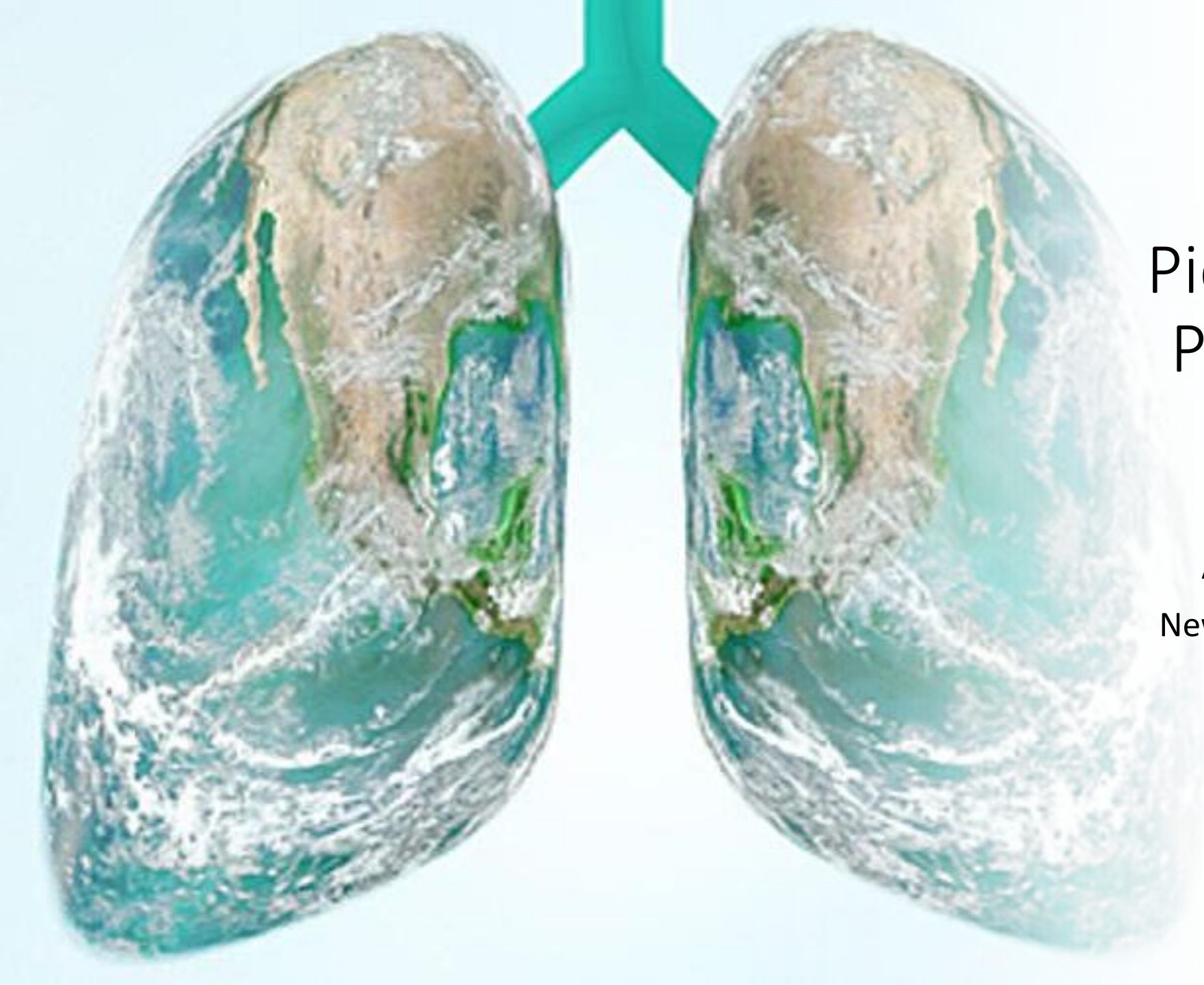


Picking Puffers for Patients and the Planet

Anna Sanderson MD, FRCPC

New Brunswick Internal Medicine Update

April 22, 2022

Disclosures

- Moderator for Valeo presentation

Objectives

- At the end of this presentation attendees will be able to
  1. Distinguish features of inhaler devices that affect usability for patients
  2. Recognize the environmental impact of inhaled medications
  3. Feel more comfortable choosing the most appropriate inhaler devices for individual patients and the planet

FINANCIAL TIMES

WORLD US COMPANIES TECH MARKETS CLIMATE OPINION WORK & CAREERS LIFE & ARTS HOW TO SPEND IT

TIME

HEALTH • ENVIRONMENT

How One Commonly Used Asthma Inhaler is

ThePrint

POLITICS GOVERNANCE ECONOMY DEFENCE INDIA FEATURES OPINION EVENTS VIDEO MORE

Home › Environment › Your asthma inhaler helps global warming. Here's how a 'green inhaler' can...

