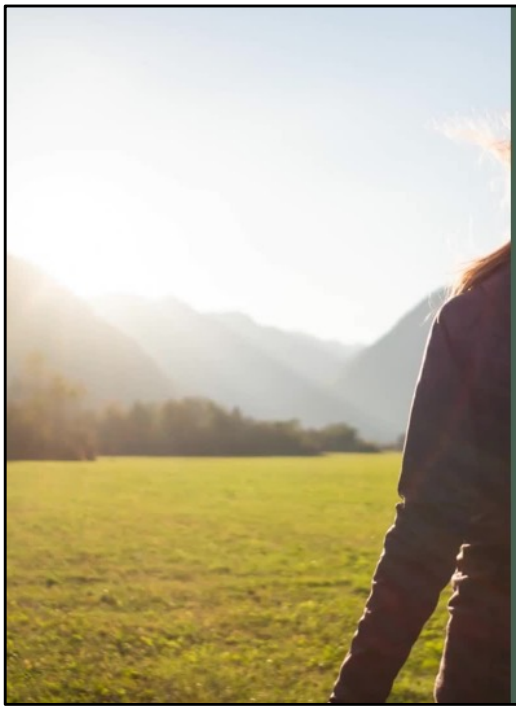


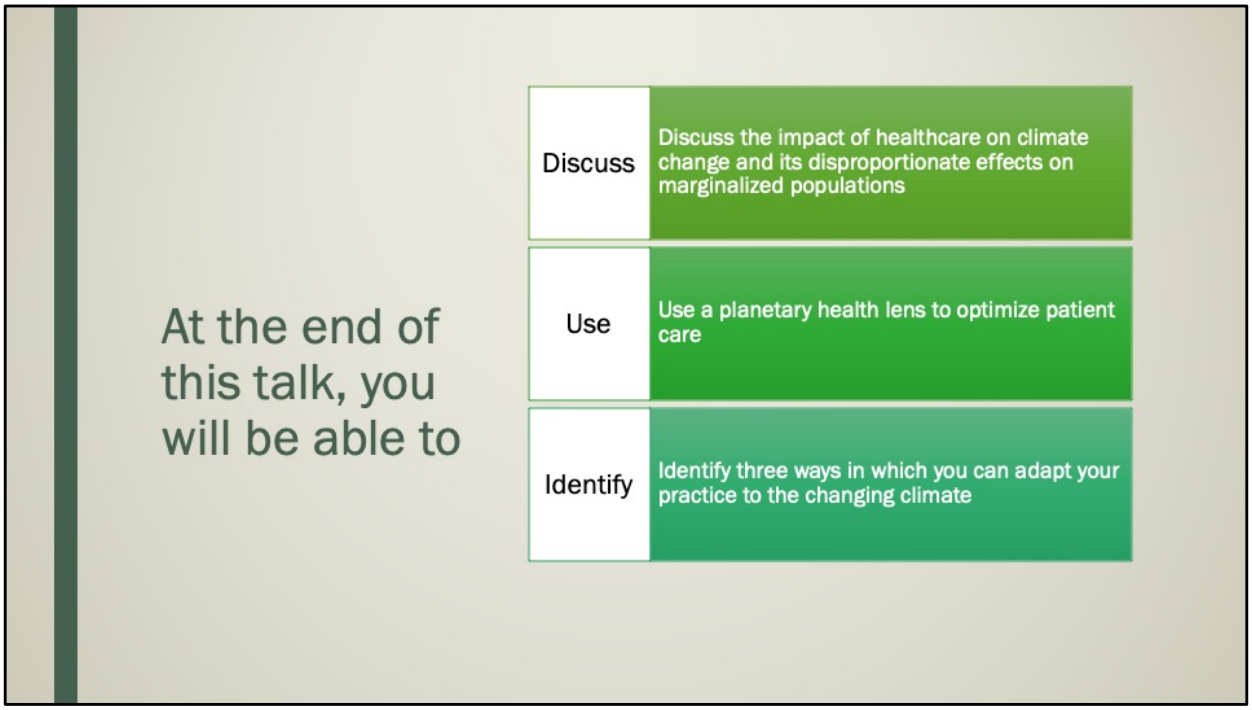
BREATHING A LITTLE EASIER

Inhalers, the climate and you

Saanich Peninsula Hospital Physicians Society
Feb 10, 2022
Dr V. Stoynova

Disclosures

- I have no financial ties to disclose


At the end of this talk, you will be able to
Discuss
Discuss the impact of healthcare on climate change and its disproportionate effects on marginalized populations
Use
Use a planetary health lens to optimize patient care
Identify
Identify three ways in which you can adapt your practice to the changing climate


CLIMATE CRISIS

In 2021 alone,

- We had the third worst forest fire year on record, with 8,700 sq km of land burned. With the drought conditions and punishing heat waves, the forest fire season season started earlier than usual. One of the most devastating and notable fires torched the village of Lytton, BC, a predominantly First Nations community, killing two and displacing thousands of of our most vulnerable populations.
- Between June 25th and July 1st, BC experienced a heat dome, high pressure weather system that created record-high temperatures across the province up to 49.6C. 595 BC citizens lost their lives to the heat dome, the majority of which were elderly people. Social isolation and poverty increased the risk of fatality with the majority of deaths occurring in areas of subsidized housing, areas with less green space and areas with lower income levels. There were two more heatwaves between July and September. The government doesn't keep data on other heat impacts such as hospital admissions.
- In November 2021, the Pineapple Express, a type of atmospheric river, brought heavy rains to Southern BC. In conjunction with deforestation, this critical weather event led to massive flooding with severe short and long term disruption of the transportation corridor linking Vancouver, and the Island to the rest of the country. Our hospital was within a hair's breadth of flooding. 15,000 more BC citizens

became climate refugees as they were displaced from their homes.

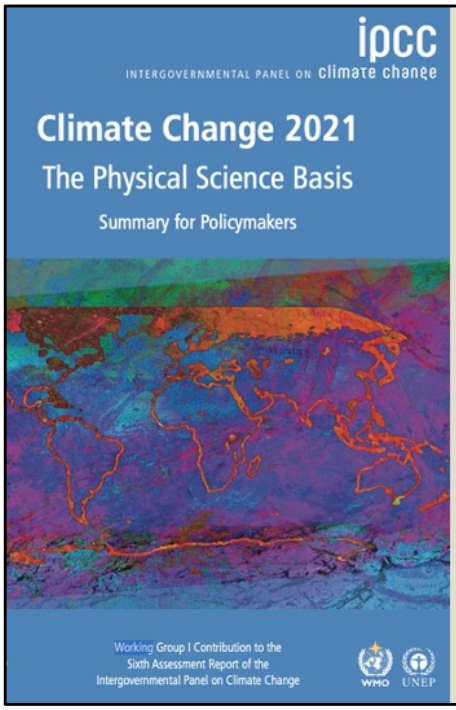
- Did I mention there's also a global pandemic going on?

