

# MEDICAL CONSEQUENCES OF CLIMATE CHANGE:

*IT'S REAL. IT'S NOW. IT'S US.*

*Douglas DeLong MD MACP FRCP  
New Hampshire ACP  
In the Cloud  
29 October, 2021*

# DISCLOSURES/COI

- Human being on planet earth
- Have three children and five grandchildren
- Submitted the original climate change resolution and helped draft ACP policy

# OBJECTIVES

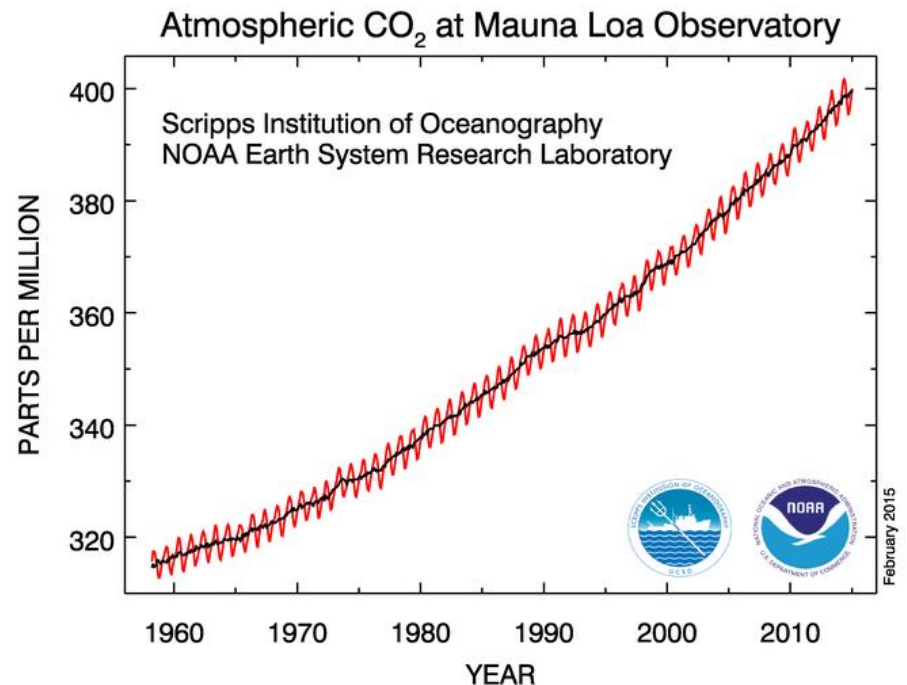
- Present very brief **overview** of the evidence for climate change
- Review **consequences** of climate change from a medical perspective
- Suggest potential **actions** to mitigate and/or adapt to these medical consequences

# The Basics

- *Damage to the climate is real and it's happening now.*
- Human activity emits greenhouse gases (like CO<sub>2</sub>) into atmosphere, gases trap heat in atmosphere, altering the Earth's climate.
- It does pose a **catastrophic threat** to the planet and human health...
- **...BUT with a concerted action we create healthy and safe communities for our families and children!**
- Addressing climate change could have major **co-benefits** – improved air quality, better physical and mental health.

# Dear Earth: It's not you, it's us.

- **Humans** are largely responsible for recent change in climate.
- GHG emissions have skyrocketed since the beginning of the Industrial Revolution, causing atmospheric concentrations of **carbon dioxide, methane, and nitrous oxide** to increase substantially.
- **Carbon dioxide** is the single largest GHG emitted by human activity.



# IT'S STILL US IN 2020

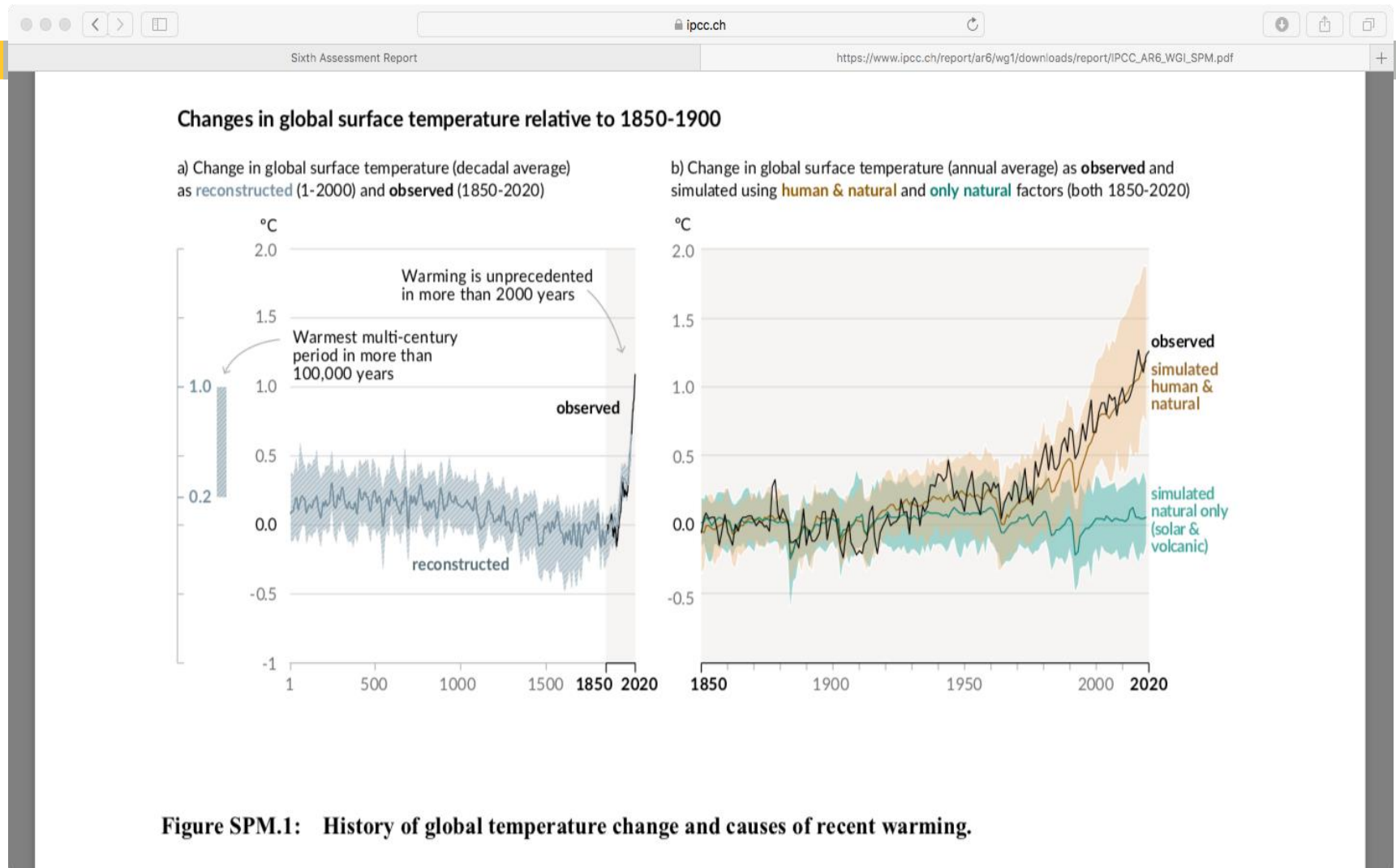
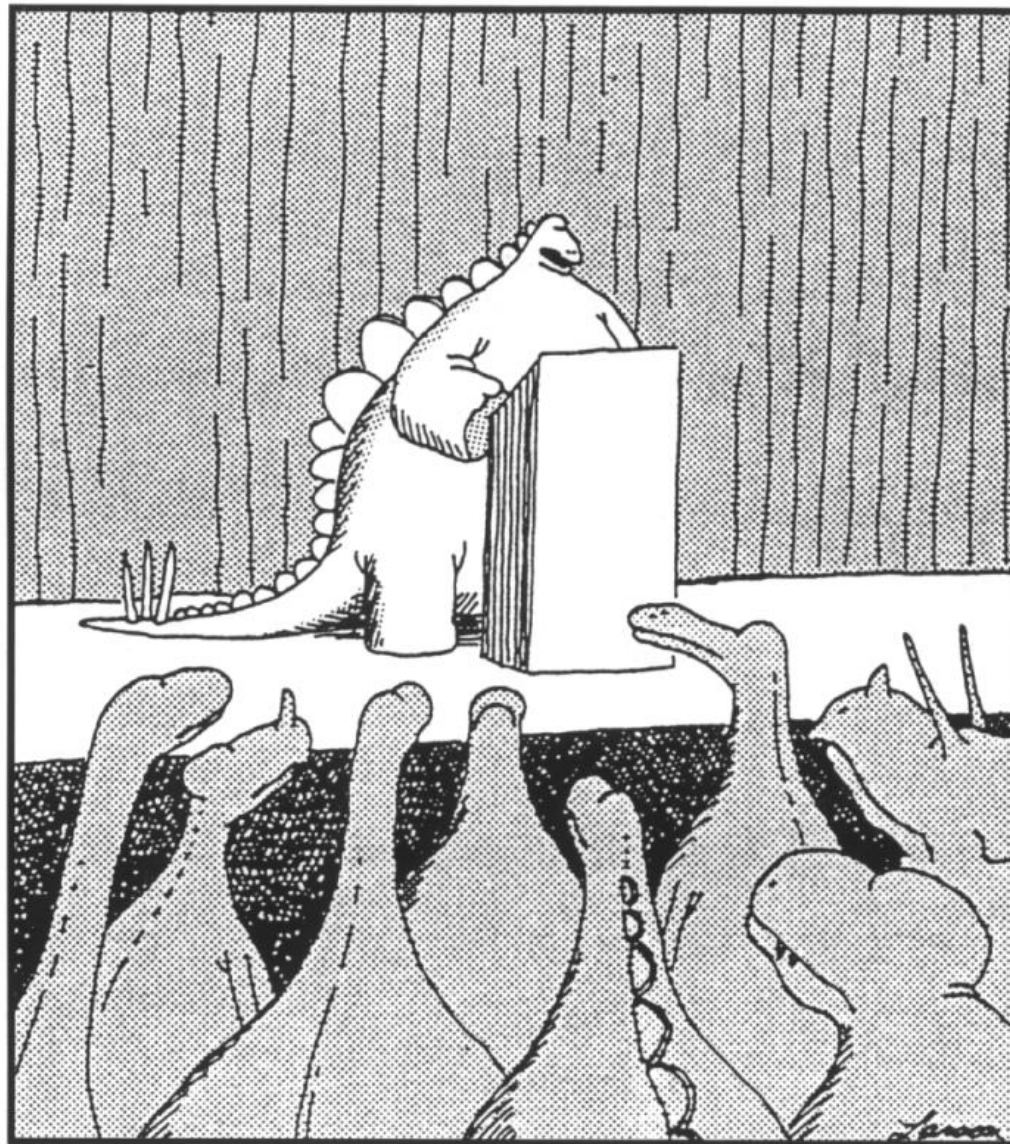


Figure SPM.1: History of global temperature change and causes of recent warming.