Environment

Your asthma
'green inhale

Why switching asthma inhaler could be better for you and the planet

BBC NEWS

By James Gallagher
Inside Health presenter, BBC Radio 4

6 February

Science CBC

Swap your inhaler, skip the laughing gas: How patients can help curb health-care emissions

Inhaler devices

Metered Dose Inhaler (MDI)

- With spacer device

Soft Mist Inhaler (SMI)

- Respimat®

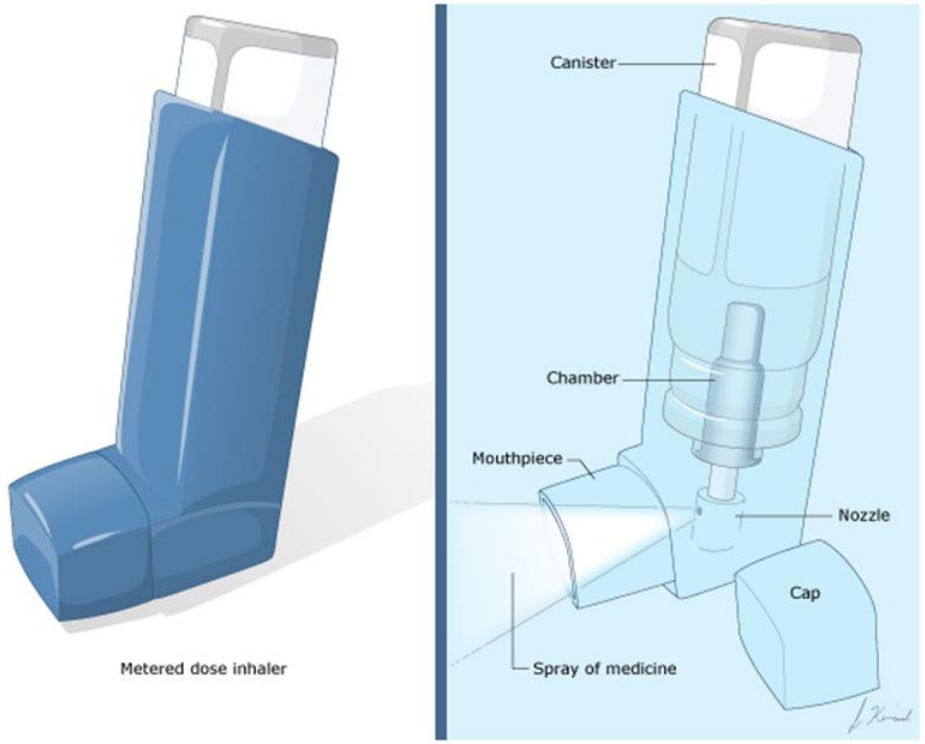
Dry Powder Inhaler (DPI)

- Diskus®
- Turbuhaler®
- Ellipta®
- Twisthaler®
- Breezhaler®
- Handihaler®
- Genuair®
- Respiclick®
- Inhub™

