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Environmental Justice and Human Health: Creating Systemic Solutions

Women's Health and Reproductive Health in a Time of Climate Crisis

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Disclosures

No personal financial conflicts of interest to disclose

Objectives

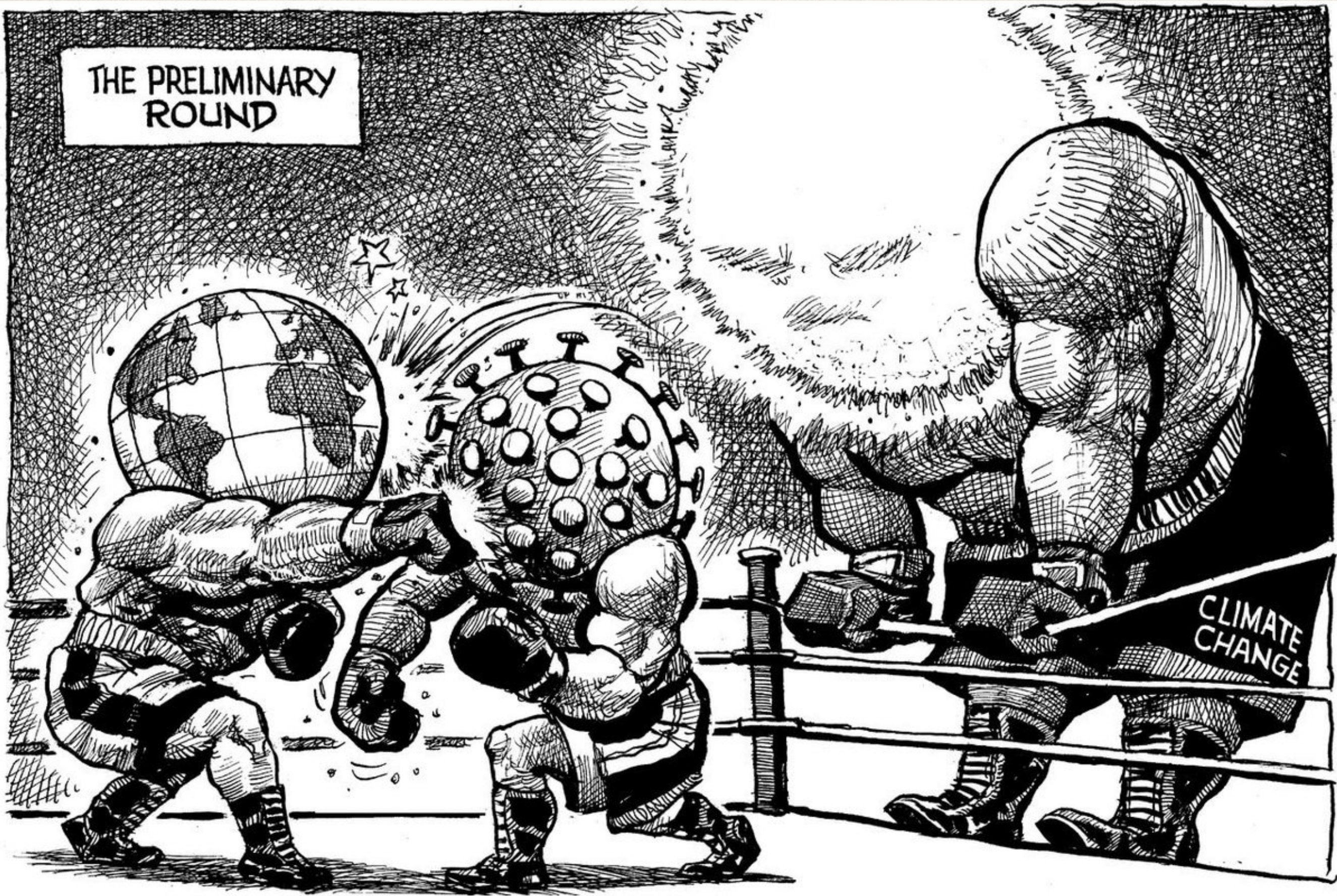
- ❖ We, as healthcare providers, should understand the fundamental principles of climate change.
- ❖ We, as women's healthcare providers, need increased awareness of climate change-related adverse impacts on women's health.
- ❖ We, as women's healthcare providers, should understand how we can assist and empower women in confronting the challenges of climate change.
- ❖ We, as healthcare providers, should understand how we can help mitigate climate change.

Climate change is happening...

“Climate change is the defining issue of our age. Our response will define our future. To ride this storm we need all hands on deck.”

*Former UN Secretary-General, Mr. Ban Ki-moon,
opening address to the UN Climate Summit, 2014*