Please review this document which goes through current and anticipated health impacts in Canada related to climate change. It includes things from worsening respiratory diseases, through to increased hospital evacuations, worsening mental health. It lists some of the cultural trauma from climate change, such as decreased availability of traditional foods in the Canadian North.

In Canada alone, more than 20,000 premature deaths each year are attributable to air pollution (Brauer at al, 2016)

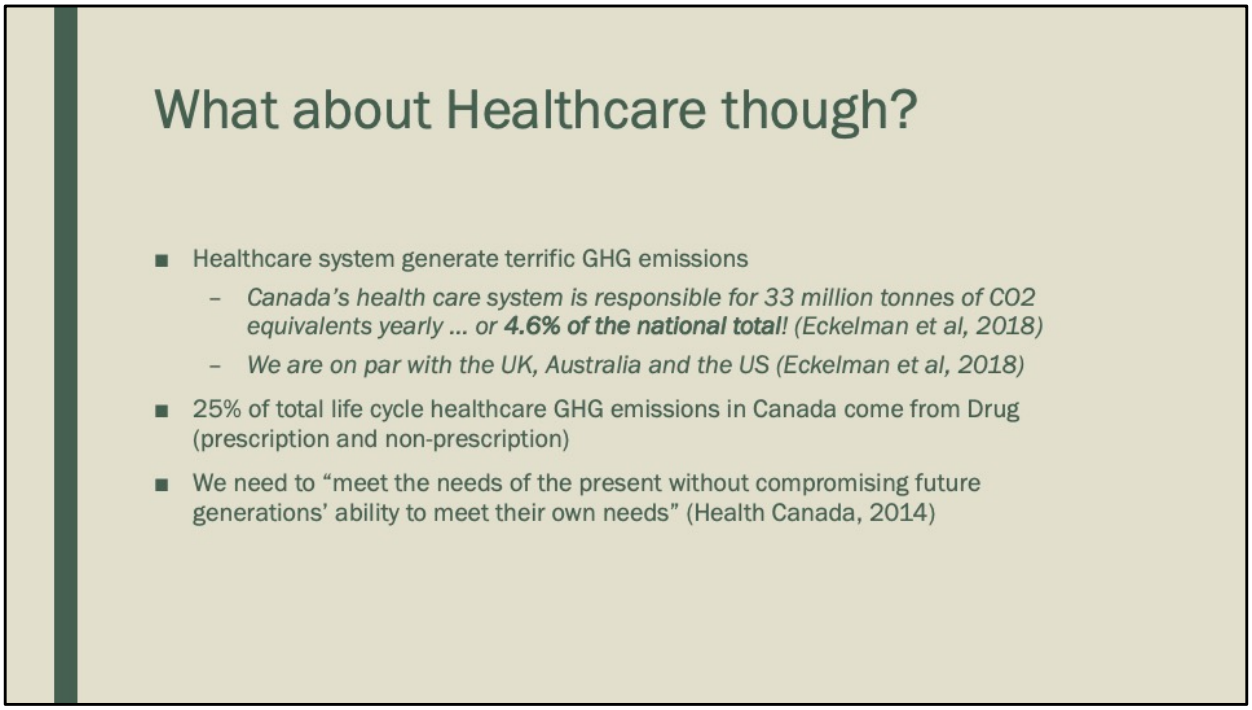
The Lancet Countdown on Health and Climate Change; Policy Brief for Canada October 2021
https://policybase.cma.ca/documents/PolicyPDF/PD22-01.pdf

Brauer M, Freedman G, Frostad J, van Donkelaar A, Martin RV, Dentener F, et al. Ambient air pollution exposure estimation for the global burden of disease 2013. Environ Sci Technol. 2016; 50(1): 79–88. https://doi.org/10.1021/acs.est.5b03709 PMID: 26595236



The path forward

- In order to limit the worst of the impact, a target of less than 1.5C above pre-industrial times
- COP26
  - *Halve emissions by 2030*
  - *Secure global net zero by mid-century*
  - *Canada has committed to net-zero emissions by 2050*

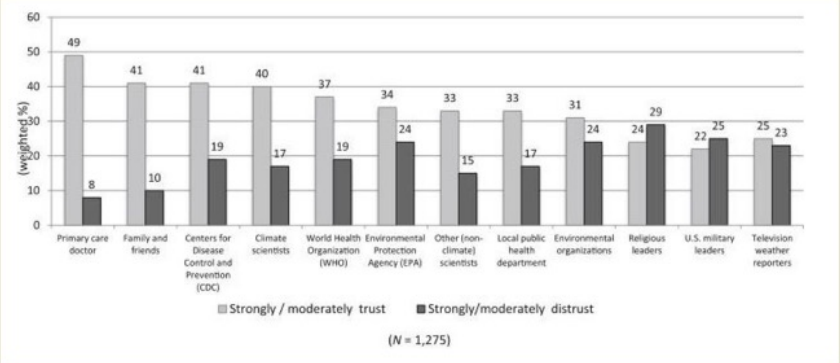


Global environmental change is being increasingly recognized as a threat to human health, but the irony is that the delivery of healthcare services themselves have a massive contribution to the carbon footprint which in turn contributes to the global burden of climate change

Eckelman MJ, Sherman JD, MacNeill AJ (2018) Life cycle environmental emissions and health damages from the Canadian healthcare system: An economic-environmental-epidemiological analysis. PLoS Med 15(7): e1002623. https://doi.org/10.1371/journal. pmed.1002623

Health Canada. Health Canada's 2014–2015 Departmental Sustainable Development Strategy: Gov- ernment of Canada; 2014. https://www.canada.ca/en/health-canada/corporate/about-health-canada/activities-responsibilities/sustainable-development.html.

Why me, why us?



For two main reasons: we have people's trust

Why me, why us?

