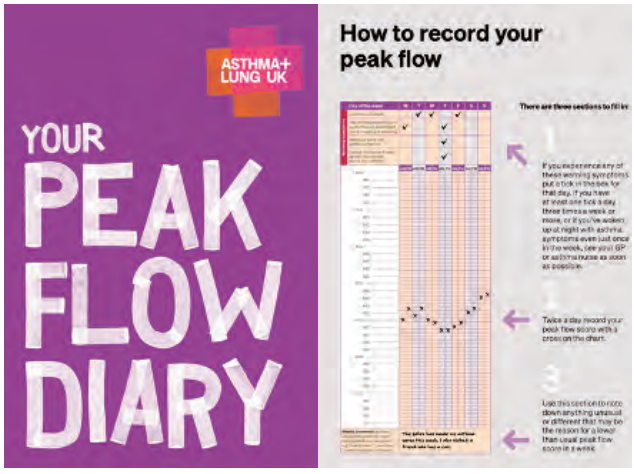
How to do it

Effective peak flow monitoring for diagnosis depends on:

1. Explaining to the patient or parent how valuable a period of peak flow monitoring is in helping to make a correct diagnosis. "This is a bit of a fuss, but it will really help us to get the right diagnosis, get you onto the right treatment, and make you better."
2. Correct teaching of how to use the peak flow meter. Best of three hard, fast blows and record the highest reading.
3. Having the patient or parent show you that they can perform peak flow measurements, correctly read the meter, and correctly plot that number on a chart. They must be able to do all three to make a meaningful peak flow chart.
4. Taking measurements twice daily, or more, for a sufficient period—usually at least 2-4 weeks—at a time when symptoms are present. Peak flow charting when introducing a trial of treatment is particularly worthwhile. Encourage measurement when symptoms are marked and when they are better. Pre- and post-exercise readings are also useful.
5. Knowing how to identify abnormal variability in peak flow.
6. Repeating the testing period at a later date if symptoms persist but initial testing is inconclusive or the diagnosis remains in doubt.

Peak expiratory flow (PEF) should be recorded as the best of three forced expiratory blows from total lung capacity with a maximum pause of two seconds before blowing. The patient can be standing or sitting. Further blows should be done if the largest two PEF are not within 40 l/min.

Charts are often provided with peak flow meters, but these are limited in duration. Asthma + Lung UK has an excellent web page that can support any discussions you have in the consultation, and a peak flow chart can be downloaded.

