SOUTHWEST IDAHO AHEC
Students, Professionals, Community

Impact of Climate Change on Obstructive Lung Diseases

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DATE: 9/11/2024

Accreditation & Disclosures

Accreditation Statement

In support of improving patient care, this activity has been planned and implemented by Southwest Idaho Area Health Education Cetner and the University of Idaho, WWAMI Medical Education Program. The University of Idaho, WWAMI Medical Education Program is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC) to provide continuing education for the healthcare team.

Financial Relationship Disclosure to Learners

No one involved in planning or presenting this activity has any relevant financial relationships to disclose.

Objectives

- Understand global warming patterns and overall affect on health
- Stratify health sector contributions to climate change
- Discuss particulate matter and affect on respiratory disease
- Highlight forest fires in NW U.S. and affect on respiratory disease
- Overview management plans and interventions both for mitigation of air pollution and treatment of respiratory disease from a climate change perspective

Climate Change Origins

- Human activities → global warming
- Average temp is 1.1 C above 1850-1900 average
- Emission arising from unsustainable uses
- Climate extremes
- Vulnerable communities are impacted more
- Currently not enough policy/financial support to meet climate goals

Climate Anxiety

Solastalgia

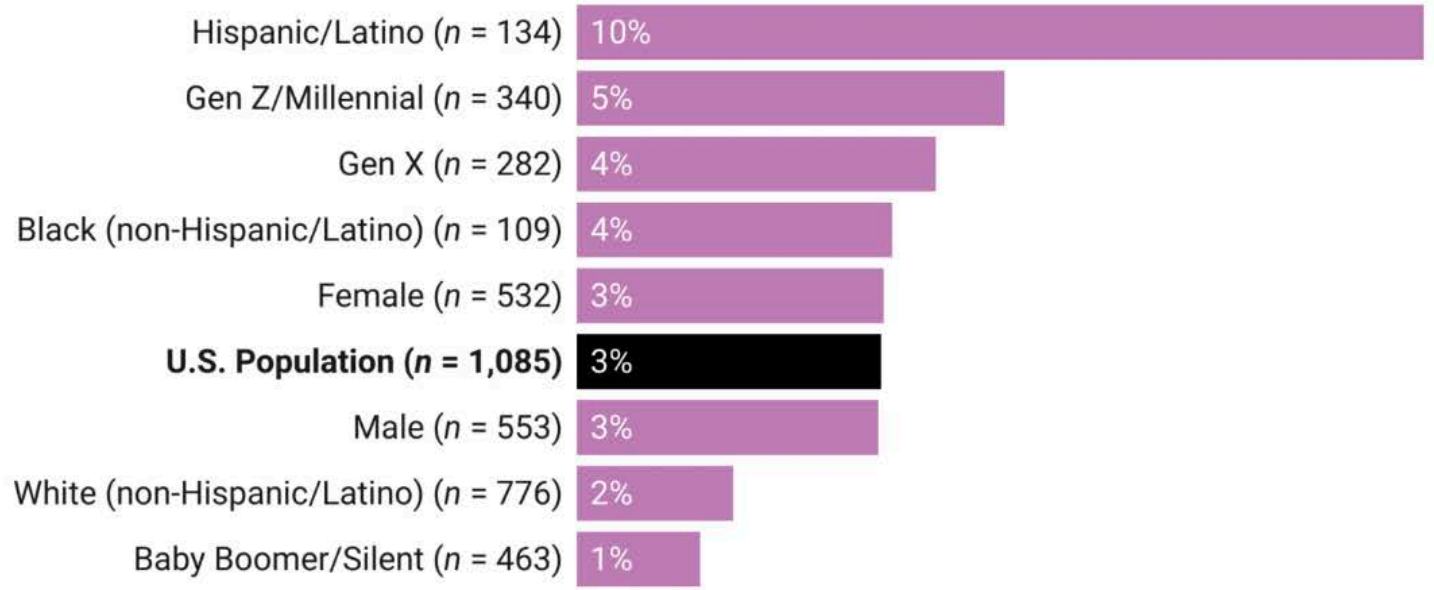
Climate Doom

Eco-grief

Eco-anxiety

Climate Change Anxiety by Race/Ethnicity, Gender, and Generation

% who meet the cut-off to be considered clinically diagnosable on the GAD-2 Climate

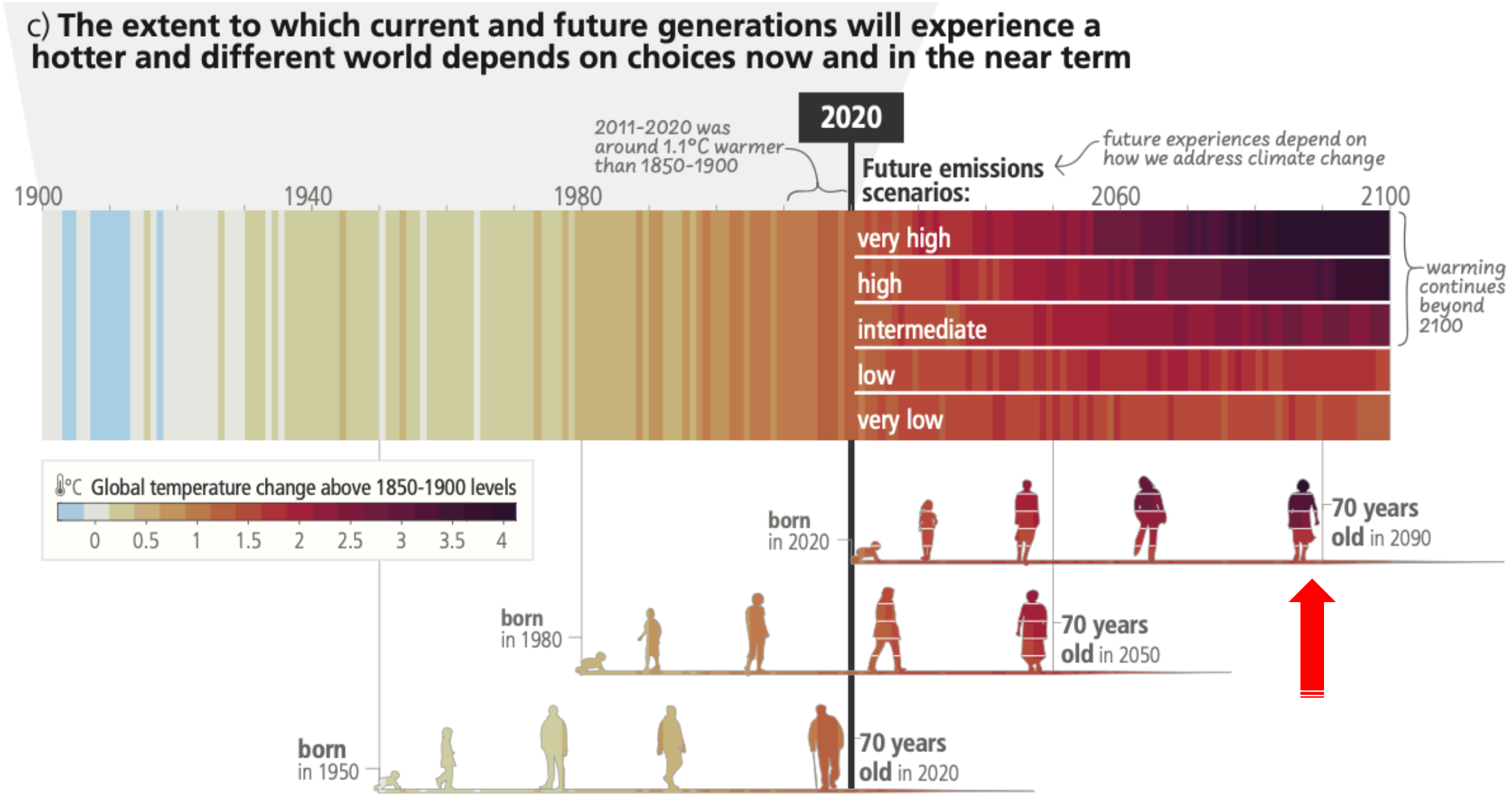


Over the last 2 weeks, how often have you been bothered by the following problems? [Feeling nervous, anxious, or on edge because of global warming] [Not being able to stop or control worrying about global warming] 0 = "Not at all", 1 = "Several days", 2 = "More than half the days", and 3 = "Nearly every day"

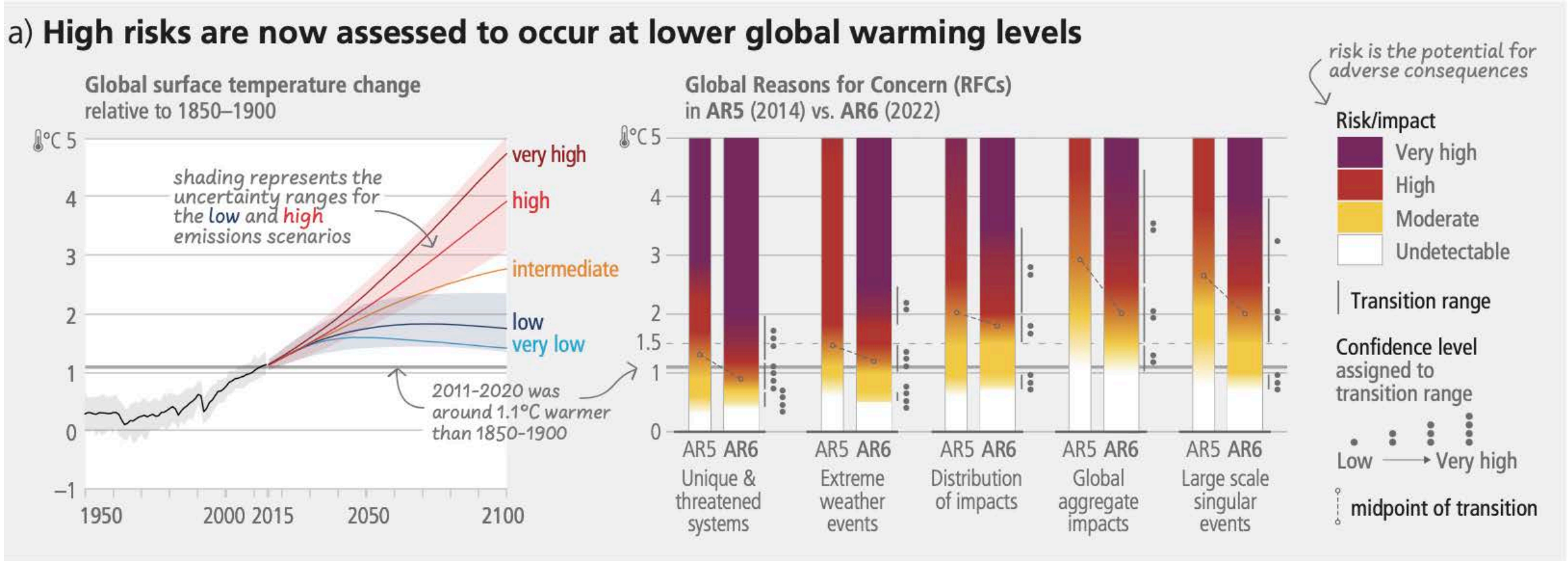
Responses to the questions were summed to create a score ranging from 0 to 6. People who scored 3 or higher were classified as having presumptive clinically significant levels of climate change anxiety.