THE PRELIMINARY ROUND

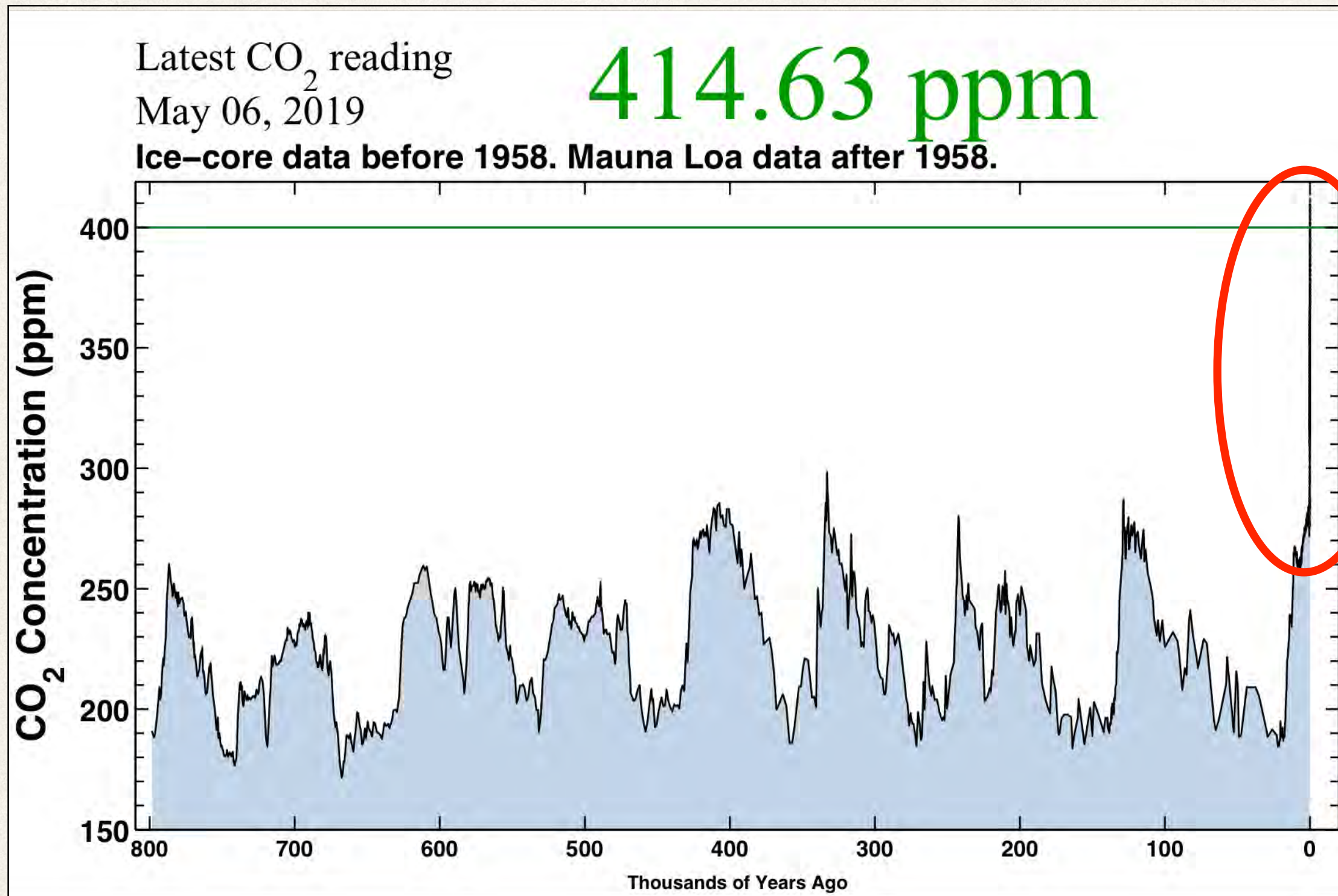


Climate Science: Principles



- ❖ Without greenhouse gases (GHGs), Earth's surface temperature would be -18°C (0°F) instead of 15°C (59°F).
- ❖ The most important human-caused (anthropogenic) GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O); CO_2 is the most abundant of these.
- ❖ Global warming due to anthropogenic carbon emissions predicted by Svante Arrhenius in 1904.

Climate Science: Observations



CO₂ data before 1958 going back 800,000 years

Site: <https://www.ncdc.noaa.gov/paleo-search/study/6091>

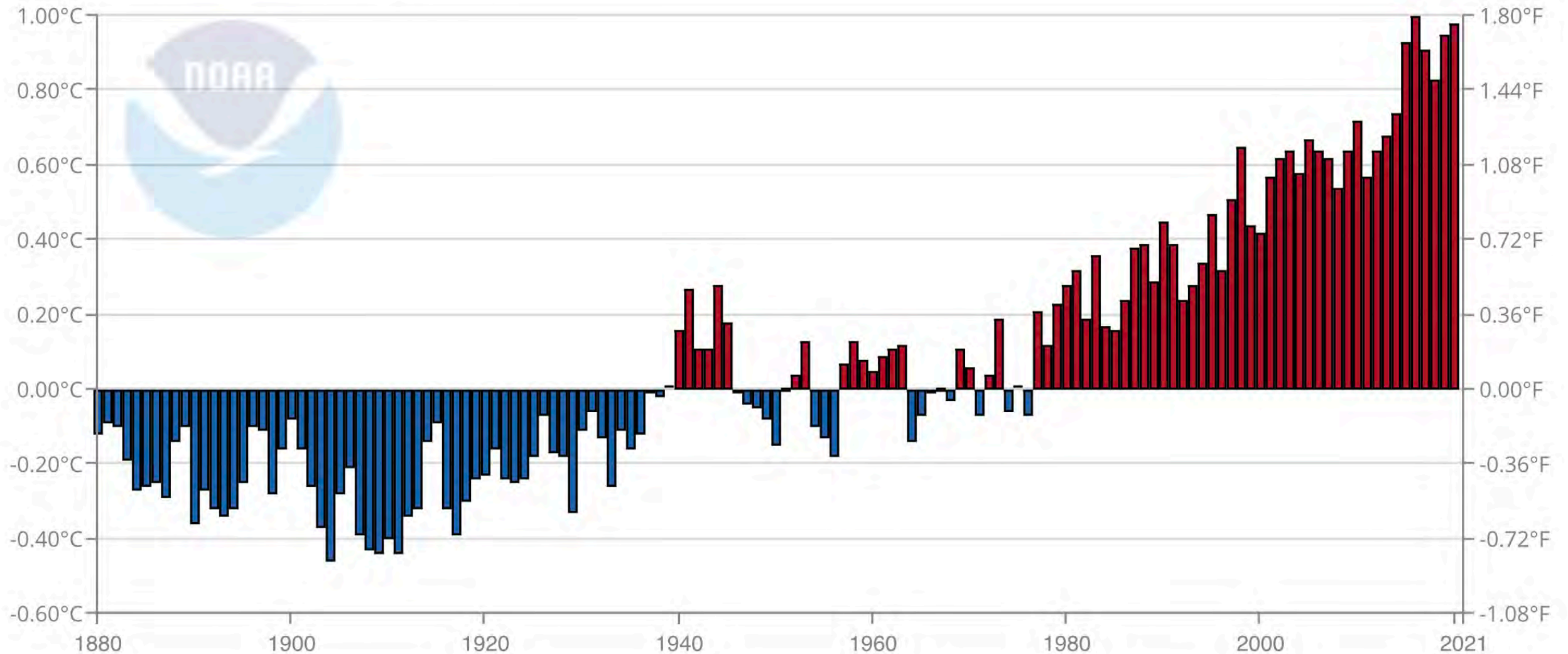
DOI: <https://doi.org/10.1038/nature06949>

