

ASK THE EXPERT

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Question

What are some common mistakes children and caretakers do when using an MDI inhaler?

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Let's start with some basics. We breathe without thinking about it. At rest, in a single breath, we only exhale a fraction of the air in our lungs and then we inhale a similar amount (tidal volume) of fresh air. However, if we try, with a special breath we can exhale much more air and then inhale a much larger amount of fresh air. When breathing in an aerosol medication, a much larger amount of air and medicine reach the lungs with this kind of a special breath. So it is really important to "gently and completely empty your lungs" before breathing in a medication. It is also important to fill the lungs fully. This results in the largest volume of air and potentially the largest dose of medication. Holding the breath a few seconds allows time for inhaled aerosol medication to settle and stick to the lining of the smaller airways deep in the lungs.

The pathway that aerosol medication must follow is not a straight line. The first big curve is at the back of the throat. Dropping the chin and looking down when breathing in a medication makes it harder for aerosol medication to "fly" around the curve at the back of your throat. When looking down, chin lowered, the airstream must first flow uphill over your tongue, around a sharp curve at the back of your throat, then downhill through your windpipe and into the lower airways. Lifting the chin changes this pathway and allows the airstream to carry more aerosol medication into your lungs. With your chin lifted and eyes looking toward the top of the adjacent wall, the pathway to your lungs is all downhill and the curve

Meet the Expert:



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at the back of your throat is not so sharp. The final journey from your windpipe down to the end of the airways involves 23 or 24 more curves as airways branch into smaller and smaller tubes. Aerosol medication gets stuck along the way, even under ideal conditions.

If the airstream is moving too fast, aerosol medication travels in a straight path and at each curve more medication will impact the airway wall. Most impaction occurs at the back of the throat. If the airstream moves too slowly aerosol falls out of the air and settles onto the tongue, throat or large airways, failing to reach the lower airways where asthma has its primary effects. In both cases – breathing too fast or too slowly - more aerosol medication is swallowed and goes to the stomach, so less medication reaches the lungs. Coaching a child to breathe in at the right rate will increase the effect of metered dose inhaler (MDI) medications.

Today's MDI medications emerge as a plume of aerosol mist traveling at about 40 miles per hour. Without a valved-holding chamber (VHC) a large proportion of the medication impacts the mouth, tongue, cheeks and throat and is then swallowed. Use of a VHC reduces oropharyngeal deposition and increases the amount of medication that reaches the lungs. Most VHCs are equipped with a whistle that sounds off when inspiratory flow reaches twice the recommended flow rate. This is helpful for managing the problem of breathing in too fast. A VHC is recommended by Expert Panel Report 3 (EPR3) to improve MDI coordination and during asthma exacerbations when using albuterol MDIs.

Now let's put this all together with some tips for avoiding common errors when using MDI medications to manage children's asthma.

Gently and completely empty the lungs. School age children should take several seconds to exhale before breathing in their medication. Pre-school children respond to the verbal cue "blow out all your old air". Infants and toddlers will not be able to intentionally exhale extra air before inhalation. The focus for this age group is keeping the mask in place for 6 breaths. Counting out loud "one, two, three..." to mark each exhalation distracts infants and toddlers and increases the likelihood they will tolerate a well-fitted mask for six breaths. Common mistakes include – school age children forgetting to empty their lungs before each MDI dose; failing to coach pre-school children to exhale before doses; failing to keep the mask in place for 6 breaths after each dose given to an infant or toddler and "stacking" doses (discharging more than one puff at a time into a VHC).

Lift the chin to open the airway. Common mistakes include – children drop their chin and look down while inhaling MDI medications. Infants and toddlers fight the placement of a VHC with mask, turning away with poor airway alignment or a broken mask seal.

Refill the lungs in a time equal to FEV1 (forced expiratory time in one second) x 2 seconds. EPR3 guidelines recommend an inspiratory flow rate of 30 LPM. At this rate it takes 2 seconds to inhale a liter



of air. (FEV1 is a volume easily measured with inexpensive digital meters. FEV1 must be monitored to adequately assess asthma control. Most children 5 years and older can produce reliable FEV1 results. There's really no excuse for not knowing this lung number if you work with children and adults who have asthma.) You should give families a "target time" to help coach children to regulate their inspiratory time to ensure an optimal dose of MDI medication is delivered. (When FEV1 is not known a rough estimate of target inspiratory time is 3-5 seconds.) Common mistakes include – children breathe in too fast or too slowly and the airstream does not carry aerosol medication deep into the lungs.

Observe and coach every dose. Common mistake – caregivers send children to another room to "take" their inhaler resulting in missed doses and sub-optimal inhalation technique. Care givers should coach each dose and watch for correct use of the VHC, emptying of the lungs before each dose, lifting the chin, refilling the lungs in the target time, breath-holding (5-10 seconds), and clearing the mouth and throat after use of inhaled corticosteroids (ICS). Remember, hearing that whistle means the airstream is moving at twice the recommended rate. SLOW DOWN! Various brands of MDI inhalers require specific care and steps for proper use. These steps vary and must be reviewed and followed for each product.

Monitor the dose counter. Common mistakes include – ICS are not consumed at the rate required to heal the airways and restore normal lung function and quick relievers are used instead of controller MDIs (ICS). Caregivers should check to see if the number of doses of the ICS-containing MDI is declining as expected. Checking once or twice a month can uncover the common problem of too many missed doses.

Download [Inhalation Instruction Guidelines for Educators and Clinicians](#) (PDF) for more information.