"The picture's pretty bleak, gentlemen. ...  
The world's climates are changing, the mammals  
are taking over, and we all have a brain  
about the size of a walnut."

# Damage to the Climate – It's Already Happening [IPCC 2013]

- “Warming of our climate system is **unequivocal**, and since the 1950s, many of the observed changes are **unprecedented** over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.” (**IPCC, 2013**)



# Damage to the Climate – It's Already Happening [IPCC 2021]

- “changes...unprecedented.”
- “some...irreversible over 100s to 1000s of years”
- “emissions of GHG from human activities responsible for 1.1C warming”
- “unless immediate, rapid and large scale reductions...limiting...to 1.5C will be beyond reach”
- “strong and sustained reductions in emissions..would limit CC” (IPCC, 2021)

## Global Warming Impact

### Intergovernmental Panel on Climate Change

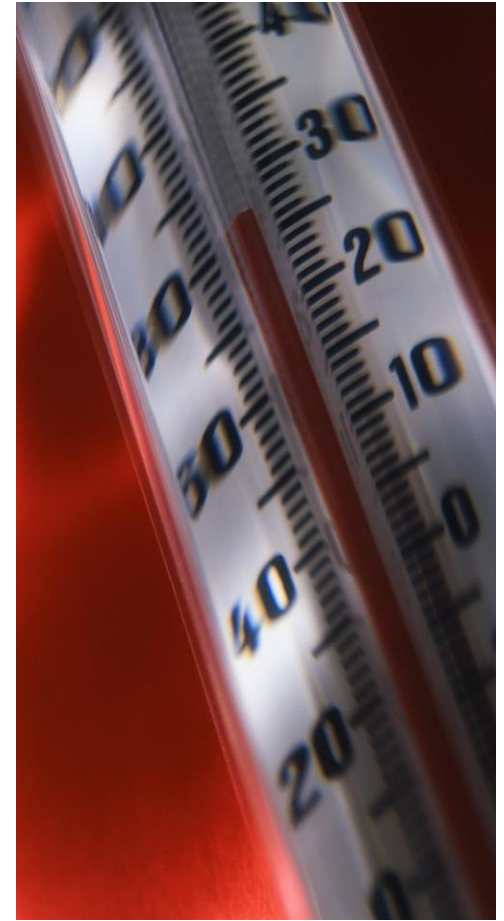
- Two degrees: Extinction of tropical reefs, sea level rise of several meters.
- Three degrees: Forests in the Arctic and loss most coastal cities.
- Four degrees: Europe in permanent drought, vast areas of China and India claimed by desert. The Colorado river a trickle. The Southwest uninhabitable
- Five degrees: End of human civilization

# Indicators of Climate Change



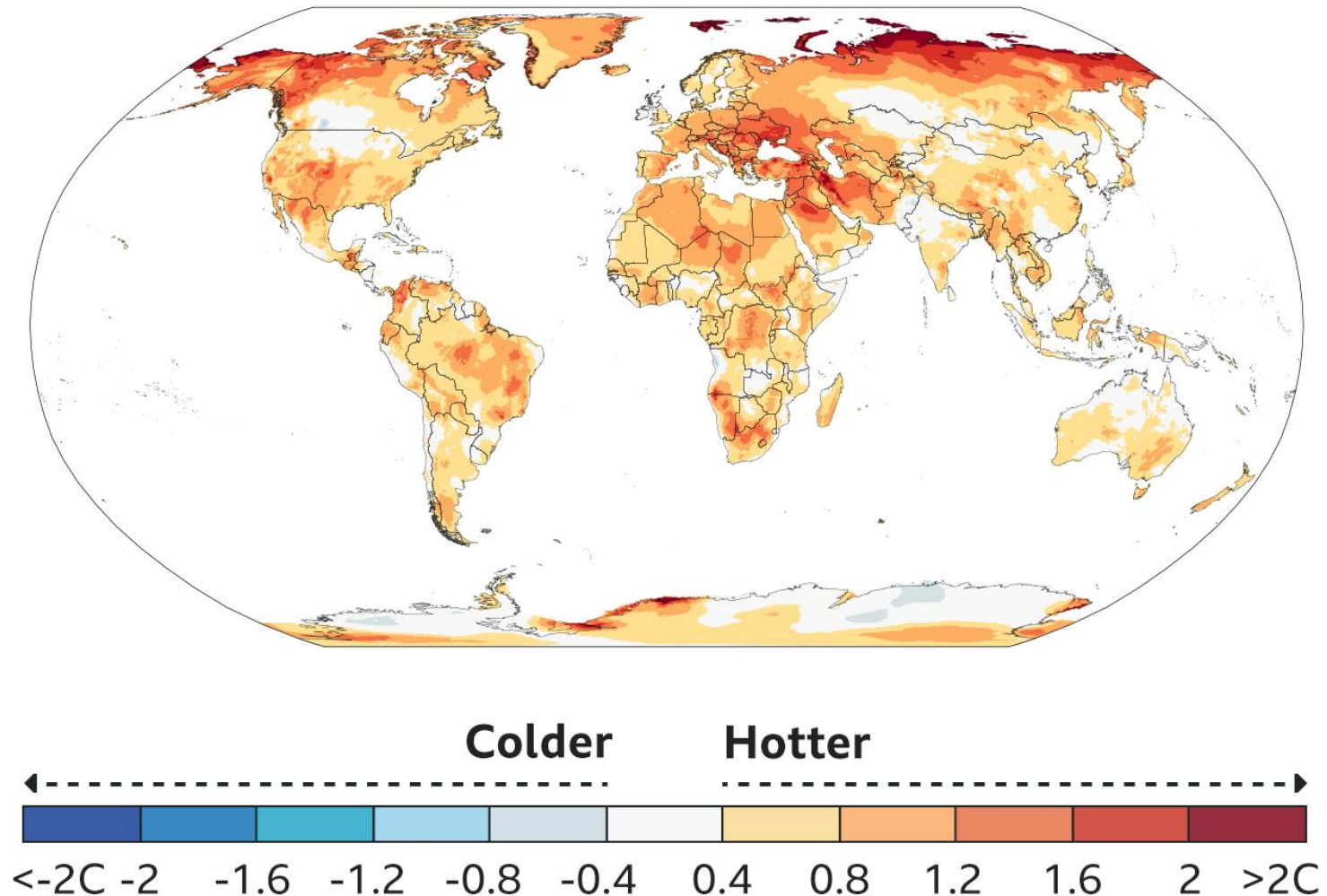
# Rising Global Surface Temperature

- The average surface air temperature of the Earth has increased by **1.2 degrees Celsius** since 1880.
- In the Northern Hemisphere, the period from 1983 to 2012 was likely the **warmest** 30-year period of the last 1400 years.
- July 2021 was hottest ever recorded.
- The past 7 years have been the hottest 7 years ever recorded.
- 2020 tied 2016 as hottest year yet.
- Days per year > **50C** [122F] more than 2x since 1980s [26 days]



# World's hottest temperatures are rising

Change in average maximum temperature, 1980-2009 compared with 2010-2019



Source: ERA5, BBC analysis



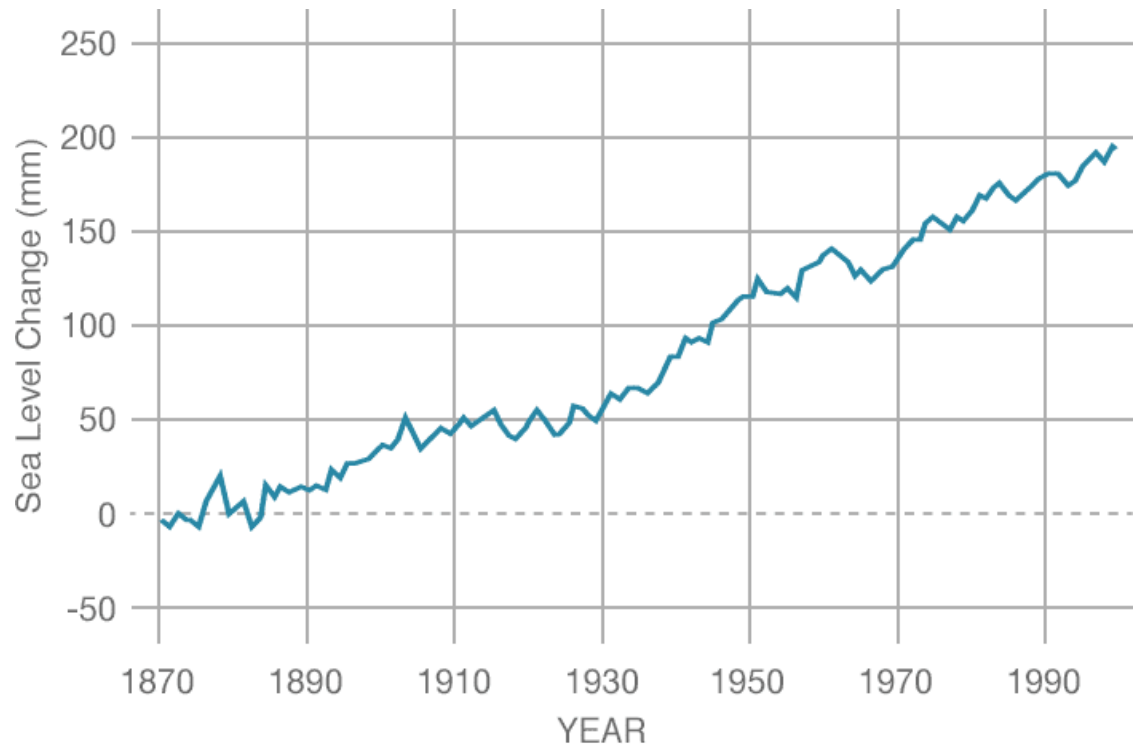
# Sea and Land Ice is Dwindling...