Citation: Lüthi, D., M. Le Floch, B. Bereiter, T. Blunier, J.-M. Barnola, U. Siegenthaler, D. Raynaud, J. Jouzel, H. Fischer, K. Kawamura, and T.F. Stocker. 2008. Hi

Climate Science: Observations

Global Land and Ocean

January-December Temperature Anomalies



Powered by ZingChart

Temperature departure from 20th century mean

(NOAA National Centers for Environmental information, Climate at a Glance: Global Time Series, published February 2021, retrieved on February 16, 2021 from <https://www.ncdc.noaa.gov/cag/>)

Impacts of the Climate Crisis

The ongoing as well as anticipated impacts of the climate change crisis include:

- ❖ Sea level rise
- ❖ Ocean acidification and heating
- ❖ More intense droughts, flooding, and storms
- ❖ More frequent hot and fewer cold extremes, resulting in increased frequency and intensity of heatwaves
- ❖ More wildfires as well as extreme weather events

Humans live in this environment...

Adverse Impacts on Human Health

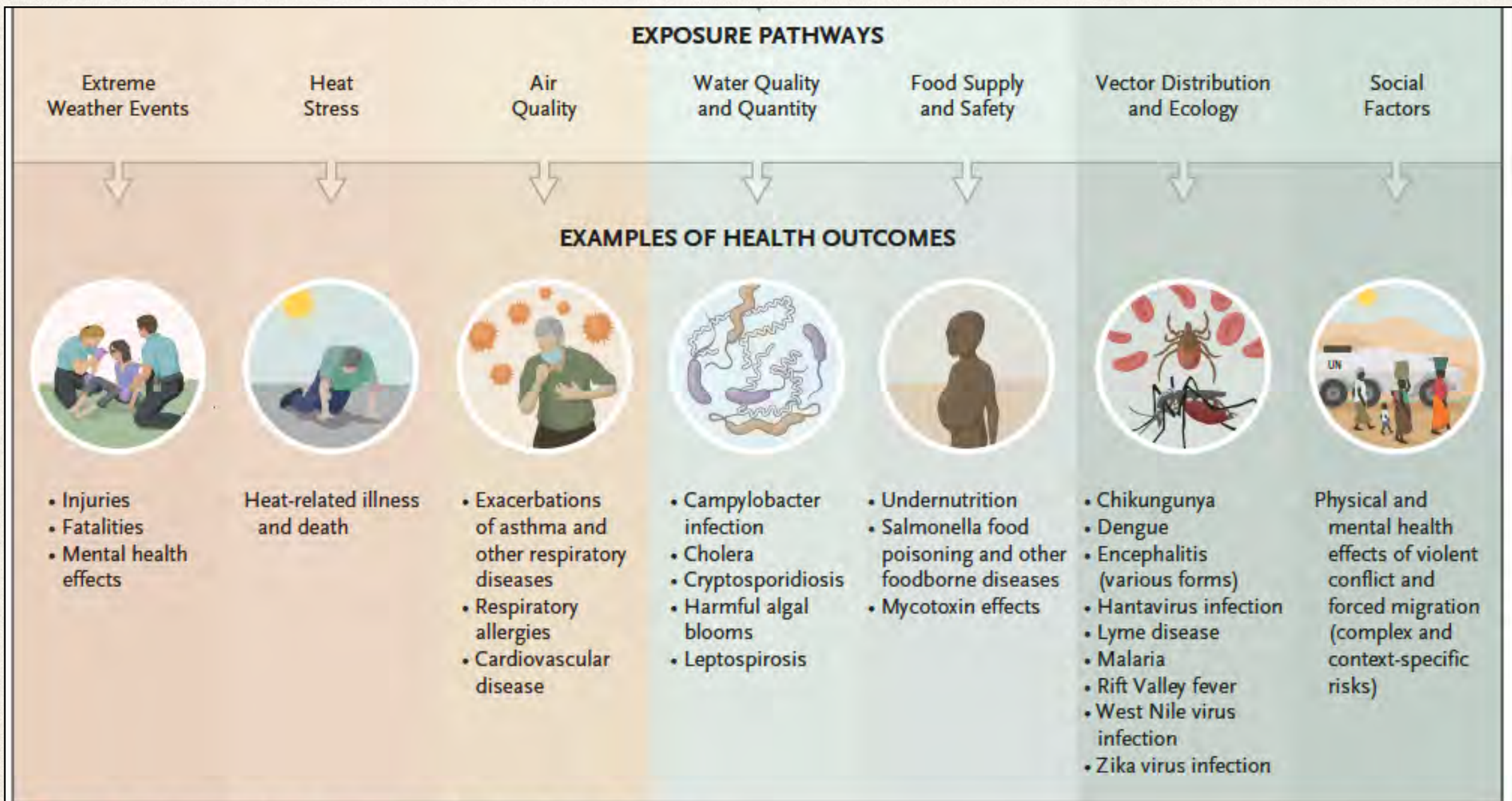


Figure 3. Major Health Risks Associated with Climate Change.

Examples of potential health outcomes and exposure pathways linking climate change with human health are shown, together with factors that can influence the magnitude and pattern of risks. The figure is based on several sources (e.g., Ebi et al.,³ Smith et al.,⁴ the World Health Organization,¹⁶ Hallegatte et al.,¹⁷ and Missirian and Schlenker¹⁸) and is not intended to be comprehensive.