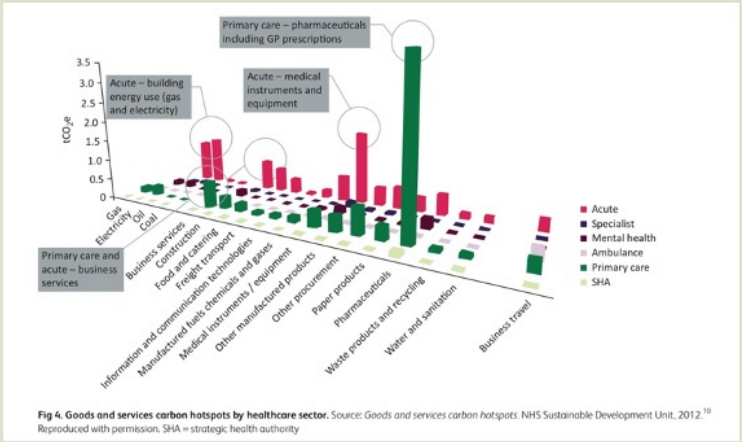
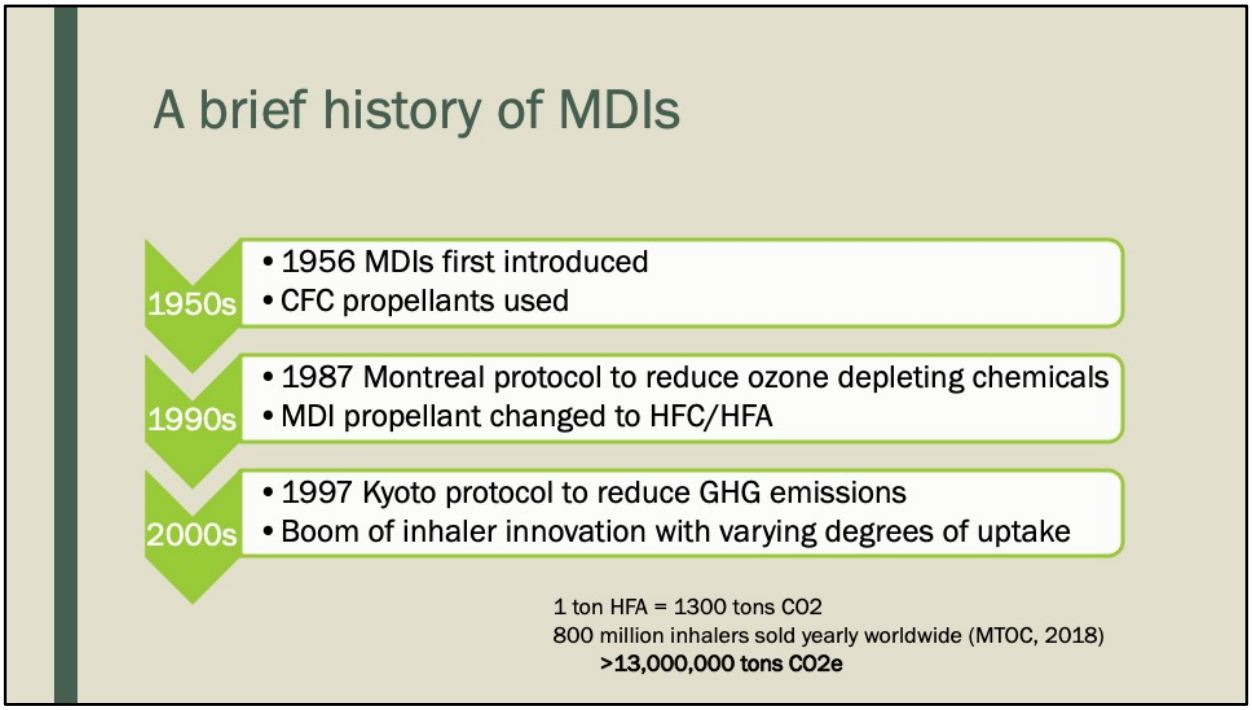


Fig 4. Goods and services carbon hotspots by healthcare sector. *Source: Goods and services carbon hotspots.* NHS Sustainable Development Unit, 2012.[10] Reproduced with permission. SHA = strategic health authority

…and a terrific amount of carbon comes out of our prescribing pens

There's a lot we can do to improve decrease our carbon footprint, improve patient-health related outcomes and decrease cost to patients'


INHALERS
This Photo by Unknown Author is licensed under CC BY-SA-NC



In the 1950s, CFC propellants were commonly used in a number of readily available medications including MDIs, nitrosprays, nasal sprays for allergic rhinitis, vaginal contraceptive foams and rectal foams for colitis.

CFC propellants are very inert and overtime diffuse into the upper stratosphere. When they get there, sunlight exposure causes breakdown which generates free chlorine radicals that then damage and breakdown ozone molecules.

In the mid-1980s, evidence mounted that the stratospheric ozone levels were decreasing at an alarming rate in no small part due to CFC gases. In 1987, countries rallied signing the Montreal Protocol calling for the elimination of CFC propellants with a target date of 1996 which led to a boom of research in generating alternative inhaler types. Pharma companies began to search for a new propellant.