- NASA: “In 2012, **Arctic** summer sea ice shrank to the lowest extent on record.”
- **Antarctica and Greenland** land ice sheets are losing mass. Greenland ice loss doubled between 1996 and 2005 ([NASA](#))



# ...and Sea Level is Rising

- Global sea level has risen 8 inches since the beginning of the 20<sup>th</sup> century.
- Sea level increase is the result of warmer oceans (ocean absorbs heat, water expands), and melting land ice.



# LT GEORGE WASHINGTON DELONG AND THE JEANETTE EXPEDITION



Photo # NH 52000 Steamer Jeanette sinking after being crushed by Arctic ice, June 1881



THE SINKING OF THE JEANETTE



# AND FOR NEW HAMPSHIRE?

Today, New Hampshire has 5,000 people **at risk of coastal flooding**. By 2050, an additional 2,000 people are projected to be at risk due to sea level rise.

# CLIMATE EVENTS IN THE UNITED STATES

- ☐ 2019 was the second wettest year on record in the Midwest.
- ☐ Three floods in Missouri, Mississippi and Arkansas rivers totaled 20 billion dollars in damage
- ☐ Wild fires have increased 19% since 2004 in frequency and intensity.
- ☐ Extreme weather events have increased by 46% since 1990.
- Pacific Northwest “Heat Dome” June 2020

# U.S. Regional Effects of Climate Change

## *Northeast U.S.*

- Projected continued heat waves,
- heavy precipitation, and
- sea level increases,
- may compromise the region's ecosystem, infrastructure, agriculture and fisheries.



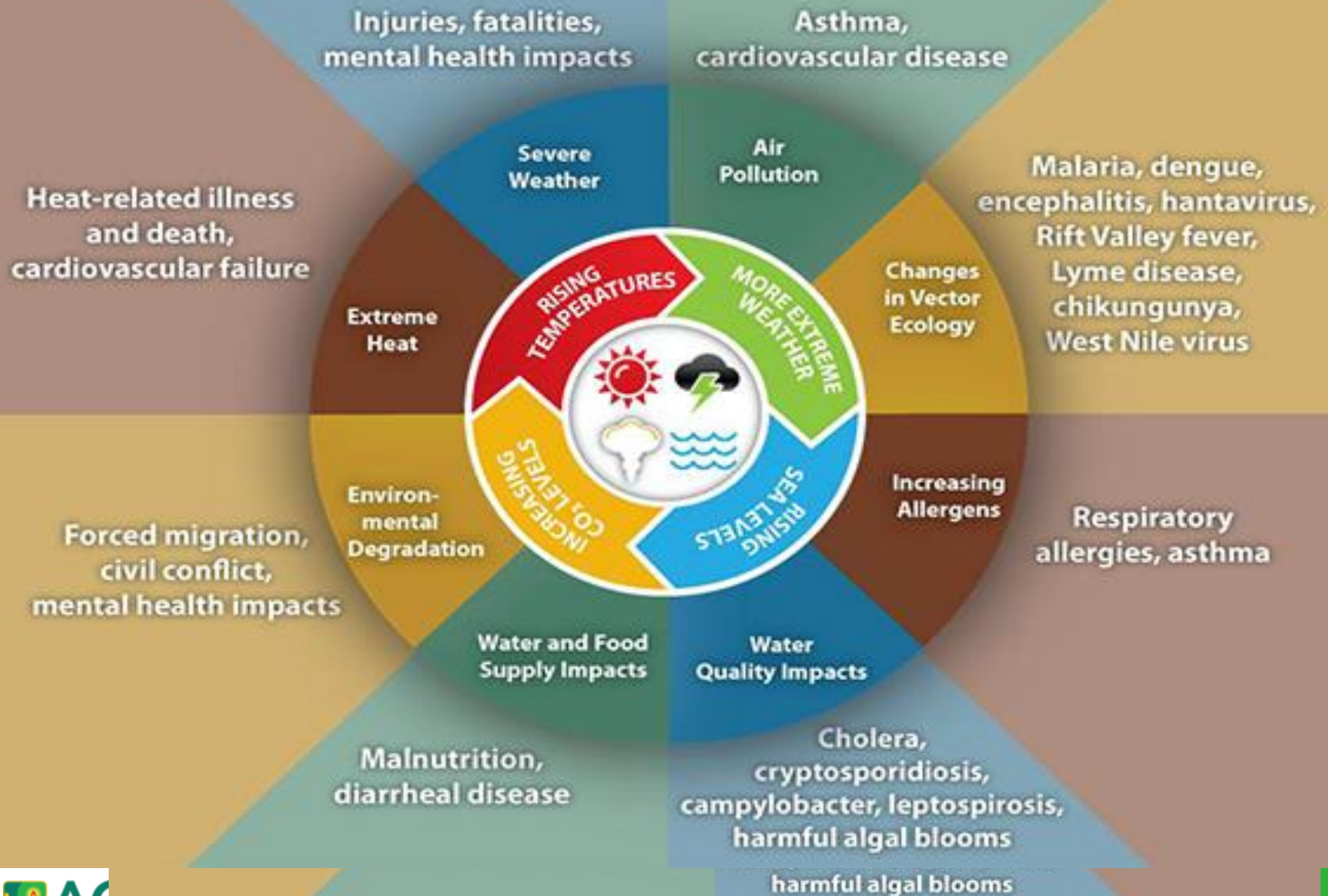
# So, What Does This Have to Do With Health?

■ **EVERYTHING!**

# WHO predicts 250,000 deaths per year from 2030-2050

- Malaria
- Dengue
- Diarrheal disease
- Heat stress
- Under nutrition
- Heaviest Burden:
  - Children, women, older people, the poor, individuals of color, disabilities, diabetes, obesity, respiratory diseases

# Impact of Climate Change on Human Health

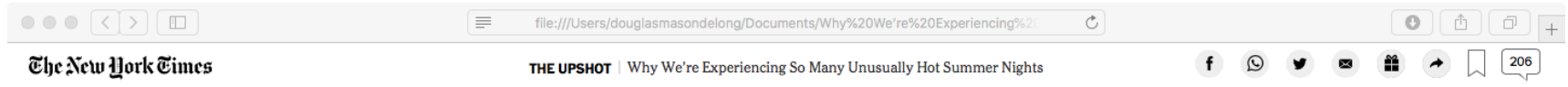




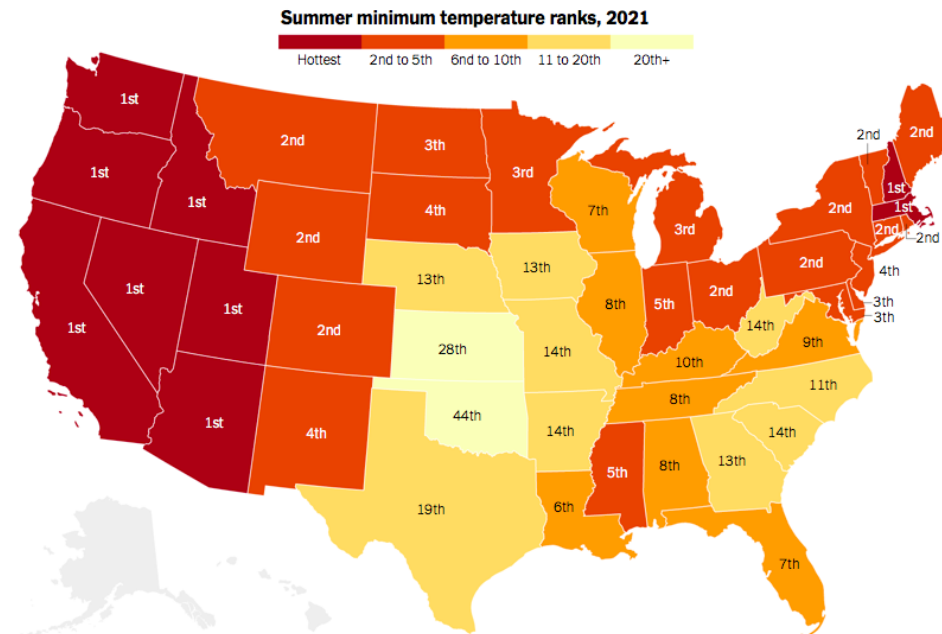
# HEAT



# YOU'RE NUMBER ONE!



In 2021, many states experienced their hottest summer nights since 1895



Source: NOAA's [National Centers for Environmental Information](#) • Map shows the ranking of 2021's summer (June-August) minimum temperatures for each U.S. state, compared with the period from 1895 to 2021. States shown in dark red experienced their hottest summer nights on record in 2021.

Nights are hotter in cities



# CONCORD, NEW HAMPSHIRE



# Heat-related disorders, including heat stress



- As the climate warms, more people will be at risk of heat-related illness, incl. rashes, cramps, heat exhaustion and heat stroke.
- **extreme heat events** that currently happen every 20 years in the U.S. will occur about **every other year** by the end of the 21<sup>st</sup> century under a higher emissions scenario.
- Across **Europe** about **70,000** premature deaths were attributed to the **2003 heat wave**.
- **2021 British Columbia \*\*\***
- The **elderly, children, and urban** area dwellers are at elevated risk of heat-related illness.

# Heat Waves

## HISTORY

- 7400 annual deaths:1999-2010 in USA
- 15000 deaths in France 2003
- 70000 excess deaths, Europe 2009
- 15000 deaths Russia 2010

## FUTURE

- By 2081 Chicago 2000 deaths per year
- In 200 US cities 11000 deaths per year by 2030
- 30,000 deaths per year in US by 2100

# HEAT RELATED DISORDERS 101

Heat Stroke: core temp  $>40^{\circ}\text{C}$  [ $104^{\circ}\text{F}$ ] with CNS dysfunction -  
>multiple organ system failure

Heat Exhaustion: core temp nl, low or high. Fatigue, tachycardia,  
diaphoresis, N/V [w/o CNS sx]

Heat Syncope: elevated core temp not needed. Rapid return to  
normal.