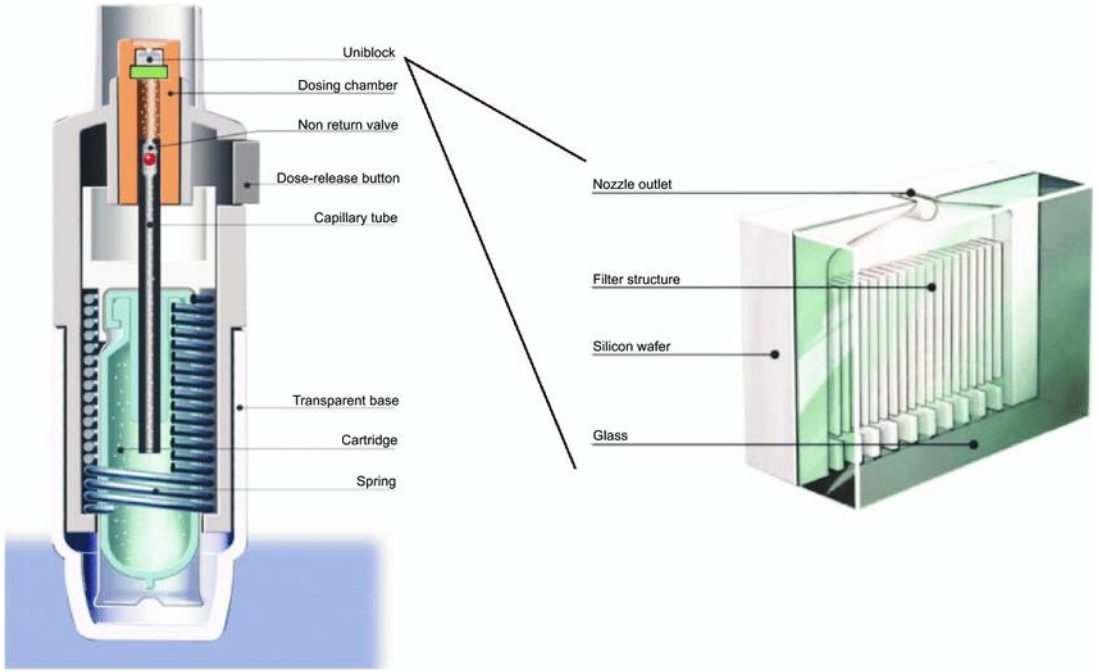
https://www.sustainablehealthsystems.ca/copsustainableinhalerinitiative

Non-Dry Powder Inhalers

pMDI



Respimat (Soft Mist Inhaler)



How to use a dry powder inhaler

A sample of some of the many dry powder inhalers available in the United States

- Load the medication dose*
- Stand or sit up straight and breathe out completely
- Put the mouthpiece in your mouth, close your lips tightly around it, and breathe in quickly and forcefully
- Take the inhaler out of your mouth, hold your breath for 5-10 seconds, and exhale slowly
- Remove and discard any capsules
- Close the device and store in a dry place

Inside some dry powder inhalers

Device	Advantages	Disadvantages
Pressurized metered dose inhaler (pMDI)	• Convenient • Portable • More efficient than a nebulizer • No drug prep required • Difficult to contaminate • Dose counter with some devices	• Patient coordination essential • Patient actuation required • High pharyngeal deposition • Difficult to delivery high doses • Not all medications available

We need pMDIs in the hospital

- When patients are sick they are less likely to be able to use dry powder inhalers effectively
- Short-acting bronchodilators are only available in non-dry powder devices
- pMDIs are needed to be given through ventilator circuits

- Acute illness/hospitalization is NOT the time to take away pMDIs!

A little bit of history

- Modern inhaler era began in 1956 with invention of the Medihaler
  - Metered dose inhaler – push on a canister to release a puff of drug mixed with a propellant
  - Chlorofluorocarbons (CFCs) were the primary propellants
- Molina and Rowland published in 1974 about CFCs causing ozone destruction
- Montreal Protocol on Substances that Deplete the Ozone Layer was signed in 1987, banning the use of CFCs
  - Medical exemption for metered-dose inhalers
- Inhaler CFCs were replaced with hydrofluoroalkane (HFA) propellants
  - HFA-134a and HFA-227ea
  - MDI design changed, promoting better drug delivery
- Subsequent diversification of inhaler technologies
  - dry powder inhalers, soft mist inhalers, nebulizer systems

The Kigali Amendment (2016)

- Hydrofluorocarbons (HFCs) are non-ozone depleting substances introduced to support the timely phase out of CFCs and HCFCs
- HFCs do not deplete the stratospheric ozone layer, but some have high global warming potential (GWP)
- HFC emissions are projected to rise to 7-19% of global CO2 emissions by 2050
- HFCs added to the Montreal Protocol list of controlled substances, including HFC-134a and HFC-227ea