Adverse Impacts on Human Health

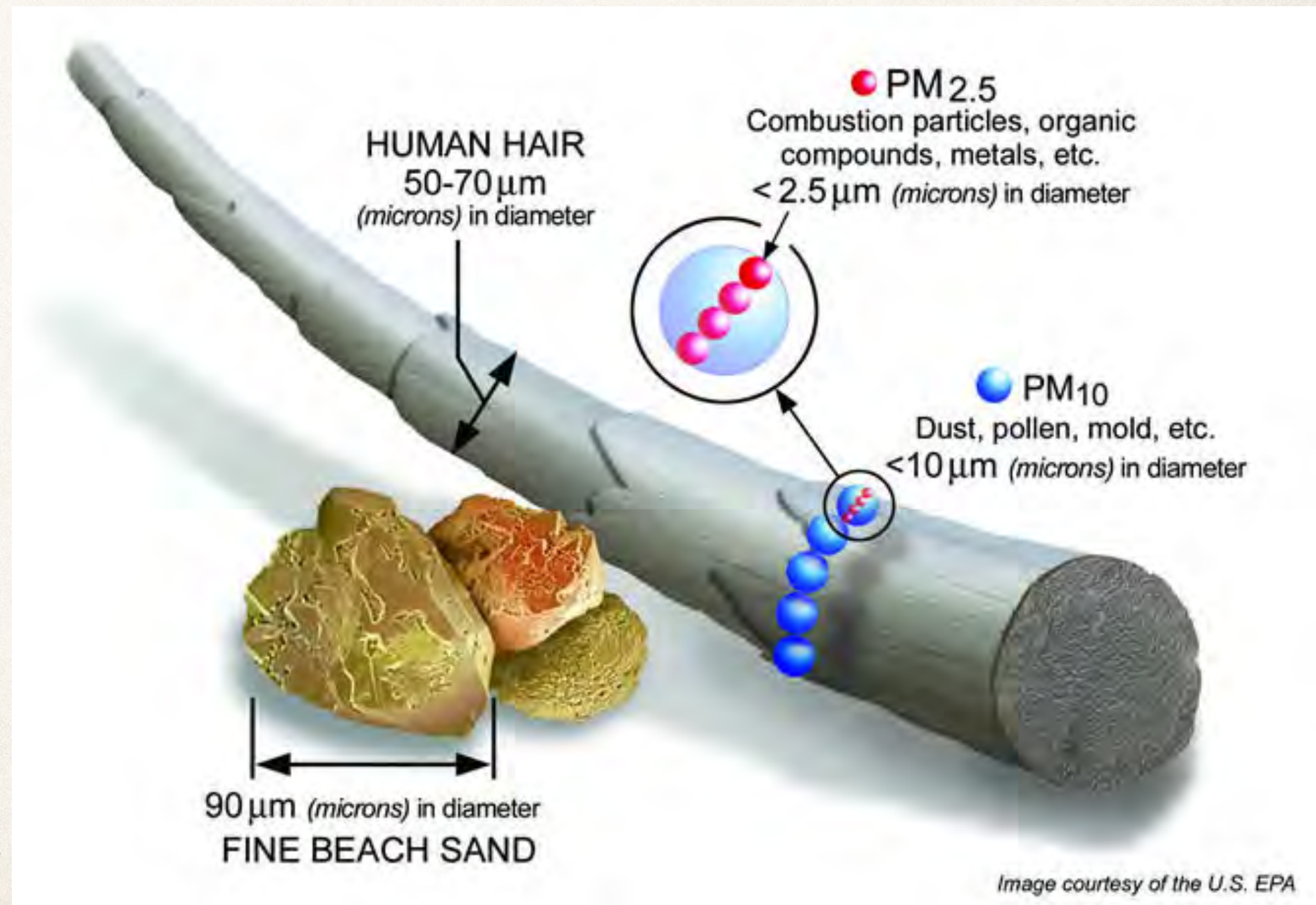
Heat:

- ❖ Lethal after several hours of exposure at sustained wet-bulb temperature $> 35^{\circ}\text{C}$ (95°F) - akin to 35°C at 100% humidity (Sherwood & Huber, 2010)
 - ❖ Equivalent to 46°C (115°F) at 50% humidity
 - ❖ No ability for evaporative cooling
 - ❖ Bodies switch from shedding heat to the environment to absorbing heat from it
- ❖ Portions of the Middle East and South Asia already achieve wet bulb temperatures near 35°C

Adverse Impacts on Human Health

Particulate Air Pollution:

Linked in multiple studies to asthma, coronary artery disease, pulmonary malignancy, premature deaths





<http://www.21stcentech.com/medical-journal-creates-resource-page-focused-climate-crisis-health/>

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Special Issue
The Future

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FEATURES

14 The Climate Crisis Is a Health Crisis

Medicine must reckon with the coming catastrophe.

Certain populations are more vulnerable than others...

Adverse Impacts on Human Health: Vulnerable Populations

Vulnerability to the Health Impacts of Climate Change at Different Life Stages



Mothers and babies

Adverse pregnancy outcomes such as low birth weight and preterm birth have been linked to extreme heat events, airborne particulate matter, and floods.



Infants and toddlers

Young children's biological sensitivity places them at greater risk from asthma, diarrheal illness, and heat-related illness.



School age and older children

The behaviors and activities of older children increase their risk of exposure to heat-related illness, vector-borne and waterborne disease, and respiratory effects from air pollution and allergens.

The Impacts of Climate Change on Human Health
in the United States: A Scientific Assessment
Fourth National Climate Change Assessment Report (2018)
US Global Change Research Program

Unique Impacts on Women's Health

- ❖ Given the differing roles women and men play in most societies, as well as women's unique reproductive burden, climate change impacts are expected to have a differential impact on women versus men.
- ❖ In many cases, adverse impacts are likely to be worse for women than men by widening health disparities that already exist in many parts of the world.