December 2022. Base: 1,085 U.S. adults (*n* refers to the total number of respondents in the sample)

Source: Yale Program on Climate Change Communication;
George Mason Center for Climate Change Communication • Created with Datawrapper

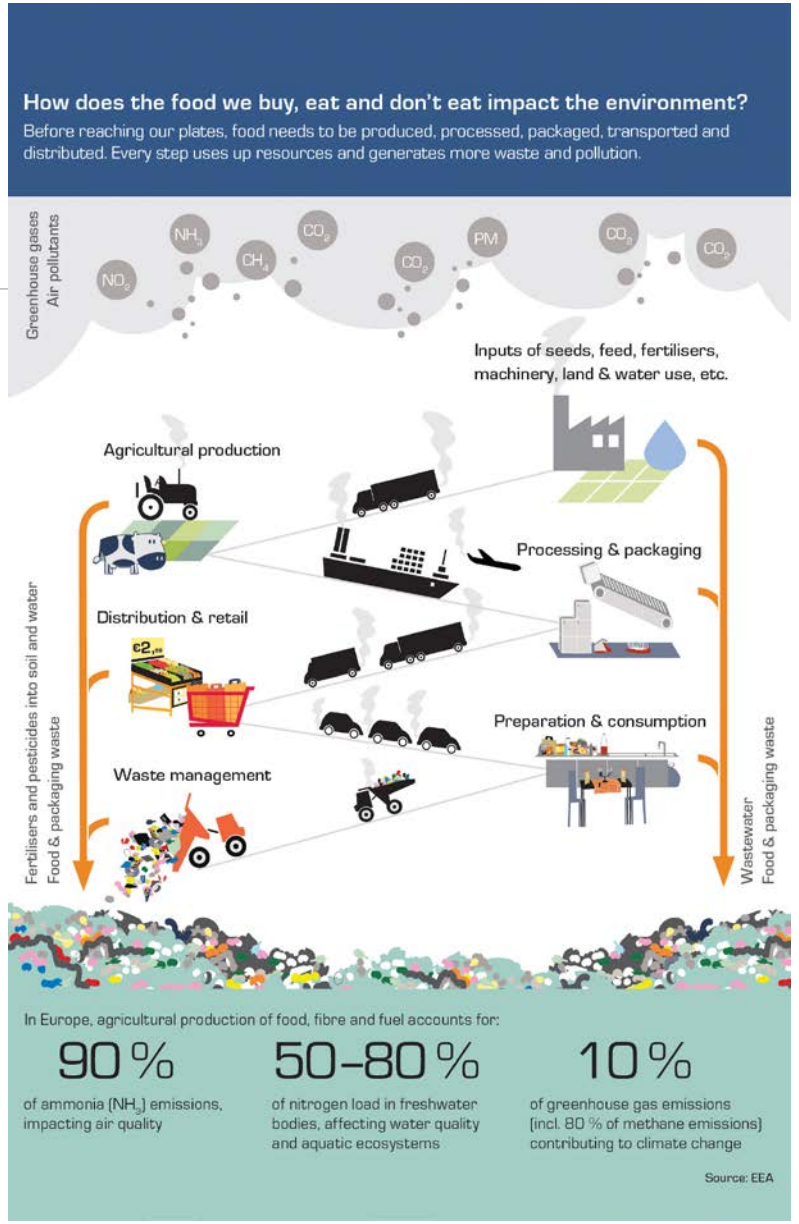

c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near term
2020
2011-2020 was around 1.1°C warmer than 1850-1900
future experiences depend on how we address climate change
Future emissions scenarios:
1900
1940
1980
2060
2100
very high
high
intermediate
low
very low
warming continues beyond 2100
°C Global temperature change above 1850-1900 levels
0
0.5
1
1.5
2
2.5
3
3.5
4
born in 2020
70 years old in 2090
born in 1980
70 years old in 2050
born in 1950
70 years old in 2020

Warming Trends

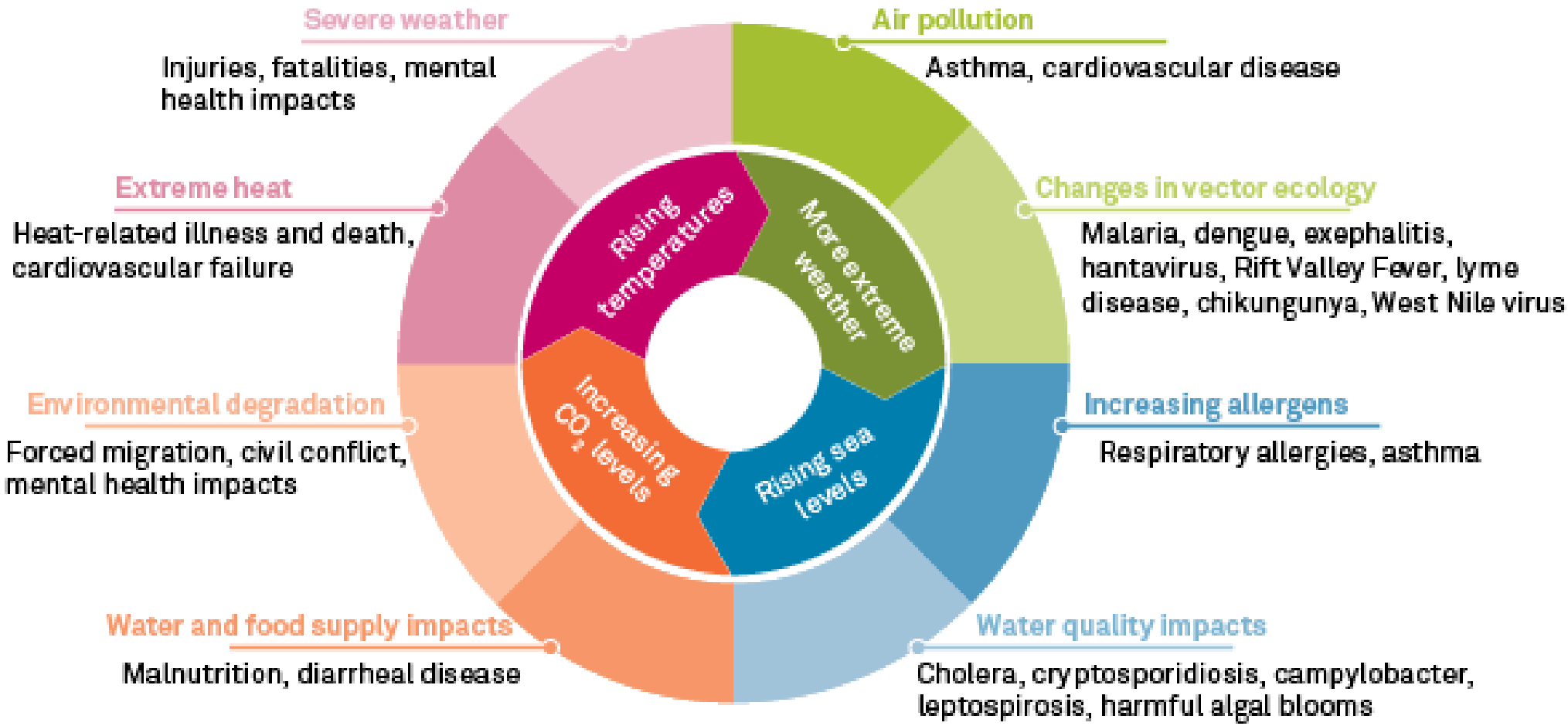


Climate Impact and Health

- Impacts on climate affect multiple areas of health
- Transportation produces ~20% emissions
- Food distribution contributes ~1/3 of greenhouse gas emissions
- Biodiversity loss
- Health gains > Cost



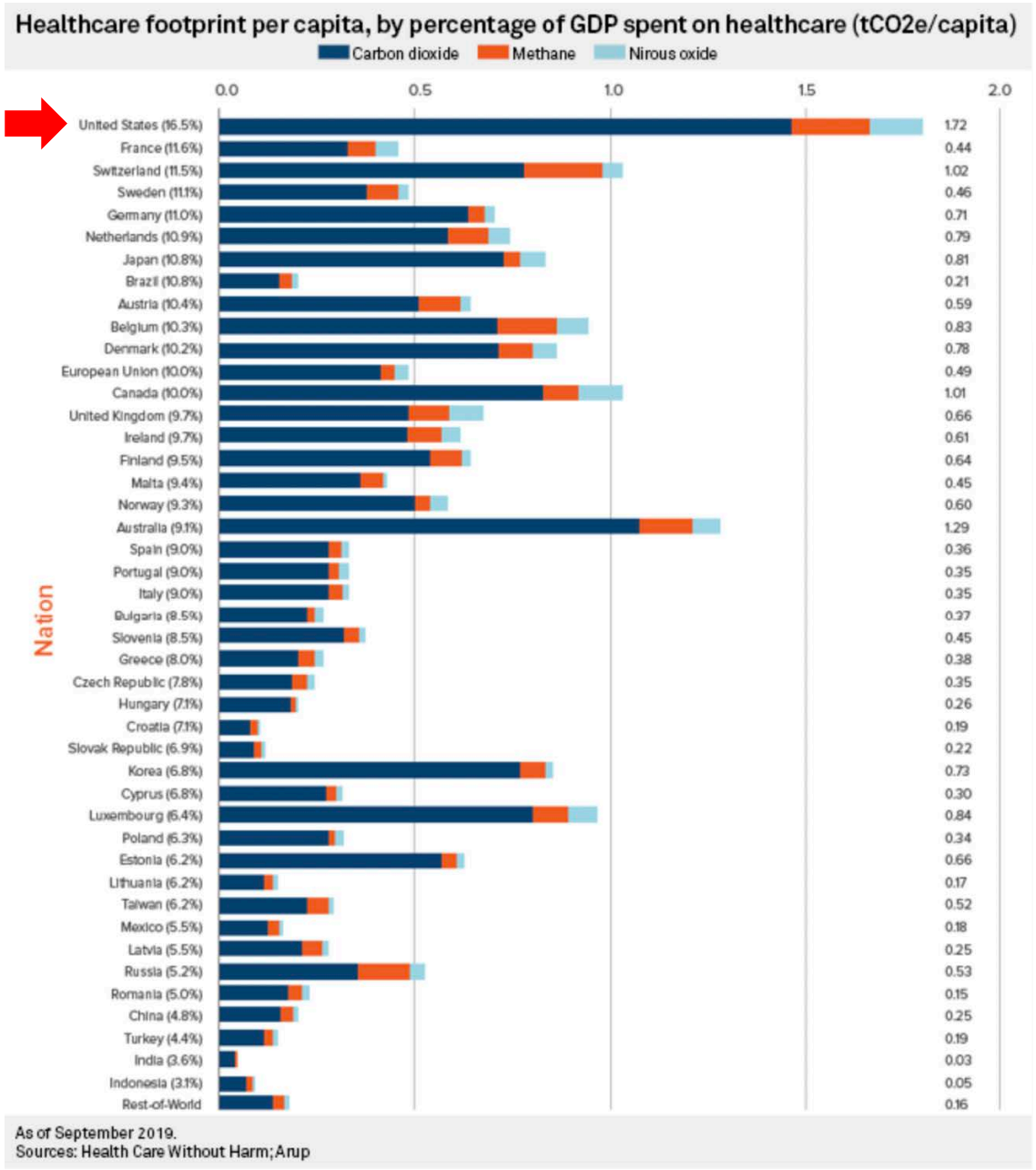
Impact of climate change on human health



