Inhaler devices for asthma and chronic obstructive airways disease

Review

Comparison of the effectiveness of inhaler devices in asthma and chronic obstructive airways disease: a systematic review of the literature

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Executive summary

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Executive summary

Background

Asthma and chronic obstructive pulmonary disease (COPD) are common diseases of the airways and lungs that have a major impact on the health of the population. The mainstay of treatment is by inhalation of medication to the site of the disease process. This can be achieved by a number of different device types, which have wide variations in costs to the health service.

A number of different inhalation devices are available. The pressurised metered-dose inhaler (pMDI) is the most commonly used and cheapest device, which may also be used in conjunction with a spacer device.

Newer chlorofluorocarbons (CFC)-free inhaler devices using hydrofluoroalkanes (HFAs) have also been developed. The drug is dissolved or suspended in the propellant under pressure. When activated, a valve system releases a metered volume of drug and propellant.

Other devices include breath-actuated pMDIs (BA-pMDI), such as Autohaler® and Easi-Breathe®. They incorporate a mechanism activated during inhalation that triggers the metered-dose inhaler.

Dry powder inhalers (DPI), such as Turbohaler®, Diskhaler®, Accuhaler® and Rotahaler®, are activated by inspiration by the patient. The powdered drug is dispersed into particles by the inspiration.

With nebulisers oxygen, compressed air, or ultrasonic power is used to break up solutions or suspensions of medication into droplets for inhalation. The aerosol is administered by mask or by a mouthpiece.

There has been no previous systematic review of the evidence of clinical effectiveness and cost-effectiveness of these different inhaler devices.

Objectives

To review systematically the clinical effectiveness and cost-effectiveness of inhaler devices in asthma and COPD.

Methods

The different aspects of inhaler devices were separated into the most clinically relevant comparisons. Methods involved systematic searching of electronic databases and bibliographies for randomised controlled trials (RCTs) and systematic reviews. Pharmaceutical companies and experts in the field were contacted for further information. Trials that met the inclusion criteria were appraised and data extraction was under-taken by one reviewer and checked by a second reviewer, with any discrepancies being resolved through agreement.

Results

In vitro characteristics versus *in vivo* testing and clinical response

There is evidence that when comparative testing is performed on inhaler devices using the same methods, there is some correlation between particle size measurements and clinical response. However, the measurements are dependent upon the methods used, and a single measure of a device in isolation is of limited value. Also, there is little data on comparing devices of different types. There is currently insufficient data to verify the ability of *in vitro* assessments to predict inhaler performance *in vivo*.

Effectiveness of metered-dose inhalers for the delivery of corticosteroids in asthma

The review of three trials in children and 21 trials in adults demonstrated no evidence to suggest clinical benefits of any other inhaler device over a pMDI in corticosteroid delivery.

Effectiveness of metered-dose inhalers for the delivery of beta-agonists in stable asthma

In children, 11 studies were reviewed, of which seven compared the Turbohaler with the pMDI. One study found a significant treatment difference in peak expiratory flow rate, although there were differences in the patients' baseline characteristics. In adults, a review of 70 studies found no demonstrable difference in the clinical bronchodilator effect of short-acting β_2-agonists

delivered by the standard pMDI compared with that produced by any other DPI, HFA-pMDI or the Autohaler device. The finding that HFA-pMDIs may reduce treatment failure and oral steroid requirement in beta-agonist delivery needs further confirmatory research in adequately randomised clinical trials.

Effectiveness of nebulisers versus metered-dose inhalers for the delivery of bronchodilators in stable asthma

In children, three included trials compared different devices with a nebuliser and demonstrated no evidence of clinical superiority of nebulisers over inhaler devices in bronchodilator delivery. A total of 23 studies in adults found equivalence for the main pulmonary outcomes and no evidence of difference in other outcomes.

Effectiveness of metered-dose inhalers for the delivery of beta-agonists in COPD

Only two studies were included in this review. No evidence of clinical difference was found in beta-agonist delivery.

Effectiveness of nebulisers versus metered-dose inhalers for the delivery of bronchodilators in COPD

Evidence from 14 trials demonstrated equivalence for the main outcomes of pulmonary function. For other outcomes there was no evidence of treatment difference in bronchodilator delivery.

Patients' ability to use metered-dose inhalers

Differences among studies and the heterogeneity of the results make it difficult to draw conclusions about inhaler technique differences between device types. The review of technique after teaching the correct technique suggests that there is no difference in patients' ability to use DPI or pMDIs.

Economic analysis

The total number of NHS prescriptions for inhaler therapy for asthma in 1998 was over 31 million, with a net ingredient cost in excess of £392 million. This economic assessment uses decision analysis to estimate the relative cost-effectiveness of inhaler devices for the delivery of bronchodilator and corticosteroid inhaled therapy. Overall, there were no differences in patient outcomes among the devices. On the assumption that the devices were clinically equivalent, pMDIs were the most cost-effective devices for asthma treatment.

Conclusions

This systematic review examined the evidence from clinical trials evaluating the clinical effectiveness of different inhaler devices in the delivery of inhaled corticosteroids and β_2-bronchodilators for patients with asthma and COPD. The evidence from the published clinical literature demonstrates no difference in clinical effectiveness between nebulisers and alternative inhaler devices compared to standard pMDI with or without a spacer device. The cost-effectiveness evidence therefore favours pMDIs (or the cheapest inhaler device) as first-line treatment in all patients with stable asthma unless other specific reasons are identified. Patients can use pMDIs as effectively as other inhaler devices as long as the correct inhalation technique is taught.

Recommendations for research

Further clinical trials are required to demonstrate any differences in the clinical effectiveness and cost-effectiveness of inhaler devices and nebulisers compared with pMDIs. These should be of sufficient statistical power and methodological rigour to demonstrate any clinical benefit. Trials should be undertaken in community settings to ensure the generalisability of results. Outcome measures should be more patient-centred and report adverse effects more completely. Reporting of data from trials should be improved.

Publication

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NHS R&D HTA Programme

The NHS R&D Health Technology Assessment (HTA) Programme was set up in 1993 to ensure that high-quality research information on the costs, effectiveness and broader impact of health technologies is produced in the most efficient way for those who use, manage and provide care in the NHS.

Initially, six HTA panels (pharmaceuticals, acute sector, primary and community care, diagnostics and imaging, population screening, methodology) helped to set the research priorities for the HTA Programme. However, during the past few years there have been a number of changes in and around NHS R&D, such as the establishment of the National Institute for Clinical Excellence (NICE) and the creation of three new research programmes: Service Delivery and Organisation (SDO); New and Emerging Applications of Technology (NEAT); and the Methodology Programme.

This has meant that the HTA panels can now focus more explicitly on health technologies ('health technologies' are broadly defined to include all interventions used to promote health, prevent and treat disease, and improve rehabilitation and long-term care) rather than settings of care. Therefore the panel structure has been redefined and replaced by three new panels: Pharmaceuticals; Therapeutic Procedures (including devices and operations); and Diagnostic Technologies and Screening.

The HTA Programme will continue to commission both primary and secondary research. The HTA Commissioning Board, supported by the National Coordinating Centre for Health Technology Assessment (NCCHTA), will consider and advise the Programme Director on the best research projects to pursue in order to address the research priorities identified by the three HTA panels.

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Reviews in *Health Technology Assessment* are termed 'systematic' when the account of the search, appraisal and synthesis methods (to minimise biases and random errors) would, in theory, permit the replication of the review by others.

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