VERSION 1.1

MANAGEMENT OF ASTHMA

INHALER DEVICES
AND TECHNIQUE

Considering the most suitable type of inhaler for child or adult with asthma, and training patients to take their inhaled medicines correctly

ABOUT

This PDF is a print-friendly reproduction of the content included in the Management – Inhaler devices and technique section of the Australian Asthma Handbook at asthmahandbook.org.au/management/devices

The content of this PDF is that published in Version 1.1 of the Australian Asthma Handbook. For the most up-to-date content, please visit the Australian Asthma Handbook website at asthmahandbook.org.au

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ABBREVIATIONS

CFC    chlorofluorocarbon
COPD   chronic obstructive pulmonary disease
COX    cyclo-oxygenase
ED     emergency department
EIB    exercise-induced bronchoconstriction
FEV₁   forced expiratory volume over one second
FVC    forced vital capacity
FSANZ  Food Standards Australia and New Zealand
GORD   gastro-oesophageal reflux disease
HFA    formulated with hydrofluoroalkane propellant
ICS    inhaled corticosteroid
ICU    intensive care unit
IgE    Immunoglobulin E
IV     intravenous
LABA   long-acting beta-2-adrenergic receptor agonist
LTRA   leukotriene receptor antagonist
MBS    Medical Benefits Scheme
NIPPV  non-invasive positive pressure ventilation
NSAIDs nonsteroidal anti-inflammatory drugs
OCS    oral corticosteroids
OSA    obstructive sleep apnoea
PaCO   carbon dioxide partial pressure on blood gas analysis
PaO    oxygen partial pressure on blood gas analysis
PBS    Pharmaceutical Benefits Scheme
PEF    peak expiratory flow
pMDI   pressurised metered-dose inhaler or ‘puffer’
SABA   short-acting beta₂-adrenergic receptor agonist
TGA    Therapeutic Goods Administration

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- The Thoracic Society of Australia and New Zealand (TSANZ)

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Inhaler devices and technique

Overview

There are three main types of inhalers for asthma and COPD medicines:

- standard pressurised metered-dose inhalers
- breath-activated pressurised metered-dose inhalers
- dry powder inhalers.

The correct inhaler technique depends on the device.

Table. Types of inhaler devices for delivering asthma medicines
Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/75

<table>
<thead>
<tr>
<th>Clinical situation</th>
<th>Consideration</th>
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<td>All patients</td>
<td>Recommend use of spacer when using reliever for acute asthma</td>
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<td>Infants and small children</td>
<td>Use a facemask with a spacer</td>
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<td>Poor manual dexterity (e.g. weak hands or osteoarthritis)</td>
<td>Consider a Haleraid device with pMDI, or a breath-activated inhaler</td>
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<td>Consider a breath-activated inhaler</td>
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<tr>
<td>Inability to form a good seal around the mouthpiece of the inhaler or spacer (e.g. person with cognitive impairment)</td>
<td>Consider a spacer plus age-appropriate facemask</td>
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<td>Difficulty speaking or reading English</td>
<td>Use an interpreter or provide written instructions in the person’s first language</td>
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<td>Using multiple inhalers</td>
<td>Choose the same type for each medicine, if possible, to avoid confusion</td>
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<td>If not possible, train person in the correct inhaler technique for each of their devices</td>
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<th>Brand name</th>
<th>Common medicines used with this type of inhaler</th>
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<tbody>
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<td><strong>Standard pMDI</strong></td>
<td>Generic inhaler</td>
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<td>APO-Salbutamol (salbutamol)</td>
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<td>regimen</td>
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<td>Preventers</td>
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<td></td>
<td>Alvesco (ciclesonide)</td>
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<td>Flutiform (fluticasone propionate plus eformoterol)</td>
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<td>Intal (sodium cromoglycate)</td>
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<td>Intal Forte (sodium cromoglycate)</td>
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<td>Qvar (beclomethasone)</td>
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<td></td>
<td></td>
<td>Seretide (salmeterol plus fluticasone propionate)</td>
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<td><strong>Dry-powder inhaler (capsule)</strong></td>
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<td>Accuhaler</td>
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<td>Ellipta</td>
<td><strong>Preventers</strong>&lt;br&gt;&lt;em&gt;Breo (fluticasone furoate plus vilanterol)&lt;/em&gt;</td>
<td></td>
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<tr>
<td>Turbuhaler</td>
<td><strong>Relievers</strong>&lt;br&gt;&lt;em&gt;Bricanyl (terbutaline sulfate)&lt;br&gt;Symbicort (budesonide plus eformoterol) when used in a maintenance-and-reliever regimen&lt;/em&gt;</td>
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<td></td>
<td><strong>Preventers</strong>&lt;br&gt;&lt;em&gt;Pulmicort (budesonide)&lt;br&gt;Symbicort (budesonide plus eformoterol)&lt;/em&gt;</td>
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<td></td>
<td><strong>Other</strong>&lt;br&gt;&lt;em&gt;Oxis (eformoterol)&lt;/em&gt;</td>
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Choosing an inhaler device to suit the individual