Sources: Health Care Without Harm; Arup; U.S. Centers for Disease Control and Prevention

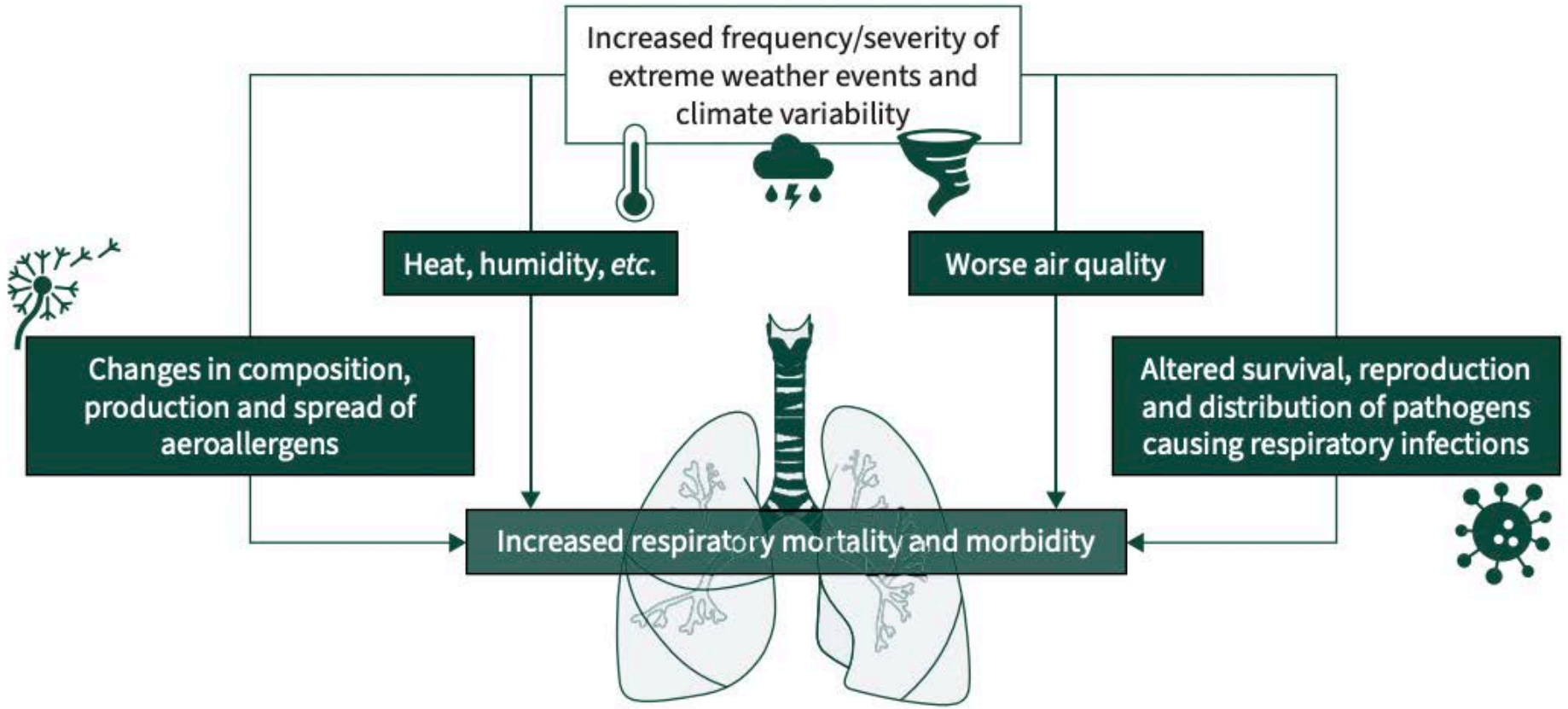
Health Care Emissions

- Health sector emits 4.4% of global greenhouse gases
- If the health sector were a country, it would be the fifth largest emitter on the planet
- US health sector is the #1 contributor of global healthcare emissions, emitting 8.5% of national greenhouse gases
- Breakdown of components in healthcare system contributing to emissions
  - 71% from supply chain
  - 17% from facilities and vehicles
  - 12% from cooling, heating, electricity, and steam



As of September 2019.
Sources: Health Care Without Harm; Arup

Effect of Climate Change on Lungs



Climate change and your lungs

Climate change is the long-term change to global temperature and weather systems. It has been sped up by human behaviour. We burn fossil fuels such as coal, gas and oil, which produce carbon dioxide and other pollutants or greenhouses gases. These build up in our atmosphere and cause global warming, which can affect your lungs.

Climate change can:

- increase the risk of developing a lung condition, or
- make pre-existing conditions worse.

Extreme heat

Extreme heat can make symptoms of lung disease worse and happen more often. High temperatures increase risks of drought. This worsens air quality as dirt and dust from the ground rise up into the air we breathe. Wildfires become more common, and the smoke pollutes the air we breathe.

Air pollution

Air pollution and climate change are closely linked. Air pollution contributes to climate change and climate change increases the risks of air pollution.

Plant pollen

Higher temperatures and more carbon dioxide mean plants produce more pollen for longer periods in more places. The pollen is also richer in the chemical that causes allergies.

Flooding

Flooding can lead to damp, which increases the risk of mould growth. Mould triggers allergies, causes lung infections and can worsen lung conditions such as asthma and rhinitis.

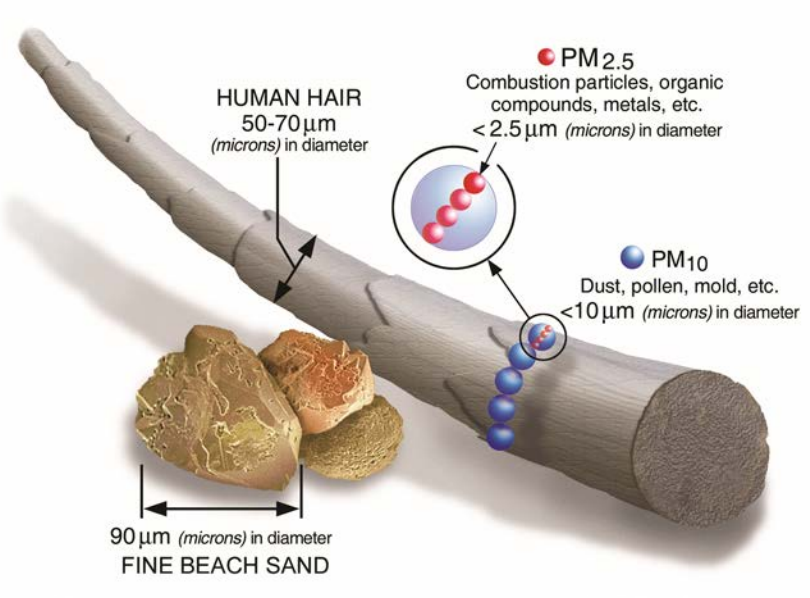
Infectious diseases

Climate change can affect how well germs that cause diseases spread, reproduce and survive. We will likely see more new viruses spreading into people and have greater risks of epidemics and pandemics due to climate change.

HEALTHY **LUNGS** FOR LIFE

Ambient Particulate Matter Pollution (APMP)

- Particles with diameter <2.5 μm ($PM_{2.5}$)
- Small size allows penetration into lungs
- Induce airway inflammation and aggravate symptoms in OLD
- Industry is contributing
- More sustainable strategies to reduce pollution causing OLD



APMP Burden

- Bronchiolitis + asthma in younger years
- No significant disease in middle ages
- Worsening OLD and lung cancer in elderly
- COPD was the main cause of medical burden in later years