Unique Impacts on Women's Health

Heat-related morbidity and mortality

- ❖ Women sweat less, have higher working metabolic rates, and have thicker subcutaneous fat that prevents them from cooling themselves as efficiently as men
- ❖ European and American heat wave data: 15-20% higher death rate among all women, and ~40% higher among elderly women

Unique Impacts on Women's Health

Respiratory and cardiovascular disease: asthma, COPD, lung malignancies, coronary artery disease

- ❖ At baseline, increased risk due to exposure to particulate indoor air pollution from cook stoves (4.3 million premature deaths per year)
- ❖ Anticipated to worsen with unabated fossil fuel consumption

Anemia and malnutrition: exacerbation of disparities that already exist

Unique Impacts on Women's Health

- ❖ Physical and sexual violence: higher incidence documented in times of natural disasters
- ❖ Decreased life expectancy for women as already observed after natural disasters, especially in societies with significant socioeconomic disparities between men and women
- ❖ Anxiety, depression, and other mood disorders are anticipated to significantly increase
- ❖ With breakdown of social safety nets: lack of access to prenatal care, contraception, family planning options

Unique Impacts on Women's Health: Pregnancy

Pathophysiology that harms pregnancy:

- ❖ Reduced ability to thermoregulate in pregnancy (Schifano et al., 2016)
- ❖ Heat exposure alters placental blood flow patterns, reducing placental integrity and increasing abruption risk (He et al., 2018)
- ❖ Adverse outcomes triggered by hitting critical temperature thresholds that vary from region to region
- ❖ Increased susceptibility to pathogens such as malaria and Zika as mosquito ranges widen
- ❖ Increased exposure to particulate air pollution (outdoor from wildfires and indoor from cooking stoves)

Unique Impacts on Women's Health: Pregnancy

Table. Summary of Evidence Key Questions 1 Through 6

Exposure and outcome	Studies finding an association, No./total No.	Births/study, mean (SD)	Total births in millions	Increased risk, median (range), % ^a	Studies finding racial disparity, No./total No.	Notable findings ^b
Air pollution						
Preterm birth	19/24	318 960 (393 272)	7.3	11.5 (2.0-19.0) ^c	10/19	Preterm birth risk increased 52% for asthmatic mothers
Low birth weight	25/29	661 205 (878 074)	18.5	10.8 (2.0-36.0) ^c	13/25	Low birth weight risk increased 3% for each 5-km proximity to a solid waste plant
Stillbirth	4/5	1 020 975 (1 176 174)	5.1	14.5 (6.0-23.0) ^c	1/4	Stillbirth risk increased 42% with high third-trimester exposure
Heat						
Preterm birth	4/5	1 926 225 (207 995)	0.8	15.8 (9.0-22.0) ^d	2/4	Preterm birth risk increased 11.6% per 5.6 °C increase
Low birth weight	3/3	1 902 277 (985 803)	2.7	31.0 (13.0-49.0) ^d	1/3	Term birth weight decreased 16 g per IQR temperature increase
Stillbirth	2/2	1 115 943 (115 933)	0.2	NA ^e	2/2	Stillbirth risk increased 6% per 1 °C increase the week before delivery during the warm season

Abbreviations: IQR, interquartile range; NA, not applicable.

^a Risk presented as range from significant studies. The median is calculated from the range; a pooled analysis was not performed. For consistency, the whole pregnancy exposure was presented where possible.

^b Single study unless specified.

^c For whole pregnancy PM_{2.5} exposure.

^d For whole pregnancy heat exposure.

^e The only 2 studies on heat and stillbirth did not provide comparable outcomes that could be combined into a range with a median.

Unique Impacts on Women's Health: Pregnancy

Heat:

- ❖ Congenital defects:
 - ❖ Increase in CHD (conotruncal and septal defects) by as much as ~60% in some parts of the US by 2035 (Lin et al., 2018; Zhang et al., 2019)
 - ❖ 51% increase in congenital cataracts (Zutphen et al, 2012)
- ❖ Higher rates of fetal distress, need for ventilation > 30 mins, meconium aspiration (Cil and Cameron, 2017)
- ❖ Higher rates of newborn dehydration and need for re-hospitalization (Kim, Lee, and Slater, 2019)
- ❖ Higher rates of maternal hypertensive disorders - more pronounced in African Americans (Cil & Cameron, 2017)
- ❖ Psychosocial outcomes:
 - ❖ Diminished cognitive ability (Hu and Li, 2019)
 - ❖ Diminished adult earnings (Isen, Rossin-Slater, and Walker, 2017)