Hydrofluoroalkane Propellants

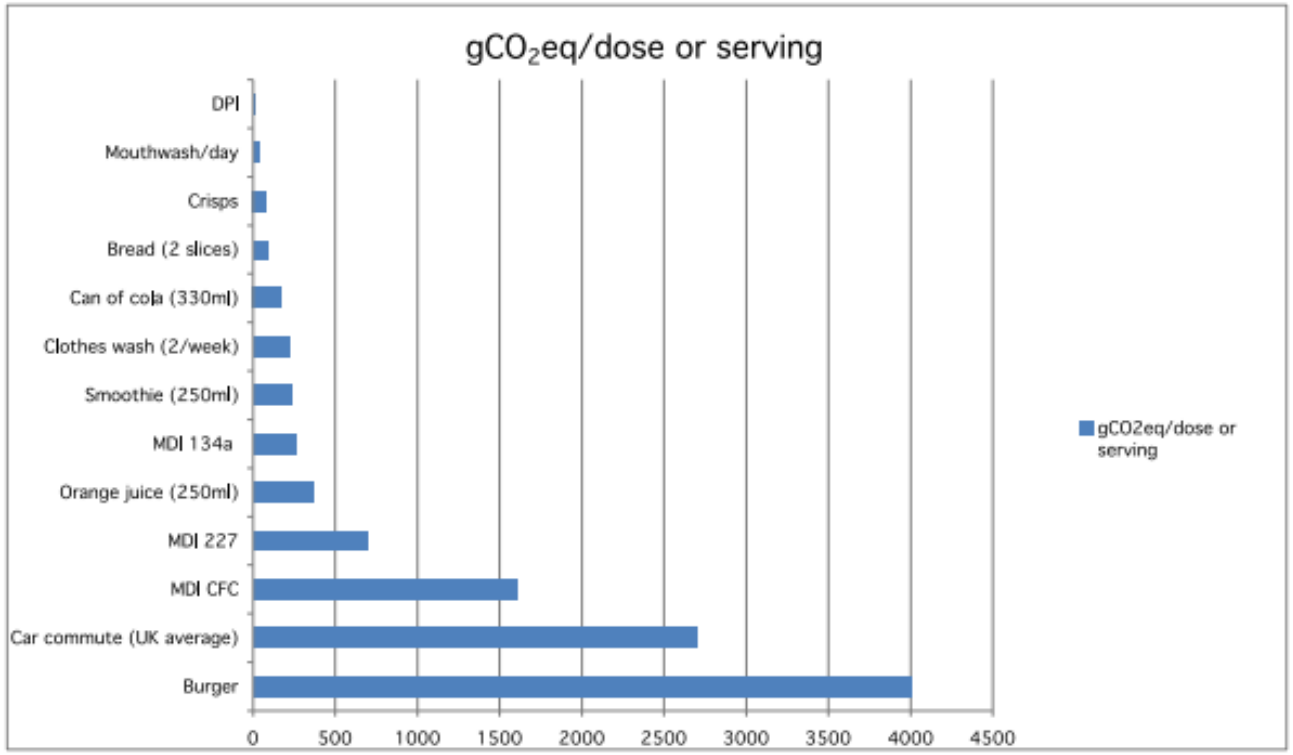
- For the year 2016, HFC propellant consumption for MDI manufacture corresponded to ~2% of global GWP-weighted total emissions of HFCs
  - Use of HFC MDIs is projected to increase
  - Particularly with increasing MDI use in developing countries

In Canadian pMDIs

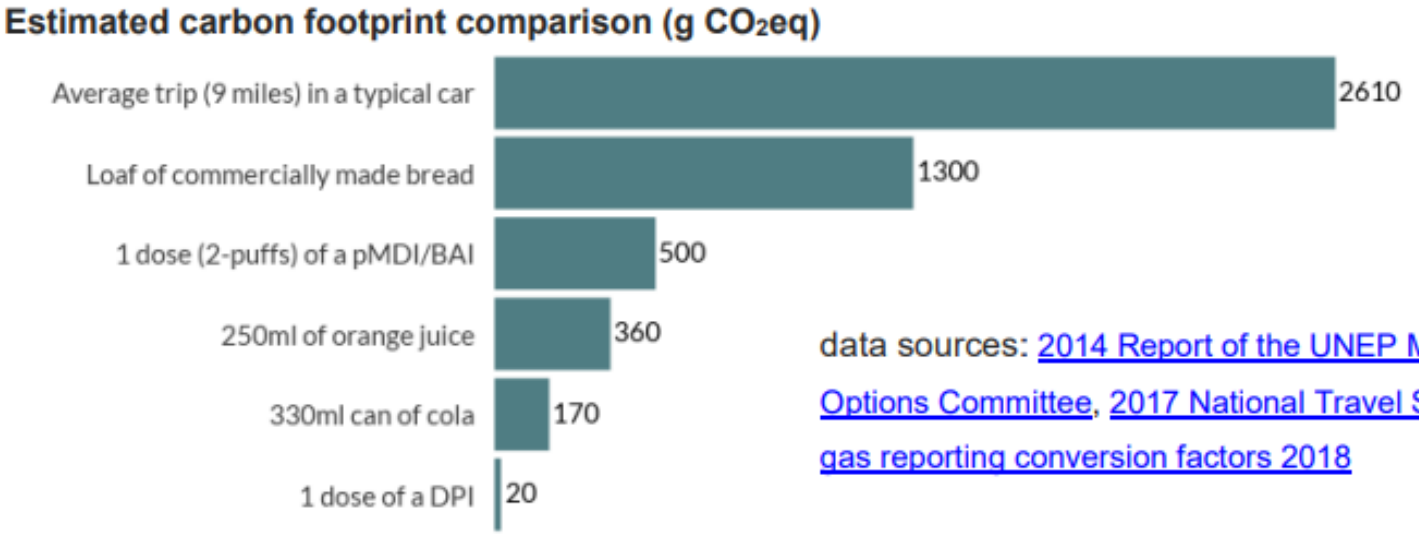
Table 2.1 Estimates of carbon footprints of a selection of respiratory devices and treatment methods (*circa.* 2014)