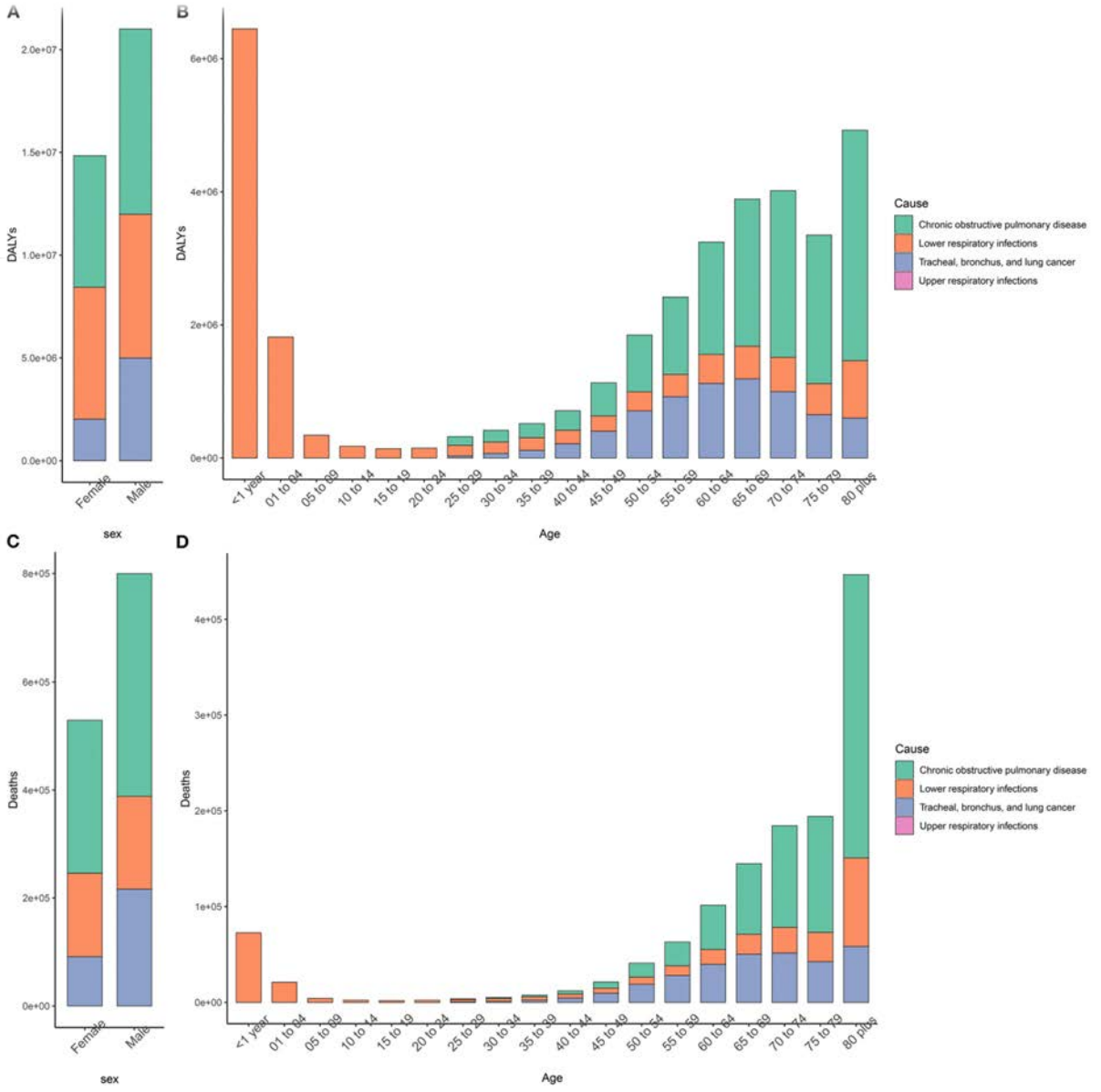


FIGURE 1 | Sex- and age-specific burden of respiratory disease attributable to ambient particulate matter pollution in 2019. **(A,B)**. DALYs; **(C,D)**. Deaths. DALY, disability-adjusted life year.

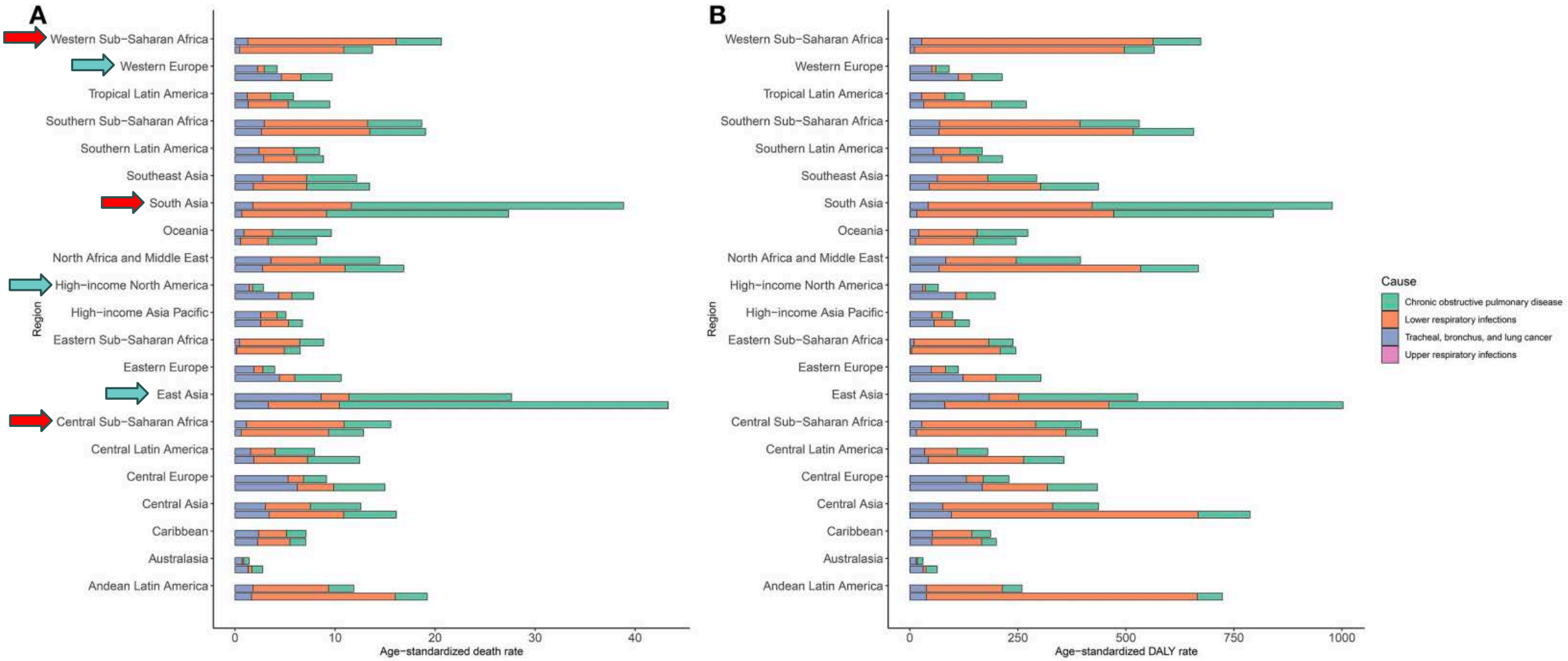


FIGURE 3 | Burden of respiratory diseases attributable to ambient particulate matter pollution among 21 regions in 1990 and 2019. The upper column in each group is data for 2019 and the lower column is for 1990. **(A)**. age-standardized death rate of respiratory diseases; **(B)**. age-standardized DALY rate of respiratory diseases. DALY, disability-adjusted life year.

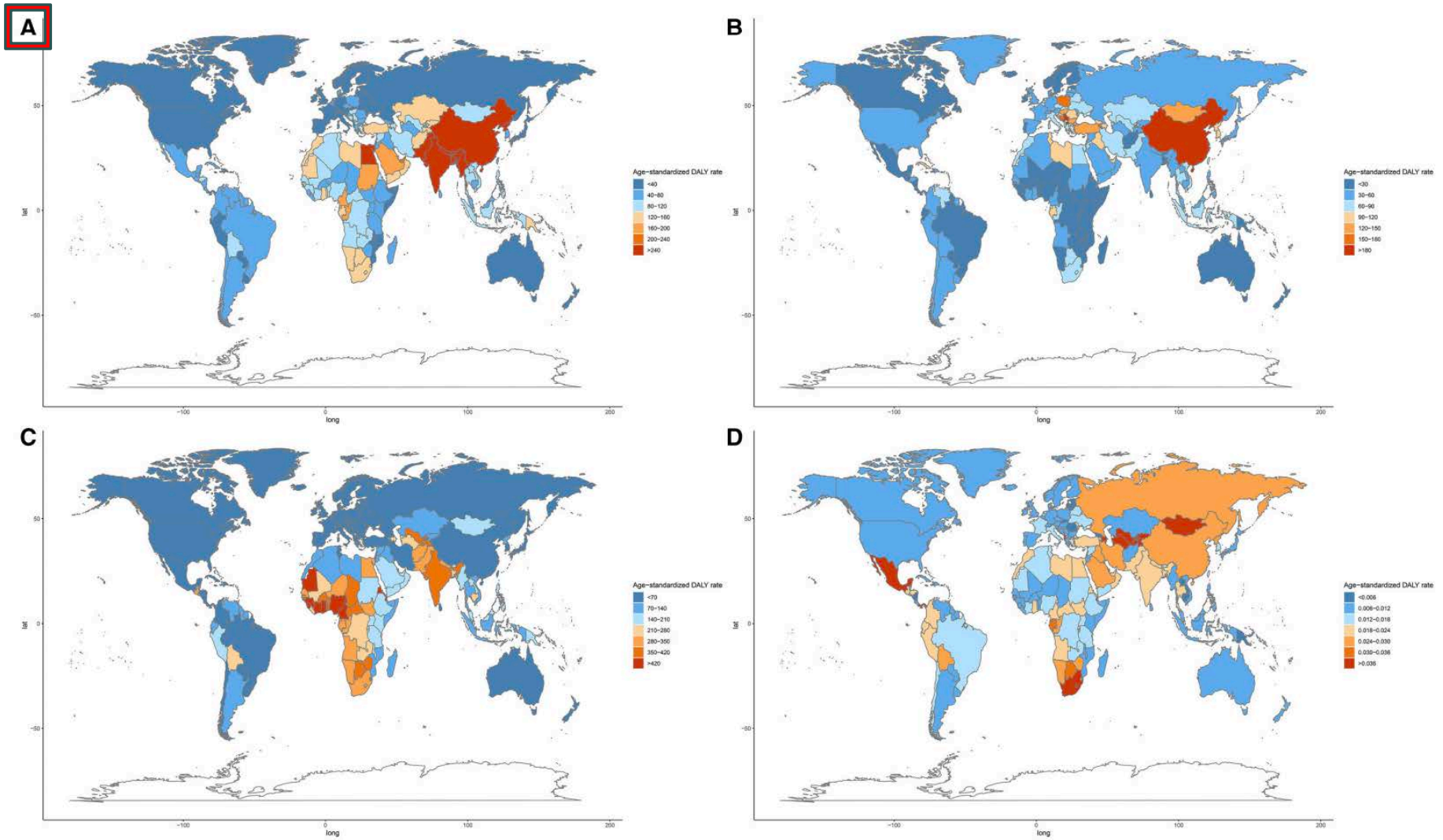
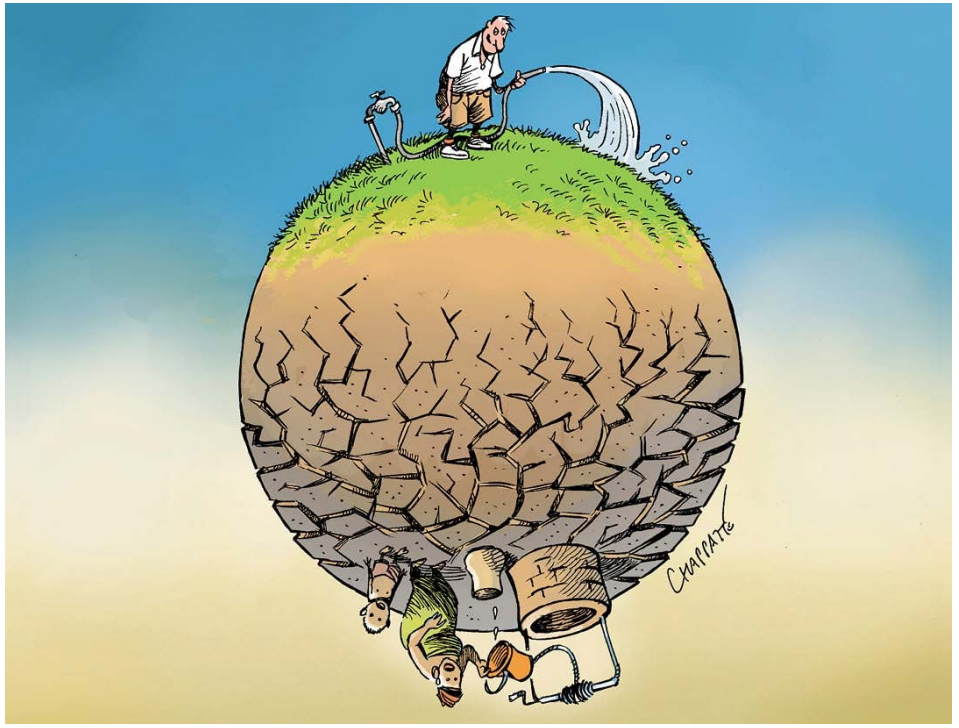