Recommendations

Choose a device type that is best for the individual, considering potential problems.

**Table. Types of inhaler devices for delivering asthma medicines**
Please view and print this figure separately: http://www.asthmahandbook.org.au/table/show/75

**Table. Considerations for choice of inhaler device type when prescribing inhaled medicines**

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Asset ID: 76

How this recommendation was developed
For patients who may find it difficult to use an inhaler (e.g. older patients with osteoarthritis or weakness), check the person’s technique to work out which inhaler type will be easiest to use.

**How this recommendation was developed**

**Consensus**
Based on clinical experience and expert opinion (informed by evidence, where available).

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**More information**

**Correct use of inhaler devices**
The majority of patients do not use inhaler devices correctly. Significant rates of incorrect use among patients with asthma or COPD have been reported for all currently used inhaler designs, even among regular adult users.\(^1\)\(^2\) Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.\(^1\)

**Common errors and problems with inhaler technique**

Common errors include:\(^1\)
- failing to load the device correctly
- multiple actuations without waiting or shaking in between doses
- inability to coordinate activation with inhalation
- failure to hold breath long enough after breathing in fully
- incorrect position of inhaler (e.g. chin down and inhaler aimed at roof of mouth or tongue – should be upright with chin up).

Common problems include:
- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to generate adequate inspiratory flow.

**Problems associated with incorrect use of inhaler devices**
Incorrect use of inhalers may lead to insufficient drug delivery to the airways, and is associated with worse asthma control,\(^1\) including increased reliever use, increased use of emergency medical services, worsening asthma and higher rates of asthma instability as assessed by a health professional.

For patients using pressurised metered-dose inhalers, the risk of poor outcomes is most pronounced among patients with poor inspiration–actuation coordination.\(^1\) Incorrect technique when using dry-powder inhalers can also lead to poor asthma outcomes.\(^2\)

With inhaled corticosteroids, poor inhaler technique is also associated with increased risk of local adverse effects such as dysphonia. Among patients taking inhaled corticosteroids, failure to rinse the mouth with water and spit after each dose increases the risk of oropharyngeal candidiasis (‘thrush’) caused by medicine deposited in the mouth and larynx.\(^1\)

**How to improve patients’ inhaler technique**
Patients’ inhaler technique can be improved by brief education from a health professional or other person trained in correct technique, provided this includes a physical demonstration and checking the patient’s technique again after training. Community pharmacists can provide effective brief training in correct inhaler technique.\(^1\)

Interventions to correct patients’ inhaler technique can improve measures of asthma control and lung function measures.\(^1\)

To maintain correct inhaler technique, patients’ technique needs to be checked repeatedly and training needs to be repeated. Even after training is provided, some patients will continue to have difficulties using inhalers properly.\(^1\) Patients who are able to demonstrate correct technique during consultation with a health professional may not maintain this standard at other times.\(^1\)
Administration of inhaled medicines in children: 0–5 years

To use inhaler devices correctly, parents and children need training in inhaler technique and in the care and cleaning of inhalers and spacers.

Children need careful supervision when taking their inhaled medicines (e.g., at preschool), especially when using a reliever for acute asthma symptoms.

During acute wheezing episodes, delivery of short-acting beta₂ agonist to airways is more effective with a pressurised metered-dose inhaler plus spacer than with a nebuliser. Dry-powder inhalers are ineffective and unreliable for preschool children because their inspiratory air flow is inadequate.