Respiratory devices and treatment methods	Carbon footprint Per 200 actuations (Grams CO_2-eq)	Carbon footprint Per dose (Grams CO_2-eq)[38]
CFC MDI	150,000-200,000	1,500-2,000
HFC-134a MDI	20,000-30,000	200-300
HFC-227ea MDI	60,000-80,000	600-800
Dry Powder Inhaler	1,500-6,000	<20
Tablets	1,500-5,000	<20

- HFA-134a
  - Ventolin (GSK)
    - APO-Salvent, NOVO-Salbutamol, TEVA-Salbutamol
  - Atrovent (BI)
  - Flovent (GSK)
  - Advair (GSK)
  - Alvesco (Takeda)
  - QVAR (Valeant)
- HFA-227ea
  - Zenhale (Organon)



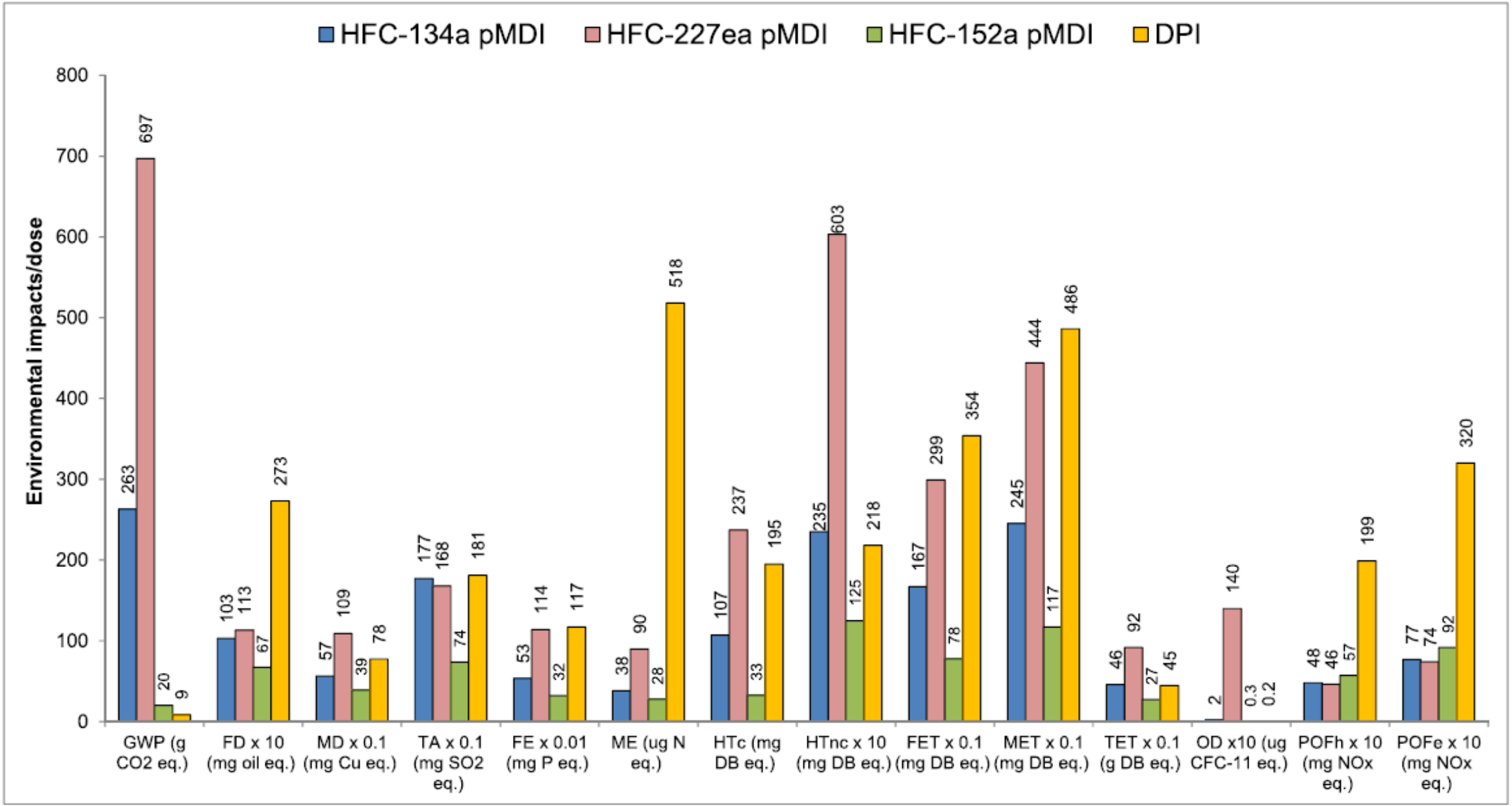
Comparisons



data sources: 2014 Report of the UNEP Medical Technical Options Committee, 2017 National Travel Survey & Greenhouse gas reporting conversion factors 2018

NICE Patient decision aid, Inhalers for Asthma

Impacts by inhaler type



Comparing different scenarios to the current situation

Replacement of all pMDIs with DPIs

	S-1	S-2	S-3	S-4	S-5	S-6	S-7
Global warming potential	-92%	-96%	-59%	-10%	-97%	-2%	-64%
Fossil depletion	-26%	122%	-34%	-13%	-51%	0%	-41%
Metal depletion	-27%	30%	-44%	-15%	-64%	-1%	-54%
Terrestrial acidification	-51%	2%	-48%	-4%	-67%	0%	-48%
Freshwater eutrophication	-31%	91%	-40%	-5%	-52%	-1%	-40%
Marine eutrophication	-10%	450%	-18%	3%	-16%	-1%	-13%
Human toxicity (cancer)	-57%	64%	-45%	-8%	-69%	-1%	-48%
Human toxicity (non-cancer)	-43%	-8%	-50%	-3%	-65%	-2%	-49%
Freshwater ecotoxicity	-42%	86%	-42%	2%	-51%	-1%	-35%
Marine ecotoxicity	-42%	77%	-42%	2%	-51%	-1%	-35%
Terrestrial ecotoxicity	-37%	-4%	-47%	-4%	-59%	-1%	-45%
Ozone depletion	-90%	-94%	-56%	-6%	-90%	-50%	-75%