Heat and Risk for PTB: California

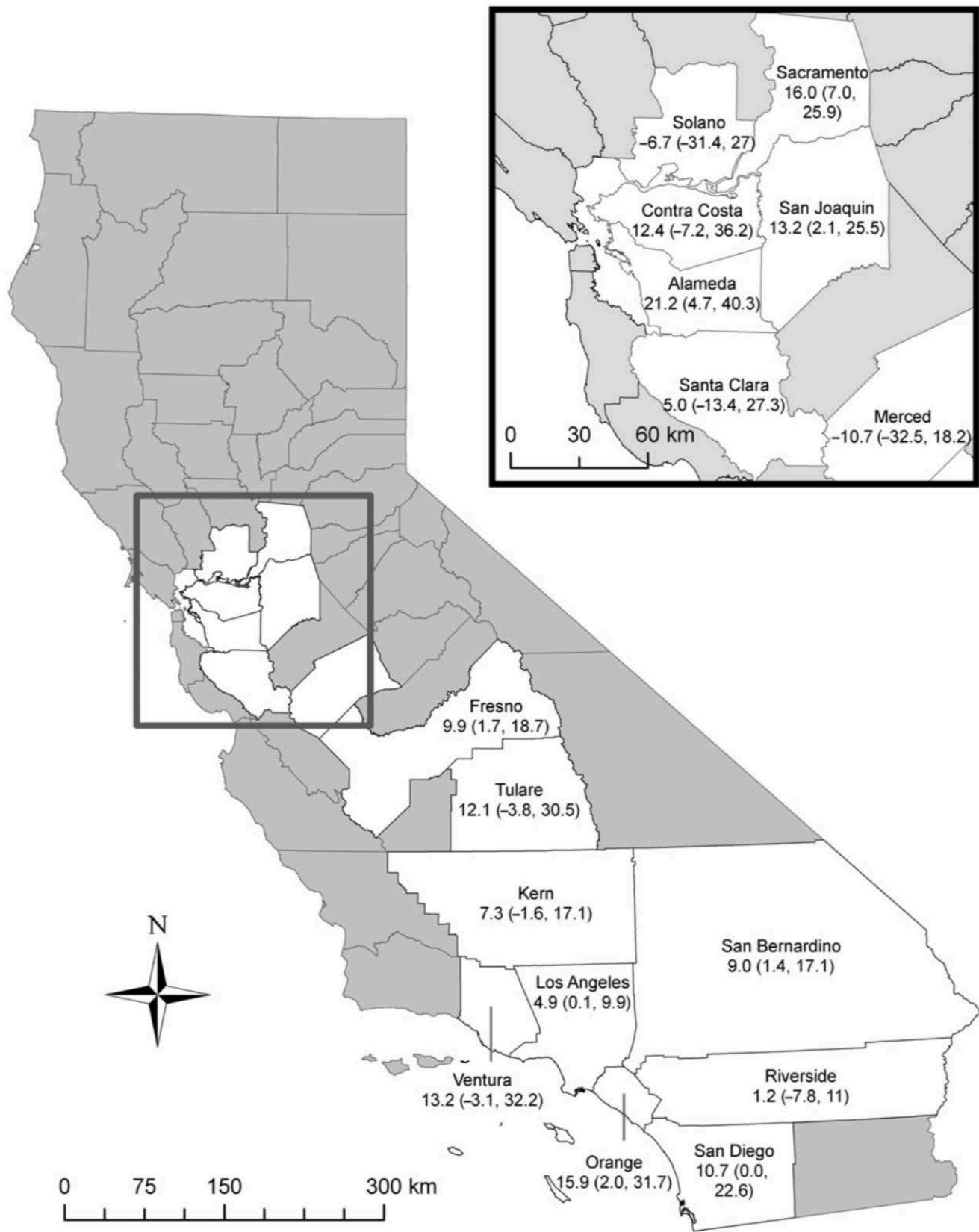


Figure 2. Map of California showing county-level estimates for the estimated percent change associated with a 10°F (5.6°C) increase in weekly average apparent temperature (lag06) and preterm birth, May–September, 1999–2006. For each county, 95% confidence intervals are given in parentheses.

Unique Impacts on Women's Health: Pregnancy

Natural disasters (multiple studies):

- ❖ Associated with higher rates of PTB, LBW, elevated BMI and central adiposity in offspring
- ❖ Higher rates of mental health effects, including autism spectrum disorders, schizophrenia, mood disorders in offspring

Unique Impacts on Women's Health: Pregnancy

Hurricane Sandy (Xiao et al, 2019; Zhang et al, 2018):

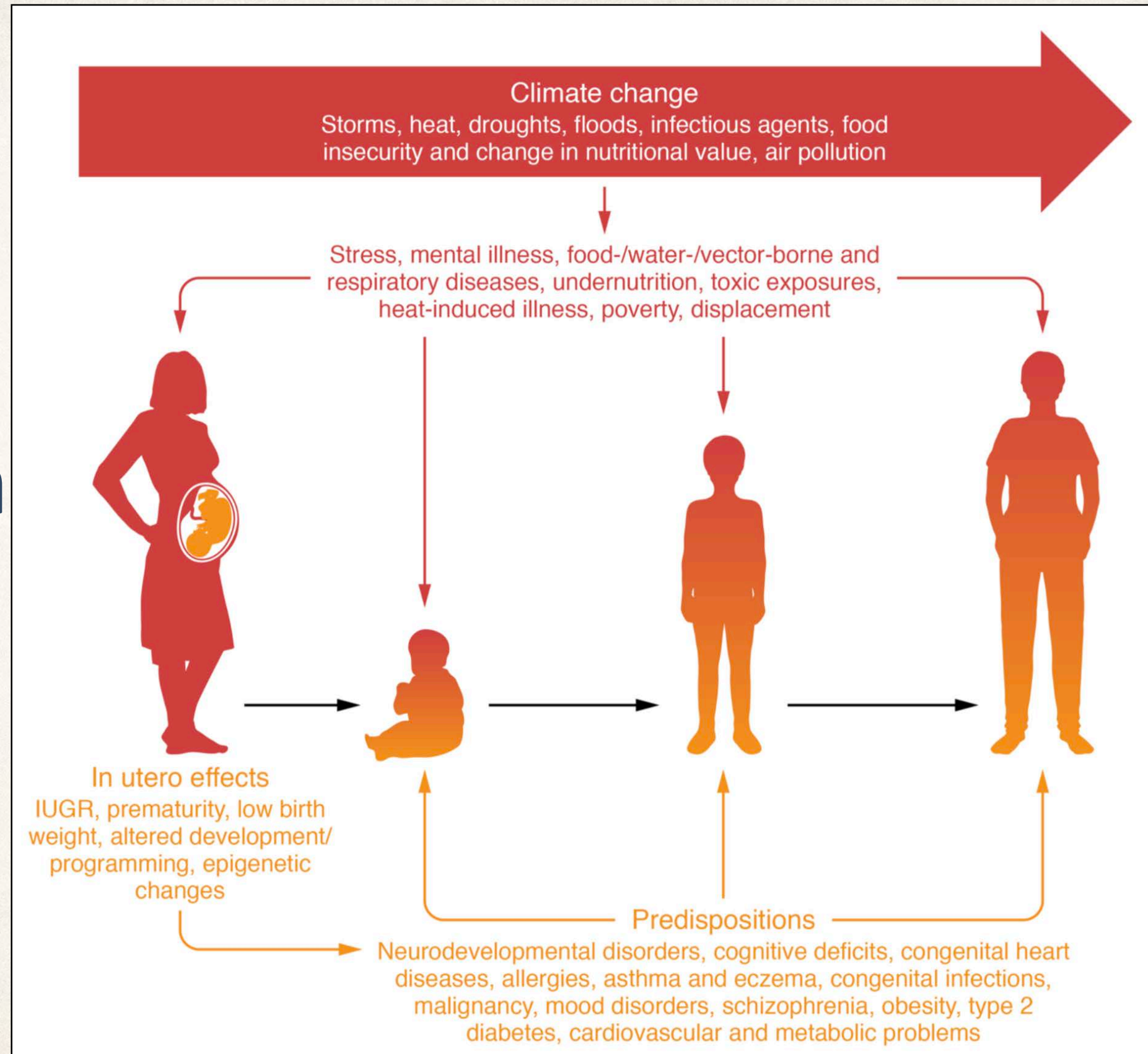
- ❖ In 6 mo old offspring exposed in utero: higher rate of fearfulness, decreased duration of orientation and affiliation/cuddliness, higher pleasure seeking, higher reactivity to environmental cues
- ❖ 21% higher rate of gestational HTN, peaking 7 months after exposure
- ❖ 33% higher rate of maternal mental illness, peaking 8 months after exposure

