Planetary Health for the General Internist

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CSIM Annual Meeting

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DISCLOSURES

DR VAL STOYNOVA

- No industry-related financial disclosures
- Funding from CASCADES, a pan-Canadian knowledge mobilization network funded by **Environment and Climate Change Canada** for her work on The Critical Air Project and National Inhaler Sustainability Chair.

DR MATHILDE GAUDREAU-SIMARD

- No industry related financial disclosures
- Grant funding from the Ottawa Hospital Acaemic Oprganization

LAND ACKNOWLEDGEMENT

OBJECTIVES

How does climate change impact the health of our patients?

How does the healthcare system contribute to climate change?

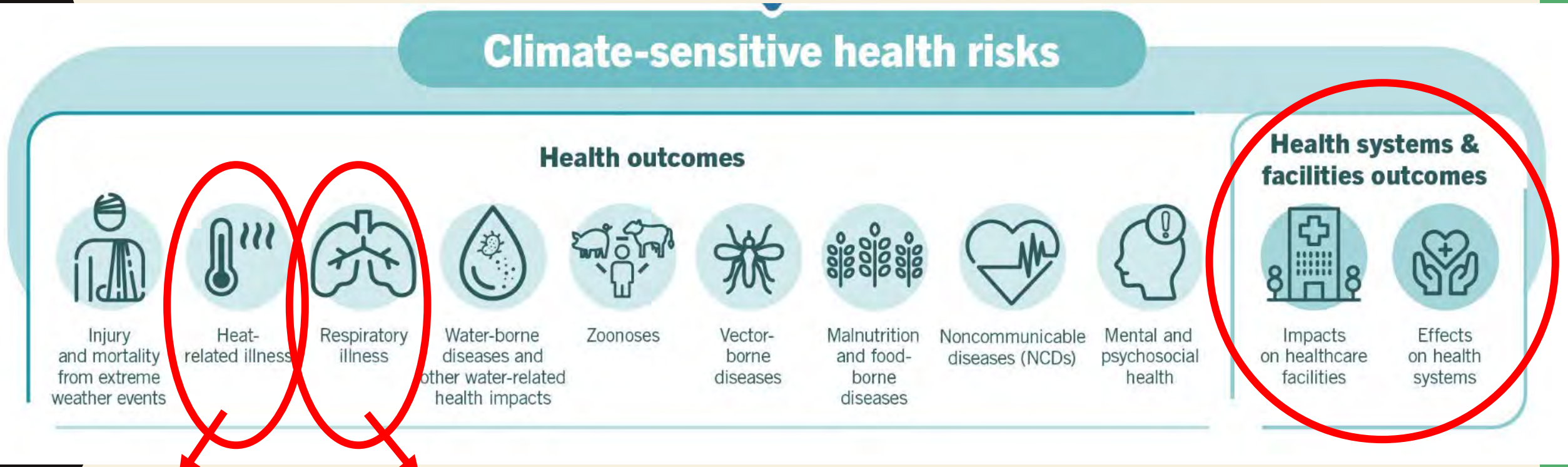
How can we adapt care to address the negative impacts of climate change for our patients and health systems?

How can we mitigate healthcare's impact on climate change while preserving high quality care?

"The health of human civilization and the state of the natural systems on which it depends"

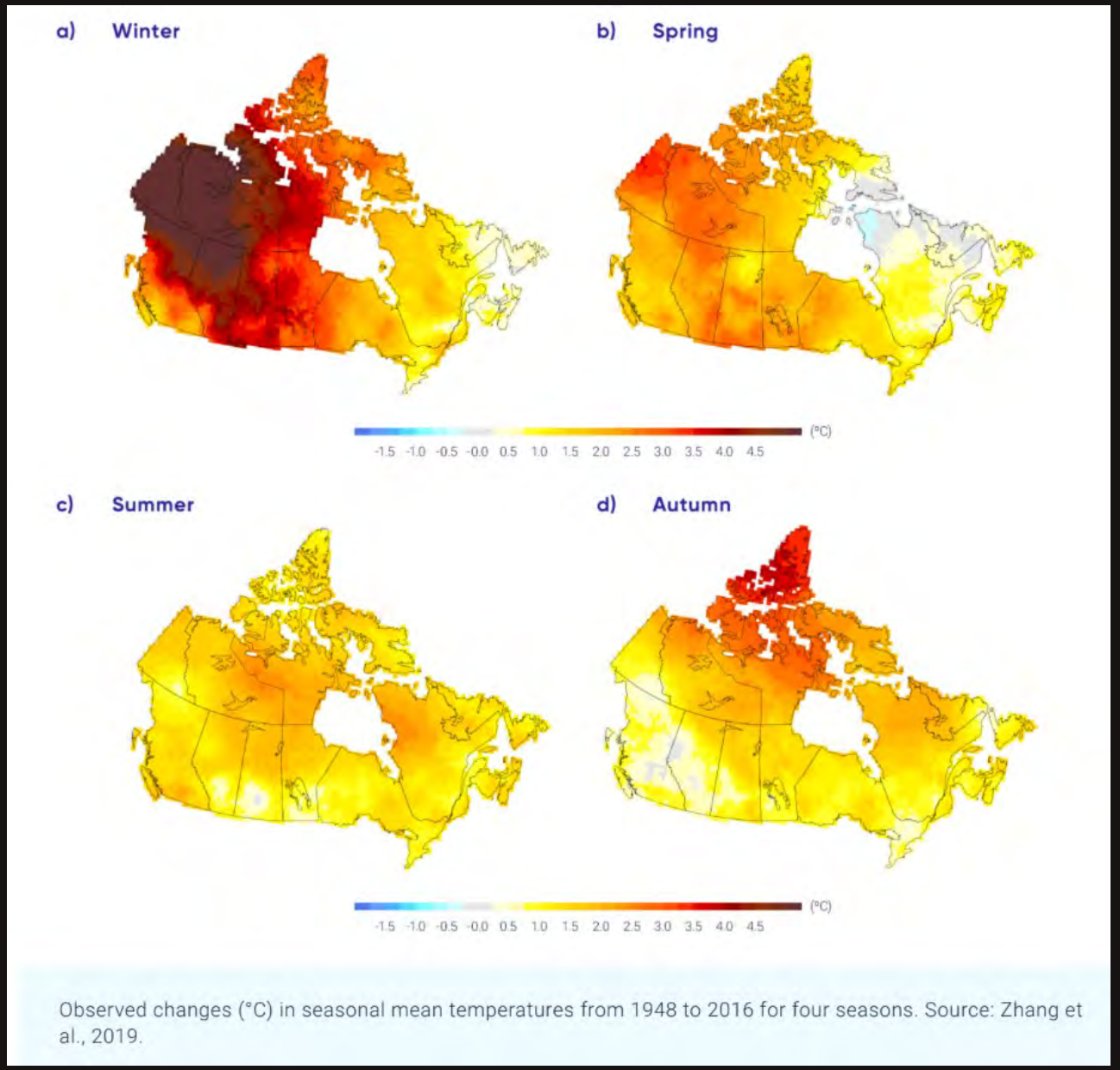
- Rockefeller Foundation-Lancet Commission on Planetary Health

HEALTH IMPACTS OF CLIMATE CHANGE



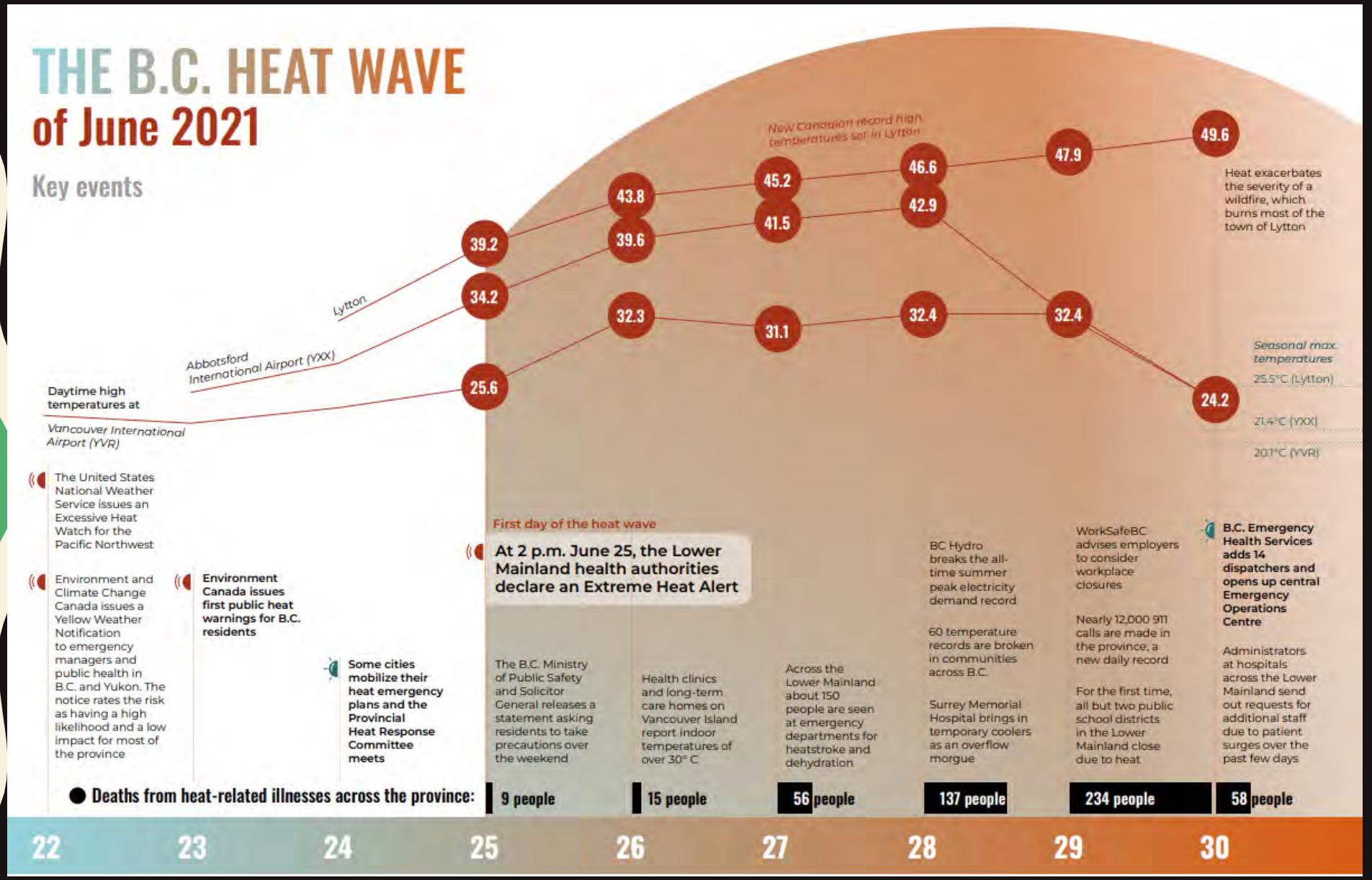
World Health Organization. *Climate change and health*. 2021; Available from: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health.

