

Chronic respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD) are exacerbated by climate change and its causes.

In addition, the inhalers prescribed for their treatment further contribute to climate change to varying degrees. Compared to dry powder inhalers (DPI), propellant-driven metered-dose inhalers (MDIs) have a significantly higher potential to damage the atmosphere. Furthermore, MDIs do not have a dose counter, making it difficult to accurately estimate the remaining amount, which can lead to increased consumption and carries the risk of insufficient treatment. The main differences between MDIs and DPIs are shown in the following table.

**Table 1: Comparison of Metered-Dose Inhalers and Dry Powder Inhalers**

Inhaler	Metered-dose inhaler (MDI)	Dry powder inhaler (DPI)
<b>Inhaler technique</b>	Hand/breath synchronisation is required (exception is with breath-triggered drug release systems)	No synchronisation required (in some cases, breathing flow-triggered)
<b>Breathing technique*</b>	Slow and deep breath**	Slow and deep breath, steady and strong inhalation**
<b>Spacers</b>	Possible	Not possible
<b>Dose counter</b>	Sometimes	Almost always
<b>Environmental impact due to propellants</b>	Very high	Low***

\* The only relevant difference refers to the inspiration technique, i.e. slow with MDIs to avoid oropharyngeal impact losses vs vigorous with powders for active aerosol generation, ensuring good aerosol quality.

\*\* The type of exhalation (slow vs fast, through the mouth with lip closure or through the nose) has little effect on efficacy once a correctly performed, differentiated inhalation maneuver and a sufficiently long breath-hold have been achieved (these two are crucial!).

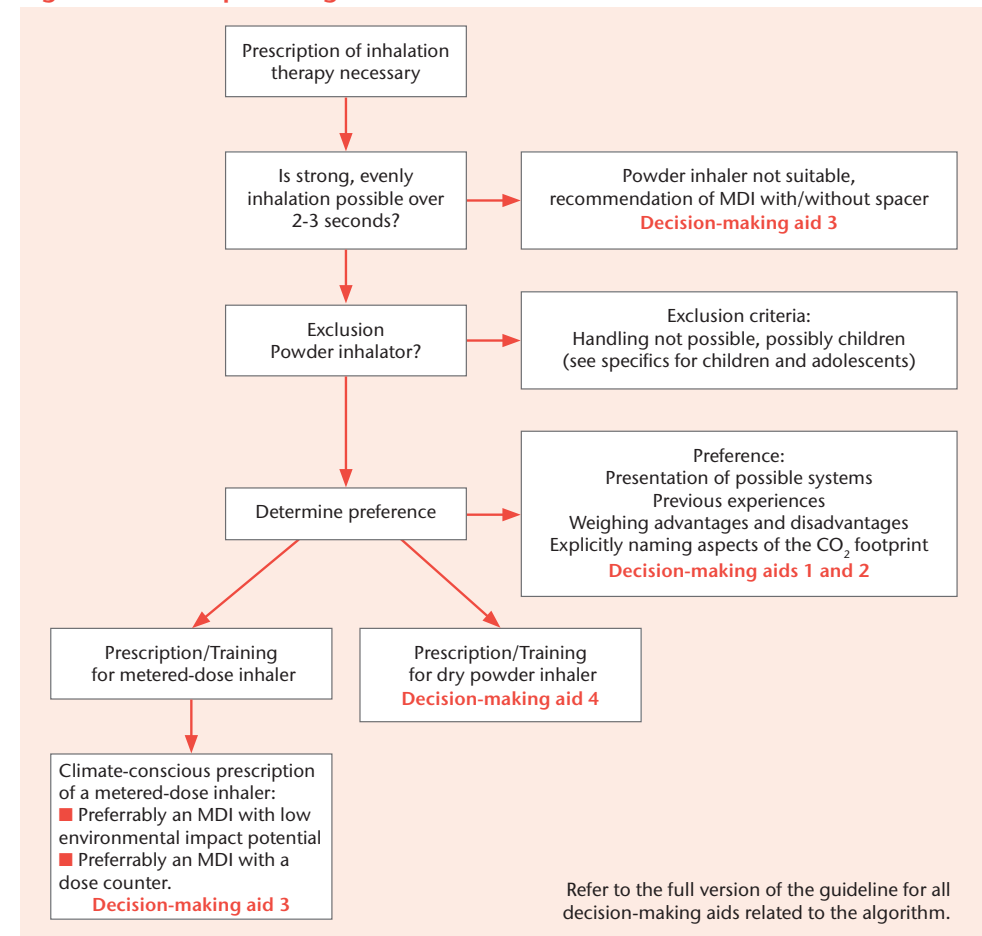
\*\*\* DPIs do not use or contain propellants, resulting in no environmental impact from propellants. Any potential environmental impacts from their use stem from other factors, such as manufacturing, transportation, and supply.

Therefore, the guideline recommends:

**For adolescents >12 years or adults with obstructive pulmonary disease, a climate-conscious inhalative therapy (preferably using a DPI) should be implemented. This generally applies to both regular and PRN use.**

The decision-making process for the selection of an inhaled drug can be seen in the following algorithm.

**Figure 1: Prescription Algorithm**



The availability of active ingredients for dry powder inhalers in Germany, irrespective of potential supply shortages, is shown in the following table:

**Table 2: Active ingredients as dry powder inhaler**

Short-acting inhaled beta-agonists Monotherapy and combination preparations	Dry powder inhaler available
Salbutamol	Yes
Ipratropium bromide + Fenoterol hydrobromide	No*
Long-acting inhaled beta-agonists Monotherapy and combination preparations	Dry powder inhaler available
Formoterol	Yes
Inhaled glucocorticoids Monotherapy and combination preparations	Dry powder inhaler available
Budesonide	Yes
Beclometasone + Formoterol	Yes
Budesonide + Formoterol	Yes
Fluticasone + Salmeterol	Yes
Fluticasone + Vilanterol	Yes
Fluticasone + Formoterol	No
Muscarinic receptor antagonists Monotherapy and combination preparations	Dry powder inhaler available
Tiotropium bromide	Yes
Formoterol + Aclidinium bromide	Yes
Formoterol + Beclometasone + Glycopyrronium bromide	Yes

Indacaterol + Glycopyrronium bromide	Yes
Olodaterol + Tiotropium bromide	No*
Vilanterol + Umeclidiniumbromid	Yes

\*Propellant-free spray nebuliser available

The selection of the listed active ingredients is based on prescription frequencies from the 2022 Drug Prescription Report, representing  $\geq 80\%$  of all prescribed mono- and combination preparations.

### The Carbon Footprint of Inhalation Therapy

To illustrate the effect of switching from an MDI to a DPI, Figure 2 shows the maximum possible savings. Depending on the therapy used and the required dosage, the reduction in the CO<sub>2</sub> footprint may be smaller

**Figure 2: CO<sub>2</sub> footprint/possible savings in CO<sub>2</sub> consumption in kg CO<sub>2</sub>** (for details and sources, see full version).