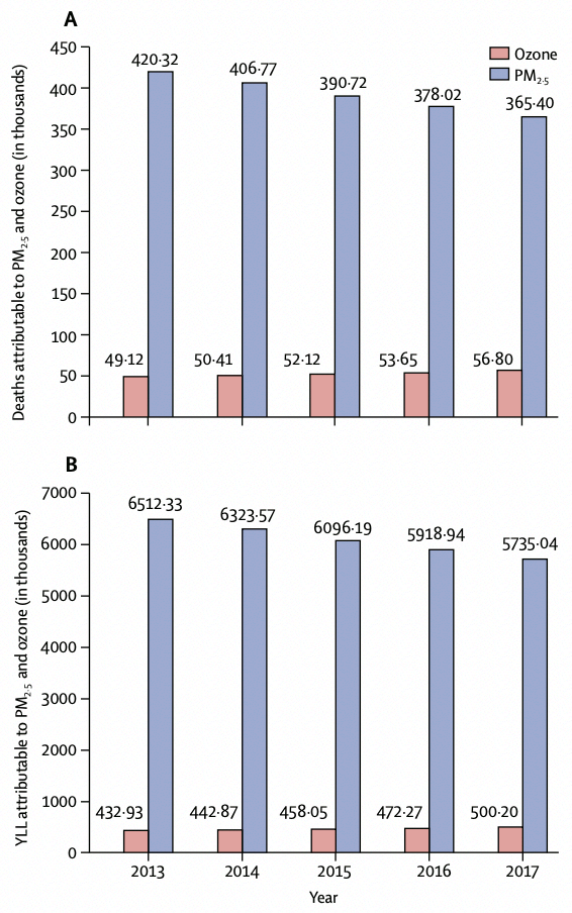
FIGURE 4 | Age-standardized DALY rate of respiratory diseases attributable to ambient particulate matter pollution among 204 countries and territories in 2019. **(A)**. COPD; **(B)**. TBL cancer; **(C)**. LRIs; **(D)**. URIs. COPD, chronic obstructive pulmonary disease; DALY, disability-adjusted life year; TBL, cancer tracheal, bronchus, and lung cancer; LRIs, lower respiratory infections; URIs, upper respiratory infections.

Social Inequities

- Affects vulnerable populations disproportionately
- Disadvantaged groups are less able to mitigate effects of climate change on health
- Lower SES people often working in occupations with higher heat exposures
- Perpetuates a cycle of disadvantaged groups suffering disproportionately, which results in greater subsequent inequality



Reducing APMP and Respiratory Burden



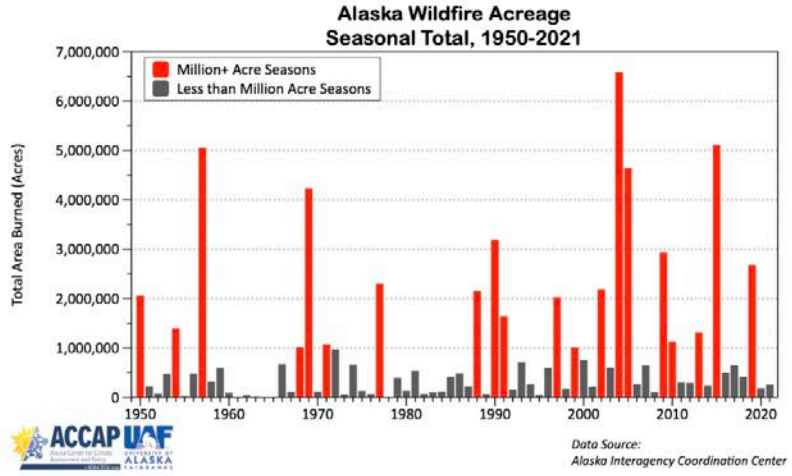
- In 2013, China created 10 tasks with measurable goals with the Air Prevention Pollution and Control Action Plan (APPCAP)
- From 2013-2017, China decreased $PM_{2.5}$ by 33.3% due to APPCAP
- 42.7k fewer deaths and 710k fewer YLL due to measures

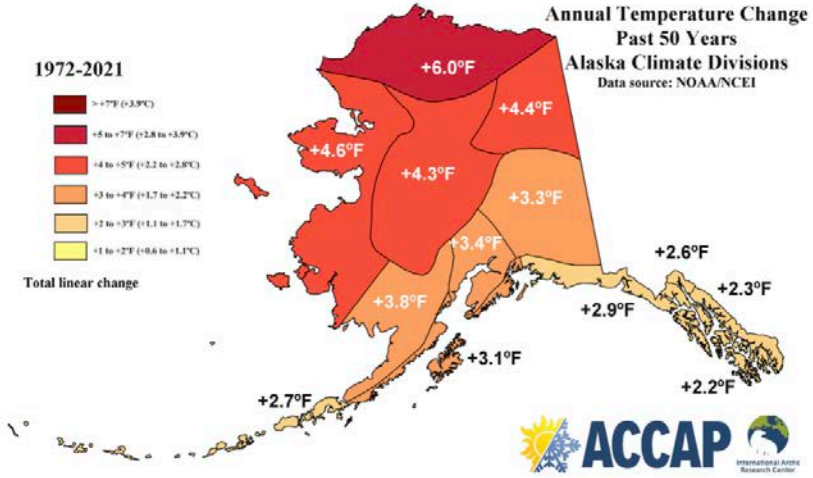
PNW Wildfires

- Temperatures are rising
- Forests are drier for longer periods
- Area burned has increased
- Snowpack is decreasing

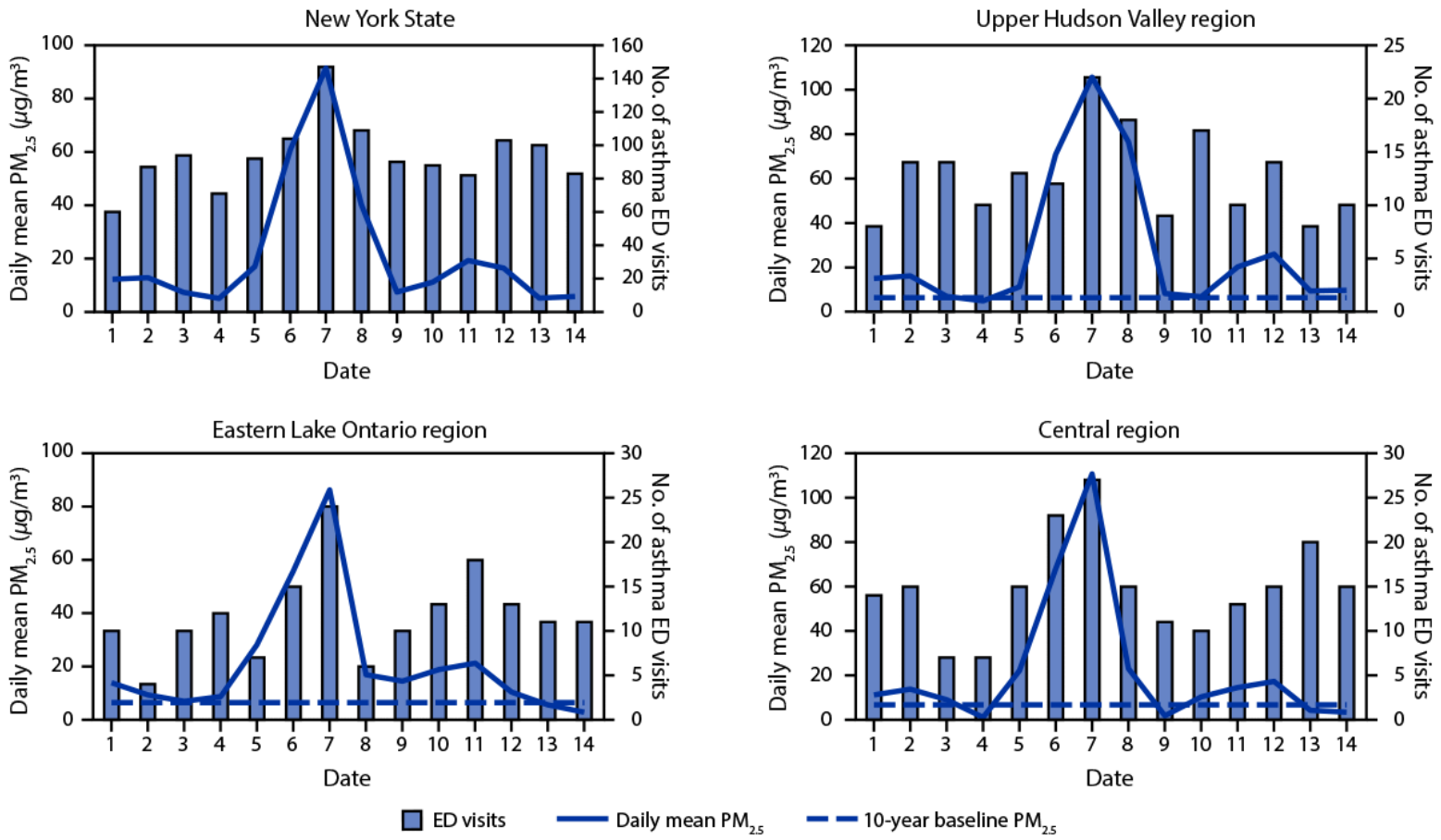
Alaska Wildfires

- 2.5x more acres burned last 20 years
- By 2050, projected 24-169% increase burn area
- In large part due to climate changes
- Alaska is leading the way in multiple depressing statistics
  - Largest Tundra (Anaktuvuk – 2007)
  - Largest Wildfire (Taylor complex – 2004)
  - Most expensive (Swan Lake – 2019)