Photochemical oxidants formation (human health)	12%	204%	-19%	-8%	-12%	0%	-17%
Photochemical oxidants formation (ecosystems)	12%	205%	-18%	-8%	-12%	0%	-17%

[a] The negative sign denotes reduction in impacts.

S1+S3+S4

Legend: ≥50% reduction | 1%-49% reduction | 1%-49% increase | ≥50% increase

Inhaler realities

- Inhalers are prescribed inappropriately
- Inhalers are used incorrectly
  - Multiple device types
- Therapeutic benefit determined by drug + device

Choosing Wisely Canada – Respiratory Medicine

- #1 **Don't** initiate long-term maintenance inhalers in stable patients with suspected COPD **if they have not had confirmation** of airflow obstruction with spirometry

- #5 **Don't** initiate medications for asthma (eg, inhalers, leukotriene receptor antagonists, or other) in patients ≥6 years old **who have not had confirmation** of reversible airflow limitation with spirometry, and in its absence, a positive methacholine or exercise challenge test, or sufficient peak expiratory flow variability

When prescribing an inhaler consider

1. What is the diagnosis?
   - Has diagnostic testing been done?
2. What drug(s) does the patient need
   - Short-acting bronchodilators, long-acting bronchodilators, inhaled corticosteroids, fixed-dose combination
3. What has the patient tried before?
4. Does the patient have physical or cognitive limitations that prohibit effective use of certain devices?
5. What is the environmental impact?
6. REASSESS

The best inhaler is the one the patient will take (as prescribed)

Encourage patients to dispose of used inhalers at pharmacies

Once fully used, MDIs can be...