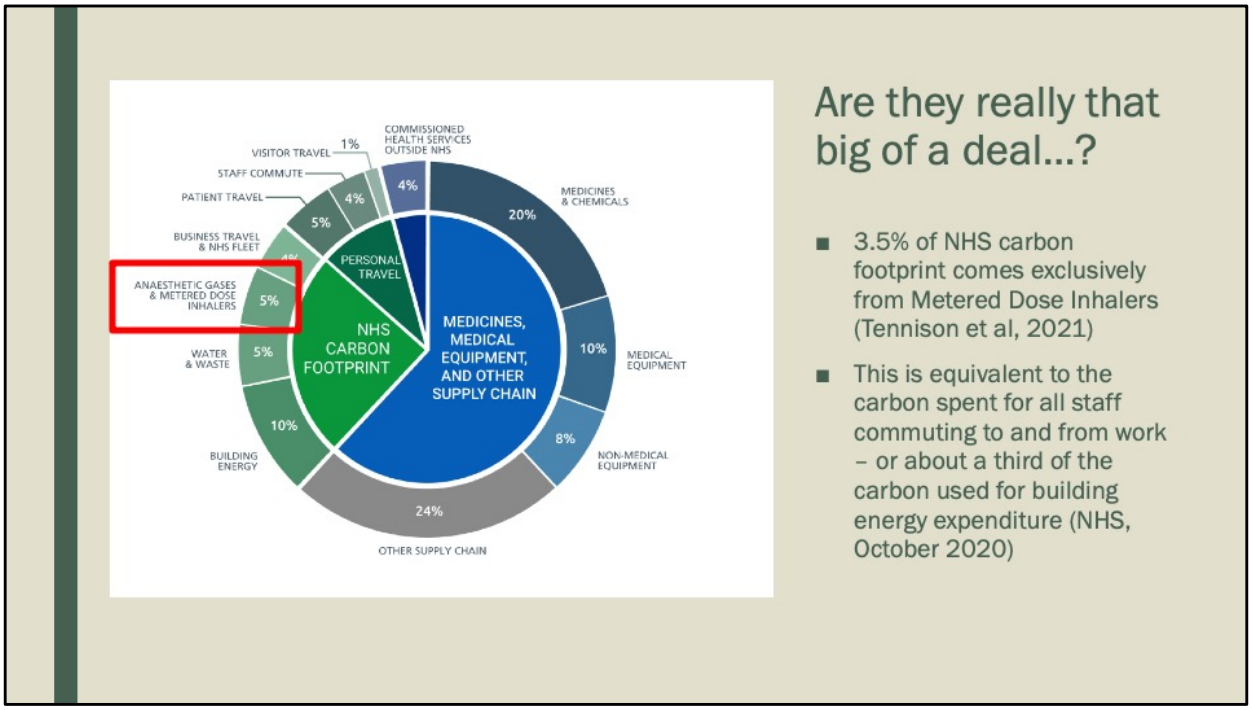
They came up with the HFA propellant which isn't ozone-depleting but is still very carbon intensive

In December 1997, the Kyoto protocol was signed with 192 countries. Canada withdrew from Kyoto in 2012 for reasons that are beyond the scope of a little hour-

long talk. The goal was to reduce the onset of global warming by reducing GHG emissions from 7 greenhouse gases, HFC/HFAs were one of the 7.

I want to start by defining carbon footprint, to make sure that we are on the same page. The term carbon footprint describes “the emissions of greenhouse gases that are generated to the environment due to human activity”. Carbon footprint is quantified by the Goal Warming Potential (GWP) expressed in tones, kilograms or grams of the equivalent emitted carbon dioxide (or CO2 equivalents). GWP shows how many times the impact of a single ton/kilo/g of any given gas emitted into the atmosphere is higher than than the greenhouse effect cause by a single ton/kilo/g of Co2. For instance – and hold onto your hats here – HFA, the main propellant used in MDIs, has 1300x the GWP as CO2. One ton of HFA has the same global warming potential as 1300 tons of C02.

Over 800 million HFA inhalers are sold annually worldwide, which amounts to 11,500 tons of HFA, or over 13 million tons of CO2. From inhalers alone.



Fletcher MJ, Upton J, Taylor-Fishwick J, et al. COPD uncovered: an international survey on the impact of chronic obstructive pulmonary disease [COPD] on a working age population. BMC Public Health. 2011; 11: 612, doi: 10.1186/1471-2458-11- 612, indexed in Pubmed: 21806798.

Accessed United Nations Environment Programme. Report of the Medical Technical Options Committee (MTOC) 2018 Assessment Report. 2018. http://ozone.unep.org/Assessment_ Panels/TEAP/Reports/MTOC/MTOC-AssessmentReport-2014. pdf (23.10.2020).

Tennison, I., Roschnik, S., Ashby, N., Boyd, R., Hamilton, I., Oreszczyn, T. (2021). Health care's respose to climate change" a carbon footprintassessment of the NHS in England. *Lancet Planetary Health*. 5(2), e84-92. DOI https://doi.org/10.1016/S2542-5196(20)30271-0

NHS Report on Delivering a "Net Zero" National Health Service, October 2020 DOI https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf

Not all inhalers are made equal

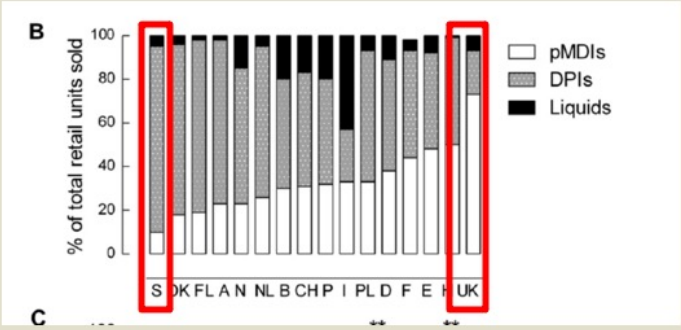
MDIs	DPIs			SMIs
	Diskus 	Ellipta 	Twisthaler 	
	Turbuhaler 	Handihaler 	Breezhaler	
	Genuair 	Respclick 	Inhub 	

Metered dose inhalers are the ones with the greatest environmental impact, which we'll get to in a minute

However, we have excellent alternatives including 9 different delivery methods for DPIs available in Canada alone. Before getting involved in this topic, I was really only familiar with Diskus, Elliipta and Handihaler formulations, but all of them have advantages.

The spectrum of inhalers is critical because no single inhaler system will work for all patients and this variety is truly needed to make sure everyone is able to get a drug and delivery mechanisms that suits their needs.

Europe and beyond



There is significant variability among different European countries about usage of DPIs versus MDIs. We are similar to the US (not pictured here) and the UK where 80-90% of our inhalers are MDIs. The use of DPIs in developing countries is negligeable.