HEAT



Observed changes (°C) in seasonal mean temperatures from 1948 to 2016 for four seasons. Source: Zhang et al., 2019.

Zhang, X., Flato, G., Kirchmeier-Young, M., Vincent, L., Wan, H., Wang, X., Rong, R., Fyfe, J., Li, G., Kharin, V.V. (2019): Changes in Temperature and Precipitation Across Canada; Chapter 4 in Bush, E. and Lemmen, D.S. (Eds.) Canada's Changing Climate Report. Government of Canada, Ottawa, Ontario, pp 112-193.



Beugin, D., et al., *The case for adapting to extreme heat: Costs of the 2021 BC heat wave*, C.C. Institute, Editor. 2023.

Table 5:

Illnesses requiring hospitalization that increased during the heat wave[10]

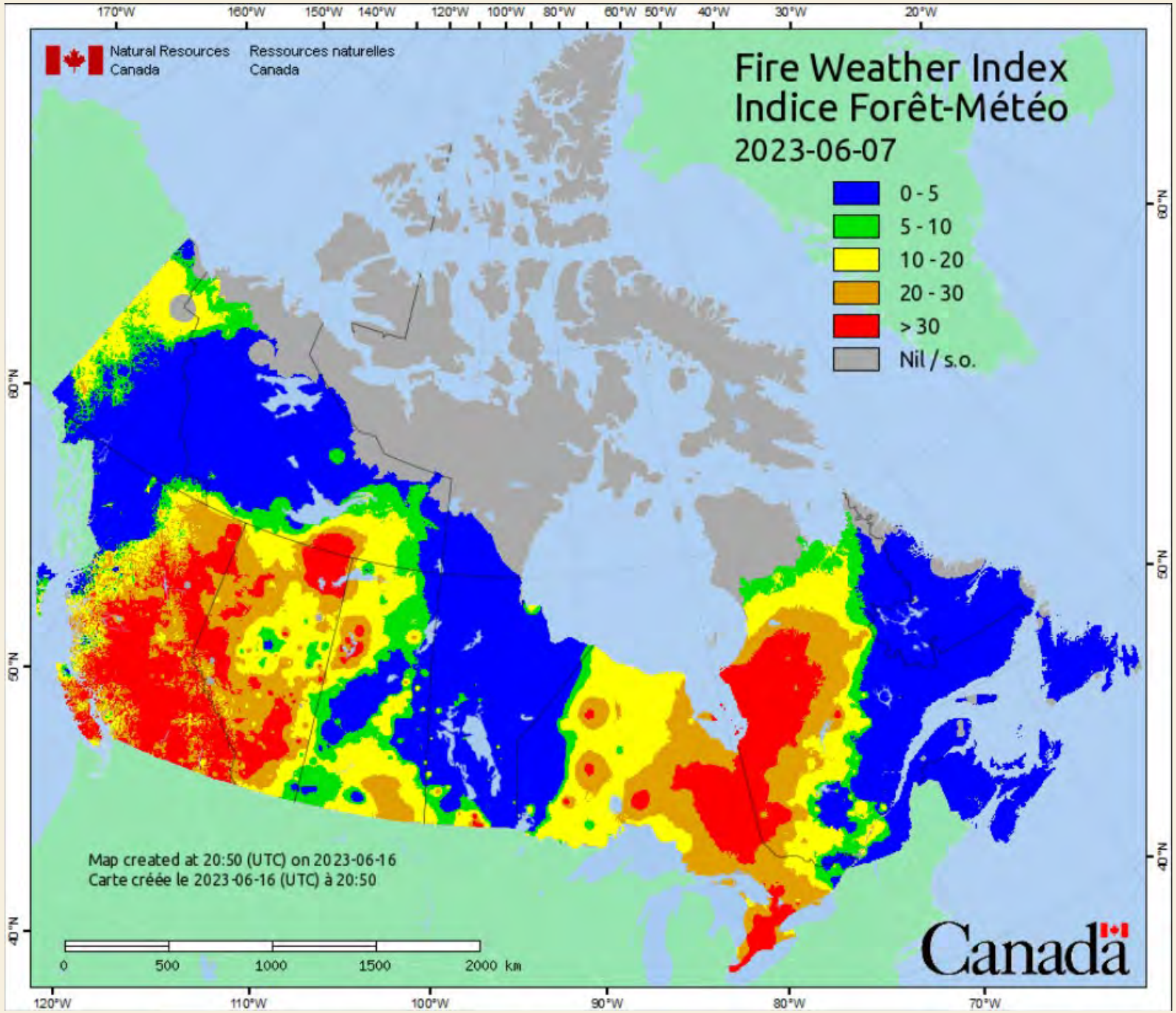
Illness	Per cent change from baseline (number of excess hospitalizations for B.C.)	Average acute bed length of stay (days)	Average cost of hospitalization per patient
Dehydration	136% increase (88)	3.8	$4,892
Acute kidney failure	45% increase (147)	6.4	$9,183
Diabetic ketoacidosis with coma	285% increase (4)	5.3	$5,739
Neurocognitive disorders*[11]	33% increase (94)	12.7	$14,513
Pneumonia	25% increase (40)	6.0	$8,718
Hepatorenal syndrome	170% increase (5)	7.9	$10,458
Heatstroke	16,876% increase (511)	5.8	$10,317

530 excess hospital admissions
619 heat related deaths
CT scanners & MRI failures

Beugin, D., et al., *The case for adapting to extreme heat: Costs of the 2021 BC heat wave*, C.C. Institute, Editor. 2023.

WILDFIRES

JUNE 7TH 2023



HEALTH IMPACTS OF AIR QUALITY DURING WILDFIRES

Biomass Burning as a Source of Ambient Fine Particulate Air Pollution and Acute Myocardial Infarction

Scott Weichenthal,[a,b] Ryan Kulka,[b] Eric Lavigne,[b,c] David van Rijswijk,[b] Michael Brauer,[d] Paul J. Villeneuve,[e] Dave Stieb,[e] Lawrence Joseph,[b] and Rick T. Burnett[f]

Research article

Association of air quality during forest fire season with respiratory emergency department visits in Vancouver, British Columbia

Matthew Douglas-Vail*, Alex Jiang, Shannon Erdelyi, Jeffrey R. Brubacher, Riyad B. Abu-Laban

Department of Emergency Medicine, University of British Columbia, Vancouver, British Columbia, Canada

BMJ Open

SOS! Summer of Smoke: a retrospective cohort study examining the cardiorespiratory impacts of a severe and prolonged wildfire season in Canada's high subarctic

Courtney Howard ,[1] Caren Rose,[2] Warren Dodd,[3] Katherine Kohle,[4] Craig Scott,[5] Patrick Scott,[6] Ashlee Cunsolo,[7] James Orbinski[8]

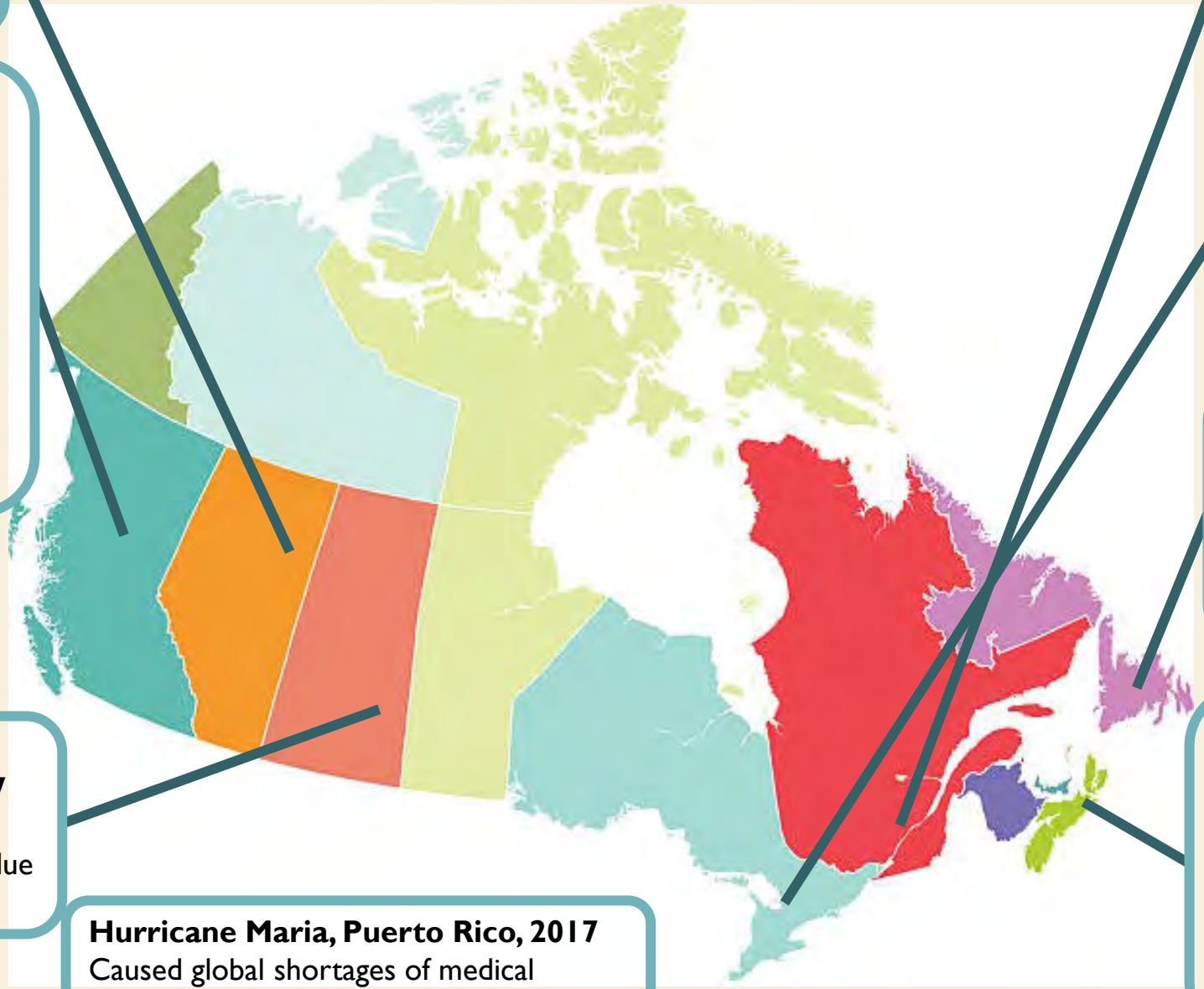
Extreme weather events and impacts on health services delivery

Fort McMurray, Alberta, 2016
Wildfires resulted in patient transfers

Interior health, British-Columbia, 2017
Wildfires resulted in the temporary closure of 19 health care facilities or sites, 880 patients evacuated, 700 health services staff displaced

Regina, Saskatchewan, 2007
Operating theatre closed for eight days due to heat and humidity

Hurricane Maria, Puerto Rico, 2017
Caused global shortages of medical supplies



Montreal, Québec, 2017
Flooding resulted in evacuation of three health care centers, patients transferred from a LTC center