Preschool children cannot use pressurised metered-dose inhalers properly unless a spacer is attached (with mask when necessary), because it is difficult for them to coordinate inspiratory effort with firing the device.

Even when using pressurised metered dose inhalers and spacers, drug delivery is very variable in young children. The inhaler design may improve spacer technique, but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children. This variation might explain fluctuations in effectiveness, even if the child's parents have been trained to use the device correctly.

When using a spacer with face mask (e.g., for an infant too young or uncooperative to be able to use a mouthpiece), effective delivery of medicine to the airways depends on a tight seal around the face. If the child is crying, medicine will probably not reach the lower airway. Masks should not be used for inhaled corticosteroids, due to the risk of exposure to eyes and skin.

When administering salbutamol to relieve asthma symptoms, the standard recommendation is to fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer with lips still sealed around the spacer mouthpiece (tidal breathing). Fewer breaths may suffice; in children with asthma aged 2–7 years (not tested during an acute asthma episode), the number of tidal breaths needed to inhale salbutamol adequately from a spacer has been estimated at 2 breaths for small-volume spacers, 2 breaths for a spacer made from a 500-mL modified soft drink bottle, and 3 breaths for a large (Volumatic) spacer.

Administration of inhaled medicines in children: 6 years and over

School-aged children (depending on the child's age, ability, and with individualised training) can correctly use a range of inhaler types, including pressurised metered-dose inhalers with spacers, breath-activated pressurised metered-dose inhalers (e.g., Autohaler), and dry-powder inhalers (e.g., Accuhaler, Turbuhaler).

A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children.

Parents and children need training to use inhaler devices correctly, including inhaler technique, and care and cleaning of inhalers and spacers.

School-aged children are unlikely to use their inhaler device correctly without careful training.

Choosing inhaler devices for older adults

Problems for older patients using inhalers

Inhaler devices should be used in favour of nebulisers wherever possible, just as for younger adults. The use of ipratropium bromide via nebulisers with loose-fitting masks has been associated with pupil dilatation, blurred vision and acute glaucoma. The use of nebulisers increases the risk of transmitting infections. In practice, many patients do not maintain their nebuliser adequately (e.g., change bulb as often as recommended).

Incorrect inhaler technique is common among older people with asthma or COPD, whether using a pressurised metered-dose inhaler or a dry-powder inhaler, particularly with those with more severe airflow limitation. Approximately 40% of people aged 60 years and over, and 60% of people aged 80 years and over, show errors in inhaler technique.

Common problems for older people include:

- inadequate inspiratory flow rate (particularly among those with COPD), which limits ability to use dry-powder inhalers or pressurised metered-dose inhalers properly
• difficulty connecting a pressurised metered-dose inhaler to a spacer
• inability to coordinate breathing in with actuating a pressurised metered-dose inhaler
• inability to activate a pressurised metered-dose inhaler due to osteoarthritis of the hands
• inability to achieve a firm seal around the mouthpiece when using inhalers alone or with a spacer (particularly for patients with cognitive impairment).

**Tips for correct use of inhalers**

Patients with osteoarthritis may find it easier to use an aid (e.g. Haleraid hand-grip device) to help them actuate their inhaler, or use a breath-activated inhaler. Mechanical difficulties can usually be overcome by checking each individual’s technique and helping the person identify which inhaler they can use best.

A breath-activated inhaler (e.g. Autohaler) or breath-activated dry-powder inhaler (e.g. Turbuhaler or Accuhaler) may be easier to use than pressurised metered-dose inhalers for some patients. However, some patients (e.g. those with severe COPD) may be unable to achieve a high enough inspiratory rate to activate dry-powder inhalers (e.g. Accuhaler or Turbuhaler). Adequate lung doses of inhaled corticosteroids may be achieved with a breath-activated inhaler, despite poor technique.

Older people with asthma can acquire and retain appropriate technique after specific instruction, but this instruction needs to be repeated intermittently to reinforce correct inhaler technique. People with cognitive impairment are likely to have problems retaining skills after instruction in the use of an inhaler.

About half of all older people with asthma or COPD use more than one inhaler device. As the number of prescribed devices increase, the frequency of error also increases.