RECYCLED
Plastic and aluminum in each device can be recycled at designated pharmacies.

INCINERATED
MDI incineration causes the thermal degradation of HFC chemicals.

Not available at any pharmacy I contacted

CO_2 emission
SAVINGS 4-18kg[8]
per inhaler*

CO_2 emission
SAVINGS 3-17kg[8]
per inhaler*

*Compared to landfill disposal

Preventing/reducing the need for inhaled medications – outpatients

- Smoking cessation
  - Tobacco, recreational drugs, illicit drugs
  - E-cigarettes, vaping devices, pipes, etc.
- Patient education
  - How to use devices, when to use inhalers, expectations
- Maintain good control of airways diseases
  - Vaccinations
  - Exercise/pulmonary rehabilitation
  - Avoidance of triggers
  - Management of comorbities
  - Early treatment of exacerbations
  - Airway clearance

Reducing the need for inhaled medications – inpatients

- Reassess scheduled MDI dosing EVERY DAY
- Does the patient need Q4H Ventolin and Q6H Atrovent when they are on long-acting versions (or do they need time for systemic therapies to work)?
- Can a patient on scheduled Ventolin or Atrovent at home be changed to a long-acting formulation once recovered?
- Use the opportunity to ensure patients are taking their inhalers properly at home
- Use the opportunity to promote smoking cessation and initiation of NRT