Heat Tetany: carpopedal spasm, paresthesia, hyperventilation

## Most at risk

- children and elderly
- low socioeconomic status
- history of heat stroke
- agricultural workers

# PHYSIOLOGY OF HEAT STRAIN

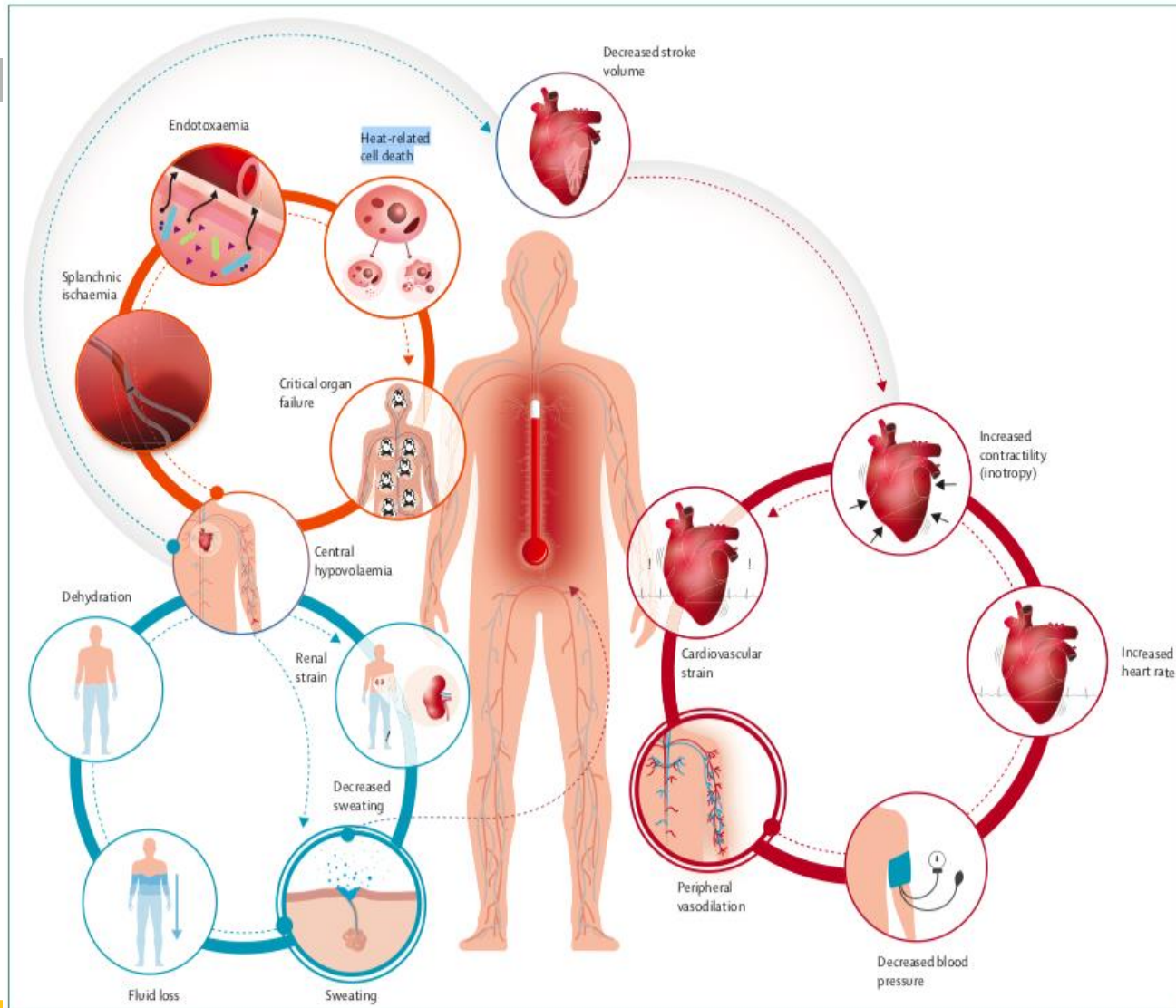


Figure: Illustration of the physiological pathways of human heat strain

# HEAT STROKE

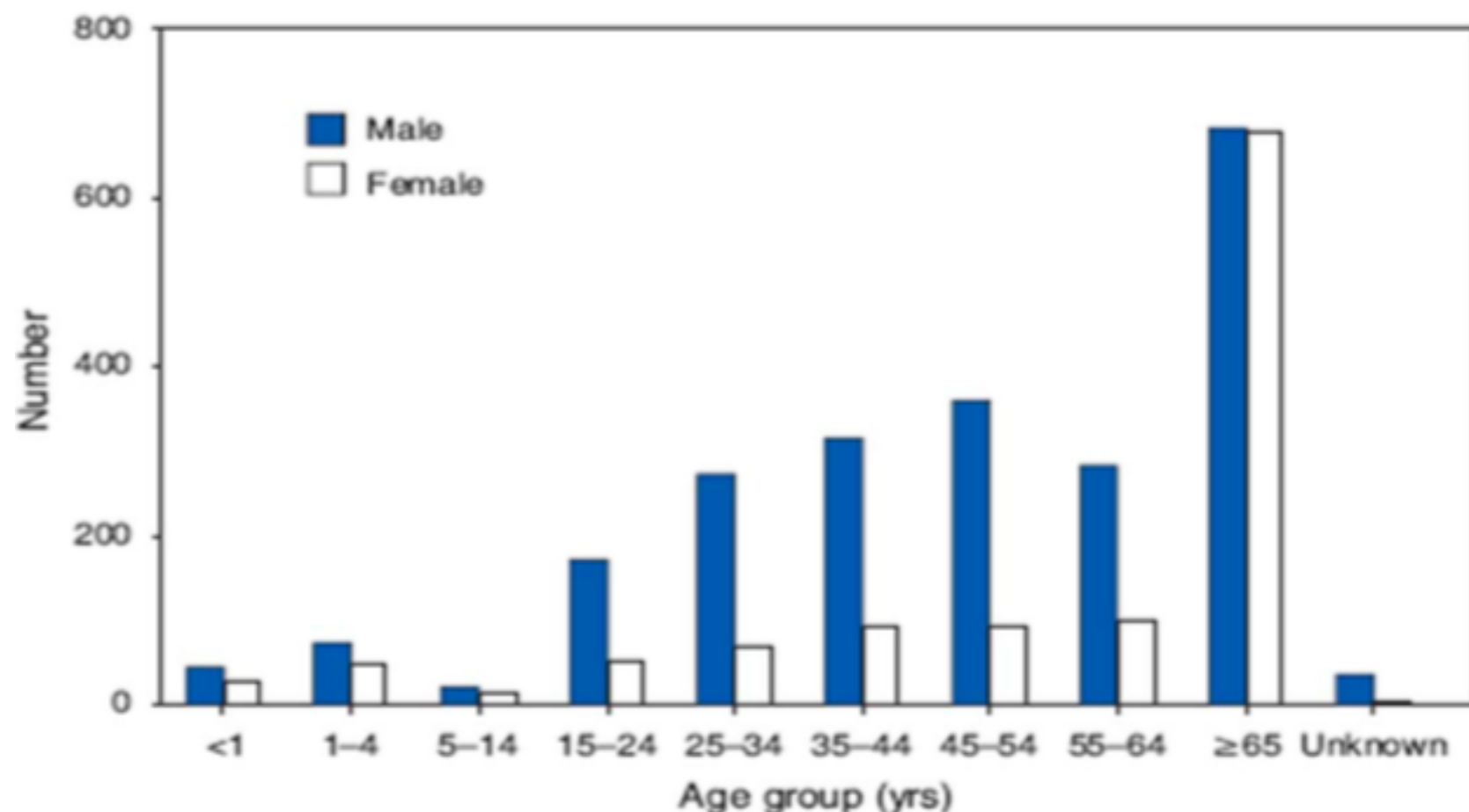
- Pathophysiology: Core temp  $> 40^{\circ}\text{C}$  leading to
  - Damage to cell volume/metabolism, a/b balance, membrane permeability [rhabdomyolysis]
  - Injury to vascular endothelium  $\rightarrow$  interstitial leakage  $\rightarrow$  SIRS
  - Decreased organ blood flow
- Treatment:
  - Rapid cooling [cold water immersion? Stop at  $38^{\circ}\text{C}$ ]
  - Fluid resuscitation [tonicity?]

## Groups at Increased Risk from Heat Waves

- **Elderly**
  - sweat less, less thirst drive/non-ambulatory/  
Cardiopulmonary and renal conditions
  - Multiple medications
  - Thermoregulation
- **Children (0-4) and older kids** – thermoregulatory issues and activities
- **Sports Enthusiasts** – may overdo
- **Laborers** – may be placed at greater risk
- **Homeless** – may not recognize the danger or have resources to cope
- **Poverty** and lack of air conditioning
- Urban settings with pavement and lack of trees
- **Chronic conditions** such as COPD and CHF



**FIGURE. Number of heat-related deaths,\* by sex and age group — United States, 1999–2003**



\* Exposure to extreme heat is reported as the underlying cause of or a contributing factor to death (N = 3,442).



# Medications and Heat Vulnerability

- Diuretics, ACE inhibitors: dehydration
- Laxatives: electrolyte imbalances
- Antipsychotic, anti-Parkinson and antiemetic: reduce sweat production and thermoregulation
- Antihistamines: vasoconstriction

# Prevention of Heat Morbidity/Mortality

- Communication by clinical teams: reach vulnerable populations
- Public Health warning systems of impending heat waves
- Temporary housing for vulnerable population
- Timely education about the risk of heat illness
- Community outreach teams organized by local public health authorities

# WEATHER IS NOT SAME AS CLIMATE

## TEXAS WINTER 2020-21



# AIR POLLUTION



# Respiratory Effects

## Particulate matter and ozone

- Source: Autos, power plants and forest fires
- 43 million in US and 92% of the world live in areas in excess of WHO limit of 10micrometers/mm<sup>3</sup>.
- In 2019 7 million deaths attributable to air pollution (WHO), which is an increase of 11.2% since 1990.
- Ozone will increase to 60 ppb by 2030/irritable to alveoli/air trapping/ more vulnerable to particulate matter
- There is some evidence of increased risk of neurodegenerative diseases such as Parkinson/Dementia.

