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Inhaled therapy: all in the technique

Poor inhaler technique is widespread, undermining the effectiveness of therapy and adversely affecting patient outcomes, and of concern, it is as common among healthcare professionals who are supposed to be able to teach it as it is among patients

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The lungs have a surface area the approximate size of a tennis court, providing direct access to the site of respiratory disease. Inhaled therapy is therefore the preferred method for the treatment of asthma and chronic obstructive pulmonary disease (COPD).[1,2]

Delivering medication directly to its site of action has a number of advantages:

- The onset of action is sometimes quicker than via the oral route, a particular advantage for bronchodilators for symptomatic relief
- Lower doses can be used
- There is less potential for systemic side effects.

Inhaled therapy is therefore an attractive option, but it also entails important disadvantages.

Swallowing a tablet is easy (for most people). In contrast, using an inhaler device correctly requires instruction and skill. Technique needs to be carefully taught and regularly checked by a proficient healthcare professional (HCP). The importance of this is reflected in the asthma and COPD guidelines,1,2 the Quality Outcomes Framework,3 and the NICE quality standards.[4]

POOR TECHNIQUE

Studies have consistently demonstrated that patients are poor at mastering and maintaining good inhaler technique, particularly with the most commonly prescribed inhaler device, the pressurised metered dose inhaler (pMDI).[5] Even with good inhaler technique only 20-35% of drug is delivered to the appropriate part of the lung.[6] With poor technique this percentage can drop to the point where therapeutic effect is significantly lessened or completely lost. Patient outcomes are then adversely affected, with poorer disease control, diminished quality of life and more frequent hospital admissions.[5,7-9]

Unfortunately HCPs' ability to demonstrate inhaler techniques are as bad as patients' use of the devices.[6] A study of hospital doctors and nurses, GPs, practice nurses, and hospital and community pharmacy staff, that included assessment of inspiratory flow, found that only 7% were able to demonstrate all the steps necessary for correct pMDI use. Worryingly, 75% of the HCPs in

TABLE 1. CLINICALLY EFFECTIVE INSPIRATORY FLOW (IN-CHECK DIAL)

Inhaler device	Clinically effective inspiratory flow (Litres/min)
pMDI	25-60
Autohaler	30-60
Easi-Breathe	20-60
Accuhaler	30-90
Clickhaler	15-60
Turbohaler	30-90
Handihaler (with adapter)	20-60

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this study were involved in teaching inhaler technique and 48% were either prescribers or involved in prescribing. Approximately two-thirds (63%) of the study subjects had received some training in inhaler technique but, for 67%, this training had taken place more than a year before.[10]

Respiratory inhalers represent the top five costliest drugs to the NHS. In 2011 over 45 million prescriptions for inhalers were issued in the UK, at a cost of £1bn,11 and when they are not used properly, it is wasteful of scarce health service resources.

In recognition of the need to improve inhaler technique, the Aerosol Drug Management Improvement Team (ADMIT), a consortium of respiratory experts from eight European countries, was set up to provide information and advice to HCPs and patients. Access to their publications and training materials is free: www.admit-online.info

INHALER TYPES

Inhaler devices can be divided into three types:

- Pressurised Metered Dose Inhalers (pMDIs)
- Dry Powder Inhalers (DPIs)
- Nebulisers.

The full range of drugs and devices can be viewed at: www.mims.co.uk/Tables/882435/Asthma-COPD-Preparations-Compatible-Devices/

pMDIs

The development of the pMDI in the mid 1950s was a major breakthrough. The main types are:

- The original ‘press and breathe’ – requires good co-ordination between inhalation and activation of the inhaler
- Breath-activated pMDIs – only release drug when the patient has generated an adequate inspiratory flow through the inhaler

The soft mist inhaler (Respimat) is a metered dose inhaler, but contains no propellant. The energy to produce a slow-moving, long-lasting aerosol plume is provided by a spring inside the canister, reducing the need for good co-ordination.

Spacers overcome the need to co-ordinate with a pMDI and can significantly improve lung deposition, compared with pMDI alone. Since large, non-respirable drug particles remain inside the spacer, they can also reduce local side-effects of inhaled corticosteroids. The major advantage of spacers is that they enable inhaled therapy to be used in all age groups. A number of small volume spacers are now available, as well as the original large volume spacer, the Volumatic.