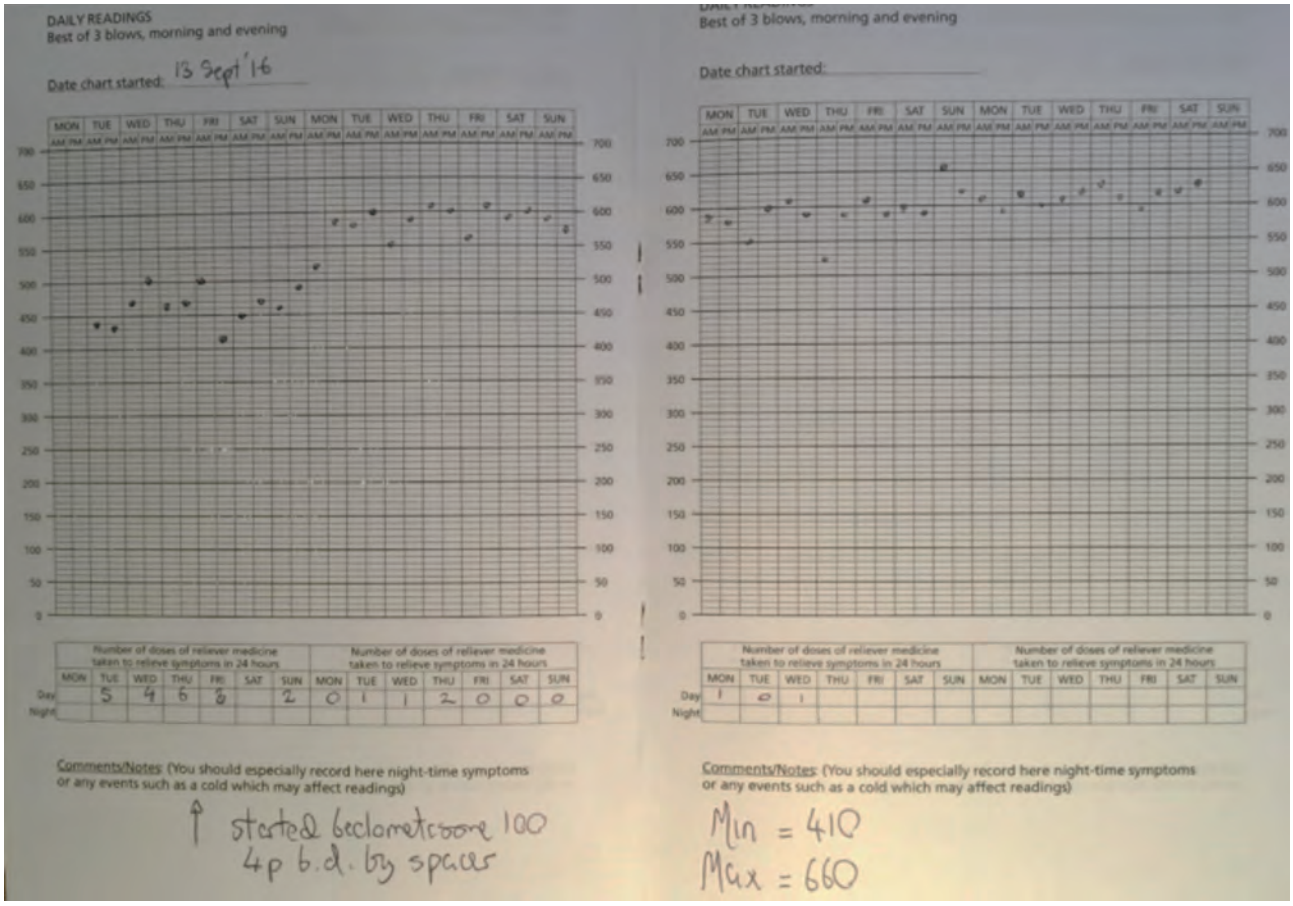


Asthma + UK peak flow diary that can be downloaded

Charting the readings on a graph is much preferable to just recording numbers since it allows better pattern recognition and easier identification of maximum and minimum readings. Digital applications and PEFR device attachments for smartphones to help record and chart results are becoming more available.

The age at which children become able to do reliable peak flow measurements cannot be easily defined. Most children aged 7 years and over will be able to perform meaningful peak flow measurements. Children should be prescribed a low-range peak flow meter.

For a patient with a suspected acute asthma attack that you are planning to treat with bronchodilators and/or oral corticosteroids, always measure peak flow before and after



Two-week peak flow tracing consistent with a diagnosis of asthma: a picture is worth a thousand words

treatment; this is good practice in any case as part of the assessment of the severity of the attack and may afterwards provide strong supportive evidence for an asthma diagnosis.

It is sometimes said that the accuracy of peak flow charting is poor. This can be mitigated by ensuring the method, purpose, and value of the charting are clearly explained and that it is made clear that charting does not need to continue once the diagnosis is made.

What is abnormal peak flow variability?

There are a variety of numerical definitions. Like blood pressure and blood glucose, peak flow variability is a continuous physiological variable, and cut-off points are arbitrary. One commonly used definition in guidelines is the difference between maximum and minimum expressed as a percentage of the mean peak flow, with more than 20% being considered abnormal. If the max-min difference is greater than 20% of the maximum reading (easier to find than the mean), then this is clearly abnormal.

As helpful as the numbers are, so is the pattern appearance of the graph. The most typical picture is of low readings with obvious saw tooth variability flattening out and rising as symptoms respond with time or treatment.

The illustration above shows the peak flow chart of a 55-year-old never-smoker with a one-year history of recurrent worsening cough and shortness of breath. His chest X-ray was normal. His symptoms had greatly improved with a one-week course of prednisolone but recurred when the steroids were stopped. The chart was done as he started on twice-daily inhaled corticosteroids with a spacer. It provides convincing objective evidence of significant peak flow variability, coinciding with the resolution of his symptoms. This is strongly supportive of an asthma diagnosis.