# AIR POLLUTION

- AIR QUALITY

- CO2
- NON CO2
- PARTICULATE

- LEADING TO:

- Increased rates/severity asthma
- Increased cardiovascular events
- COPD
- Decreased cognitive function?
- SARS COV2?



# *Respiratory disorders, including asthma and allergies*

- Higher temperatures and increased pollen load may exacerbate respiratory problems. Elevated **ground-level ozone** concentrations could affect lung function.
- In **2012, 7 million deaths** were connected to the joint effects of outdoor ambient air pollution and household indoor air pollution, according to the [WHO](#).
- **Pollen season** has lengthened in central North America as temperatures have risen and the frost-free period has extended ([1](#),[2](#)).
- Elevated **carbon dioxide** concentration may facilitate the increased growth of allergen-producing **weeds grasses, trees and fungus**.([1](#),[2](#))
- Heavy rainfall and flooding can cause dampness in homes, potentially leading to **indoor mold and fungal** growth, associated with nasal and throat symptoms, coughing, wheezing, asthma exacerbation, and other problems. ([1](#),[2](#))

# Allergies and Asthma

- **Allergies:** 11 million office visits per year
- \$11.2 billion per year to treat
- **Asthma/COPD:** 2 million ED visits/.5 million hospitalization/3600 deaths
- 56 billion dollars per year

# Allergies and Asthma

- 55% of US and European population tests positive for allergens and 34 million people with asthma
- Increased length of pollen season in North America and Europe
- Increased CO<sub>2</sub> production leads to increase growth of allergen producing weeds, grasses, trees and fungus.
- Rain and floods leads to increase mold and fungal growth

# AIR POLLUTION AND COGNITIVE FUNCTION

## The impact of exposure to air pollution on cognitive performance

 Xin Zhang, Xi Chen, and  Xiaobo Zhang

PNAS September 11, 2018 115 (37) 9193-9197; first published August 27, 2018

<https://doi.org/10.1073/pnas.1809474115>

# AIR POLLUTION AND SARS-COV2?

## Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis

X. WU , R. C. NETHERY , M. B. SABATH , D. BRAUN , AND F. DOMINICI  [Authors Info & Affiliations](#)


*SCIENCE ADVANCES* • 4 Nov 2020 • Vol 6, Issue 45 • DOI: [10.1126/sciadv.abd4049](https://doi.org/10.1126/sciadv.abd4049)

# HOTTER YEARS, MORE FIRES

Number of Large Fires Across Western states



Wildfires greater than 1,000 acres reported to USFS. Prescribed burns excluded.  
Aggregated average annual temperature of 11 western states ([cc-acis.org](http://cc-acis.org))  
Source: U.S. Forest Service

CLIMATE  CENTRAL



# WILDFIRES CALIFORNIA 2021



**Seattle Wash. September 2020 from wildfire  
smoke.**



## What is in Wildfire Smoke?

- Fine Particulate Matter
- Polycyclic aromatic hydrocarbons (PAHs)
- Pesticides
- Herbicides
- Fire-retardants
- CO
- Other human made products
- Ozone precursors
- Travel thousands of miles from site

# WILDFIRES AND SARS-COV2?

The  
Harvard  
Gazette

HEALTH & MEDICINE

## Link between wildfires and COVID cases established

# PARTICULATE EXPOSURE AND COPD



The Lancet Planetary Health  
Volume 2, Issue 3, March 2018, Pages e114-e125



## Articles

Effect of long-term exposure to fine particulate matter on lung function decline and risk of chronic obstructive pulmonary disease in Taiwan: a longitudinal, cohort study

Cui Guo MSc<sup>a</sup>, Zilong Zhang MSc<sup>a</sup>, Alexis K H Lau PhD<sup>d, e</sup>, Chang Qing Lin PhD<sup>d, e</sup>, Yuan Chieh Chuang MSc<sup>f</sup>, Jimmy Chan PhD<sup>d</sup>, Wun Kai Jiang MSc<sup>f</sup>, Tony Tam PhD<sup>b</sup>, Eng-Kiong Yeoh MBBS<sup>a</sup>, Ta-Chien Chan PhD<sup>g</sup>, Ly-Yun Chang PhD<sup>f, h</sup>, Prof Xiang Qian Lao PhD<sup>a, c, g, i</sup>

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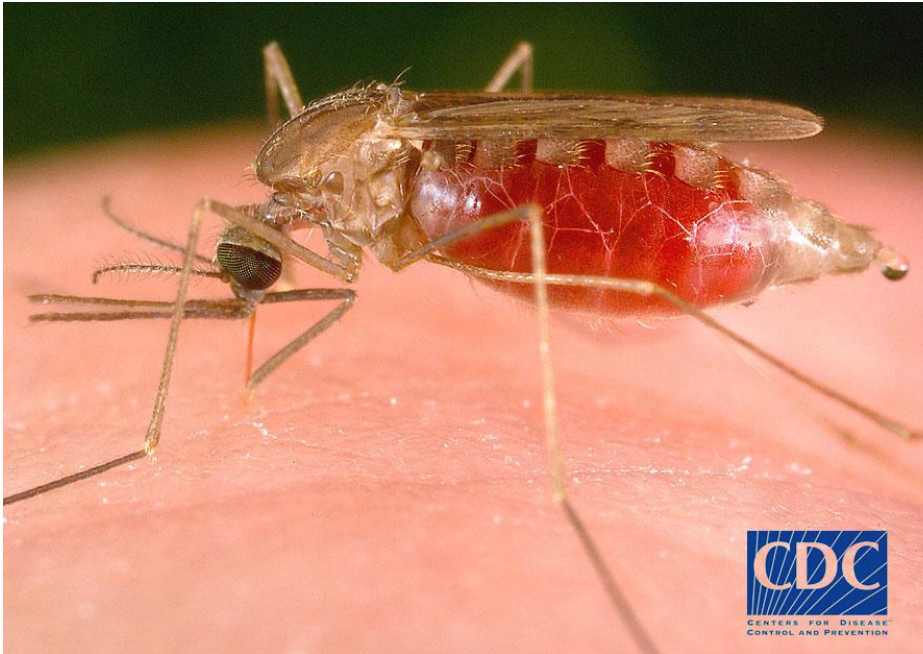
- -Long-term exposure PM2.5 with reduced and faster decline lung function
- -increased risk incidence of COPD

# Advise to patients with lung disease

- Pay attention to local weather trends and smog alerts, excessive heat, wildfires.
- Avoid excess physical activity and stay indoors
- N95 masks reduce particulate inhalation especially in wildfires.
- Ask patients about their knowledge of air pollution
- Inform patients about symptoms (sputum, dyspnea)
- Counsel to carry an inhaler and stay indoors.



# CHANGES IN VECTOR ECOLOGY



# Vector- and water-borne diseases

- A warmer climate and changing rainfall patterns may also create hospitable environments for **climate-sensitive vectors** like mosquitos and ticks that spread diseases like **dengue fever** and **chikungunya**([1](#),[2](#))
- Some models predict that climate change could be a factor in extending **Lyme disease** into Canada. ([1](#))
- **Water-borne** diseases may also thrive in flooded regions as well as those where water is scarce.
- For example, **cholera** may develop and spread in drought-stricken areas where lack of water leads to poor sanitation ([1](#))



# WHO Vector Borne Diseases in North American/European Region

## ■ Mosquito:

- Dengue 58.4 million cases/
- 10000 deaths in 2013
- Chikungunya
- Malaria
- West Nile Fever
- Zika