Wildfire and asthma exacerbations

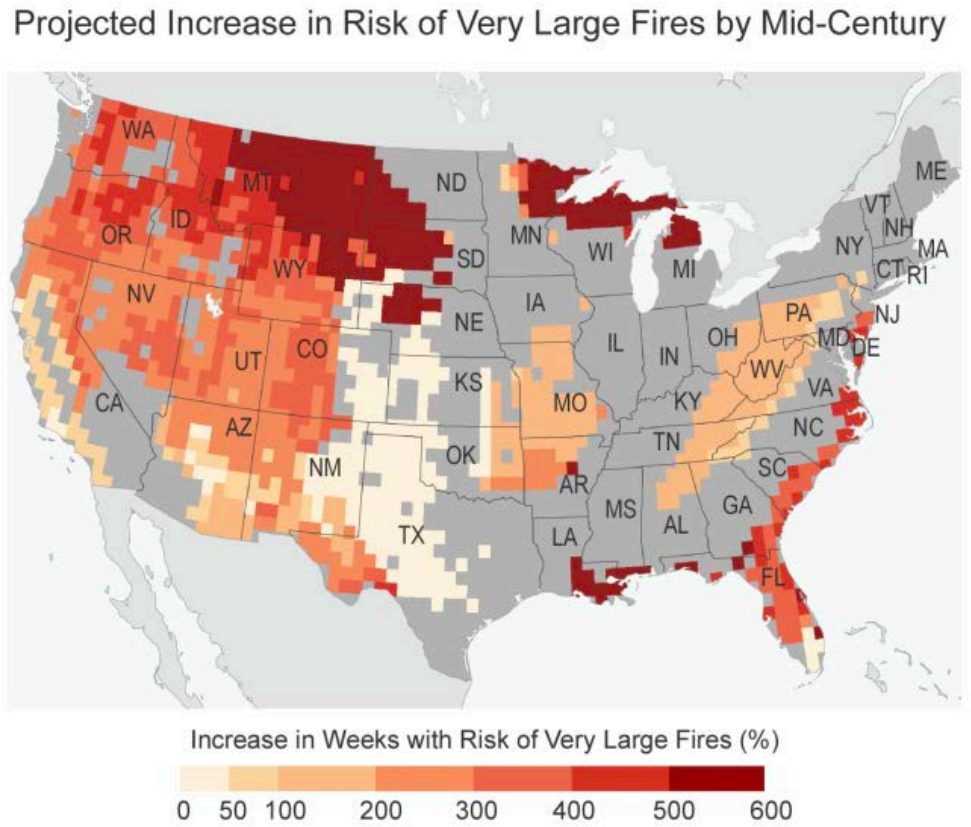


Wildfires and Health

- Major source of APMP
- Wildfires increase other harmful chemicals
- APMP gets indoors and into homes
- Immediate/traumatic harms of wildfires
- Smoke travels long distances
- Puts added stress on health systems

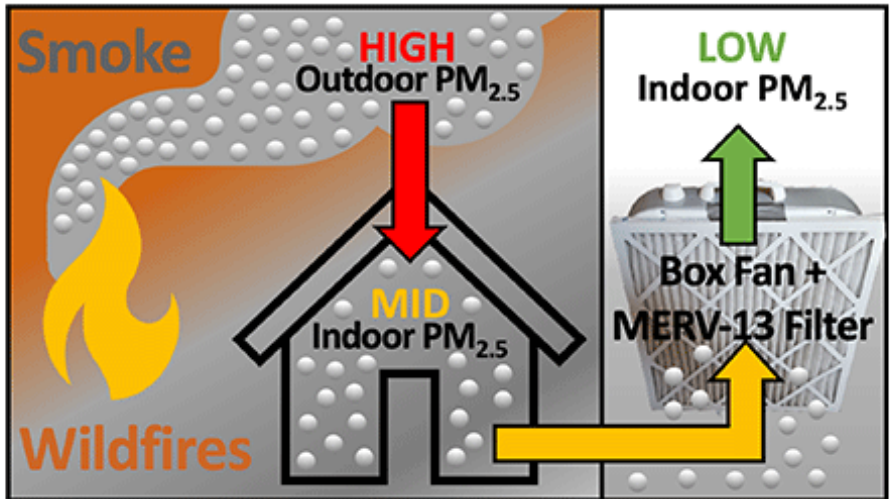
Climate and Economic Toll from Wildfires

- Increased frequency and intensity of wildfires
- Increasing wildland-urban interface development
- Warming weather → bark beetles → increased CO2
- Wildfires contribute to climate change
  - 3% of annual emissions come from wildfires
  - Forests are important for carbon sequestration



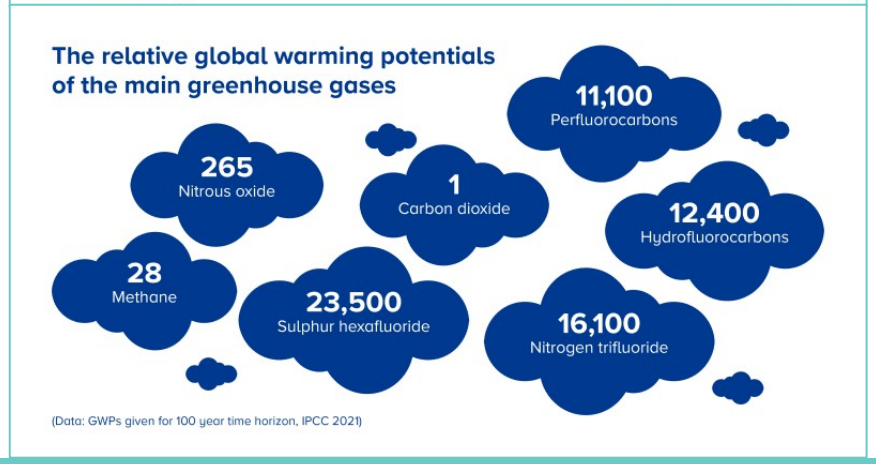
Wildfire Mitigation Approaches

- Advise patients with pr-existing conditions
- Promote safe air when sheltering indoors
- Educate on defending against fires
- Advocate for mitigation strategies
  - Land-use policies
  - Flame-resistant materials in building codes
  - Smart forestry management funding



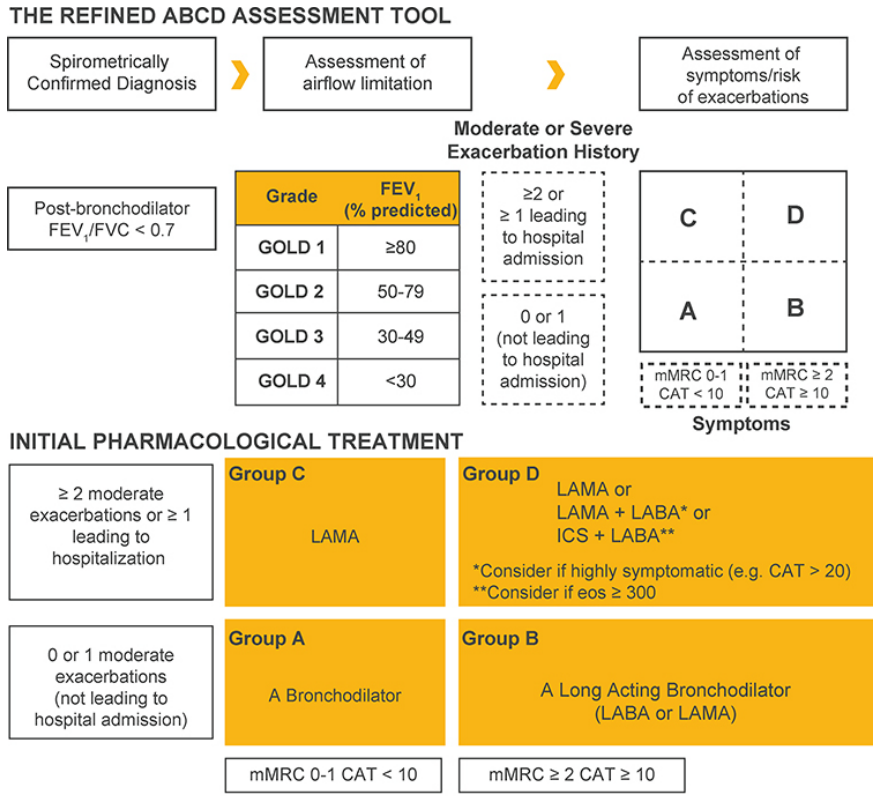
Inhalers and Climate Change

- Inhalers are the mainstay of treatment for OLD
- MDIs have more carbon footprint than DPIs
  - MDIs use hydrofluorocarbon propellants
- Netherlands study in 2020 highlighted the potential impacts of MDIs → DPIs
  - Emission reduction if 70% of MDI inhaler users switched to DPIs
  - 1.4 million patients, 364 million inhaler doses
  - 49.6% inhaler doses were MDIs
  - If 70% reduction was achieved → 63 mil kg CO2e and 49.1 mil euro savings