### Table. Considerations when choosing inhaler devices for older patients

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reduced maximal inspiratory flow</strong></td>
<td>Consider pMDI alone or with spacer</td>
</tr>
<tr>
<td></td>
<td>Avoid dry-powder inhalers</td>
</tr>
<tr>
<td><strong>Reduced manual dexterity (e.g. due to osteoarthritis)</strong></td>
<td>Consider a Haleraid with a pMDI</td>
</tr>
<tr>
<td></td>
<td>Consider pMDI with small-volume spacer or breath-actuated dry-powder inhaler</td>
</tr>
<tr>
<td></td>
<td>Avoid pMDI without spacer</td>
</tr>
<tr>
<td><strong>Inability to coordinate actuation and inhalation</strong></td>
<td>Consider pMDI with spacer, breath-actuated pMDI or breath-actuated dry-powder inhaler</td>
</tr>
<tr>
<td></td>
<td>Avoid pMDI without spacer</td>
</tr>
<tr>
<td><strong>Inability to form effective seal with lips around mouthpiece</strong></td>
<td>Use spacer plus face mask</td>
</tr>
</tbody>
</table>

**References**


Training patients in inhaler technique

Recommendations

Make sure your own knowledge of correct technique is up to date.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).

Train patients to use their inhaler devices correctly (including use of spacers, where recommended).

How this recommendation was developed
Adapted from existing guidance
Based on reliable clinical practice guideline(s) or position statement(s):
- Basheti et al. 2007¹
- National Asthma Council Australia, 2008²

Check the person’s inhaler technique at each encounter:
- Have the patient demonstrate their inhaler technique, while checking against a purpose-developed checklist of steps.
- Demonstrate correct technique and correct any specific errors identified.
- Have the patient repeat the demonstration to check they have understood. If necessary, repeat instruction until the patient has all steps correct.

Notes:
Watch the person use their inhaler – don’t just ask if they think they know how to use it properly.
Checklists of steps for various types of inhalers are available on National Asthma Council Australia’s website.

Go to: National Asthma Council Australia’s Using your inhaler webpage for information, patient resources and videos on inhaler technique

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):
- Basheti et al. 2013³
- National Asthma Council Australia, 2008²

Consider giving the patient a written record of any step(s) incorrectly performed at the initial demonstration, e.g. by highlighting these on a printed label attached to the patient’s inhaler or on a pictorial instruction sheet.

How this recommendation was developed
Consensus
Keep your advice and explanations relevant to the person's age, cultural background and education.

**How this recommendation was developed**

**Consensus**

Based on clinical experience and expert opinion (informed by evidence, where available).

For people instructed to use a spacer with their inhaler, ask in a non-judgemental manner whether they sometimes or often use the inhaler alone. Emphasise that using the spacer is an important part of correct technique for best results.

**How this recommendation was developed**

**Consensus**

Based on clinical experience and expert opinion (informed by evidence, where available).

More information

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**Correct use of inhaler devices**

The majority of patients do not use inhaler devices correctly. Significant rates of incorrect use among patients with asthma or COPD have been reported for all currently used inhaler designs, even among regular adult users. Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.

**Common errors and problems with inhaler technique**

Common errors include:

- failing to load the device correctly
- multiple actuations without waiting or shaking in between doses
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Go to: National Asthma Council Australia’s Using your inhaler webpage for information, patient resources and videos on inhaler technique
Go to: National Prescribing Service (NPS) MedicineWise information on Devices used with asthma medicines

**Administration of inhaled medicines in children: 0–5 years**

To use inhaler devices correctly, parents and children need training in inhaler technique and in the care and cleaning of inhalers and spacers.

Children need careful supervision when taking their inhaled medicines (e.g. at preschool), especially when using a reliever for acute asthma symptoms.

During acute wheezing episodes, delivery of short-acting beta\(_2\) agonist to airways is more effective with a pressurised metered-dose inhaler plus spacer than with a nebuliser.\(^6\) Dry-powder inhalers are ineffective and unreliable for preschool children because their inspiratory air flow is inadequate.\(^6\)

Preschool children cannot use pressurised metered-dose inhalers properly unless a spacer is attached (with mask when necessary), because it is difficult for them to coordinate inspiratory effort with firing the device.\(^6\)

Even when using pressurised metered-dose inhalers and spacers, drug delivery is very variable in young children.\(^7\) The inhaler design may improve spacer technique,\(^7\) but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children.\(^6\) This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.