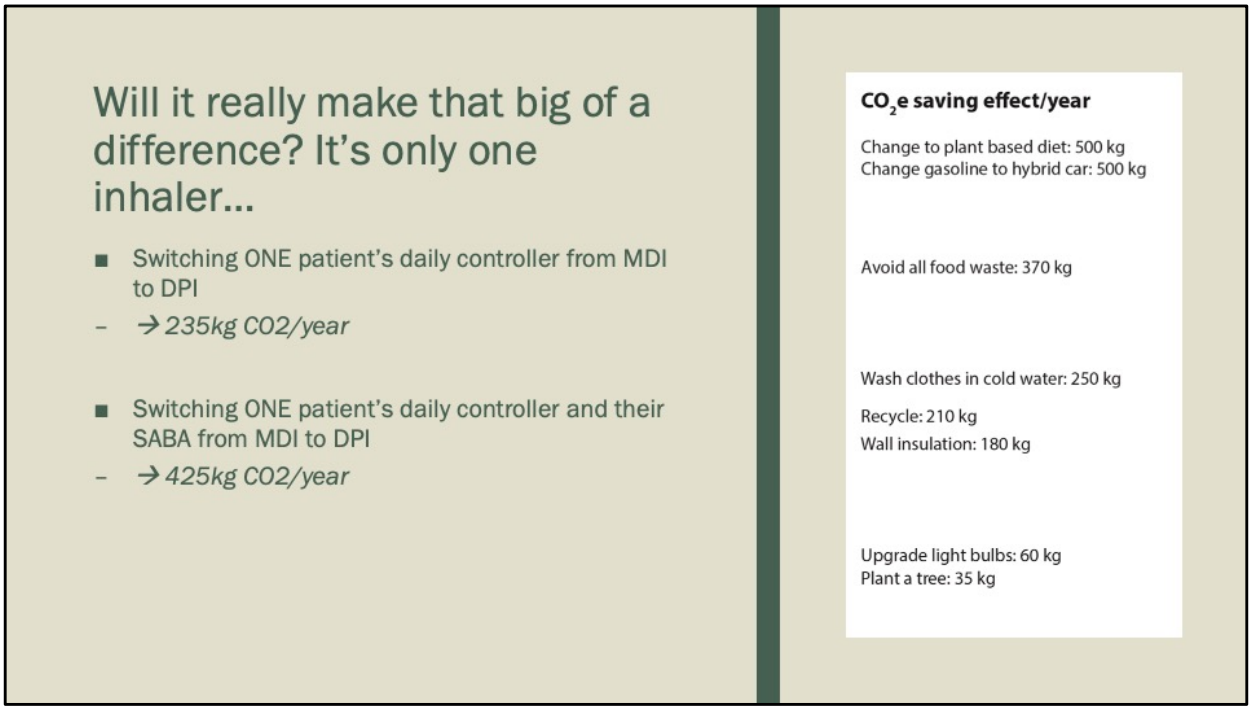
By contrast, Danemark and Sweden use predominantly DPIs. This is for several reasons, but the most proeminent of which is likely a couple of strong local manufacturers of DPIs in Sweden and Danemark and a longstanding tradition of prescribing them. Simply put; people do this because this is what they've been taught.

Lavorini, F., Corrigan, C., Barnes, PJ. (2011). Retail sales of inhalation devices in European countries: So much for a global policy. *Respiratory Medicine.* 105(7): 1099-1103.

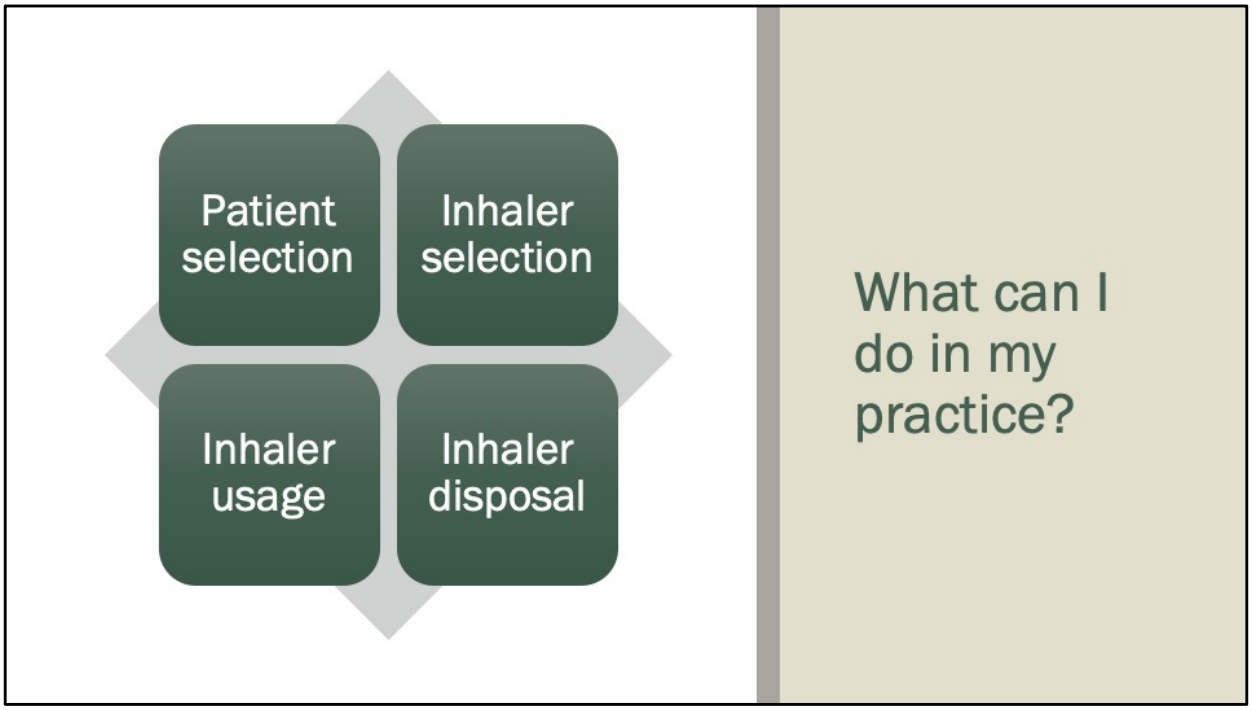
Atkins, PJ., Woodcock, A., Blinova, O., Khan, J., Stechert, R., Wright, P., Yizhong, Y., Fakes, D. & Seki, M.. (2005) Chapter 8: Medical Aerosols. In IPCC/TEAP Special Report: Safeguarding the Ozone Layer and the Global Climate System.