Barrie, Ontario, 2019
Cancellation of 130 surgeries, patient transfers due to A/C break down due to heat and humidity

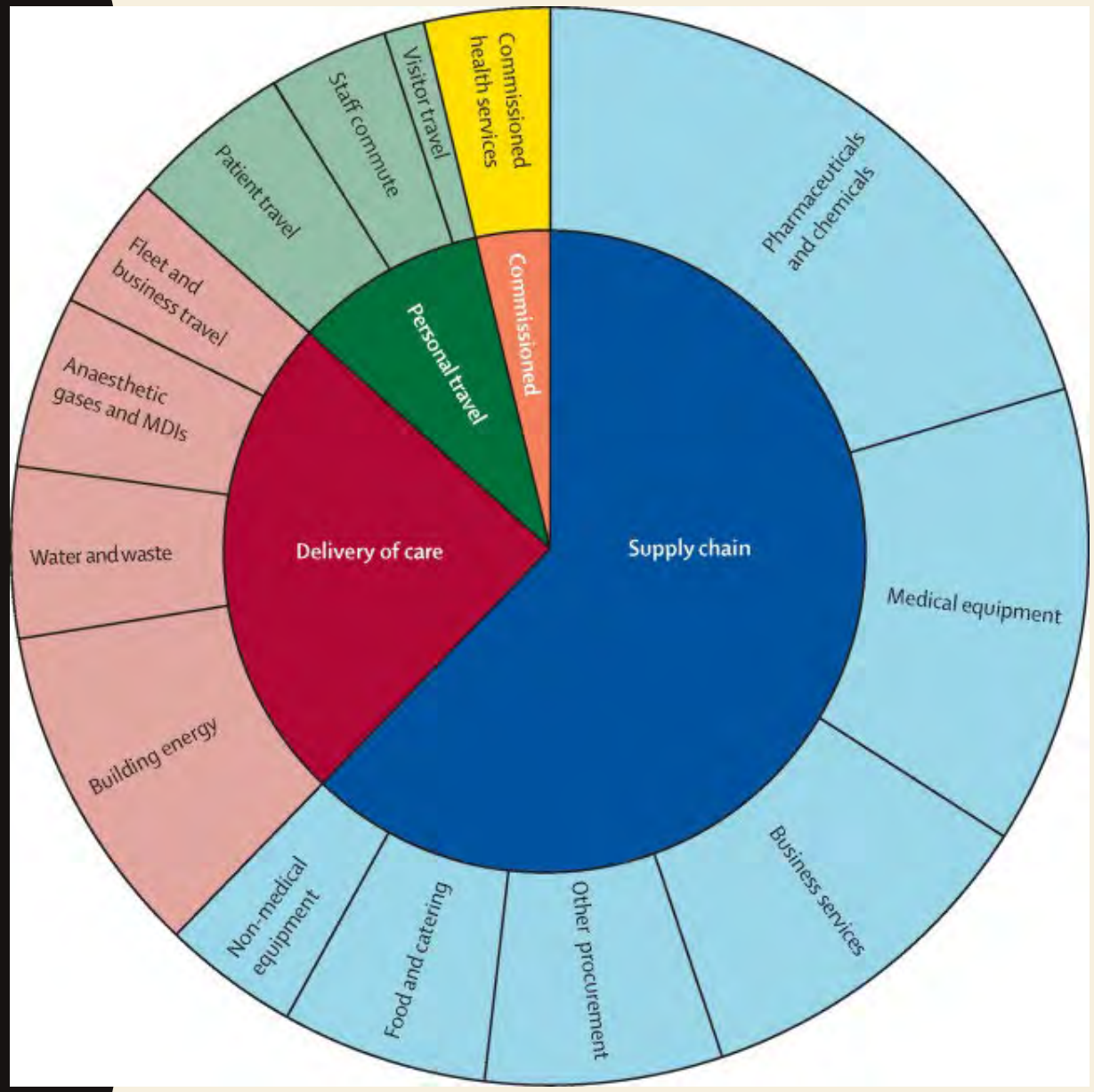
St-John's, Newfoundland 2020
Extreme snowfall. Non-urgent services cancelled for a few days. Closures of clinics, pharmacies, blood collection services.

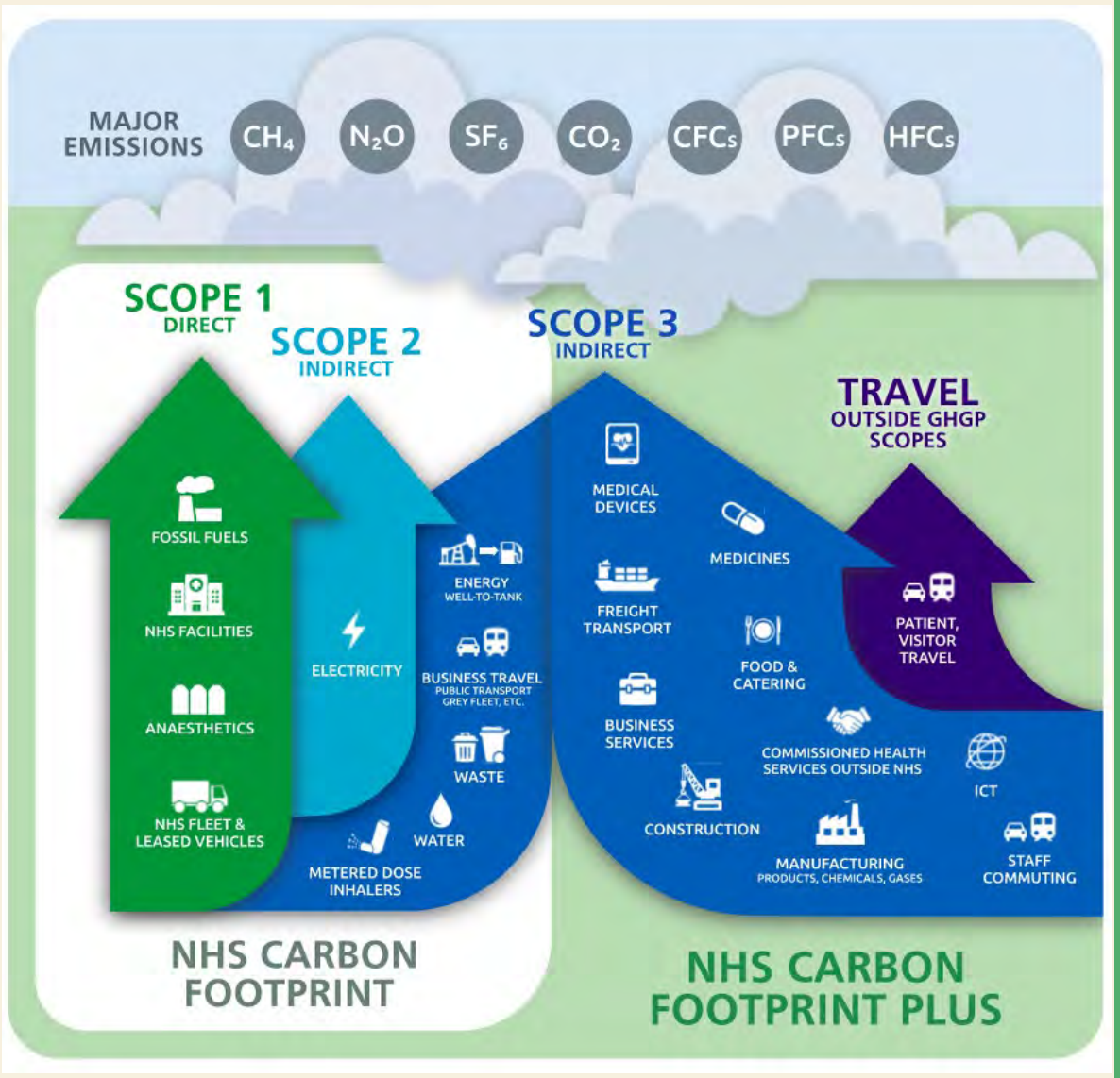
Nova Scotia Health Authority, Nova Scotia, 2019
Hurricane Dorian caused power outages at many hospitals,. Sites experienced water damage, temporary closure and cancellations of appointments and procedures.

HEALTHCARE'S CARBON FOOTPRINT

THE HEALTHCARE SECTOR ACCOUNTS FOR 4.6% OF CANADA'S TOTAL GHG

GLOBALLY, IF HEALTHCARE WAS ITS OWN COUNTRY, IT WOULD BE THE FIFTH LARGEST CONTRIBUTOR TO GREENHOUSE GAS EMISSIONS


Commissioned health services
Visitor travel
Staff commute
Patient travel
Fleet and business travel
Anaesthetic gases and MDIs
Water and waste
Building energy
Non-medical equipment
Food and catering
Other procurement
Business services
Medical equipment
Pharmaceuticals and chemicals
Commissioned
Personal travel
Delivery of care
Supply chain


MAJOR EMISSIONS
CH_4
N_2O
SF_6
CO_2
CFCs
PFCs
HFCs
SCOPE 1
DIRECT
SCOPE 2
INDIRECT
SCOPE 3
INDIRECT
TRAVEL
OUTSIDE GHGP SCOPES
FOSSIL FUELS
NHS FACILITIES
ANAESTHETICS
NHS FLEET & LEASED VEHICLES
ELECTRICITY
METERED DOSE INHALERS
ENERGY
WELL-TO-TANK
BUSINESS TRAVEL
PUBLIC TRANSPORT
GREY FLEET, ETC.
WASTE
WATER
MEDICAL DEVICES
MEDICINES
FREIGHT TRANSPORT
FOOD & CATERING
PATIENT, VISITOR TRAVEL
BUSINESS SERVICES
COMMISSIONED HEALTH SERVICES OUTSIDE NHS
ICT
CONSTRUCTION
MANUFACTURING
PRODUCTS, CHEMICALS, GASES
STAFF COMMUTING
NHS CARBON FOOTPRINT
NHS CARBON FOOTPRINT PLUS

WHAT CAN WE DO?

A LOT.