Remember occupational asthma

The possibility of occupational asthma should be kept in mind whenever you make a new asthma diagnosis in an adult. In addition to careful history-taking around occupation and

symptoms, a period of peak flow charting indicating when the patient is at work is vital. Patients in whom occupational asthma is suspected should be referred for specialist assessment but should chart their peak flow until seen. Further information about occupational asthma is available at https://www.asthmaandlung.org.uk/conditions/asthma/occupational-asthma

Does peak flow monitoring have any place in the diagnosis of COPD?

Peak flow measurement is not adequate for COPD diagnosis, but it can be informative. During the pandemic, PCRS developed a position statement on spirometry that encouraged the use of PEFR charting if full spirometry would otherwise delay the initiation of therapy for COPD beyond a reasonable period. This statement advises that for patients with suspected COPD, a tentative diagnosis using PEFR diary monitoring can be made because a PEFR <75% predicted suggests a degree of airflow obstruction. Then, with serial measurements over 2 weeks that do not vary but also remain low despite the use of salbutamol for symptom relief, a clinical suspicion can be objectively supported until confirmatory spirometry is performed. As asthma can develop at any age, and if late-onset asthma (or COPD with a substantial reversible component) is suspected, then peak flow charting in addition to spirometry can be valuable and provide additional useful diagnostic information.

Do patients with asthma need to continue to monitor their peak flow?

Usually not. But it is worth keeping their peak flow meter and knowing their best and lowest readings. Restarting peak flow measurements may be useful for some people as part of a personal asthma action plan. Most patients can effectively self-manage based on symptoms alone, but some are slow to recognise significant deteriorations, and they may find regular peak flow checking helpful.

Microspirometry

Simple, inexpensive microspirometers, programmed at each use with the patient's age, height, and sex, can give good, accurate readings of FEV_1 (forced expiratory volume in 1 second) and express this as percent predicted. The simplest and cheapest devices measure FEV_1 only, but some are now available cheaply that also provide FEV_6, FVC, and will calculate the FEV_1 /FVC ratio.

The necessary expiratory manoeuvre and the correct use of the instrument are more demanding than the measurement of peak flow, but it is possible both to teach their use and to supervise their performance by video link.

Microspirometer

These instruments are not a substitute for full diagnostic spirometry in COPD. But as with PEFR charting, until timely access to full diagnostic spirometry is possible, it is much better to obtain some results from microspirometry than to rely solely on clinical features for a diagnosis of COPD.

The simplest microspirometers are useful for investigating adults—especially symptomatic older smokers—for possible COPD. An FEV_1 of 80% predicted or less should prompt consideration of full diagnostic spirometry. Note that if COPD is being considered as a diagnosis, then diagnostic spirometry should be done at least 4-6 weeks after the resolution of acute symptoms. If asthma is suspected, then what you need is a microspirometry at the time the patient is symptomatic, with measurements of FEV_1 before and after treatment.

In the assessment of asthma, a rise in FEV_1 of 12% and at least 200ml with time or treatment is suggestive of asthma. An increase of 400ml or more in FEV_1 is strongly suggestive of asthma. Here, the key difference is that measurements both before and after treatment or resolution of acute symptoms provide the best information.

Conclusion

Asthma diagnosis is difficult, and the best approach to a confident diagnosis remains a matter of controversy. There are concerns about overdiagnosis, although delayed diagnosis is also still a problem. The latest BTS/SIGN asthma guideline[3] contains a comprehensive discussion of the approach to diagnosis and recommends spirometry as the preferred test of airway obstruction. The NICE guideline on diagnosis and monitoring of asthma suggests a different approach involving the measurement of Fractional Exhaled Nitic Oxide (FeNO) in addition to spirometry. Both guidelines retain a place for peak

flow measurements but relegate these to a subsidiary role. However, spirometry is very often normal in suspected asthma in primary care. The quality of full diagnostic spirometry in primary care is variable, and substantial training is needed if it is to be easily available to all. Issues of training and the availability of quality-assured spirometry have prompted the development of community diagnostic hubs for the provision of this and other diagnostic services, but this remains a work in progress due to pandemic delays in network development, and such hubs are not yet available in many areas.

Peak flow monitoring, which is cheap, (relatively) simple, and easily repeatable, and microspirometry should both play an important role in respiratory diagnosis. Their importance and usefulness have increased following the pandemic experience. All primary healthcare professionals involved in respiratory care should know how to teach their use and interpret their results.

Acknowledgement
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