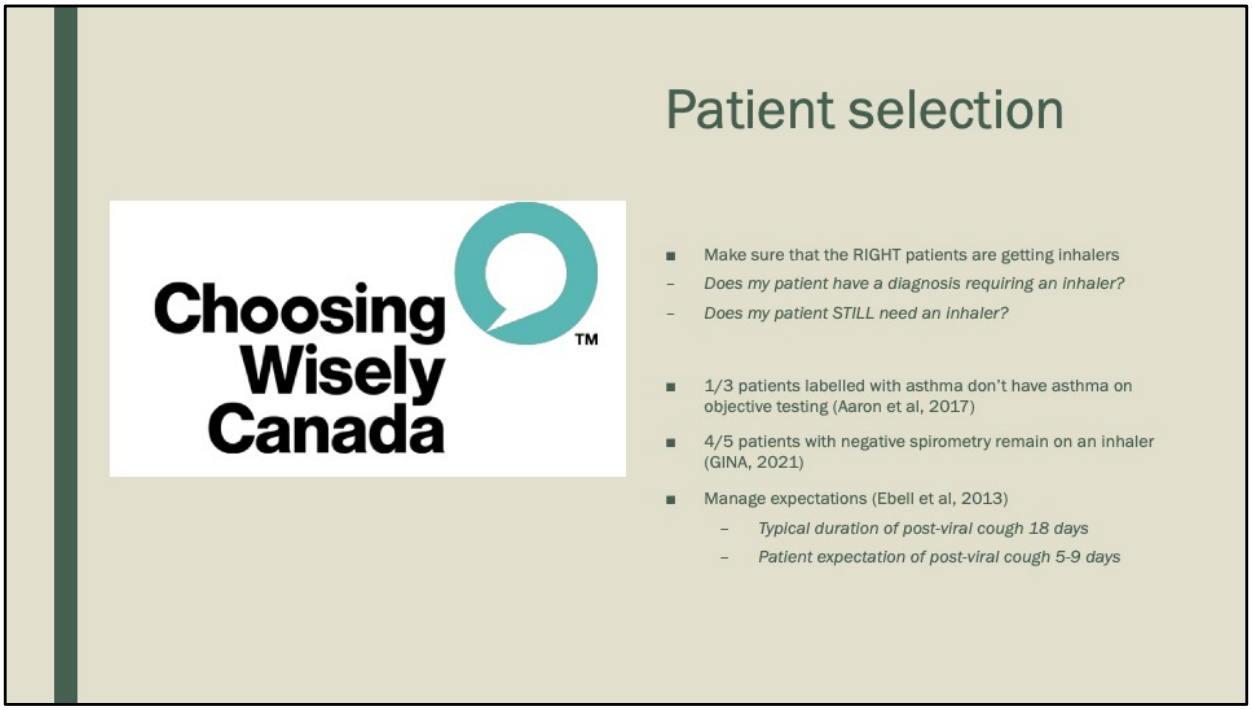
Some MDI concerns

- Exorbitant carbon footprint
- Require complex coordination techniques to achieve a clinically effective dose
  - *Very poor drug delivery to lung tissue when using "real life" technique*
- No dose counters
  - *Patient can unknowingly run out of medication, resulting in exacerbations*
  - *Patient can ask for refill earlier than needed, resulting in wasted doses*



Janson, C., Henderson, R., Lofdahl, M., Hedberg, M., Sharma, R., Wilkinson, AJK. (2019). Carbon footprint impact of the choice of inhalers for asthma and COPD. *BMJ Thorax*. 0:1-3. doi:10.1136/thoraxjnl-2019-213744


Patient selection
Inhaler selection
Inhaler usage
Inhaler disposal
What can I do in my practice?



Choosing wisely Canada, Respiratory Medicine, March 2021

- **Don't initiate long-term maintenance inhalers in stable patients with suspected COPD if they have not had confirmation of post-bronchodilator airflow obstruction with spirometry.**
- **Don't initiate medications for asthma (e.g., 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.**

Aaron et.al. JAMA. 2017; 317(3): 269-279. Re-evaluation of Diagnosis in Adults With Physician-Diagnosed Asthma

Global Initiative for Asthma (GINA) Guidelines 2020, page 26. Available at https://ginasthma.org/wp- content/uploads/2020/06/GINA-2020-report_20_06_04-1-wms.pdf

Ebell MH, Lundgren J, Youngpairoj S. How long does a cough last? Comparing patients' expectations with data from a systematic review of the

literature.
Ann Fam Med. 2013 Jan-Feb;11(1):5-13. doi: 10.1370/afm.1430. PMID: 23319500; PMCID: PMC3596033. https://pubmed-ncbi-nlm-nih-gov.myaccess.library.utoronto.ca/23319500/

Inhaler selection

Make sure that the RIGHT inhaler gets prescribed

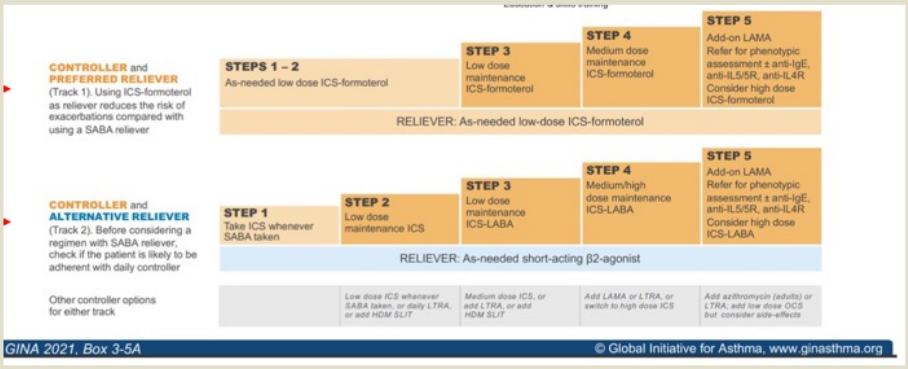
- What type of active ingredient do they need?
- Are they well controlled?

What delivery mechanism should we chose?

- Inspiratory capacity
- Ability to use inhaler (eg arthritis, weakness)
- Cost/coverage concerns

Highlighting importance of join decision making

GINA 2021


CONTROLLER and PREFERRED RELIEVER
(Track 1). Using ICS-formoterol as reliever reduces the risk of exacerbations compared with using a SABA reliever
STEPS 1 – 2
As-needed low dose ICS-formoterol
STEP 3
Low dose maintenance ICS-formoterol
STEP 4
Medium dose maintenance ICS-formoterol
STEP 5
Add-on LAMA
Refer for phenotypic assessment ± anti-IgE, anti-IL5/5R, anti-IL4R
Consider high dose ICS-formoterol
RELIEVER: As-needed low-dose ICS-formoterol
CONTROLLER and ALTERNATIVE RELIEVER
(Track 2). Before considering a regimen with SABA reliever, check if the patient is likely to be adherent with daily controller
STEP 1
Take ICS whenever SABA taken
STEP 2
Low dose maintenance ICS
STEP 3
Low dose maintenance ICS-LABA
STEP 4
Medium/high dose maintenance ICS-LABA
STEP 5
Add-on LAMA
Refer for phenotypic assessment ± anti-IgE, anti-IL5/5R, anti-IL4R
Consider high dose ICS-LABA
RELIEVER: As-needed short-acting β2-agonist
Other controller options for either track
Low dose ICS whenever SABA taken, or daily LTRA, or add HDM SLIT
Medium dose ICS, or add LTRA, or add HDM SLIT
Add LAMA or LTRA, or switch to high dose ICS
Add azithromycin (adults) or LTRA; add low dose OCS but consider side-effects
GINA 2021, Box 3-5A
© Global Initiative for Asthma, www.ginasthma.org

Is my patient relying too heavily on SABAs?