WHAT CAN WE DO

ADAPTATION

INCREASE CLIMATE RESILIENCE IN OUR PATIENTS

MITIGATION

PROVIDE HIGH QUALITY, LOW CARBON CARE

WHAT CAN WE DO

ADAPTATION

Increase climate resilience in our patients

PREPARING FOR POOR AIR QUALITY

- Limited number of hard endpoint studies for personalized intervention to reduce air pollution exposure

- Recommendations are consistent w AHA position statement (Rajagopalan et al, 2020)

RISK MITIGATION STRATEGIES

- Portable Air Cleaners
  - Best used in small area (room) with windows closed. Reduce PM2.5 concentration up to 60% (Chen et al, 2015; Morishta et al, 2018)
  - CLEAN AIR study (Hansel et al, 2022)
    - improved symptoms (SGRQ -7.7)
    - lower rate of exacerbations (OR 0.32)
    - Decrease use of rescue medication (OR 0.54)

Compared to Tiotropium
SGRQ -3.3
Exacerbations OR 0.34
(Cochrane, 2015)

- N95/N99 masks
  - Efficacy largely depends on fit
  - In patient w documented CAD, wearing N95 walking outdoors in poor air quality: decreased BP, decreased max STD, increased HR variability (Langrish et al, 2012)

- No evidence to support surgical masks or cloth masks

PREPARING FOR CRITICAL CLIMATE EVENTS

- Air Quality Health Index in Canada – predictive of clinical cardiovascular disease measures

- Stay indoors, use air conditioning (Yu et al, 2017)
- Keep windows closed, fireplace dampers closer
- Use portable air filters (Hansel et al, 2022)
- Plan ahead
  - Make sure you have extra COPD action plan/asthma action plan available
  - Have extra medications including inhalers in your go bag

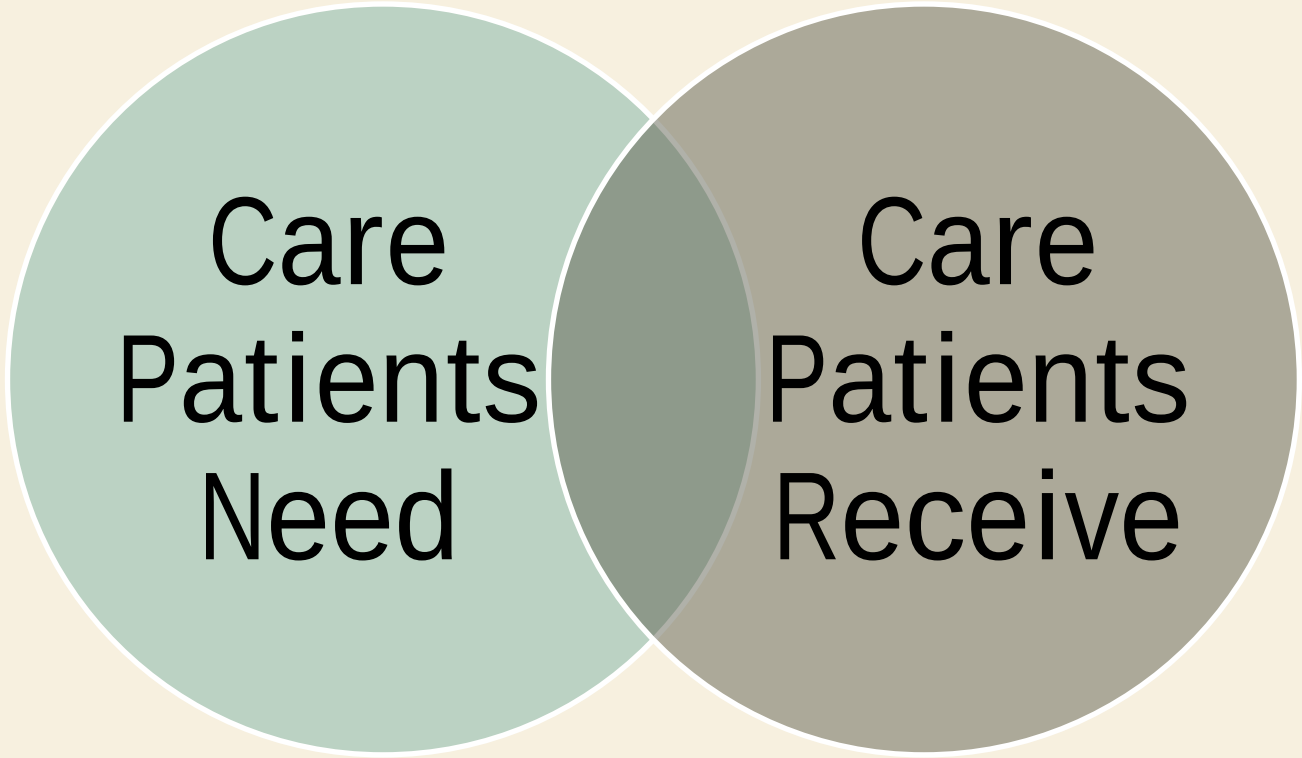
Upcoming BC COPD guidelines (pending publication)

WHAT CAN WE DO

MITIGATION

PROVIDE HIGH QUALITY, LOW CARBON CARE

GREEN CARE IS GREAT CARE



THE 60-30-10 RULE

60% of care delivered is guideline-driven (Brathwaite et al, 2018; Mangione-Smith, 2007; McGlynn et al, 2003; Runciman et al, 2012; Steel et al, 2008)

30% of care is waste, duplication or low value care that doesn't change clinical outcomes (Berwick & Hackbarth, 2012; OECD, 2017; Saini et al, 2017)

10% of care actively causes harm (Baker et al, 2004; Brennan et al, 1991; Vincent et al, 2001; Wilson et al, 1995; National Academy of Medicine, 2018)

LIMITING LOW VALUE TESTS

- Choosing Wisely Canada Recommendations
- Avoid annual stress imaging or advanced non-invasive imaging as routine follow up in asymptomatic patients (ACC Task Force, 2011; Hendel et al, 2009; Natarajan et al, 2013)
- Consider patient's prognosis, preferences and goals of care before offering therapies on the basis of survival benefit (Detering et al, 2010; Shaw et al, 2020)
- Avoid stress cardiac imaging or advanced non-invasive imaging as part of pre-op assessment in asymptomatic patients going for low-risk non-cardiac surgery (ACC, 2011; Fleisher et al, 2007, Hendel et al, 2009; Natarajan et al, 2013)

EXCELLENT CHRONIC DISEASE MANAGEMENT

Preventing an acute decompensation will save much more carbon in the long run

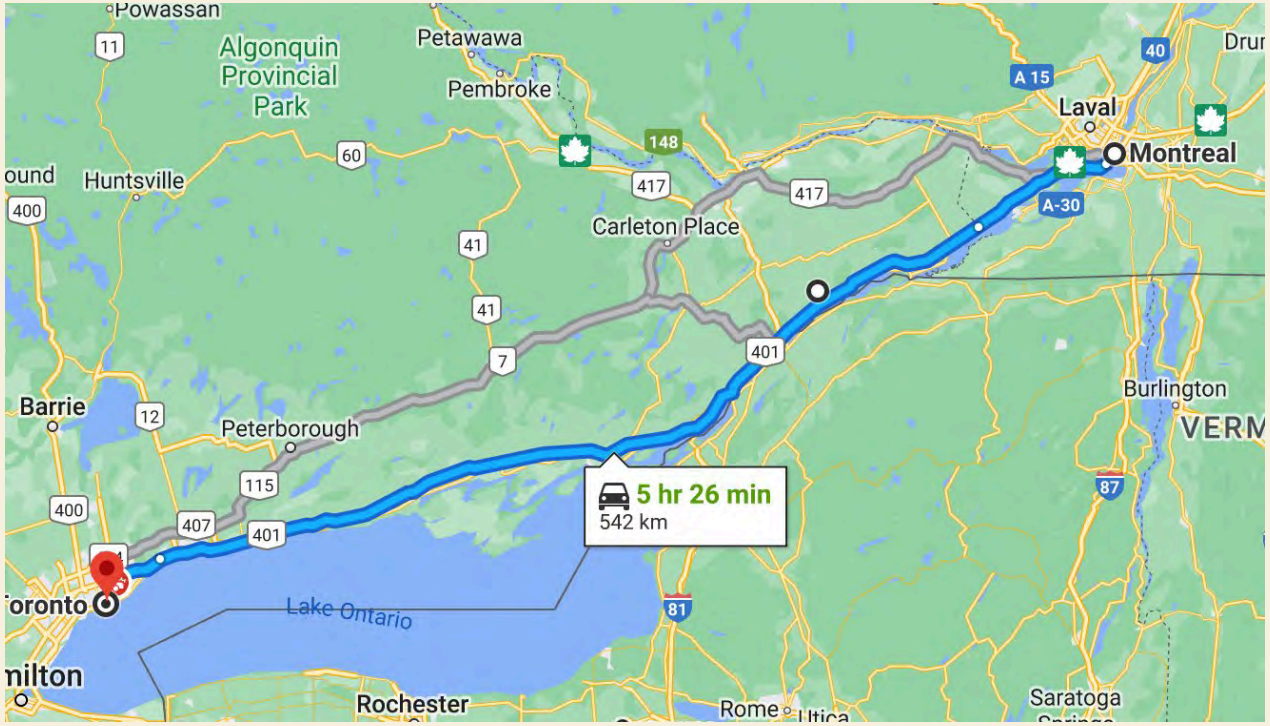
Heart failure in Canada (CIHI, 2022)

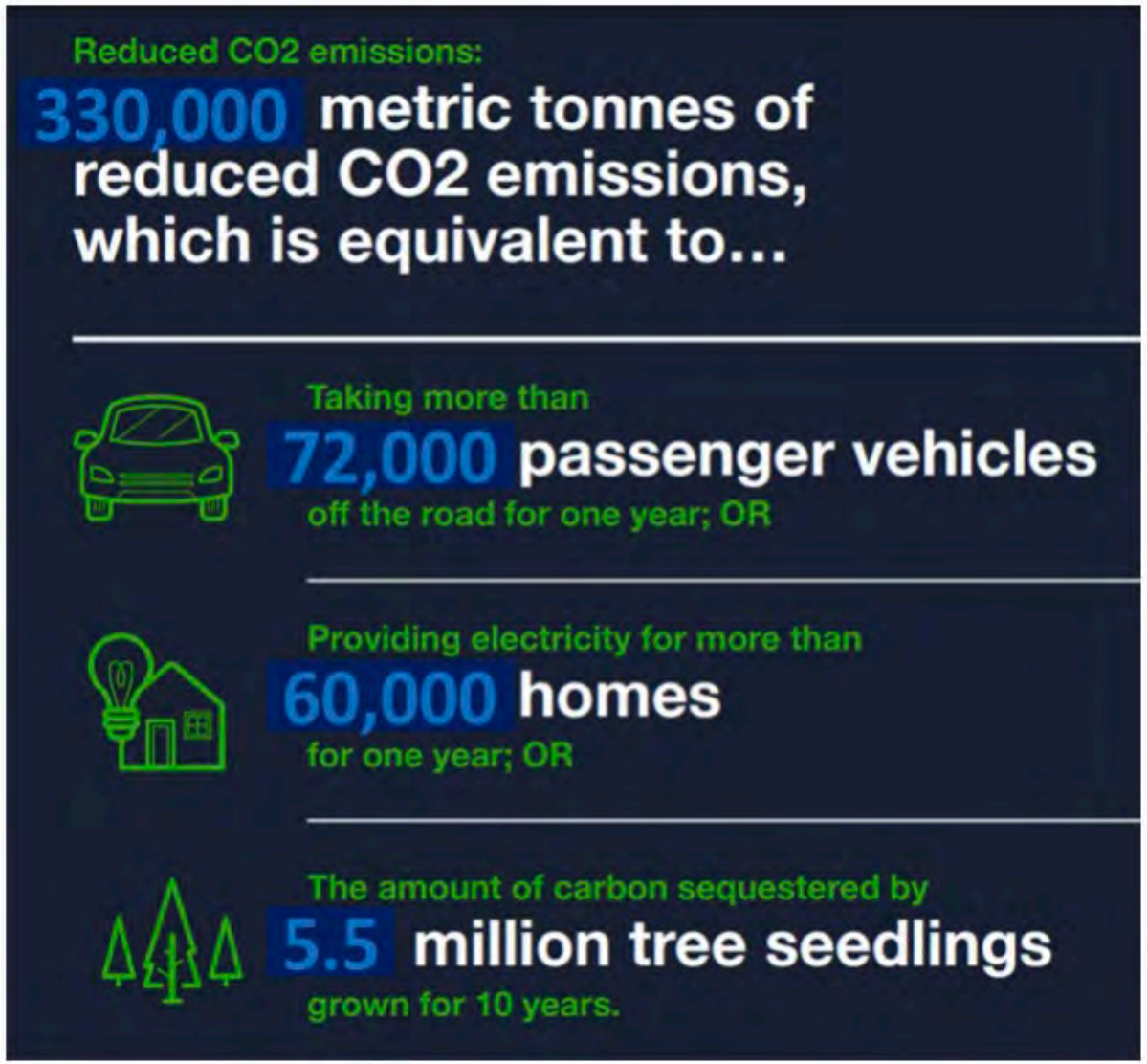
- 2.9M acute care admissions annually
- Third most common reason for admission
- LOS 9.2 days