## Sandfly borne:

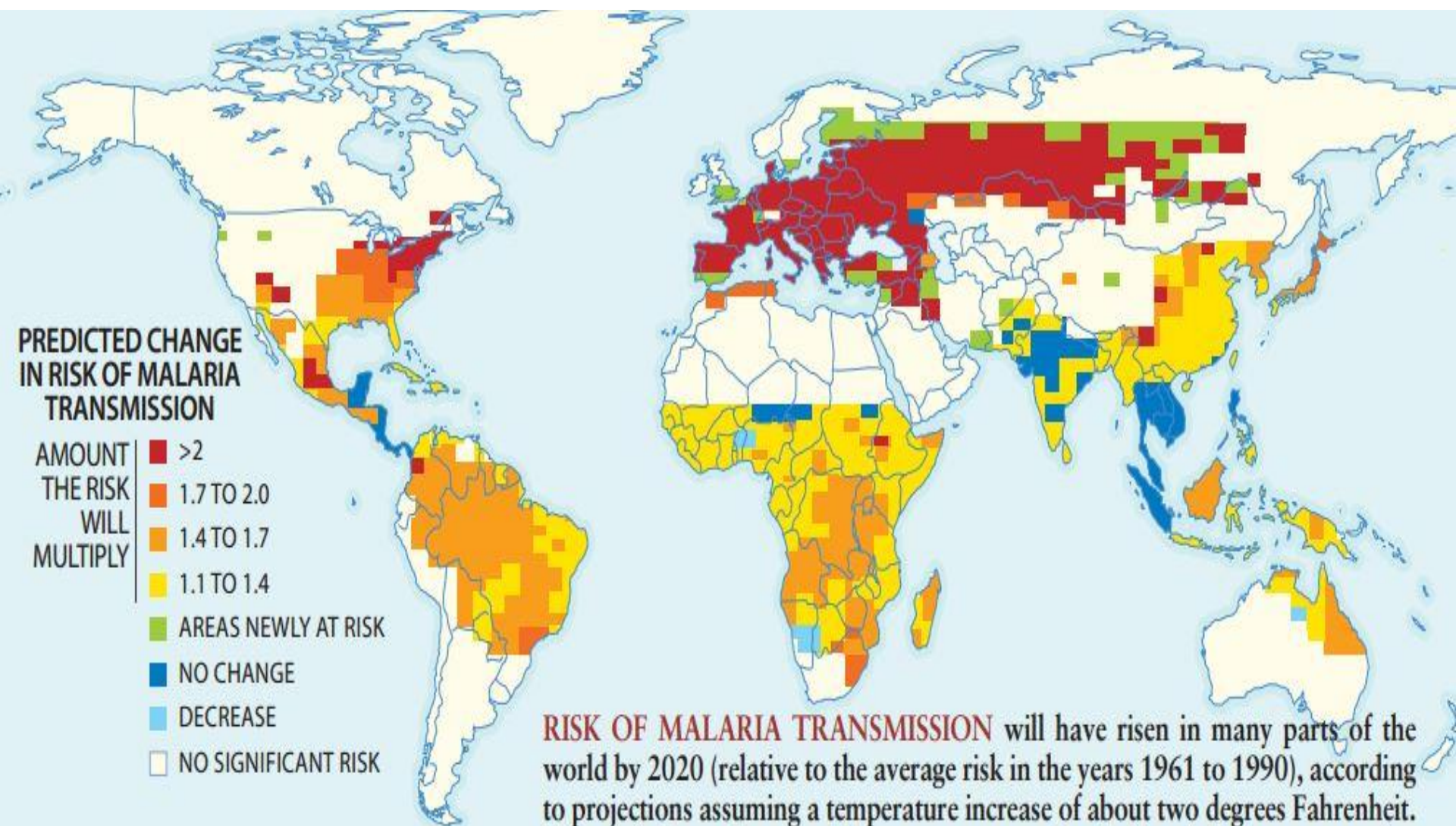
Leishmaniasis

## Tick borne:

Lyme/Anaplasma/Babesia/Powassan

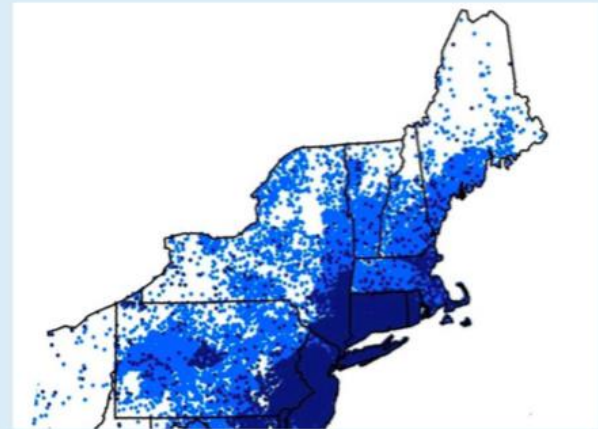






**RISK OF MALARIA TRANSMISSION** will have risen in many parts of the world by 2020 (relative to the average risk in the years 1961 to 1990), according to projections assuming a temperature increase of about two degrees Fahrenheit. The analysis was based solely on temperature threshold and did not assess other factors that could influence malaria's spread.

# AND IN NEW HAMPSHIRE



*Increase in Lyme disease between 1996 and 2013. Each dark dot shows one case reported in 1996; light dots show 2013. The increased range shown here has been attributed to factors other than climate change. Nevertheless, additional warming will lengthen the season during which people are exposed to Lyme disease and may allow the disease to spread to colder areas. Source: CDC.*

# CANDIDA AURIS AND CLIMATE CHANGE?

- New **drug-resistant** fungal species. First isolate **2009**. Now world-wide. Independently on **three continents simultaneously**. Clonal but genetically distinct.
- “**Thermal restriction zone**” protects mammals. Difference between high basal temp and environmental temperatures.
- Avian intermediate hosts. Sea birds.
- Casadevall et al. mBio 10:e01397-19



# CANDIDA AURIS AND CLIMATE CHANGE?

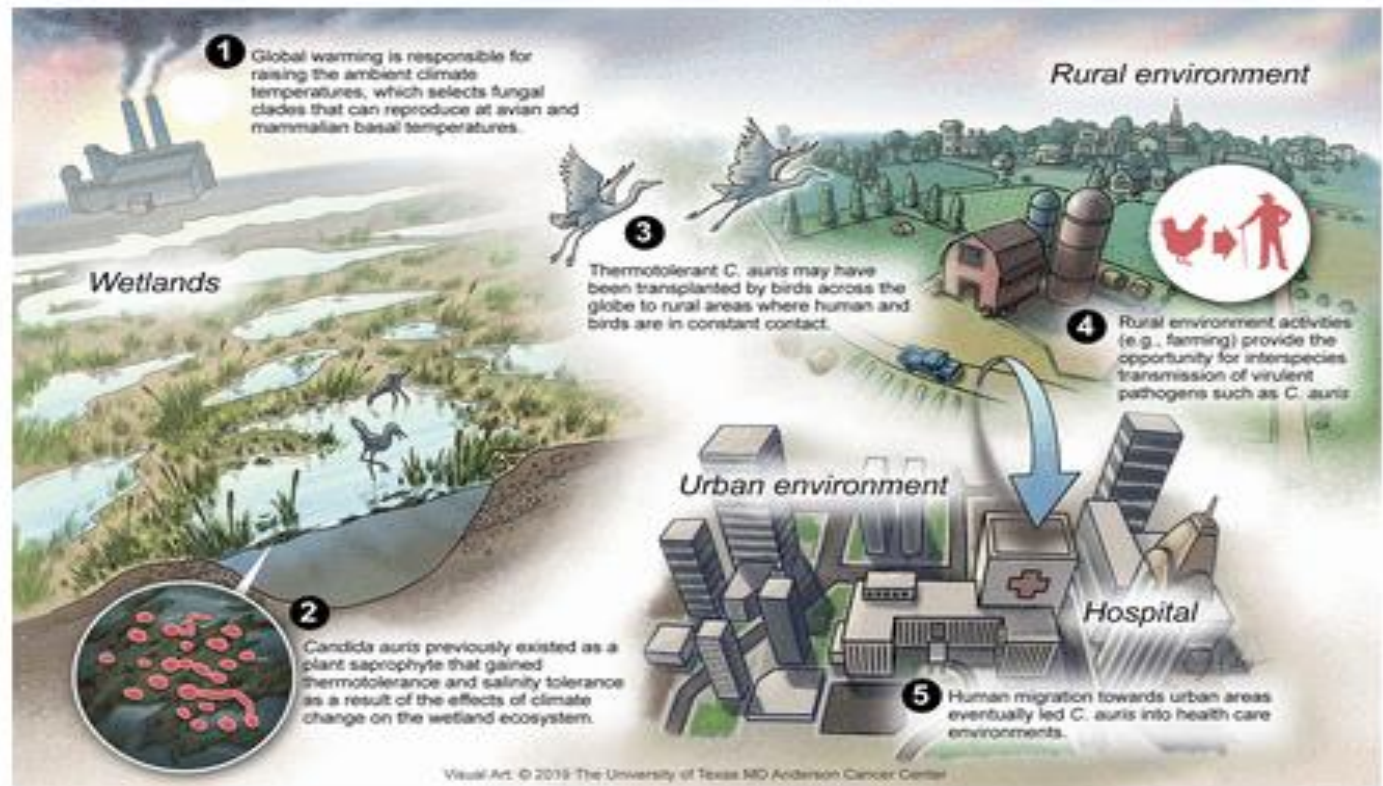


FIG 2

[Open in new tab](#) | [Download](#)

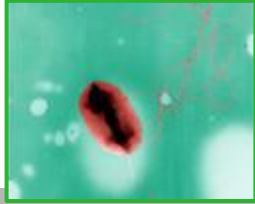
Proposed scheme for the emergence of *C. auris*.

# WATER



# WATER QUALITY AND HEALTH

- FOOD- AND WATER-BORN DISEASES
  - VIBRIO CHOLERAEE
  - CRYPTOSPORIDIOSIS
  - CAMPLYOBACTER
  - LEPTOSPIROSIS
  - SALMONELLA
  - ENTERIC VIRUSES
  - ROTAVIRUS
  - ALGAL BLOOM-DINOFLAGELLATES, CYANOBACTERIA



## Bacterial Contamination



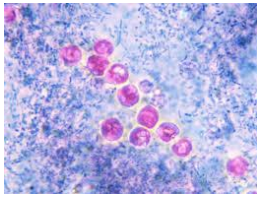
- **E. Coli (O157:H7)** from contaminated food and water-bloody diarrhea, vomiting-may lead to kidney failure and even death
- **Campylobacter**-common cause of food poisoning from meats/unpasteurized dairy products/contaminated water.
- **Salmonella**-common cause of food poisoning
- **Leptospira**-spread through the urine of infected animals, rodents, through the soil and water, and during flooding. Infections in urban kids increasing.
- Higher temperatures are associated with higher rates of production and disease.



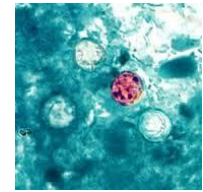
## Bacteria: Vibrio Species & Legionella

- **Vibrio** is strongly influenced by climate-both fresh and marine waters
- **V. Cholera** causes estimated 3-5 million cases and 100,000-120,000 deaths yearly world-wide. Young children in endemic areas most affected.
- Virulent V. parahaemolyticus strain found in Maryland shellfish & Alaskan oysters in Price William Sound (furthest north) -big public health concern.
- **Legionella** (Legionnaire's Disease)-respiratory illness transmitted solely by water. Warm water and perhaps other factors, like association with amoebae, influence the potential to colonize water systems.

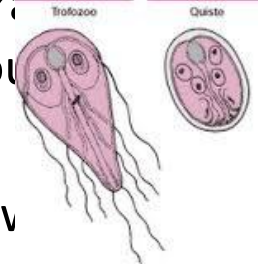




## Parasitic Disease



- **Cryptosporidium**-2,000-3,000 cases annually in the U.S.- through livestock waste & contaminated water, oocysts detected in 65% to 97% of surface waters tested in the U.S. ,common disinfectants, like chlorination is ineffective, 1993 outbreak in Milwaukee was the largest outbreak ever documented in the U.S. with 400,000 cases and 100 deaths.
- **Giardia lamblia**-second most common parasite in the U.S., found in raw surface water from animal and human feces, 9% of filtered drinking water found (17%) and Crypto (27%)
- **Cyclospora**-often associated with fresh produce from contaminated water outbreak in 2013 from salad bar/cilantro in TX, NE and IA.