DPIs

The DPIs are breath-activated and do not require co-ordinated inspiration and actuation of the inhaler. They are of two basic types:

- Reservoir devices – hold a reservoir of drug and load each dose from the reservoir
- Devices that hold each dose separately – the dose is either loaded immediately before use or a number of individual doses are held within the device.

BASIC PRINCIPLES OF INHALED THERAPY

Particle size

Drug particle size is measured in micrometres – µm – (1 millionth of a metre) The ideal particle size for respiratory therapeutics is 2-5µm. Particles over 5µm are deposited in the mouth and throat. Those under 2µm are deposited in the peripheral airways and alveoli where they are more likely to be systemically absorbed, with greater potential for side effects. Inhalers produce a range of particle sizes, depending on their efficiency and on the patient's inhaler technique.

Sedimentation

Inhaling fully and holding the breath increases lung deposition of drug through sedimentation. Full inhalation and an adequate breath hold are important, often neglected elements of technique.

Inspiratory flow rate (IFR)

IFR is an important factor in determining where drug is deposited. Too high and drug particles impact at the back of the throat and at the bifurcations of the major airways; too low and drug is deposited in the mouth.

pMDIs release a high-speed plume of aerosol. The patient's inspiration should aim to slow down this plume and reduce impaction of particles in the upper airways. The IFR through a pMDI should, ideally, be less than 60 litres per minute. Breathing in too fast is a common error, in patients and HCPs alike.[12]

The patient's IFR, and the speed at which they produce it, is critical in determining drug particle size, as well as lung deposition, with the DPIs.

Internal resistance, turbulence and inspiratory effort

There is a vast range of DPIs, all differently designed and requiring different IFRs to produce the turbulence needed to aerolise drug powder into optimum particle size.

Some DPIs create turbulence to aerolise the drug by having a complicated route for air to follow through the device. This increases the internal resistance of the inhaler and will require the patient to make a greater inspiratory effort to produce the appropriate IFR. Inhalers with low internal resistance require less inspiratory effort but may still require the patient to generate a high IFR in order to produce the right size particles.

Drug formulation

In some DPIs the drug is attached to a carrier molecule, usually lactose. Turbulence separates drug from carrier. If the drug de-aggregates from the carrier, or aerolises easily then less turbulence may be required. Even if the inhaler device has a high internal resistance, the patient may, in this case, only need to produce a low IFR to operate it effectively. It is important to remember that if an inhaler has a high internal resistance, the effort required from the patient may still be low if the device and drug formulation are designed to operate at low IFR.

The speed at which optimum IFR is achieved is also important. IFR at the start of inhalation needs to be fast enough to separate drug from carrier. If this is only achieved slowly (i.e. a slow start to inhalation with a gradually increasing IFR) the delivered dose will be reduced.

In summary:

- All inhaler devices are different and require varying effort to produce the correct IFR for effective drug delivery

- Patients need to be taught to generate the right IFR for optimal drug deposition with each device.

TEACHING AIDS[13]

There are a variety of devices to help teach patients to generate the correct IFR for their inhaler. They may also be useful for inhaler selection; if a patient is unable to generate the appropriate IFR for a given device then an alternative can be selected.

Teaching aids can be helpful, but they only assess one aspect of inhaler technique. It is still vital to teach and check all the steps necessary for correct use of the device – removing the cap, loading or priming it, ability to co-ordinate etc. – at every patient contact. And, as a general rule, the fewer steps there are the easier it is for the patient to learn.

2 Tone Trainer

This 'single patient use' device can be given to patients to take home. Practising with the trainer can help them produce the correct IFR for optimum use of a pMDI. If they inhale too slowly no sound is produced, too fast and the sound is two-tone and discordant. The correct IFR produces a clear, single tone. The trainer can help maintenance of correct technique, leading to improvements in the Asthma Quality of Life Questionnaire score.[14]

Aerosol Inhalation Monitor (AIM)

AIM is a desktop, electronic pMDI trainer. It assesses IFR, co-ordination and breath-hold. It provides feedback in the form of different coloured lights and a needle gauge indicating IFR while using the inhaler; patients should aim to keep the needle within the desired flow range. The three lights indicate 'firing', 'delivery' and 'breath-hold'. A satisfactory technique is indicated by three green lights. Red lights indicate incorrect technique.