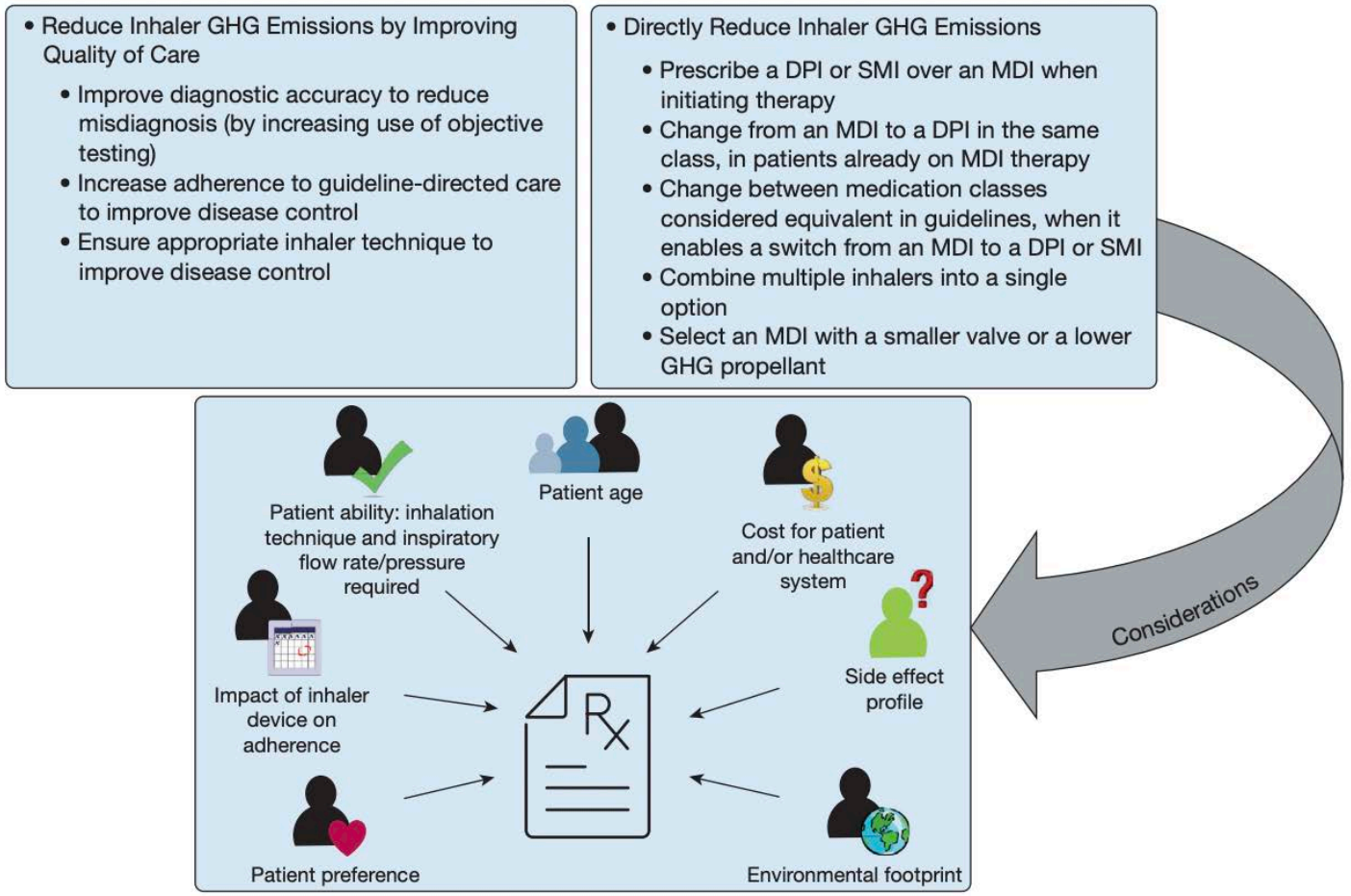


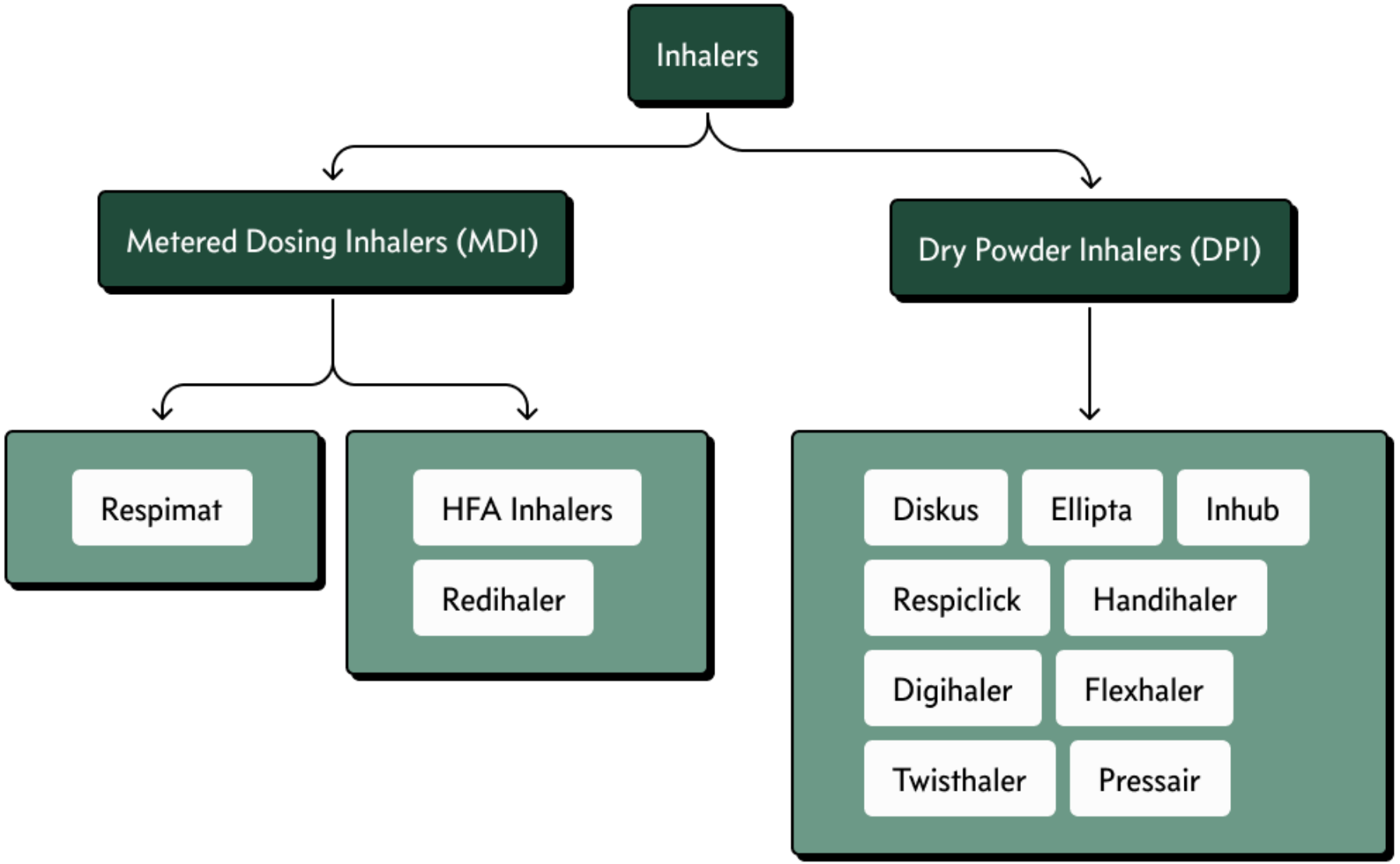
Provider's Role with Inhalers

- Improve overall quality of OLD care
  - Better diagnostic testing
  - Adherence to guideline-directed care
  - Proper inhaler use
- Climate conscious inhaler prescribing
  - DPI > MDI
  - Switching to different medication class
  - Use combined inhalers when possible
  - Use MDIs with less propellant



Considerations with Inhaler Prescribing

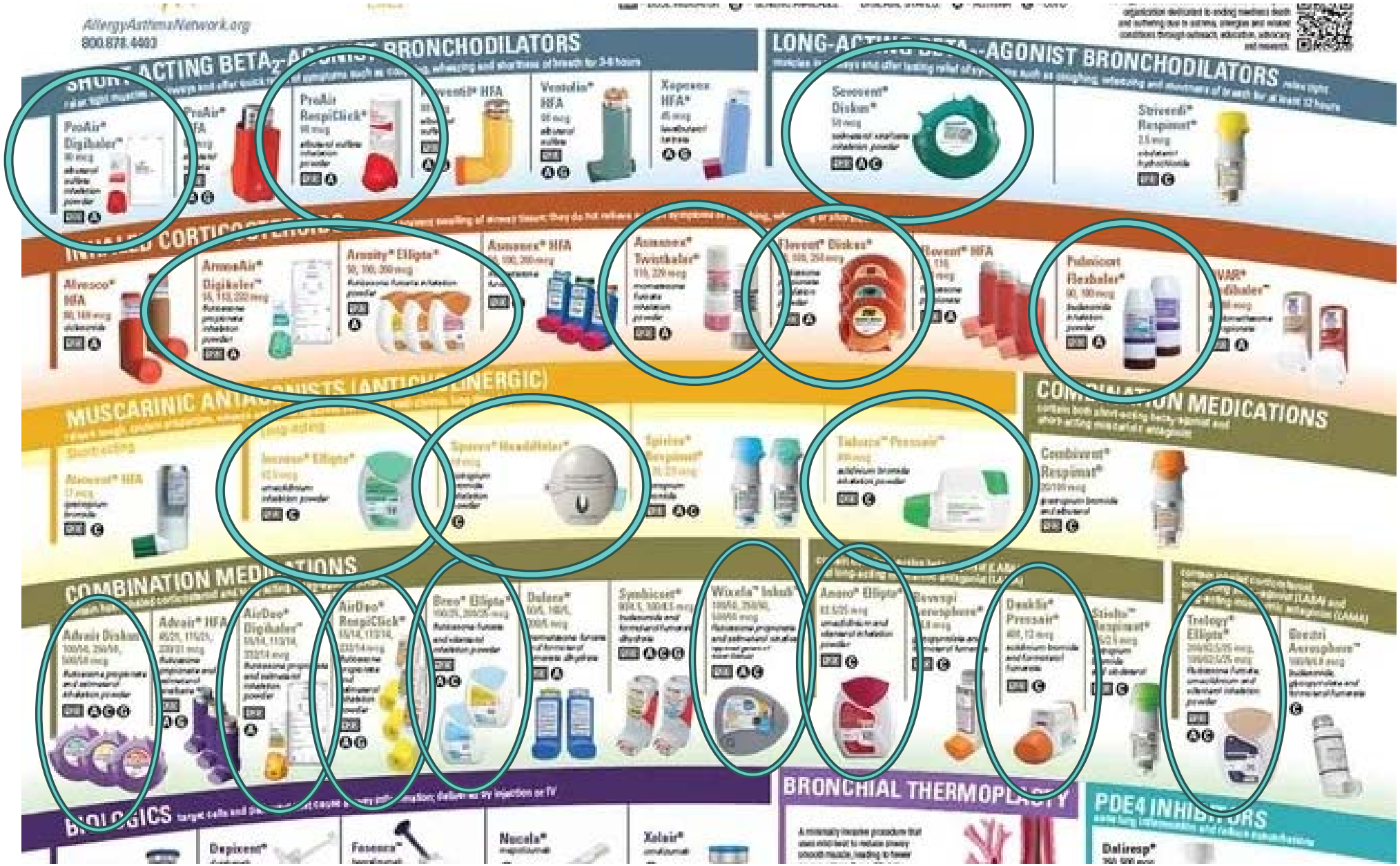



Inhalers
Metered Dosing Inhalers (MDI)
Dry Powder Inhalers (DPI)
Respimat
HFA Inhalers
Redihaler
Diskus
Ellipta
Inhub
Respiclick
Handihaler
Digihaler
Flexhaler
Twisthaler
Pressair