Life cycle analysis carbon emission 263 kgCO2e per CHFE admission (Zhang et al, 2022)

~ 1,041km drive

~ round trip Montreal to Toronto





VIRTUAL CARE

In 2021 (Simms et al, 2022)

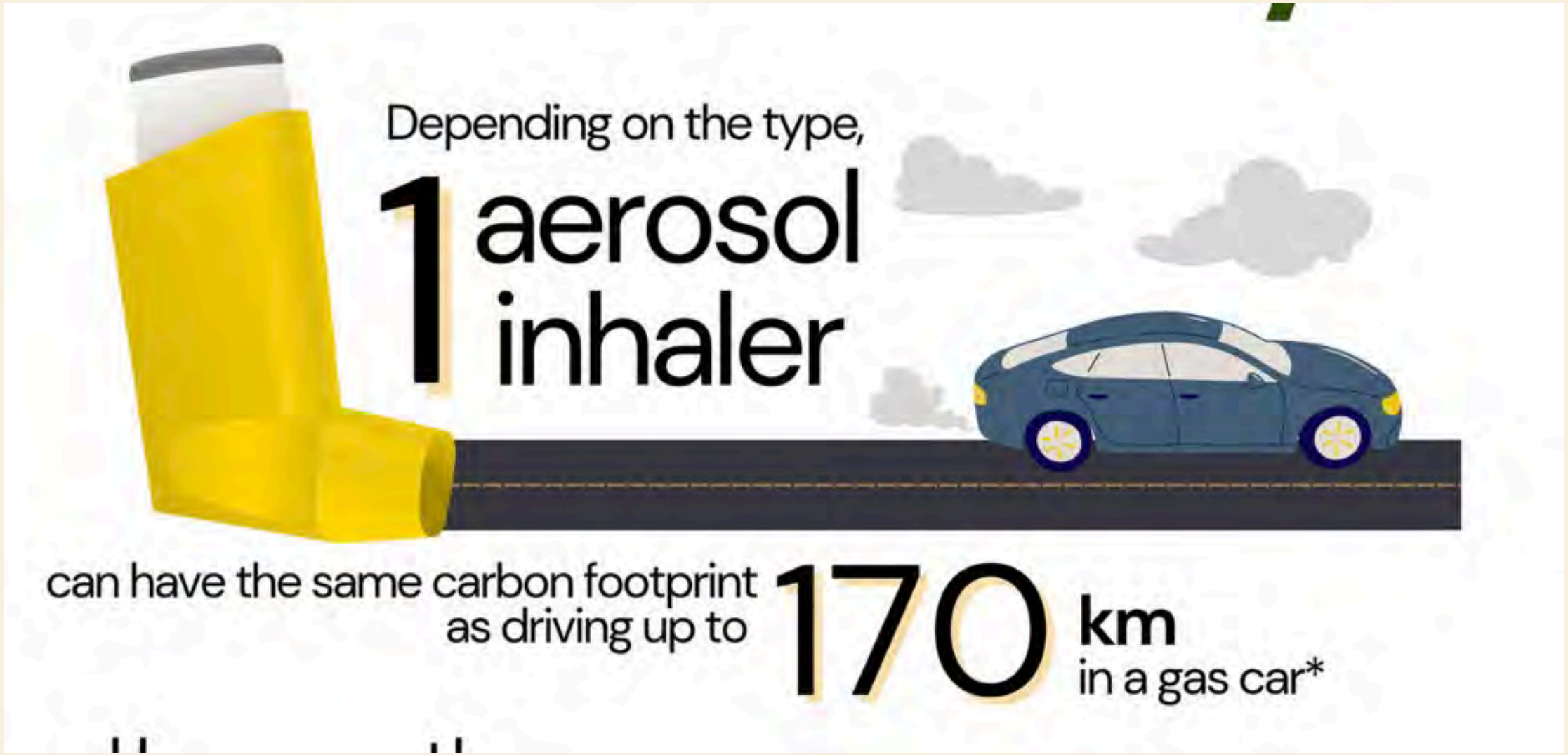
57.5 million virtual care visits in Canada

1.2 billion km of travel saved as a direct result of virtual care utilization in Canada

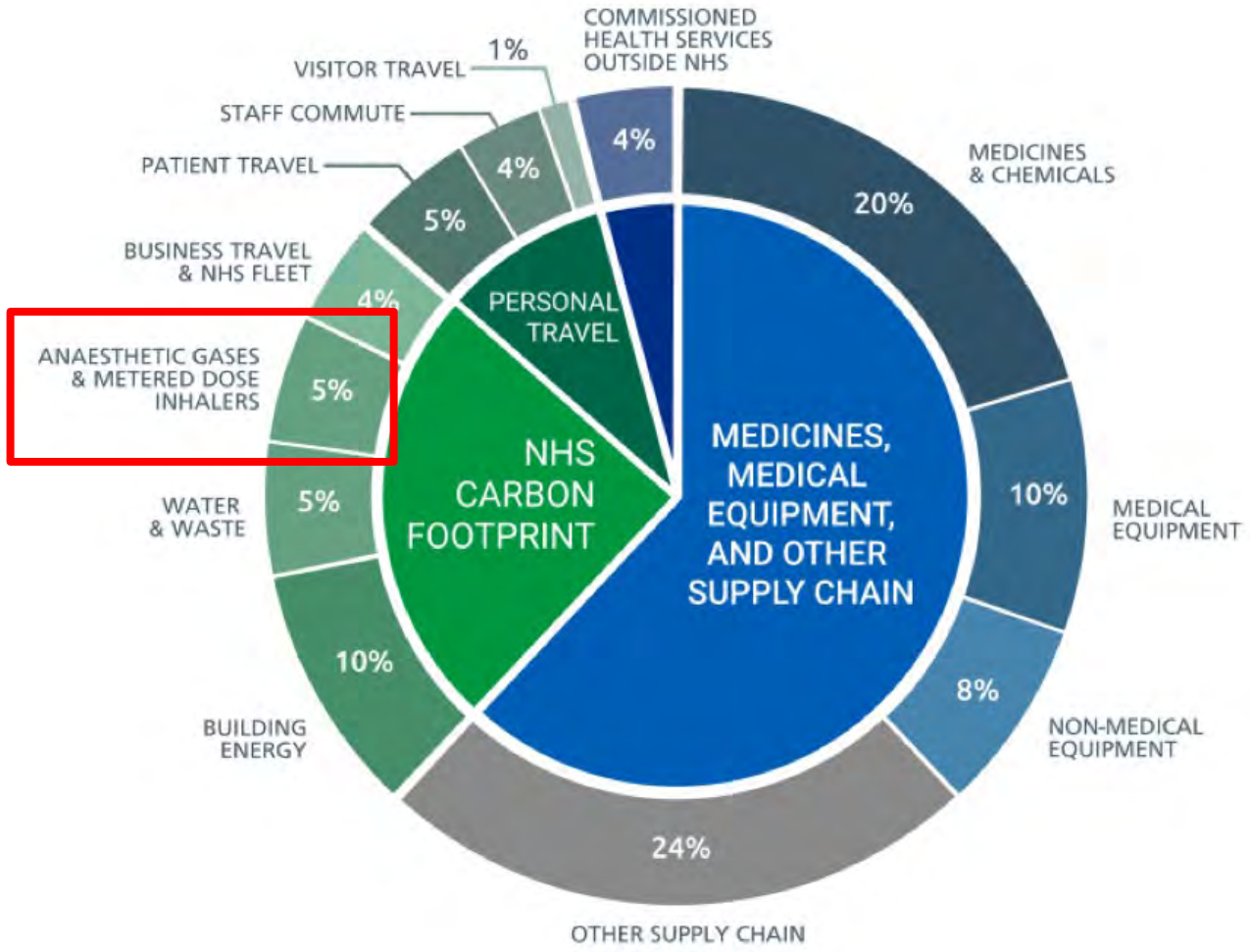
Average travel distance 35.7km in rural settings and 12.6km in urban setting

SUSTAINABLE PRESCRIBING

MEDICATIONS ACCOUNT FOR 25% OF HEALTHCARE'S CARBON FOOTPRINT


Depending on the type,
1 aerosol inhaler
can have the same carbon footprint as driving up to 170 km in a gas car*

ARE THEY REALLY THAT BIG OF A DEAL…?