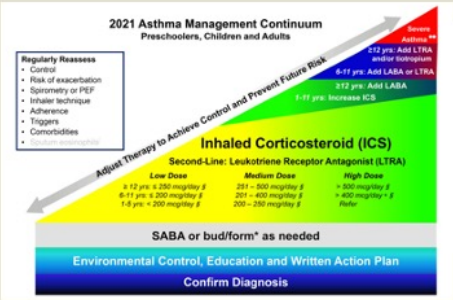


Table 3. Well-controlled asthma criteria.

Characteristic	Frequency or value
Daytime symptoms	≤2 days/week
Nighttime symptoms	<1 night/week and mild
Physical activity	Normal
Exacerbations	Mild and infrequent+
Absence from work or school due to asthma	None
Need for a reliever (SABA or bud/form)†	≤2 doses per week
FEV_1 or PEF	≥90% of personal best
PEF diurnal variation	<10–15%‡
Sputum eosinophils	<2–3%•

A patient who meets all of the above criteria would be considered to have well-controlled asthma.

What about the delivery mechanism?

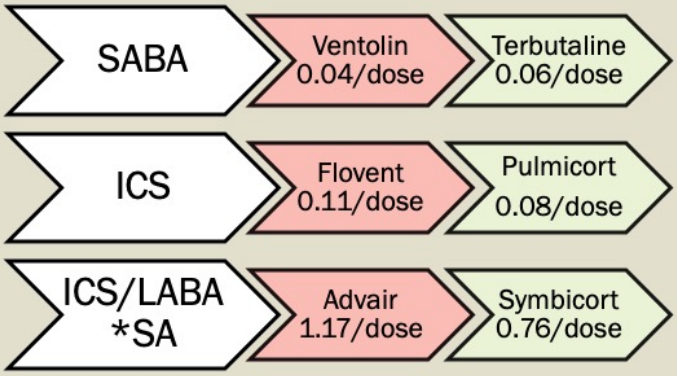
- Inspiratory capacity
- Ability to use inhaler
- Cost/coverage concerns

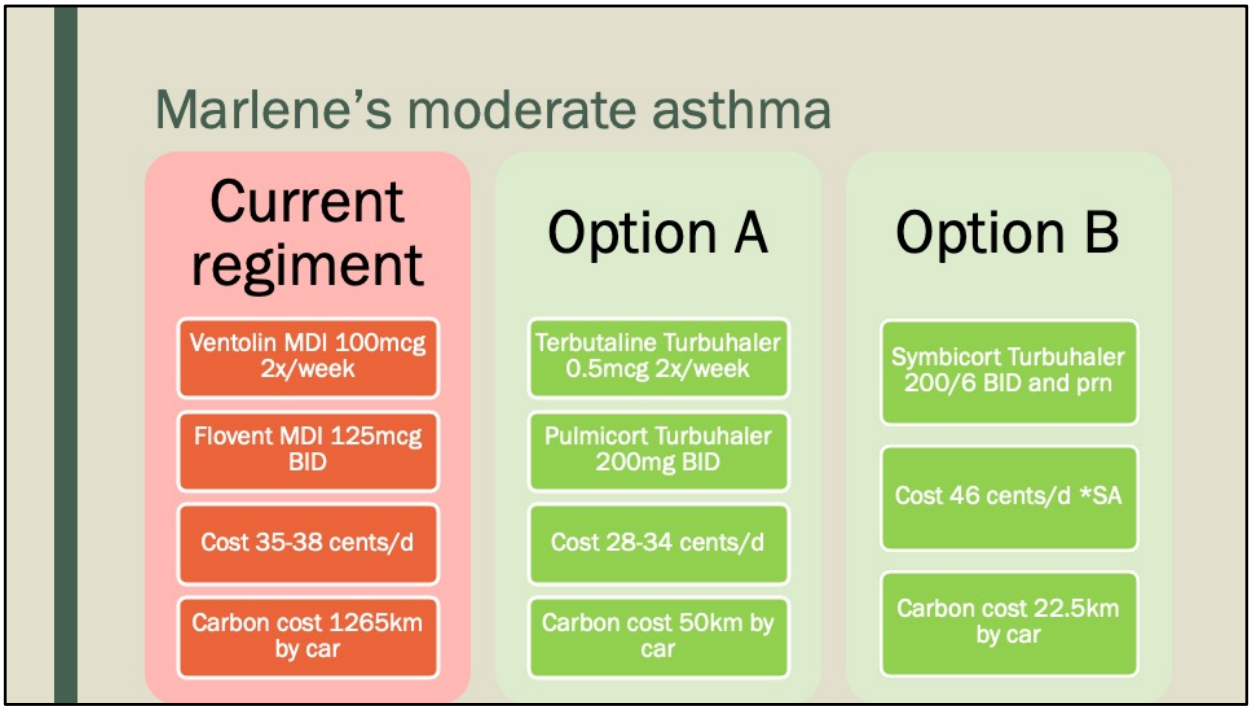
But DPIs are so much more expensive...