When using a spacer with face mask (e.g. for an infant too young or uncooperative to be able to use a mouthpiece), effective delivery of medicine to the airways depends on a tight seal around the face. If the child is crying, medicine will probably not reach the lower airway.\(^6\) Masks should not be used for inhaled corticosteroids, due to the risk of exposure to eyes and skin.

When administering salbutamol to relieve asthma symptoms, the standard recommendation is to fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer with lips still sealed around the spacer mouthpiece (tidal breathing).\(^8\) Fewer breaths may suffice; in children with asthma aged 2–7 years (not tested during an acute asthma episode), the number of tidal breaths needed to inhale salbutamol adequately from a spacer has been estimated at 2 breaths for small-volume spacers, 2 breaths for a spacer made from a 500-mL modified soft drink bottle, and 3 breaths for a large (Volumatic) spacer.\(^9\)

**Administration of inhaled medicines in children: 6 years and over**

School-aged children (depending on the child’s age, ability, and with individualised training) can correctly use a range of inhaler types,\(^10\) including pressurised metered-dose inhalers with spacers,\(^11\) breath-activated pressurised metered-dose inhalers (e.g. Autohaler), and dry-powder inhalers (e.g. Accuhaler, Turbuhaler).\(^11, 12\)

A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children.\(^10\)

Parents and children need training to use inhaler devices correctly, including inhaler technique, and care and cleaning of inhalers and spacers.

School-aged children are unlikely to use their inhaler device correctly without careful training.\(^13\)

**References**


Considerations when using inhaled reliever or preventer medicines

Recommendations

Advise patients and carers that new inhalers must be primed before first use, by firing a number of actuations into the air.

Note: Instructions differ between products, so they should follow the manufacturer’s instructions

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available).

For patients who use a pressurised metered-dose inhaler ('puffer') for their reliever (e.g. Airomir, Asmol, Ventolin), advise patients or parents how to take the medicine during asthma symptoms:

• For children, use a spacer whenever possible.
• Use a spacer for adults whose symptoms are not relieved when using the inhaler on its own, and whenever possible for acute asthma.
• Shake the puffer before every puff (whether using a spacer or not). If using a spacer, either disconnect the puffer and shake it before reconnecting to spacer, or take the spacer mouthpiece out of the mouth and shake the puffer while still connected to the spacer.

Notes

Provide written instructions.

In an emergency, it may not be practical to disconnect and shake before each puff.

See: First aid instructions for patients, parents and community members

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

• Barry and O'Callaghan 1994
• Cyr et al.1991
• Laube et al. 2011
• National Asthma Council Australia 2008
• Rau et al.1996

In clinical settings, when delivering salbutamol by pressurised metered-dose inhaler for patients with acute asthma:

• Use a spacer.
• Shake the puffer before firing each dose into the spacer.

Table. Using pressurised metered-dose inhalers in acute asthma
Administration of salbutamol by health professionals for a patient with acute asthma

1. Use a salbutamol pressurised metered-dose inhaler (100 mcg/actuation) with a spacer that has already been prepared (see note).
2. Shake inhaler and insert upright into spacer.
3. Place mouthpiece between the person's teeth and ask them to seal lips firmly around mouthpiece.
4. Fire one puff into the spacer.
5. Tell person to take 4 breaths in and out of the spacer.
6. Remove the spacer from mouth. Shake the inhaler after each puff before actuating again. (This can be done without detaching the pressurised metered-dose inhaler from the spacer.)

Notes

The process is repeated until the total dose is given (e.g. 12 puffs for an adult, 6 puffs for a child). Different doses are recommended for patients and carers giving asthma first aid in the community.

New plastic spacers should be washed with detergent to remove electrostatic charge (and labelled), so they are ready for use when needed. In an emergency situation, if a pre-treated spacer is not available, prime the spacer before use by firing 20 puffs of salbutamol into the spacer.

Priming or washing spacers to reduce electrostatic charge before using for the first time is only necessary for plastic spacers; polyurethane spacers (e.g. E-Chamber, AeroChamber Plus), disposable cardboard spacers and metal spacers do not require treatment to reduce electrostatic charge.