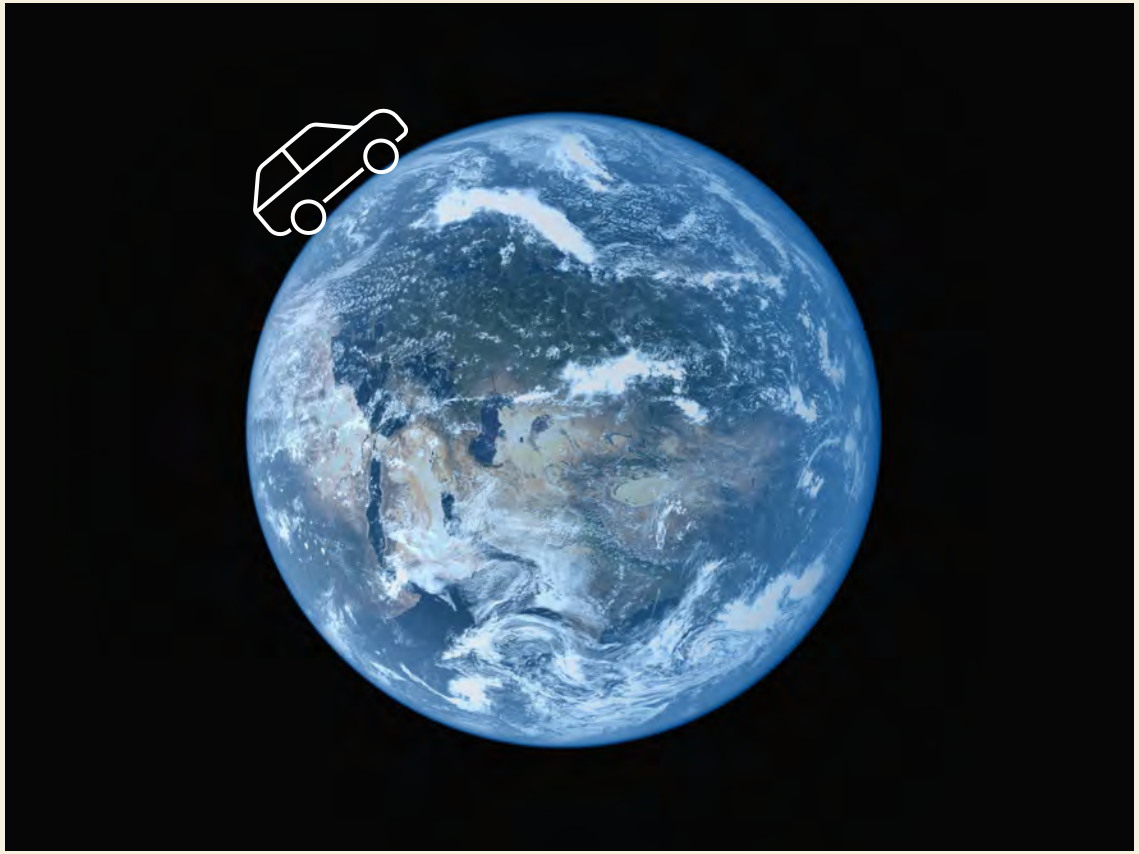


3.5% of NHS carbon footprint comes exclusively from Metered Dose Inhalers (Tennison et al, 2021)

A SINGLE BC HEALTH AUTHORITY'S INHALER USE IS EQUIVALENT TO…

9822 tCO_2e

Driving around the circumference of the earth 979 times



(Liang et al, 2022)

SOME (MORE) MDI CONCERNS

Require complex coordination techniques to achieve a clinically effective dose

- Critical handling error compromising drug delivery in up to 94% of patients (Lavorini et al, 2008; Jahedi et al, 2017)

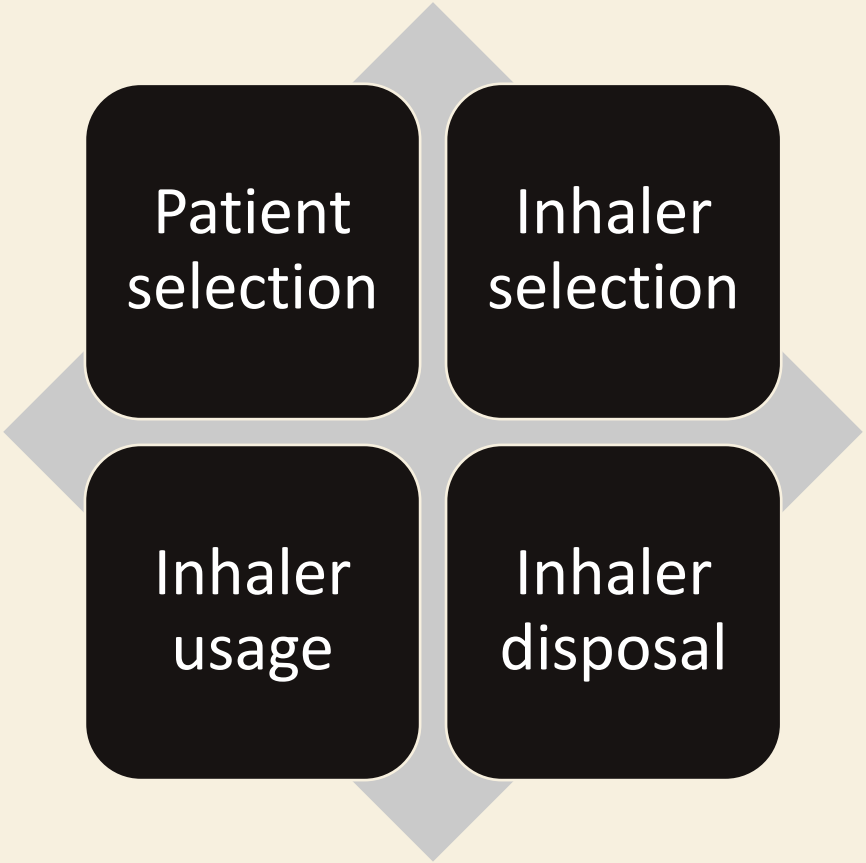
No dose counters

- OVERestimating doses left: Up to 40% of patients believe they are taking their medication when MDI empty (Conner & Buck, 2013)
- UNDERrestimating number of doses left: More than half of patients refill their MDIs more frequently than would be advised (Sander et al, 2006)

NOT ALL INHALER DEVICES ARE MADE EQUAL

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

WHAT CAN I DO IN MY PRACTICE?



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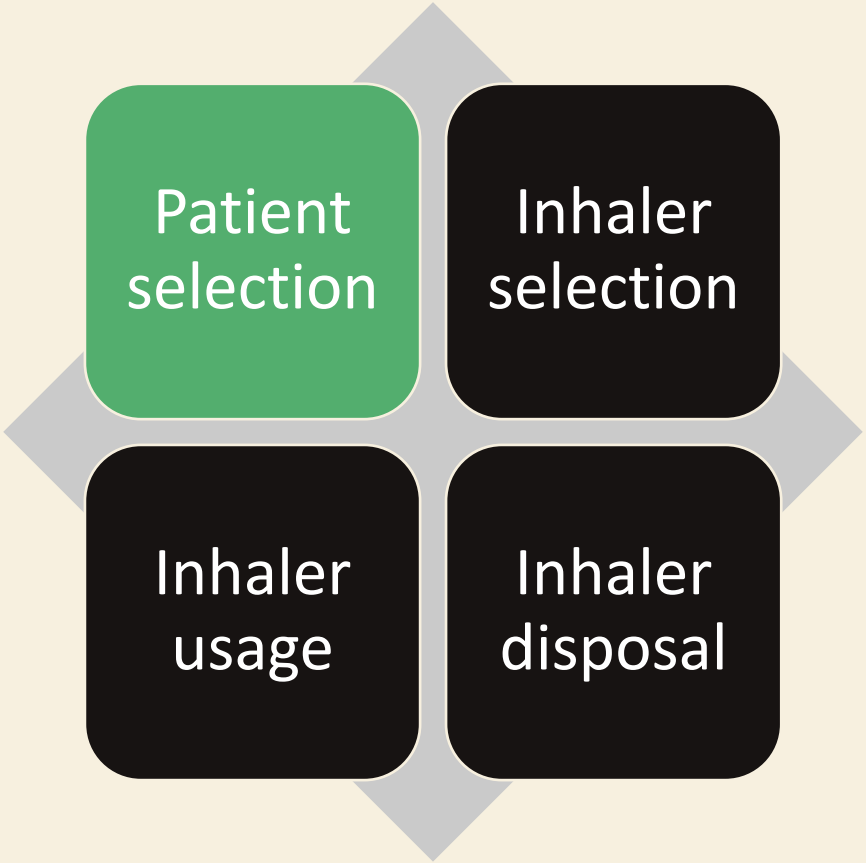


DOES MY PATIENT ACTUALLY NEED AN INHALER?

- 1/3 patients labelled with asthma don't have asthma (Aaron et al, 2017)
- 4/5 patients with negative spirometry remain on an inhaler (GINA, 2021)
- Manage expectations (Ebell et al, 2013)
  - Typical duration of post-viral cough 18 days
  - Patient expectation of post-viral cough 5-9 days
- What's the harm? (Kavanagh et al, 2019)
  - Missing an alternate diagnosis
  - Identifying/labelling someone as sick
  - Financial impact
  - Drug side effects
  - Insurance coverage issues

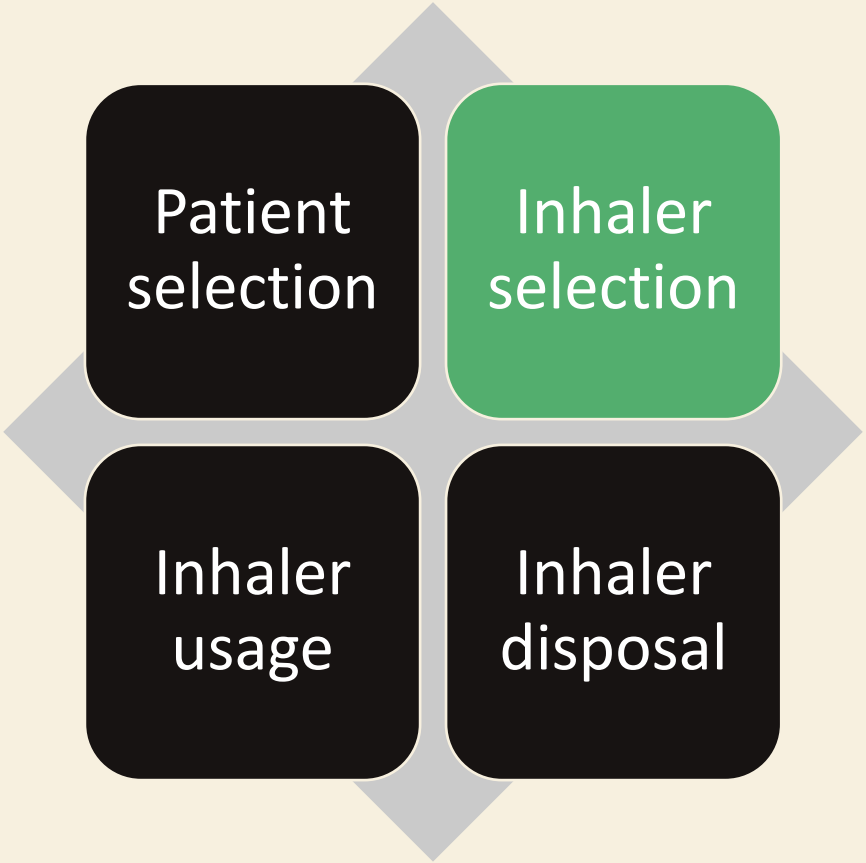
Choosing Wisely Canada™

DOES MY PATIENT ACTUALLY NEED AN INHALER?

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. (Choosing Wisely Canada, 2021)

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. (Choosing Wisely Canada, 2021)

WHAT CAN I DO IN MY PRACTICE?



IS MY PATIENT GETTING THE RIGHT DELIVERY MECHANISM FOR THEM?

What is their inspiratory capacity?

- PIFR < 30 in 10-12% of patients with COPD (Chen et al, 2020;Hua et al 2020)

Do they have physical barriers to inhaler use?

- Arthritis, weakness, **age**

TABLE 1. MINIMAL AND OPTIMAL PEAK INSPIRATORY FLOW RATES (L/MIN) FOR DRY POWDER INHALERS

Device	*Minimal*	*Optimal*
Turbuhaler®/Flexhaler®	30	60
Easyhaler®	30	30
Diskus®	30	60
HandiHaler®	20	30
Ellipta®	30	60
Aerolizer®	40	65
Genuair®	40	45
Breezhaler®	50	50
Spiromax®	40	40
Novolizer®	35	50
NEXThaler®	35	35

(Ghosh et al, 2017)

Table 3. Well-controlled asthma criteria.