In-check Dial

This mimics the internal resistance of a range of commonly used inhaler devices so that the IFR that the patient is able to generate through a device can be measured. This will enable you to:

- Check that the patient is able to generate sufficient IFR for a particular device
- Teach the patient how much inspiratory effort needs to be made to generate the optimum IFR.

Table 1 gives the clinically effective flow rates for the devices included in the In-check Dial.

Turbutest

This is a replica Turbohaler attached to an electronic sensor that measures peak IFR and grades it visually with three lights; over 60Litres/min will light all three lights, 40-60Litres/min two lights, 30-40Litres/min one light and less than 30Litres/min no lights. The patient needs to light a minimum of two lights. The Turbutest also checks whether the patient has primed the inhaler effectively.

Mag-flo

The Mag-Flo uses a magnetic flow sensor attached, via an adaptor, to an inhaler or placebo. It assesses ability to generate the appropriate IFR to use a variety of DPIs. When the patient inhales correctly a green light provides visual feedback.

Multimedia

Providing written information alone is inadequate for teaching a patient how to use an inhaler. Verbal counseling and physical demonstration is needed, and these techniques can now be supported by a variety of multimedia training tools:

- ADMIT – training video material www.admit-online.info
- Asthma UK - http://www.asthma.org.uk/knowledge-bank-treatment-and-medicines-using-your-inhalers
- Greater Manchester Inhaler Technique Improvement Innovation Project
- Video and podcast material widely available from a variety of sources, e.g. https://wessexhiecpartnership.org.uk/wires/video-series/inhaler-technique; http://www.cppe.ac.uk/News/Article. asp?articleID=297&ID=78

PRACTICALITIES: SOLUTIONS & DIFFICULTIES

Who does the teaching and checking?

Inhaler technique needs to be an integral part of routine management of all patients with asthma or COPD. Adequate time and resources are needed, but sessions do not need to be prolonged, and inhaler technique training and reviews can be undertaken by a variety of HCPs – provided they are properly trained for the task. Regular, ongoing education of HCPs is important.

An inhaler technique project on the Isle of Wight demonstrated that pharmacists delivering inhaler training during medicines use review were able to improve patients' asthma control scores and COPD CAT scores. An association between the introduction of the project and reduced emergency admissions was suggested, but further, detailed analysis is required to demonstrate statistical significance.[15]

Practice formularies

Restricted formularies may limit choice of inhaler devices, but this may not be a bad thing. A limited formulary allows HCPs to become expert with a small range of devices. Problems can arise, however, with an overly prescriptive formulary that does not include a reasonable range of devices to suit varying patient need. It should always be remembered that the most expensive inhaler is the one that the patient cannot or will not use!

Placebos

Inhaler technique can be checked using the patient's own device, but a new device will need to be demonstrated. This requires a supply of placebo devices, and therein lies a problem. Placebos are expensive to produce and pharmaceutical companies may not be able to supply them in sufficient quantities.

Due to the largely theoretical risk of cross infection, some areas have also introduced policies that make placebo devices 'single patient use' items. A practical solution to this impasse may be to:

- Assess a patient's ability to use a device with a training aid, such as the In-check dial
- Demonstrate the use of the device with a placebo
- Check the patient's handling of the device and technique with their own inhaler after they have collected it from the pharmacy.

However, this solution is not ideal, and although advice has been published by the British Thoracic Society,[16] you will need to follow your local guidance.

CONCLUSION

Inhaled therapy requires patients to acquire adequate inhaler technique.

There is ample evidence that, despite a wide range of inhaler devices to suit different individual needs, inhaler technique is frequently poor.

In order that patients get the best possible therapeutic effect and NHS resources are used effectively, inhaler technique needs to be taught and regularly checked by a competent individual. Everybody responsible for teaching and checking inhaler technique needs to ensure that they are properly trained for the task, have access to regular updates and have their skills regularly reassessed.

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