DO NOT MAKE PATIENTS FEEL GUILTY ABOUT USING THEIR INHALERS

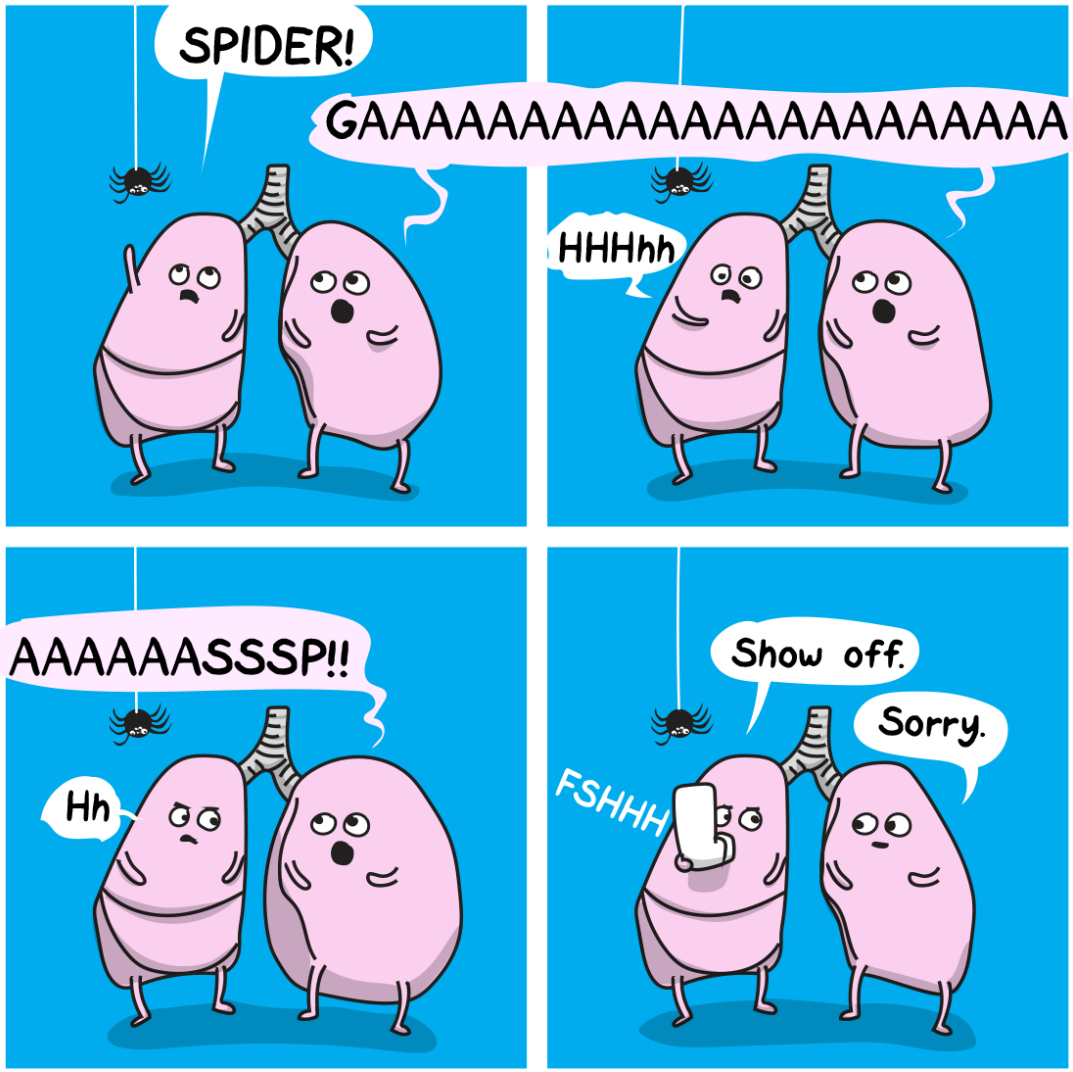
NOT HELPFUL

References

- Clark et al. 2020. The confusing world of dry powder inhalers: it is all about inspiratory pressures, not inspiratory flow rates. *Journal of Aerosol Medicine and Pulmonary Drug Delivery,* 33(1), 1-11.
- DeWeerdt, S. (2020). The inhaler makeover. *Nature, 581*, S14-S18.
- Eckelman, MJ et al. (2018). Life cycle environmental emissions and health damages from the Canadian healthcare system: An economic-environmental-epidemiological analysis. *PLOS Medicine,* 31 July 2018.
- Jeswani, HK & Azapagic, A. (2019). Life cycle environmental impacts of inhalers. *Journal of Cleaner Production, 237.*
- Keeley, D et al. (2020). Minimising the environmental impact of inhaled therapies: problems with policy on low carbon inhalers. *European Respiratory Journal; 55*: 2000048. [https://doi.org/10.1183/13993003.00048-2020].
- Leach, CL. (2005). The CFC to HFA Transition and Its Impact on Pulmonary Drug Development. *Respiratory Care, 50*(9), 1201-1208.
- NICE. (2020). Patient decision aid: Inhalers for asthma. https://www.nice.org.uk/guidance/ng80/resources/inhalers-for-asthma-patient-decision-aid-pdf-6727144573 [Accessed 18 April 2022]
- Product monographs: Advair, Alvesco, Atrovent, Flovent, Ventolin, Apo-Salvent, Teva-Salbutamol, Novo-Salbutamol, QVAR, Zenhale
- Stein, S & Theil, C. (2017). The History of Therapeutic Aerosols: A Chronological Review. *Journal of Aerosol Medicine and Pulmonary Drug Delivery, 30*(1), 20-41.
- UNEP. About Montreal Protocol. https://www.unep.org/ozonaction/who-we-are/about-montreal-protocol [Accessed 18 April 2022]
- UNEP. Montreal protocol on substances that deplete the ozone layer: Medical and Chemicals Technical Options Committee 2018 Assessment Report. https://ozone.unep.org/sites/default/files/2019-04/MCTOC-Assessment-Report-2018.pdf [Accessed 18 April 2022]
- UNEP. The Kigali Amendment (2016). https://ozone.unep.org/treaties/montreal-protocol/amendments/kigali-amendment-2016-amendment-montreal-protocol-agreed [Accessed 18 April 2022]
- University of Toronto Sustainable Health System Community of Practice – Sustainable inhaler initiative. https://www.sustainablehealthsystems.ca/copsustainableinhalerinitiative [Accessed 18 April 2022]
- UpToDate. Delivery of inhaled medications in adults. [Accessed 18 April 2022]
- Usmani, OS et al. (2019). Our planet or our patients – is the sky the limit for inhaler choice? *The Lancet, 7*, 11-13.
- Woodcock, AW et al. (2022). Effects of switching from a metered dose inhaler to a dry powder inhaler on climate emissions and asthma control: post-hoc analysis. *Thorax, 0,* 1-6. Epub ahead of print. Doi:10.1136/thoraxjnl-2021-218088.

Questions?

Thank you!


SPIDER!
GAAAAAAAAAAAAAAAAAAAAA
HHHhh
AAAAAASSSP!!
Hh
Show off.
Sorry.
FSHHH
theAwkwardYeti.com