Inhaler category	DIN		Active ingredient	Brand name	Number of doses	Cost per device W/O	Cost per device W	Cost per dose W/O	Cost per dose W	Coverage	Carbon	Car km
SABA	2241497	Salbutamol	Salbutamol 100 mcg/puff	Ventolin HFA	200	18.45	5.54	0.09	0.03	Regular	141	787
			Salbutamol 200 mcg/inh	Ventolin Diskus	60	23.72	N/A	0.4	N/A	None		
	2232570		Salbutamol 100 mcg/puff	Airomir pMDI	200	18.26	5.48	0.09	0.03	Regular	141	787
		Terbutaline	Terbutaline 0.5mg/inh	Bricanyl Turbuhaler	100	21.38	6.42	0.21	0.06	Regular	27	151
SAMA			Ipratropium 20 mcg/puff	Atrovent HFA	200	36.15	10.85	0.18	0.05	Regular	104	167
ICS		Budesonide	Budesonide 100 mcg/dose	Pulmicort Turbuhaler	200	52.03	15.61	0.26	0.08	Regular	14	22.5
			Budesonide 200 mcg/dose	Pulmicort Turbuhaler	200	91.17	27.38	0.46	0.14	Regular	14	22.5
			Budesonide 400 mcg/dose	Pulmicort Turbuhaler	200	127.74	38.32	0.64	0.19	Regular	14	22.5
		Fluticasone	Fluticasone 50 mcg/dose	Flovent HFA	120	44.72	13.42	0.37	0.11	Regular	297	478
			Fluticasone 125 mcg/dose	Flovent HFA	120	66.63	19.99	0.56	0.17	Regular	297	478
			Fluticasone 250 mcg/dose	Flovent HFA	120	66.92	20.08	0.56	0.17	Regular	297	478
			Fluticasome 100 mcg/dose	Flovent Diskus	60	44.72	13.42	0.75	0.22	Regular		
			Fluticasone 250 mcg/dose	Flovent Diskus	60	66.92	19.99	1.12	0.33	Regular		
			Fluticasone 500 mcg/dose	Flovent Diskus	60	97.53	29.26	1.63	0.49	Regular		
			Fluticasone 55mcg/inh	Aermony Respclick	60	32.07	9.62	0.53	0.16	Regular		
			Fluticasone 113 mcg/inh	Aermony Respclick	60	49.46	14.84	0.82	0.25	Regular		
			Fluticasone 232mcg/inh	Aermony Respclick	60	68.21	20.46	1.14	0.34	Regular		
			Fluticasone 100mcg/inh	Arnuity Ellipta	30	61.74	18.82	2.06	0.63	Regular		
			Fluticasone 200mcg/inh	Arnuity Ellipta	30	108.08	32.42	3.6	1.08	Regular		
		Ciclesonide	Ciclesonide 100mcg/inh	Alvesco pMDI	120	67.86	20.38	0.57	0.17	Regular		
			Ciclesonide 200mcg/inh	Alvesco pMDI	120	108.05	31.52	0.9	0.26	Regular		
		Mometasone	Mometasone 200mcg/dose	Asmanex Twisthaler	60	55.55	16.67	0.93	0.28	Regular		
			Mometasone 400mcg/dose	Asmanex Twisthaler	60	55.55	28.87	0.93	0.48	Regular		
		Beclomethasone	Beclomethasone 50 mcg/dose	QVAR pMDI	200	55.77	16.73	0.28	0.08	Regular		
			Beclomethasone 100 mcg/dose	QVAR pMDI	200	96.38	28.91	0.48	0.14	Regular		
LABA		Indacaterol	Indacaterol 75 mcg/capsule	Onbrez Breezhaler	60	66.24		1.1		SA	7	11.3
		Formoterol	Formoterol 12 mcg/capsule	Foradil Aerolizer	60	76.55		1.28		SA		
			Formoterol 6mcg/dose	Oxeze Turbuhaler	60	52.8		0.88		SA	14	22.5
			Formoterol 12 mcg/dose	Oxeze Turbuhaler	60	66.65		1.11		SA	14	22.5
		Salmeterol	Salmeterol 50 mcg/capsule	Serevent Diskhaler	60	87.02		1.45		SA		
			Salmeterol 50 mcg/capsule	Serevent Diskus	60	87.02		1.45		SA		

Excel document sent separately

But DPIs are so much more expensive…




Marlene's moderate asthma
Current regiment
Ventolin MDI 100mcg 2x/week
Flovent MDI 125mcg BID
Cost 35-38 cents/d
Carbon cost 1265km by car
Option A
Terbutaline Turbuhaler 0.5mcg 2x/week
Pulmicort Turbuhaler 200mg BID
Cost 28-34 cents/d
Carbon cost 50km by car
Option B
Symbicort Turbuhaler 200/6 BID and prn
Cost 46 cents/d *SA
Carbon cost 22.5km by car

(INHALER USAGE)

Review inhaler technique

(Referral to COPD Clinic/RT)

Counsel on appropriate usage

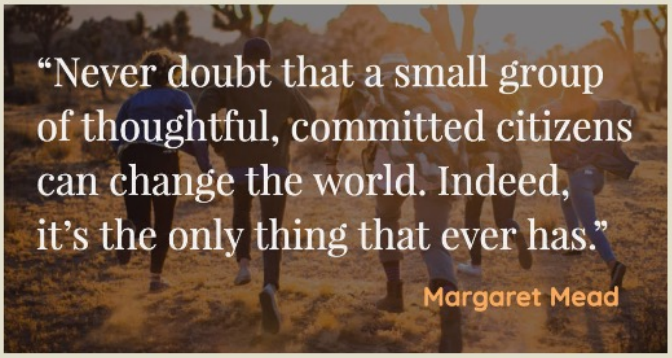
(Inhaler disposal)

- Safe disposal at pharmacy
  - *You can't just chuck these things in the trash!*

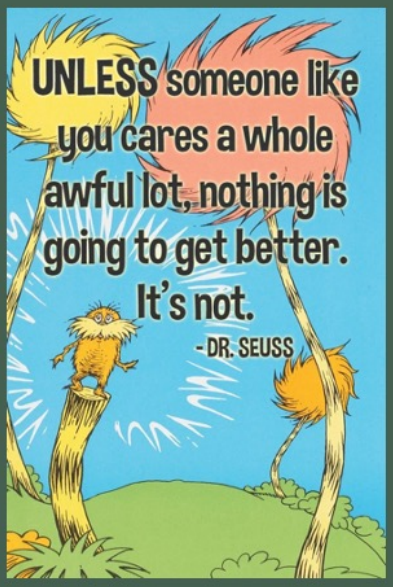
Systemic changes underway

- Outpatient
  - *CASCADES initiative rolling out nation-wide this spring/summer*
- Inpatient
  - *Getting terbutaline on formulary*
  - *Pilot project at RJH 5N ward (and hopefully at Saanich…?)*
  - *Changing pre-printed order set*
  - *Inpatient inhaler disposal*
- Policy changes
  - *Include Planetary Health Lens on current BC COPD/Asthma guidelines*

Call to action



- EVERYONE's feedback is needed on the formulary requests
- We need to think about Carbon Stewardship the same way we think about Antibiotic Stewardship
- Review your patient's inhalers



QUESTIONS? COMMENTS?