## Nova Scotia oyster producers guarding against bacteria spread by climate change



*Vibrio* bacteria is transmitted by eating raw or undercooked seafood

Moina Donovan - CBC News

Posted: August 24, 2016



The *Vibrio* bacteria is transmitted by eating raw or undercooked seafood, and is spreading into northern waters as oceans warm. (Tourism NB)



# Viruses

- Viruses are heat resistant and likely to survive sewer treatment processes. Viruses found in shellfish contaminated with wastewater and fecal sources.
  - Hepatitis A
  - Noro virus
  - Norwalk virus

# Food Security

# Food security problems and water scarcity



- As the population grows and food demand rises, "climate change could result in an increase of **20%** of people at risk of **chronic hunger**."([1](#))
- Under some forecasts, rice, maize, and wheat crop yields may suffer in areas that do not implement adaptation plans; in high elevation areas, yields may increase with the temperature.([1](#))
- Water scarcity may be accelerated as the climate changes and more regions experience drought. Risk is especially pronounced in presently dry regions.
- One study estimates that about **100 million additional urban dwellers** will experience **perennial water shortages** under climate change conditions than under current climate.([1](#))
- 1C increase -> 1.4% probability of severe food insecurity

# Compromised Food and Water security

- Increased **crop losses** from diseases such as fungi, bacteria and viruses
- In 2020, up to **19%** of global land surface area affected by extreme drought any given month.
- Global climate change will **decrease food production** by **2% per year** in the face of a 14% per year increase in demand.
- 6% decline in global **wheat** yield and 10% **rice** for 1 C rise in temperature.
- **Reduced water supply** from droughts with **100 million people** in areas of water shortage.

# NOW GETTING SERIOUS!

nature  
plants

ARTICLES

<https://doi.org/10.1038/s41477-018-0263-1>

## Decreases in global beer supply due to extreme drought and heat

Wei Xie <sup>1\*</sup>, Wei Xiong<sup>2,3,4</sup>, Jie Pan <sup>2</sup>, Tariq Ali<sup>1</sup>, Qi Cui<sup>5</sup>, Dabo Guan <sup>6,7\*</sup>, Jing Meng <sup>8</sup>,  
Nathaniel D. Mueller<sup>9</sup>, Erda Lin <sup>2\*</sup> and Steven J. Davis<sup>9,10</sup>

Beer is the most popular alcoholic beverage in the world by volume consumed, and yields of its main ingredient, barley, decline sharply in periods of extreme drought and heat. Although the frequency and severity of drought and heat extremes increase substantially in range of future climate scenarios by five Earth System Models, the vulnerability of beer supply to such extremes has never been assessed. We couple a process-based crop model (decision support system for agrotechnology transfer) and a global economic model (Global Trade Analysis Project model) to evaluate the effects of concurrent drought and heat extremes projected under a range of future climate scenarios. We find that these extreme events may cause substantial decreases in barley yields worldwide. Average yield losses range from 3% to 17% depending on the severity of the conditions. Decreases in the global supply of barley lead to proportionally larger decreases in barley used to make beer and ultimately result in dramatic regional decreases in beer consumption (for example, -32% in Argentina) and increases in beer prices (for example, +193% in Ireland). Although not the most concerning impact of future climate change, climate-related weather extremes may threaten the availability and economic accessibility of beer.



The bad news is you've got advanced-stage humans. The good news is they've just about run their course and you should be on the mend soon.



# ENVIRONMENTAL DEGRADATION





## Mass Migration

Over one billion people will need to migrate within 21<sup>st</sup> century due rising sea level. 225 million between 2008 and 2019



# Effects of Hurricane Katrina

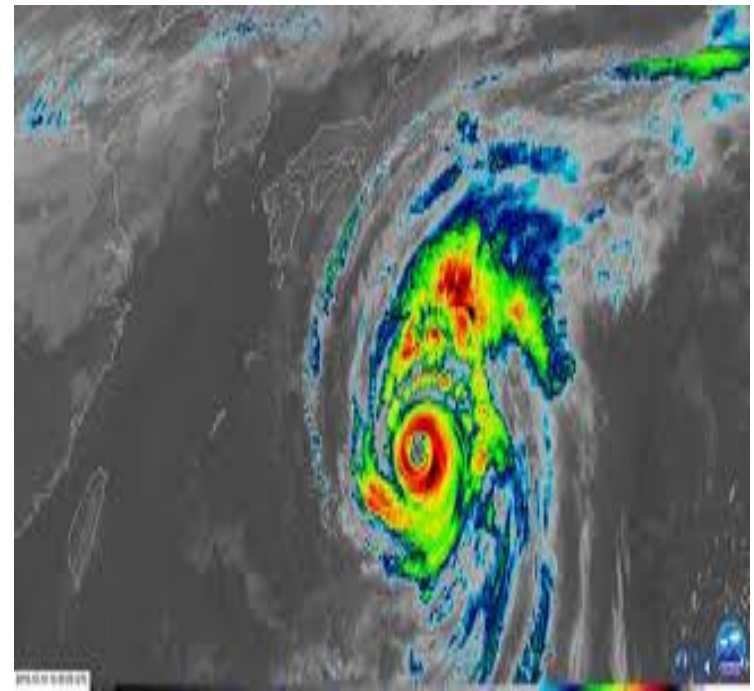
49% developed an anxiety or mood disorder  
1 in 6 developed posttraumatic stress disorder

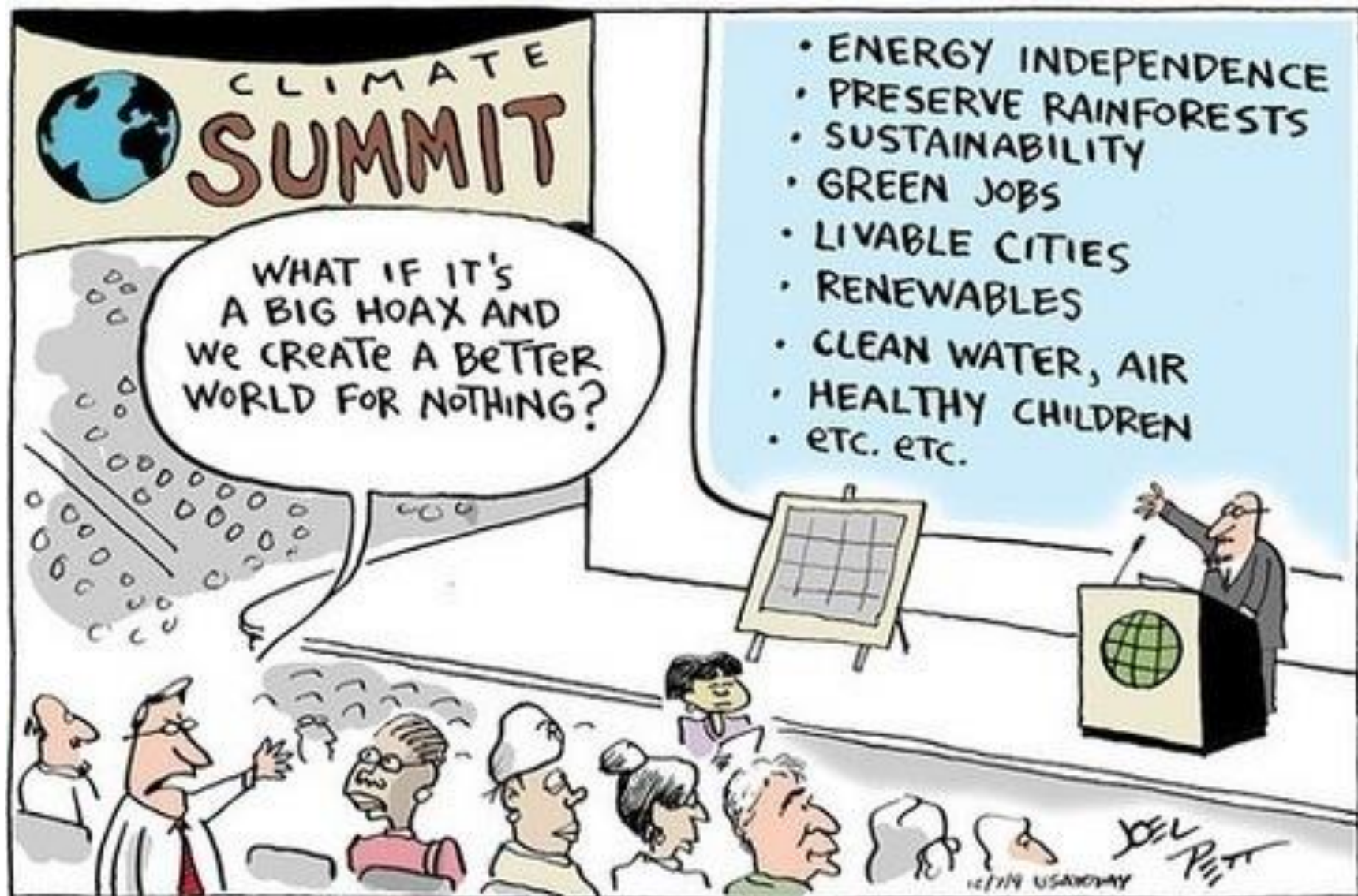




## *Mental health disorders, including post-traumatic stress disorder and depression connected to natural disasters.*

- Disasters caused by climate change may have a negative effect on mental health. **Extreme weather events** can cause stress that may result in a decline in mental health and prolonged heat or cold events may cause chronic stress problems that exacerbate health issues ([1](#))
- Mental health problems can occur due to **displacement, relocation and loss of property and personal finances in the aftermath of a disaster.** ([1](#))
- Nearly half of surveyed New Orleans residents affected by **Hurricane Katrina** reported anxiety mood disorder and a substantial number reported post-traumatic stress disorder. ([1](#))
- The **U.S. military** considers climate change to be a “**threat multiplier**,” a factor that exacerbates existing problems, such as food insecurity, pandemic disease, and conflict over resources. ([1](#))





# Physician and public health organizations have spoken up about climate change and health

“The changing climate is causing physical, chemical, and ecological changes that are fundamentally altering the planet. These changes pose significant threats to human health, with children representing a uniquely vulnerable group.” ([American Academy of Pediatrics](#))

“Our **AMA supports** the findings of the **Intergovernmental Panel on Climate Change’s** fourth assessment report and concurs with the scientific consensus that the **Earth is undergoing adverse global climate change and that anthropogenic contributions are significant**. These climate changes will **create conditions that affect public health, with disproportionate impacts on vulnerable populations, including children, the elderly, and the poor.**” ([American Medical Association](#))

“Climate change can harm the water supply, increase vector-borne disease and increase extreme weather events. Vulnerable populations such as communities of color, the elderly, young children, the poor and those with chronic illnesses bear the greatest burden of injury, disease and death related to climate change. As an APHA priority, we believe in the need for strong climate change strategies and interventions that protect people's health. The public health community plays a critical role.” ([American Public Health Association](#))

# ACP Recommendations

- A global effort is required to reduce anthropogenic greenhouse emissions and address the health impact of climate change. The United States must commit to taking both a leadership and collaborative role in developing, implementing and ensuring the success of such a global effort and in reducing its own contributions to greenhouse emissions. Climate change adaptation strategies must be established and mitigation measures must be adopted.