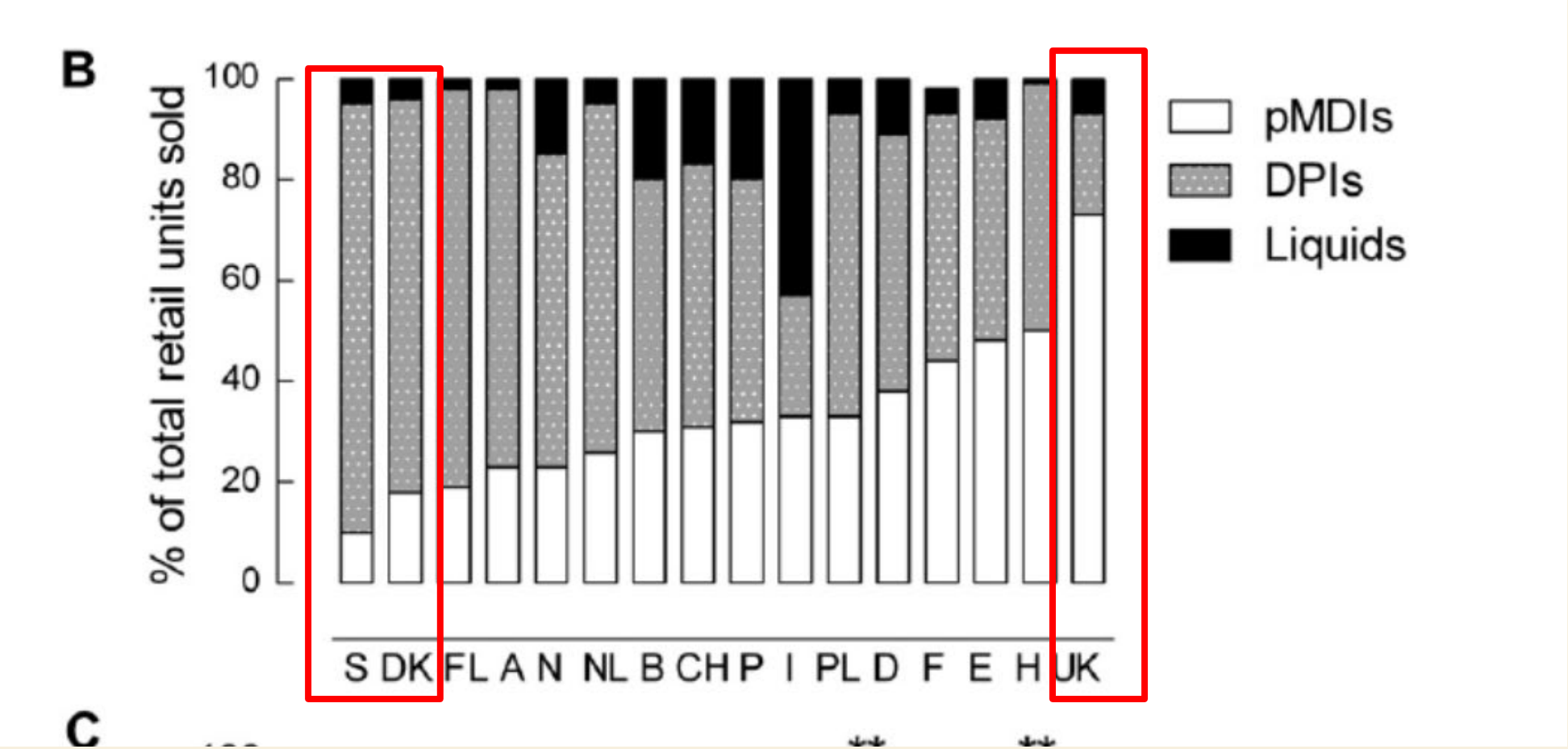
Characteristic	Frequency or value
Daytime symptoms	≤2 days/week
Nighttime symptoms	<1 night/week and mild
Physical activity	Normal
Exacerbations	Mild and infrequent*
Absence from work or school due to asthma	None
Need for a reliever (SABA or bud/form)†	≤2 doses per week
FEV_1 or PEF	≥90% of personal 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.

HIGH QUALITY ASTHMA MAINTENANCE THERAPY

(CTS Guidelines, 2021)

WHAT'S EUROPE DOING?



(Lavorini et al, 2011)

CO_2e saving effect/year

Change to plant based diet: 500 kg
Change gasoline to hybrid car: 500 kg

Avoid all food waste: 370 kg

Wash clothes in cold water: 250 kg

Recycle: 210 kg

Wall insulation: 180 kg

Upgrade light bulbs: 60 kg

Plant a tree: 35 kg

(Janson et al, 2019)

WILL IT REALLY MAKE THAT BIG OF A DIFFERENCE? IT'S ONLY ONE INHALER…

Switching ONE patient's daily controller from MDI to DPI

235kg CO2/year

Switching ONE patient's daily controller and their SABA from MDI to DPI

425kg CO2/year

IS MY PATIENT COMFORTABLE WITH CHANGING INHALERS?

- Importance of shared decision-making when discussing inhaler changes (Bloom et al, 2019; Bjermer, 2014)
- Non-consensual switch associated with "patient discontent, reduced confidence in the medication, and [patient] uncertainty regarding the degree of disease control" (Pangione et al, 2020)
- Some DPIs and Lactose content considerations

WHAT ABOUT COST OF SWITCHING?

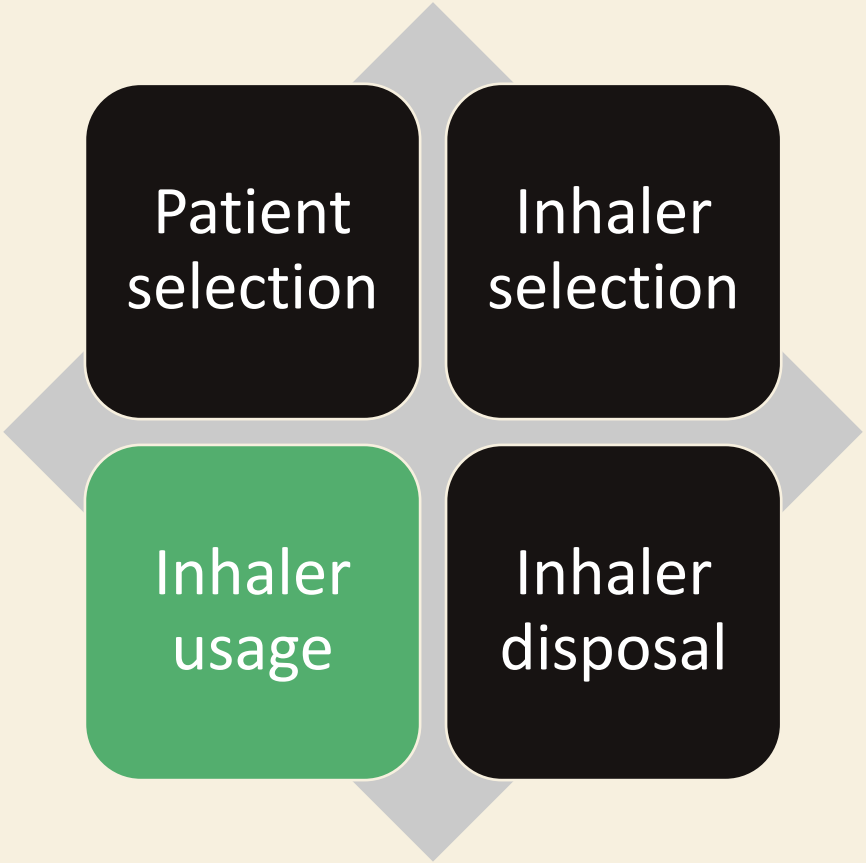
Example of moderate intensity ICS prescription	**Cost of inhaler***	**Number of actuations per device**	**Cost per dose****
Fluticasone MDI 125 mcg 1 inh BID	$66.63	120	**$0.56/dose**
Budesonide DPI 200 mcg 1 inh BID	$91.17	200	**$0.46/dose**
Example of moderate intensity ICS/LABA prescription	**Cost of inhaler*****	**Number of actuations per device**	**Cost per dose****
Fluticasone/Salmeterol MDI 125/25 mcg 1 inh BID	$140.82	120	**$1.17/dose**
Budesonide/Formoterol DPI 200/6 mcg 1 inh BID	$115.86	120	**$0.97/dose**
Example of SABA prescription	**Cost of inhaler***	**Number of actuations per device**	**Cost per dose****
Salbutamol MDI 100 mcg 2 inh QID PRN	$18.45	200	**$0.19/dose (2 inh)**
Terbutaline DPI 0.5 mg 1 inh QID PRN	$21.38	100	**$0.21/dose**

**excludes dispensing fee*

***cost retrieved from drugsearch.ca*

Stoynova & Culley, 2022

WHAT CAN I DO IN MY PRACTICE?



INHALER TECHNIQUE

- Familiarize yourself with different inhaler delivery mechanisms

https://www.lung.ca/lung-health/get-help/how-use-your-inhaler

- Review patient's technique– or ask pharmacist/RT to do so

- Spacer devices are a must

WHAT CAN I DO IN MY PRACTICE?