Hurricane Katrina:

- ❖ Nearly 17-fold higher rate of maternal PTSD with exposure
- ❖ Greater than 3-fold higher rate of maternal depression with exposure

What will happen when worsening heat, air pollution, and climate disasters all conspire to occur at the same time?

A Continuum of Harm



Women don't have to be victims - they can actually be a part of, and can themselves help with, flattening the emissions curve...

The Unique Role of Women

- ❖ Mitigation and adaptation initiatives will help alleviate the negative impacts of climate change on human health, but to have maximized benefit, they will need to account for anticipated health disparities between men and women.
- ❖ Our patients' health intersects with environmental science, energy use, agriculture, land use, and public policy.

The Unique Role of Women

Women's traditional responsibility as family caregivers in many parts of the world places them in unique decision-making roles that can impact climate repeatedly throughout the day and long-term:

- ❖ Use of appliances (e.g., for lighting, cooking, heating or cooling, heating water, laundry, etc., including time and frequency of use)
- ❖ Purchases of household goods
- ❖ Establishment of family dietary habits and patterns (e.g., frequency and amount of consumption of meat, dairy, and vegetables)
- ❖ Education and shaping of their children's energy consumption habits
- ❖ Number of offspring

The Unique Role of Women: Reproduction

Women mediate the interplay between population growth and climate change through their reproductive behavior

- ❖ ~225 million women in lower income nations desire greater control over their pregnancies, but lack access to contraception
- ❖ 74 million unintended pregnancies annually worldwide
- ❖ 45-50% of US pregnancies are unintended
- ❖ Number of offspring is linked with education level

The Unique Role of Women: Reproduction

Meeting unmet contraceptive demand:

- ❖ Ranked as the 7th most impactful change we could do; could reduce CO₂ emissions by 60 gigatons by 2050 (Hawken, 2017)
- ❖ CO₂ emissions could be reduced by 30% by 2100 while eliminating > 100,000 maternal deaths per year (IPCC 2014, O'Neill et al., 2012)
- ❖ Would lead to greater reduction in per capita emissions in developed nations than developing nations immediately
- ❖ Would prevent birth of millions in developing nations who will contribute to future emissions
- ❖ Slowing rapid population growth is a prerequisite to allow countries vulnerable to climate change to develop appropriate adaptive policies - *a means to build climate-resilient societies*
- ❖ Would lead to improvements in women's empowerment, equality, and well-being
- ❖ *Would cost less than \$10 billion per year for the developing world!*

The Unique Role of Women: Reproduction Linked to Education

Achieving universal education (12 years of schooling):

- ❖ Ranked as the 6th most impactful change we could do; could reduce CO₂ emissions by 60 gigatons by 2050 (Hawken, 2017)
- ❖ “Difference between a woman with no years of schooling and with 12 years of schooling is almost four to five children per woman” (Winthrop & Karas, Brookings Institution, 2016)
- ❖ Educating girls is considered by many to be the single most important socioeconomic factor to reduce vulnerability to natural disasters
- ❖ *Would cost \$39 billion per year worldwide (low- and lower-middle-income nations)!*

The Unique Role of Women

By educating women about the impact of their daily decisions...

By empowering women over their reproductive fates...

By advocating for equal pay and career opportunities which provide means for self-reliance and resiliency...

By elevating their leadership roles within families and communities...

...women do not have to be victims - rather, they can become powerful agents in the mitigation of, and adaptation to, climate change!

“Women are disproportionately affected by climate change impacts such as droughts, floods and other extreme weather events. They also have a critical role in combating climate change, but need to be better represented at all levels in decision-making. Empowering women will be a significant factor in meeting the climate challenge.”