# ADAPTATION: Limiting the Damage Done

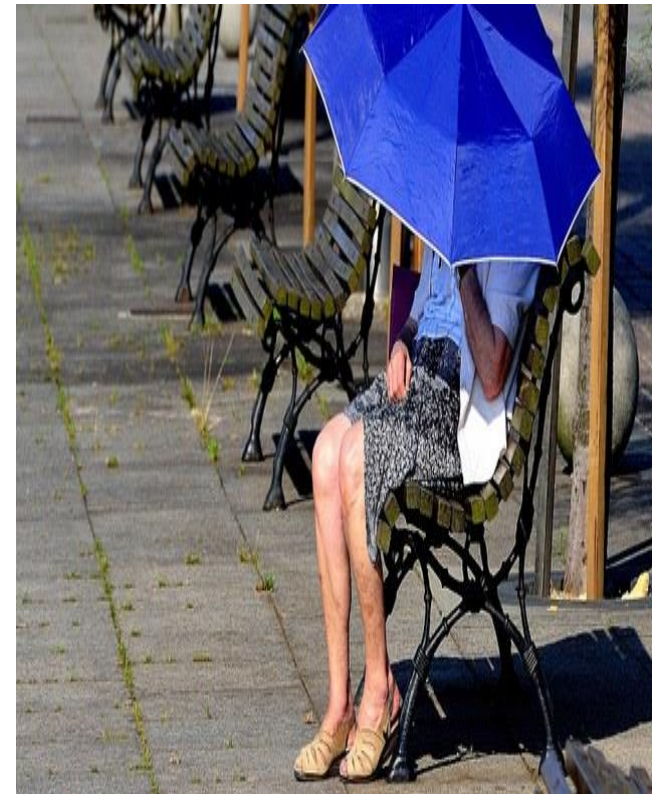
**Adaptation is “adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.” (1)**

## Problem

- Drought in Africa
- Extreme Heat Events in Europe
- Urban flooding in North America

## Adaptation Strategy (1)

- Reducing non-climate stressors on water rec., sustainable urban devel., strengthen institutional capacities for demand mgmt.
- Warning systems, reduced emissions to improve air qual., residence, workplace modifications
- Use of pervious surfaces, rooftop gardens; wetland conservation, planting of mangroves, coast-protecting vegetation.





# MITIGATION: The Key to Stopping Further Climate Change

- Climate change mitigation is the goal of “implementing policies to reduce greenhouse gas emissions and enhance sinks,”([1](#)) including
  - more efficient use of energy
  - expanded use of carbon neutral or low-carbon energy
  - reductions in deforestation and increases in reforestation
  - lifestyle and behavioral changes (such as energy conservation and reduced energy demand).

# Mitigation could have major health benefits

## Action

- Increasing safe active transport and use of lower-emission vehicles
- Increase use of clean-burning stoves
- Reduction in use of coal-generated electricity

## Outcome

- Reduce heart disease, cerebrovascular disease, dementia, depression(1)
- Reduce indoor air pollution exposure, respiratory illness(1)
- Lower air pollution, better respiratory health

# Climate Change Poses Risks and Opportunities Related to Health

- The 2015 *Lancet Commission on Climate Change and Health* report stated: “The effects of climate change are being felt today, and future projections represent an unacceptably high and potentially catastrophic risk to human health.”
- The 2019 report: “**life of every child born today will be profoundly affected**” “populations around the world facing extremes of weather, food and water insecurity, changing patterns of infectious disease”. “**unprecedented challenge demands an unprecedented response**”.

# Addressing Climate Change is a Win-Win Situation

- Fossil fuel combustion creates dirty energy, endangering respiratory health
  - Switching to clean energy or reducing consumption can improve the air breathed by children, elderly, people with chronic illness
- Agriculture industry emits massive amounts of methane and other greenhouse gases
  - Reducing meat consumption in favor of more fruits and vegetables may contribute to a more healthy, balanced diet
- Healthy buildings – recycled construction materials, encourage use of stairs over elevators, use of natural lighting
  - Less construction-related pollution, improved physical activity from stair use, better mental health from day-lighting.(1)

# The Health Care Industry is One of the Largest Consumers of Energy

- The health care sector is ranked **second in energy use** after the food industry
- It spends about \$9 billion annually on energy costs
- Hospitals in the United States produce a massive amount of garbage/waste (>2.3 million tons per year)



# NEJM: CALL TO ACTION 10/13/21



*The* NEW ENGLAND JOURNAL *of* MEDICINE

## Perspective

### **Decarbonizing the U.S. Health Sector — A Call to Action**

Victor J. Dzau, M.D., Rachel Levine, M.D., George Barrett, M.B.A., and Andrew Witty, B.A.



# ACP Recommendation

- The **health care** sector, within the United States and globally, must **implement environmentally sustainable and energy-efficient practices** and **prepare for the impacts** of climate change to ensure continued operations during periods of elevated patient demand.

# How Can You Help “Green” Your Facility?

- Transportation
- Energy operations
- Energy in the built environment
- Waste
- Food Service

(Source: [Health Care without Harm](#))



# Green Transportation Strategies

- Transportation is 27% of Total U.S. Greenhouse Gas Emissions ([1](#))
- **Reduce fleet emissions** – *Hospital fleets to include high-fuel efficiency, hybrid, alt fuel vehicles*
- **Help commuters reduce/eliminate emissions** – *Encourage use of mass transit, carpooling, telecommuting for employees; shuttles to public transit. Telemedicine!*
- **choose suppliers with efficiency or alternate-fuel standards**
- **prefer local suppliers** – *reduce transportation and shipping distance, fuel consumption*
- **purchase energy-efficient shipping** – *choose lighter products with less packaging, encourage environmentally sustainable packaging* ([1](#))

# Reduce Your Facility's Energy Use

- **Make buildings more energy efficient** – switch to energy efficient *light bulbs* (CFLs, LED bulbs), turn down *thermostat*, *upgrade* major equipment to most energy-efficient model
- **Install On-Site Renewable Energy Capability** - *Solar panels* can generate a portion of facility's energy, solar hot-water heating system
- **Purchase Energy-Efficient Products** – Buy Energy Star or Federal Energy Management Program-designated products.
- **Reduce Standby Energy Use** – Plug computers/electronic equipment into power strip and turn off when not in use.
- **Purchase Green Power** – Use power generated from renewable sources like wind, solar.

# Energy – The Built Environment

- **incorporate green building principles** – *Use day lighting, natural ventilation, green roofs.*
- **consider overall transportation impacts of facility siting** – *Site facility near public transportation hub, build in developed areas.*
- **use native vegetation and plant trees on site, use local and regional building materials** – *Trees, vegetation can reduce heat island effect, act as carbon sinks, native plants need less water.*
- **offset emissions from building construction** – *less energy required to transport local products to building site.*
- **purchase only lumber products certified by the Forest Stewardship Council** – *support sustainable forestry practices.*

# Reducing Health Care Waste for a Healthier Future

- **recycle and buy recycled products** – *Recycle all recyclable products, including electronics*
- **collect and recycle nitrous oxide anesthetic gases** – *limit the amount that escapes into atmosphere during use*
- **dispose of waste locally** – *Local disposal reduces travel-related emissions*
- **prevent waste** – *through recycled material use, reduced use of virgin material*
- **divert at least 90% of constructed waste** – *produced during construction and demolition*



# Food Service: Healthy Food, Healthy Planet

- **Reduce the amount of meat protein on menus** – Agriculture/meat protein production is a major source of greenhouse gas emissions.
- **buy local and seasonal food** – reduce long-distance food transport leads to lower emissions
- **procure organic food when possible** – Would reduce use of fossil fuel-related pesticides, fertilizers
- **compost food waste** - creates a recycled product (compost) that can replace fertilizer
- **eliminate bottled water** – encouraging tap water use will reduce waste.

# ANOTHER LECTURE/ANOTHER TIME

## LANCET EATS



# ADVOCACY: How to Communicate about Climate Change

When discussing the issue with your colleagues, grand rounds audience, or your community, mention the following key points:

- Climate change is **real and human-caused**.
- Climate change is **bad for us and our community** in a number of ways.
  - *Localize the issue (if you live in S. Florida, talk about how climate change could worsen flooding, leading to displacement, dampness-related respiratory illness, etc.)*
- We need to start taking **action now** to protect the health of our community's most vulnerable members—including our children, our seniors, people with chronic illnesses, and the poor—because our climate is **already changing** and **people are already being harmed**.
- Taking action creates a “win-win” situation for us because, in addition to dealing with climate change, most of these actions will benefit our health too.
  - *For example, walking or biking instead of driving short distances could reduce the risk of cardiovascular disease as well as reduce greenhouse gas emissions.*

# TO DO LIST

- EDUCATE: yourself, your community, your patients
- BE GREEN: home, office, work
- SUPPORT: international relief agencies
- AGITATE: professional societies
- LEGISLATE: state, national, international

# FOR MAX, MATTHEW, BENSON, ELLEN AND EWAN



# SELECTED RESOURCES

- <https://www.cdc.gov/climateandhealth/effects/default.htm>
- <https://nca2018.globalchange.gov/chapter/14/>
- [https://www.who.int/health-topics/climate-change#tab=tab\\_1](https://www.who.int/health-topics/climate-change#tab=tab_1)
- <https://www.acponline.org/advocacy/advocacy-in-action/climate-change-toolkit>
- <https://medsocietiesforclimatehealth.org/reports/medical-alert/>





Protect People and the Planet  
*We Can Do This*