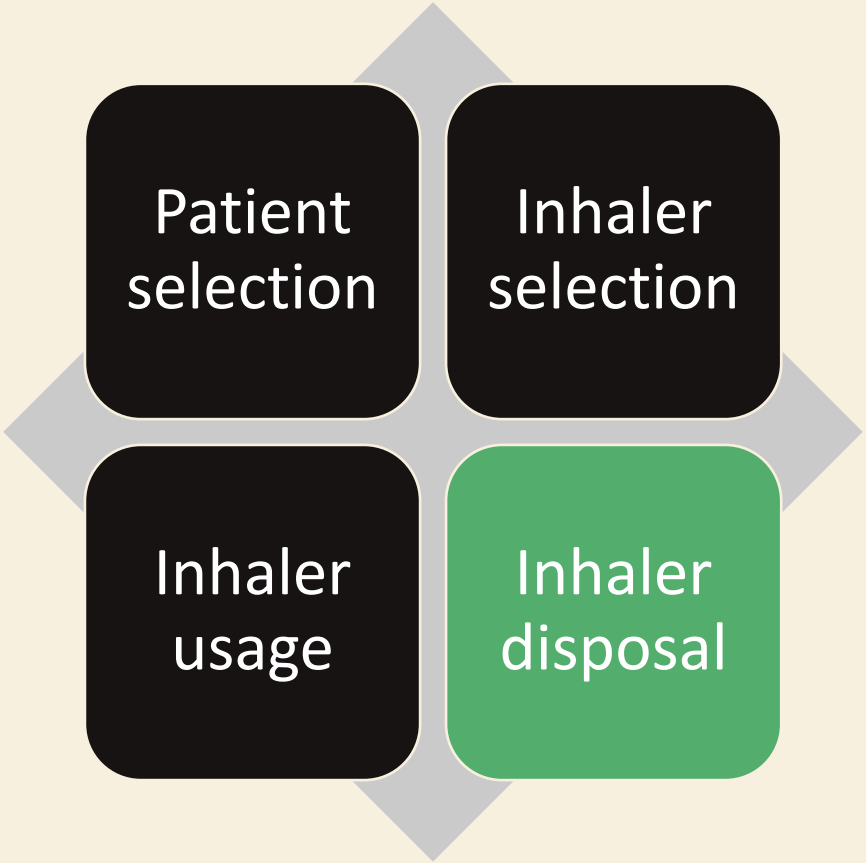
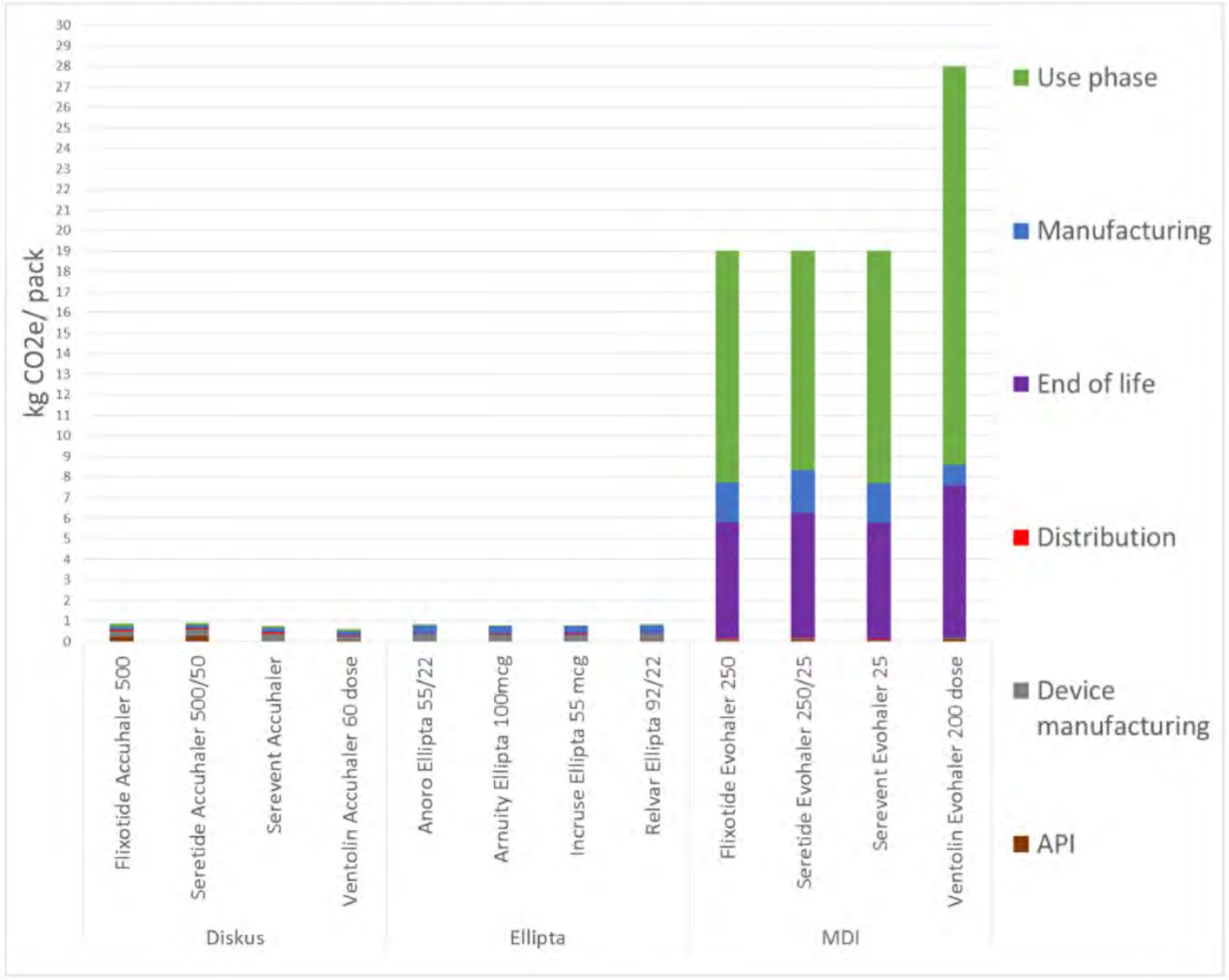


Figure 1: Absolute emissions per pack (kg CO2e/pack) for all products



INHALER DISPOSAL

A third of MDI footprint comes from from end-of-life emissions (Janson et al, 2020)

You can't just chuck these things in the trash!

- Bring to pharmacy for safe disposal
- Current best practices are incineration which is poorly enacted (Thomas et al, 2019)

ADVOCATING FOR SYSTEMS-LEVEL CHANGE

2

INDIVIDUALS

1

YEAR

The Critical Air Project

INPATIENT INHALER USE

- Each month, Island Health hospitals dispense
  - 2,930 inhalers
  - ~50 tCO2e
  - ~18,500 km by car
- MDIs are necessary and irreplaceable in hospital

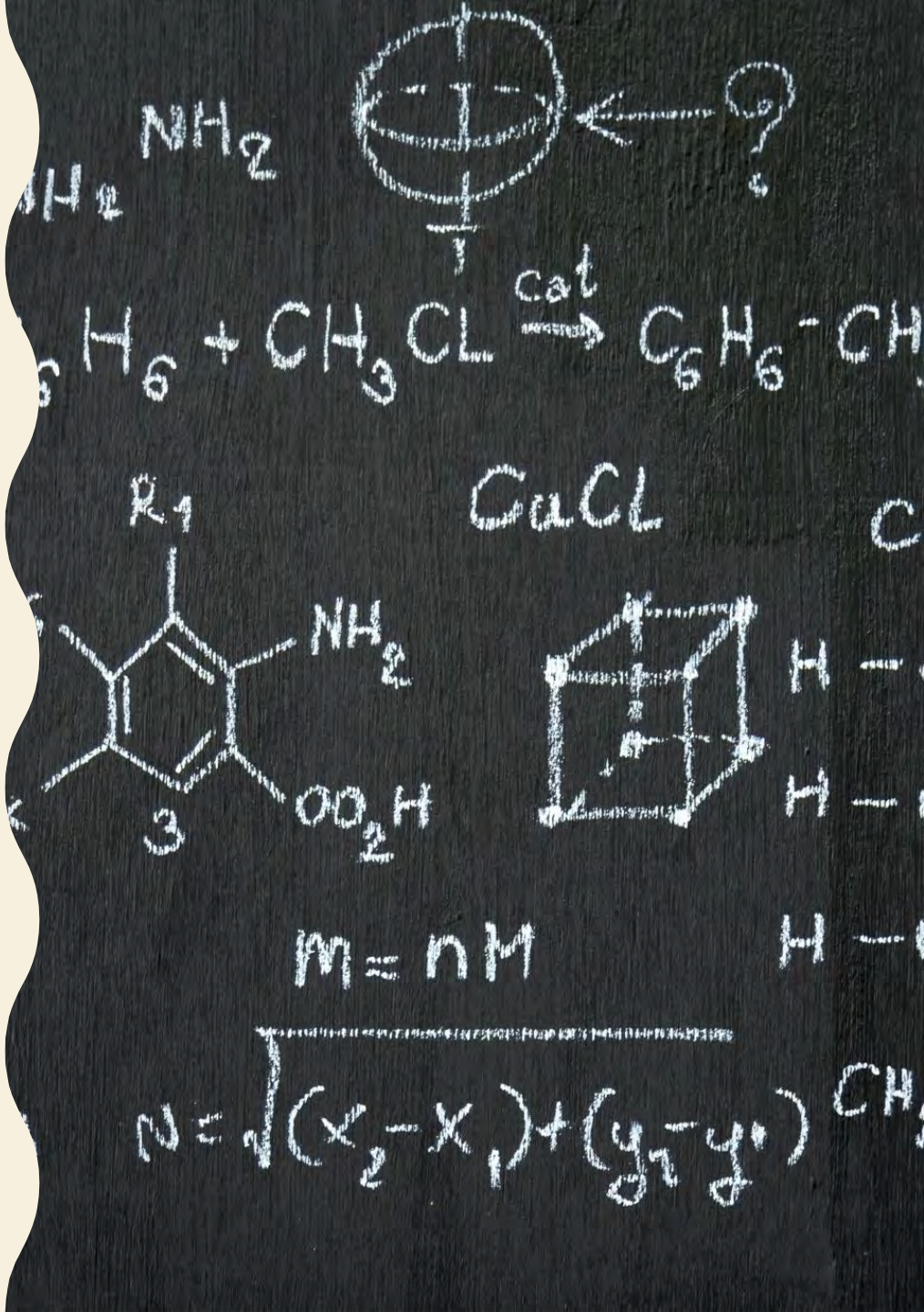
DOING THE MATH

- The carbon footprint of an MDI varies significantly with the propellant (HFA) content of the MDI device
  - Low volume HFA MDI = 9,720 gCO2e/inhaler = 38.8 km
  - High volume HFA MDI = 28,200 gCO2e/inhaler = 112.6 km

- The provincial contract for salbutamol MDIs was up for renegotiation in January 2023. We conducted an environmental impact analysis.

- Island Health currently contracts with a low volume HFA provider
- Changing to a high-volume HFA would result in:
  - 290% relative increase in carbon footprint
  - …or 45% of Island Health's entire vehicle fleet

- Report disseminated to pharmacy leadership at Island Health and provincially



1847 TONNES CO2E SAVED PER YEAR – PROVINCE WIDE

EQUIVALENT TO DRIVING 6.4 MILLION KM BY CAR

ADVOCATING FOR SYSTEMS-LEVEL CHANGE

BCGuidelines.ca
Guidelines & Protocols Advisory Committee

Asthma Diagnosis, Education and Management

Effective Date: July 26, 2023

Environmental Impact and Climate Change

Climate and Asthma Management

While asthma exacerbations can occur at any time during the year, there are seasonal patterns.[42]

In children, exacerbation rates are highest in the fall. The "September Epidemic" has been attributed to an increased in rhinovirus respiratory infections among children when they return to school. Environmental factors (pollen, temperature, and air pollutants) also contribute to this phenomenon.

Climate change impacts the seasonal asthma cycle in two ways

- By shifting weather patterns, which can lead to a prolonged pollen season[43]
- Through increasingly common climate events, such as wildfires[22]

Other climate events, such as heat domes[44] and flooding[43] may also present exacerbation risks for patients with asthma. Consider climate events when developing their Asthma Action Plans.

GROWING THE CLIMATE CONSCIOUS PRESCRIBING MOUVEMENT

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Canadian Thoracic Society Position Statement on Climate Change and Choice of Inhalers for Patients with Respiratory Disease

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QUESTIONS? COMMENTS?

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