UNFCCC Executive Secretary, Christiana Figueres, 2014

The Unique Role of Healthcare Providers

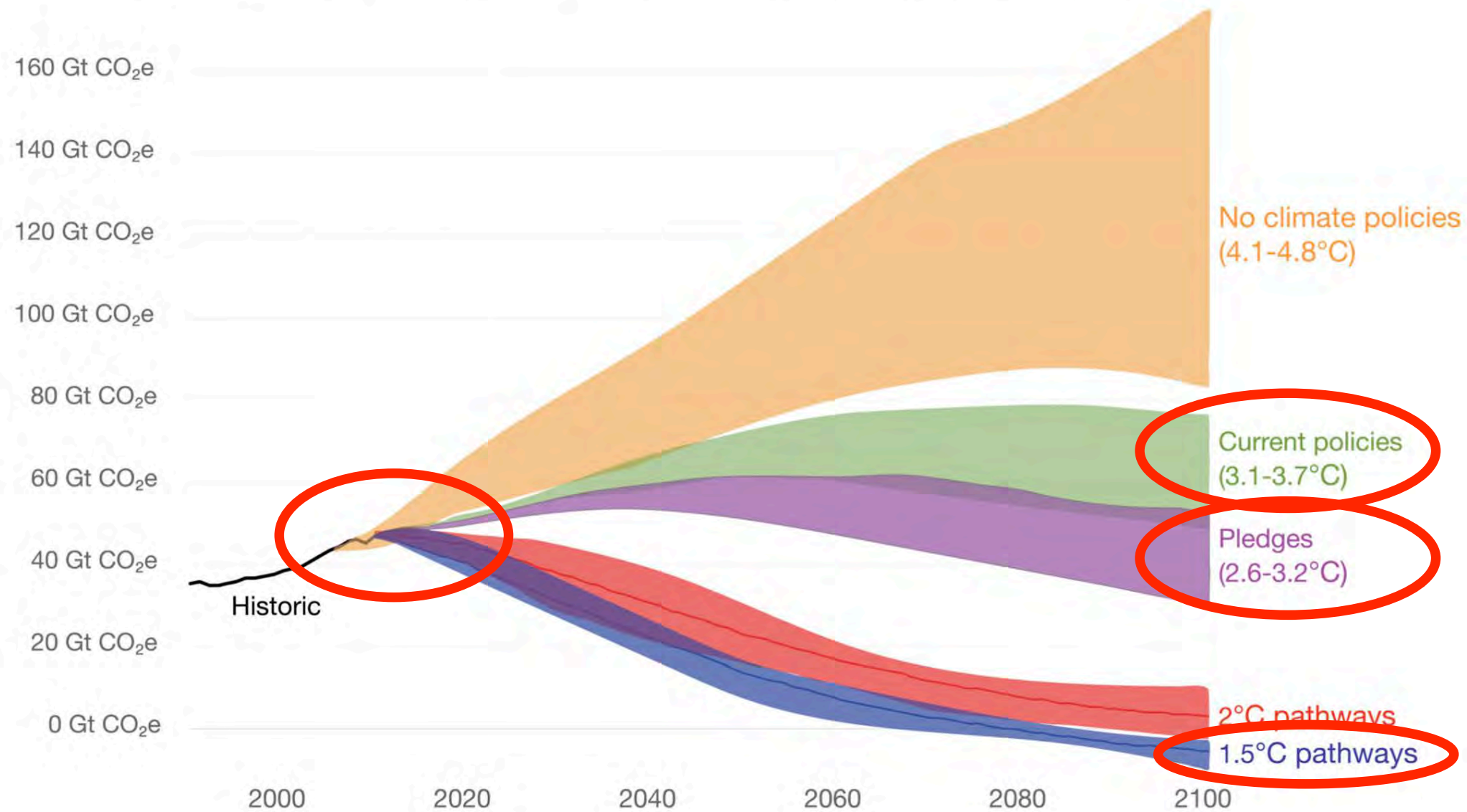
- ❖ Fight the tendency to ask “what business is it of mine?” ...
- ❖ We each strive daily to effectively care for our patients, with the assumption our patients will live in environments that will not harm them...
- ❖ The imminent climate crisis will overwhelm and negate all of the historic public health and basic science advances we have achieved thus far...
- ❖ *Are we not the “conservation biologists” for our own species? We all took an oath to protect our patients: we have an ethical duty to act!*

Our Time is Limited

Global greenhouse gas emissions scenarios

Our World
in Data

Potential future emissions pathways of global greenhouse gas emissions (measured in gigatonnes of carbon dioxide equivalents) in the case of no climate policies, current implemented policies, national pledges within the Paris Agreement, and 2°C and 1.5°C consistent pathways. High, median and low pathways represent ranges for a given scenario. Temperature figures represent the estimated average global temperature increase from pre-industrial, by 2100.



Based on data from the Climate Action Tracker (CAT).

The data visualization is available at OurWorldinData.org. There you find research and more visualizations on this topic.

Licensed under CC-BY-SA by the authors Hannah Ritchie and Max Roser.

- ❖ We will have to limit temperature increase to 1.5°C by 2100 to avoid the worst outcomes: but we can only emit 340 Gt of CO₂ before we exceed our 1.5°C budget (*only 8 - 10 years of current emissions!*)

Women's and Human Health Improvements Make a Huge Impact

- ❖ We can flatten the curve for emissions and buy more time; the gigatons we can reduce by 2050 add up:
 - ❖ Contraception: 60 Gt
 - ❖ Diet changes: 66 Gt
 - ❖ Exercise/mobility: 10 Gt
 - ❖ Clean cookstoves: 16 Gt
 - ❖ Education: 60 Gt
 - ❖ **212 Gt total: *more than half the amount of our remaining CO₂ budget***
- ❖ *Climate change mitigation is very much in the purview of healthcare providers and public health/policy measures - not just fancy technology!*

Summary Points

- ❖ Human-induced climate change is anticipated to have numerous adverse implications to human health.
- ❖ Women, especially throughout their reproductive years, are disproportionately vulnerable to potential adverse effects on their health that can lead to reverberating lifelong impacts on their offspring.
- ❖ Nevertheless, women are also uniquely qualified to play a central role in the mitigation of, and adaptation to, climate change.
- ❖ Women's healthcare providers should be aware of the potential negative impacts of climate change on our patients, and how we can assist our patients in becoming effective agents of mitigation and adaptation.
- ❖ Healthcare providers can push society, including our respective political and medical institutions, to reduce emissions - but our actions must be soon, and efficacious

Thank you...