For small children who cannot form a tight seal with their lips around the spacer mouthpiece, attach a well-fitted mask to the spacer.

Asset ID: 62

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Barry and O'Callaghan 1994
- Cyr et al. 1994
- Laube et al. 2011
- Rau et al. 1996

Advise all patients using inhaled corticosteroids to rinse their mouth with water and spit after each dose, if possible.

How this recommendation was developed

Consensus

Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- National Asthma Council Australia, 2008
- Rachelefsky et al. 2007
- Yokoyama et al. 2007

More information
The majority of patients do not use inhaler devices correctly. Significant rates of incorrect use among patients with asthma or COPD have been reported for all currently used inhaler designs, even among regular adult users.\(^4,8\) Regardless of the type of inhaler device prescribed, patients are unlikely to use inhalers correctly unless they receive clear instruction, including a physical demonstration, and have their inhaler technique checked regularly.\(^4\)

**Common errors and problems with inhaler technique**

Common errors include:\(^4\)

- failing to load the device correctly
- multiple actuations without waiting or shaking in between doses
- inability to coordinate activation with inhalation
- failure to hold breath long enough after breathing in fully
- incorrect position of inhaler (e.g. chin down and inhaler aimed at roof of mouth or tongue – should be upright with chin up).

Common problems include:

- difficulty manipulating device due to problems with dexterity (e.g. osteoarthritis, stroke, muscle weakness)
- inability to generate adequate inspiratory flow.

**Problems associated with incorrect use of inhaler devices**

Incorrect use of inhalers may lead to insufficient drug delivery to the airways, and is associated with worse asthma control,\(^4\) including increased reliever use, increased use of emergency medical services, worsening asthma and higher rates of asthma instability as assessed by a health professional.

For patients using pressurised metered-dose inhalers, the risk of poor outcomes is most pronounced among patients with poor inspiration–actuation coordination.\(^4\) Incorrect technique when using dry-powder inhalers can also lead to poor asthma outcomes.\(^8\)

With inhaled corticosteroids, poor inhaler technique is also associated with increased risk of local adverse effects such as dysphonia. Among patients taking inhaled corticosteroids, failure to rinse the mouth with water and spit after each dose increases the risk of oropharyngeal candidiasis (‘thrush’) caused by medicine deposited in the mouth and larynx.\(^4\)

**How to improve patients’ inhaler technique**

Patients’ inhaler technique can be improved by brief education from a health professional or other person trained in correct technique, provided this includes a physical demonstration and checking the patient’s technique again after training. Community pharmacists can provide effective brief training in correct inhaler technique.\(^4\)

Interventions to correct patients’ inhaler technique can improve measures of asthma control and lung function measures.\(^5\)

To maintain correct inhaler technique, patients’ technique needs to be checked repeatedly and training needs to be repeated. Even after training is provided, some patients will continue to have difficulties using inhalers properly.\(^4\) Patients who are able to demonstrate correct technique during consultation with a health professional may not maintain this standard at other times.\(^4\)

- Go to: National Asthma Council Australia’s [Using your inhaler](https://www.nationalasthma.org.au/using-your-inhaler) webpage for information, patient resources and videos on inhaler technique
- Go to: National Prescribing Service (NPS) MedicineWise information on [Devices used with asthma medicines](https://www.medicineswise.org.au/Devices-used-with-asthma-medicines)

**Technical notes: pressurised metered-dose inhalers with spacers**

Manufacturers of most delivery devices recommend shaking the device before actuating. The physical characteristics of each formulation, including the effects of shaking, differ widely,\(^2\) but for simplicity it is best always to recommend shaking. When a spacer is used with a pressurised metered-dose inhaler, delivery of the medicine to the patient’s airways is maximised when the patient inhales from the spacer after each actuation.\(^1,5\) Multiple actuations of a pressurised metered-dose inhaler into a spacer can reduce the amount of respirable medicine available because aerosol particles can agglomerate into larger particles or become attached to the spacer walls.\(^1\)

Therefore, the ideal way to deliver salbutamol via pressurised metered-dose inhaler and spacer is to shake the device, fire a single actuation into the spacer, and have the person inhale each from the spacer before repeating the process until the total intended number of actuations is taken. Patients should be trained to follow these instructions when using their inhalers, and first aid instructions should include these instructions.
In practice, however, optimal delivery of inhaled medicines involves a balance between maximising the proportion of respirable medicine and maximising efficiency of inhalation by the patient within real-world constraints. The optimal delivery of salbutamol in real-world circumstances is not well defined.