MDI vs DPI

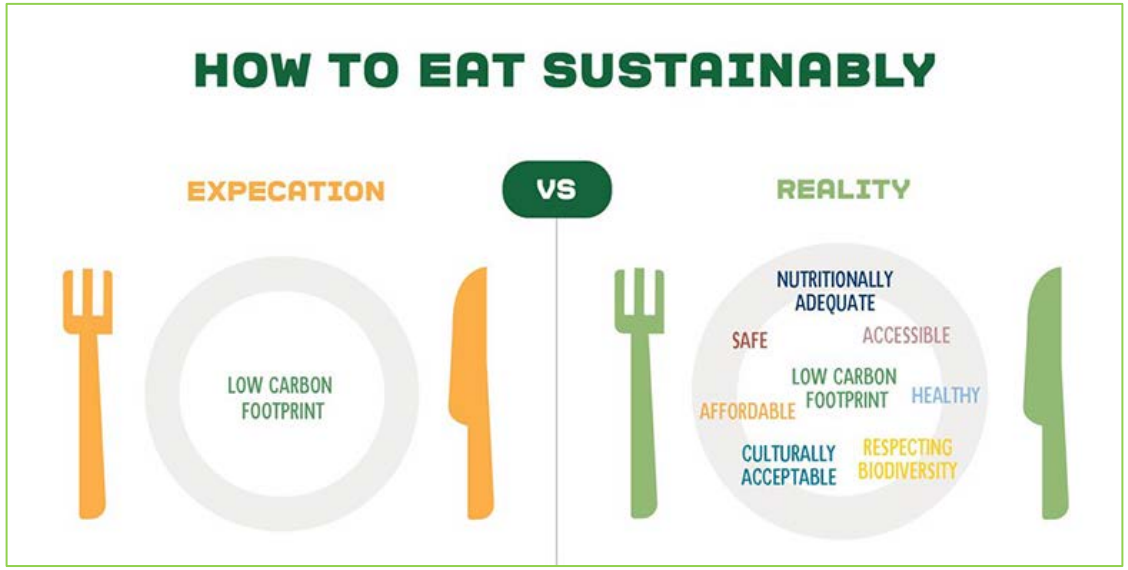
- Study in 2021 for COPD patients
  - Multicenter RCT with 342 patients
  - Cross-over study with triple therapy MDI and DPI
  - DPI was non-inferior to MDI
- Study in 2020 for asthma patients
  - RCT with 63 patients asthmatic patients age >55
  - Treated with either MDI or DPI form of ICS + LABA
  - MDI group was non-inferior to DPI

- Study in 2021 for asthma patients looking more at inhaler carbon footprint
  - Post hoc analysis of >2k asthma patients
  - Patients either kept on MDI or switched to DPI inhaler, ICS + LABA
  - >50% decrease in carbon foot print with DPI group
  - DPI group also showed better control


AllergyAsthmaNetwork.org
800.878.4403
LONG-ACTING BETA2-AGONIST BRONCHODILATORS
ProAir® Digihaler®
ProAir® RespiClick®
Ventolin® HFA
Xopenex HFA®
Serevent® Diskus®
Striverdi® Respimat®
Alvesco® HFA
AirmeAir® Digihaler®
Arnuity® Ellipta®
Asmanex® HFA
Asmanex® Twisthaler®
Flovent® Diskus®
Flovent® HFA
Pulmicort Flexhaler®
MUSCARINIC ANTAGONISTS (ANTICHOLINERGIC)
Spiriva® Handihaler®
Spiriva® Respimat®
Tudorza™ Pressair®
COMBINATION MEDICATIONS
Combivent® Respimat®
Advair Diskus®
Advair® HFA
AirDuo® Digihaler®
AirDuo® RespiClick®
Dulera®
Symbicort®
Wixela™ Inhub™
Anoro® Ellipta®
Stiolto™ Respimat®
Trelegy® Ellipta®
Breztri Aerosphere™
BIOLOGICS
Dupixent®
Fasenra™
Nucala®
Xolair®
BRONCHIAL THERMOPLASTY
PDE4 INHIBITORS
Daliresp®

“The Climate Crisis is a Health Crisis”

- COP26, health agenda joins the picture
- Traditional role of health care providers to provide adaptation strategies
- More recently an increased call for healthcare works to focus on mitigation efforts, sustainability, and planetary health
- ”Co-benefits”



Tips for the Sustainable Physician

- Acknowledge and discuss
- Attention to high-risk populations
- Nature prescribing
- Environmental monitoring
- Cooling centers
- Promote “co-benefit” activities
- Raise awareness and advocacy
- Interdisciplinary research
- Be an example

Thank You

- American Forest Foundation (n.d.) Wildfires and climate change.
- Andersen ZJ, Vicedo-Cabrera AM, Hoffmann B, Melén E. Climate change and respiratory disease: clinical guidance for healthcare professionals. Breathe (Sheff). 2023 Jun;19(2):220222. doi: 10.1183/20734735.0222-2022. Epub 2023 Jul 11. PMID: 37492343; PMCID: PMC10365076.
- Beeh KM, Kuna P, Corradi M, Viaud I, Guasconi A, Georges G. Comparison of Dry-Powder Inhaler and Pressurized Metered-Dose Inhaler Formulations of Extrafine Beclomethasone Dipropionate/Formoterol Fumarate/Glycopyrronium in Patients with COPD: The TRI-D Randomized Controlled Trial. Int J Chron Obstruct Pulmon Dis. 2021 Jan 14;16:79-89. doi: 10.2147/COPD.S291030. PMID: 33488071; PMCID: PMC7814657.
- Beitler, J. (October 2006). Tracking Nature's Contribution to Pollution. NASA Earth Observatory.
- Center for Climate Change and Health
- Chen J, Hoek G. Long-term exposure to PM and all-cause and cause-specific mortality: A systematic review and meta-analysis. Environ Int. 2020 Oct.
- Chi MC, Guo SE, Hwang SL, Chou CT, Lin CM, Lin YC. Exposure to Indoor Particulate Matter Worsens the Symptoms and Acute Exacerbations in Chronic Obstructive Pulmonary Disease Patients of Southwestern Taiwan: A Pilot Study. Int J Environ Res Public Health. 2016 Dec 22.
- Dohrenwend, P.B., Le, M.V., Bush, J.A., Thomas, C.F. (2013). The impact on emergency department visits for respiratory illness during the southern California wildfires. Western Journal of Emergency Medicine, 14(2):79- 84
- Gupta S, Couillard S, Digby G, Tse SM, Green S, Penz E. Climate Change and Inhaler Selection in Patients With Respiratory Disease. Chest. 2024 Mar;165(3):503-506. doi: 10.1016/j.chest.2023.09.025. PMID: 38461016.
- Huan Minh Tran, Feng-Jen Tsai, Yueh-Lun Lee, Jer-Hwa Chang, Li-Te Chang, Ta-Yuan Chang, Kian Fan Chung, Han-Pin Kuo, Kang-Yun Lee, Kai-Jen Chuang, Hsiao-Chi Chuang., 2023. The impact of air pollution on respiratory diseases in an era of climate change: A review of the current evidence. Science of The Total Environment, Volume 898.
- Huang J, Pan X, Guo X, Li G. Health impact of China's Air Pollution Prevention and Control Action Plan: an analysis of national air quality monitoring and mortality data. Lancet Planet Health. 2018 Jul.
- IPCC 2023
- Meek HC, Aydin-Ghormoz H, Bush K, et al. *Notes from the Field:* Asthma-Associated Emergency Department Visits During a Wildfire Smoke Event — New York, June 2023. MMWR Morb Mortal Wkly Rep 2023;72:933–935
- Ten Have P, van Hal P, Wichers I, Kooistra J, Hagedoorn P, Brakema EA, Chavannes N, de Heer P, Ossebaard HC. Turning green: the impact of changing to more eco-friendly respiratory healthcare - a carbon and cost analysis of Dutch prescription data. BMJ Open. 2022 Jun 14;12(6):e055546. doi: 10.1136/bmjopen-2021-055546. PMID: 35701064; PMCID: PMC9198801.
- Uppalapati et al., *The prevalence of climate change psychological distress among American adults*. Yale Program on Climate Change Communication. (2024, June 21).
- WHO COP28
- Woo SD, Ye YM, Lee Y, Lee SH, Shin YS, Park JH, Choi H, Lee HY, Shin HJ, Park HS. Efficacy and Safety of a Pressurized Metered-Dose Inhaler in Older Asthmatics: Comparison to a Dry Powder Inhaler in a 12-Week Randomized Trial. Allergy Asthma Immunol Res. 2020 May;12(3):454-466. doi: 10.4168/aair.2020.12.3.454. PMID: 32141259; PMCID: PMC7061154.
- Woodcock A, Janson C, Rees J, Frith L, Löfdahl M, Moore A, Hedberg M, Leather D. Effects of switching from a metered dose inhaler to a dry powder inhaler on climate emissions and asthma control: post-hoc analysis. Thorax. 2022 Dec;77(12):1187-1192. doi: 10.1136/thoraxjnl-2021-218088. Epub 2022 Feb 7. PMID: 35131893; PMCID: PMC9685707.
- Wu Y, Song P, Lin S, Peng L, Li Y, Deng Y, Deng X, Lou W, Yang S, Zheng Y, Xiang D, Hu J, Zhu Y, Wang M, Zhai Z, Zhang D, Dai Z, Gao J. Global Burden of Respiratory Diseases Attributable to Ambient Particulate Matter Pollution: Findings From the Global Burden of Disease Study 2019. Front Public Health. 2021 Nov 23.