Many available in vitro studies of aerosol particle deposition in the airways were performed using older CFC-propelled formulations, which are now obsolete. For some brands of spacers, two rapid actuations of a CFC-pressurised metered-dose inhaler into a spacer, followed by a breath, was likely to result in only a small loss of total dose, compared with single actuations followed by a breath. Three rapid actuations at once resulted in a loss of efficiency so that the delivered dose was not significantly greater than if only two actuations were given. Similar studies have not been performed for current non-CFC pressurised metered-dose inhalers, so the maximum number of actuations that can be fired into the spacer before loss of efficacy occurs is unknown.

Inhaling slowly with a single breath maximises delivery of the medicine to the lungs and minimises deposition in the upper airways when using a conventional pressurised metered-dose inhaler with or without a spacer, or when using a breath-activated pressurised metered-dose inhaler. However, slow breathing may not be possible for patients with acute asthma. Tidal breathing through the spacer (e.g. four breaths in and out without removing the spacer) is used in acute asthma.

Administration of inhaled medicines in children: 0–5 years

To use inhaler devices correctly, parents and children need training in inhaler technique and in the care and cleaning of inhalers and spacers.

Children need careful supervision when taking their inhaled medicines (e.g. at preschool), especially when using a reliever for acute asthma symptoms.

During acute wheezing episodes, delivery of short-acting beta₂ agonist to airways is more effective with a pressurised metered-dose inhaler plus spacer than with a nebuliser. Dry-powder inhalers are ineffective and unreliable for preschool children because their inspiratory air flow is inadequate. Preschool children cannot use pressurised metered-dose inhalers properly unless a spacer is attached (with mask when necessary), because it is difficult for them to coordinate inspiratory effort with firing the device. Even when using pressurised metered dose inhalers and spacers, drug delivery is very variable in young children. The inhaler design may improve spacer technique, but will not necessarily improve clinical outcomes. The amount of medicine delivered by inhaler devices to the lower airways varies from day to day in preschool children. This variation might explain fluctuations in effectiveness, even if the child’s parents have been trained to use the device correctly.

When using a spacer with face mask (e.g. for an infant too young or uncooperative to be able to use a mouthpiece), effective delivery of medicine to the airways depends on a tight seal around the face. If the child is crying, medicine will probably not reach the lower airway. Masks should not be used for inhaled corticosteroids, due to the risk of exposure to eyes and skin.

When administering salbutamol to relieve asthma symptoms, the standard recommendation is to fire one puff at a time into the spacer and have the child take 4–6 breaths in and out of the spacer with lips still sealed around the spacer mouthpiece (tidal breathing). Fewer breaths may suffice; in children with asthma aged 2–7 years (not tested during an acute asthma episode), the number of tidal breaths needed to inhale salbutamol adequately from a spacer has been estimated at 2 breaths for small-volume spacers, 2 breaths for a spacer made from a 500-mL modified soft drink bottle, and 3 breaths for a large (Volumatic) spacer.

Administration of inhaled medicines in children: 6 years and over

School-aged children (depending on the child’s age, ability, and with individualised training) can correctly use a range of inhaler types, including pressurised metered-dose inhalers with spacers, breath-activated pressurised metered-dose inhalers (e.g. Autohaler), and dry-powder inhalers (e.g. Accuhaler, Turbuhaler).

A pressurised metered-dose inhaler and spacer is an appropriate first choice for most children. Parents and children need training to use inhaler devices correctly, including inhaler technique, and care and cleaning of inhalers and spacers.

School-aged children are unlikely to use their inhaler device correctly without careful training.
References

Use and care of spacers

Recommendations

Advise patients and parents to clean plastic or polyurethane spacers monthly and after the resolution of any respiratory tract infection.

To clean a spacer:

- Dismantle as per manufacturer’s instructions, if necessary.
- Wash parts in warm water with liquid dishwashing detergent.
- Allow to air dry without rinsing.

Note: Do not dry plastic spacers with a cloth or paper towel because this can result in electrostatic charge on the inside of the spacer, which can reduce the available dose.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Berg, 1995
- Brand et al. 2008
- Dompeling et al. 2001
- National Asthma Council Australia, 2008

Advise patients and parents to wash plastic spacers before first use to reduce electrostatic charge. If a new plastic spacer must be used immediately, it can be primed by firing multiple puffs of medicine into the spacer. Patients should follow the manufacturer’s instructions.

Note: Priming or washing spacers to reduce electrostatic charge before using for the first time is only necessary for plastic spacers; polyurethane spacers (e.g. E-Chamber, AeroChamber Plus), disposable cardboard spacers and metal spacers do not require treatment to reduce electrostatic charge.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available), with particular reference to the following source(s):

- Berg, 1995
- Brand et al. 2008
- Dompeling et al. 2001
- National Asthma Council Australia, 2008

Ask patients to bring their spacer with them to be checked every 6–12 months. Check that there are no cracks and that the valve is working.

How this recommendation was developed
Consensus
Based on clinical experience and expert opinion (informed by evidence, where available).
Preparation of new spacers before first use

Electrostatic surface charge on new plastic spacers reduces the proportion of medicine available for delivery to the airway. This charge can be reduced by washing the plastic spacer in detergent and allowing it to dry without wiping. Alternatively, priming the spacer by actuating the device several times into the spacer also overcomes the charge, but this wastes medicine.

The optimal number of actuations for priming is not known and the findings of in vitro studies vary widely. One study (using older, CFC-based formulations of asthma medicines) reported that up to 40 actuations fired into a new plastic spacer overcame the effect of the electrostatic charge. Others have concluded that the electrostatic charge on plastic spacers does not reduce in vivo efficacy of bronchodilator therapy in children with asthma.

Disposable cardboard spacers, antistatic spacers (e.g. E-Chamber, AeroChamber Plus) and metal spacers (rarely used in Australia) do not have this problem.

Note: Priming is also necessary for new delivery devices. This involves actuating the device into the air (away from the patient) before first use, following the manufacturer’s instructions.

Technical notes: pressurised metered-dose inhalers with spacers

Manufacturers of most delivery devices recommend shaking the device before actuating. The physical characteristics of each formulation, including the effects of shaking, differ widely, but for simplicity it is best always to recommend shaking.

When a spacer is used with a pressurised metered-dose inhaler, delivery of the medicine to the patient’s airways is maximised when the patient inhales from the spacer after each actuation. Multiple actuations of a pressurised metered-dose inhaler into a spacer can reduce the amount of respirable medicine available because aerosol particles can agglomerate into larger particles or become attached to the spacer walls.

Therefore, the ideal way to deliver salbutamol via pressurised metered-dose inhaler and spacer is to shake the device, fire a single actuation into the spacer, and have the person inhale each from the spacer before repeating the process until the total intended number of actuations is taken. Patients should be trained to follow these instructions when using their inhalers, and first aid instructions should include these instructions.

In practice, however, optimal delivery of inhaled medicines involves a balance between maximising the proportion of respirable medicine and maximising efficiency of inhalation by the patient within real-world constraints. The optimal delivery of salbutamol in real-world circumstances is not well defined.

Many available in vitro studies of aerosol particle deposition in the airways were performed using older CFC-propelled formulations, which are now obsolete. For some brands of spacers, two rapid actuations of a CFC-pressurised metered-dose inhaler into a spacer, followed by a breath, was likely to result in only a small loss of total dose, compared with single actuations followed by a breath. Three rapid actuations at once resulted in a loss of efficiency so that the delivered dose was not significantly greater than if only two actuations were given. Similar studies have not been performed for current non-CFC pressurised metered-dose inhalers, so the maximum number of actuations that can be fired into the spacer before loss of efficacy occurs is unknown.

Inhaling slowly with a single breath maximises delivery of the medicine to the lungs and minimises deposition in the upper airways when using a conventional pressurised metered-dose inhaler with or without a spacer, or when using a breath-activated pressurised metered-dose inhaler. However, slow breathing may not be possible for patients with acute asthma. Tidal breathing through the spacer (e.g. four breaths in and out without removing the spacer) is used in acute asthma.

References


