



Massachusetts General Hospital
Founding Member, Mass General Brigham

Climate Change

Addressing Vulnerability through Primary Care

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National Advisory Council Meeting

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HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL



Massachusetts General Hospital

Founding Member, Mass General Brigham

Center for the Environment and Health

Pillar One

Deliver health care in an environment-friendly way and serve as a model for others.



Pillar Two

Create new knowledge about the inextricable links between the environment and health as well as how to deliver health care sustainably.



Pillar Three

Engage and educate employees, patients and families on the connections between the environment and health and how to work and live sustainably.



Pillar Four

Advocate for a healthy environment for everyone, particularly those who have been disproportionately and unjustly harmed by pollution.



Outline

1. Discuss how climate change affects health.
2. Discuss how to identify patients at increased risk of environmental exposures (heat, air pollution).
3. Give examples of interventions in primary care to reduce these risks and increase patient resiliency.



Background

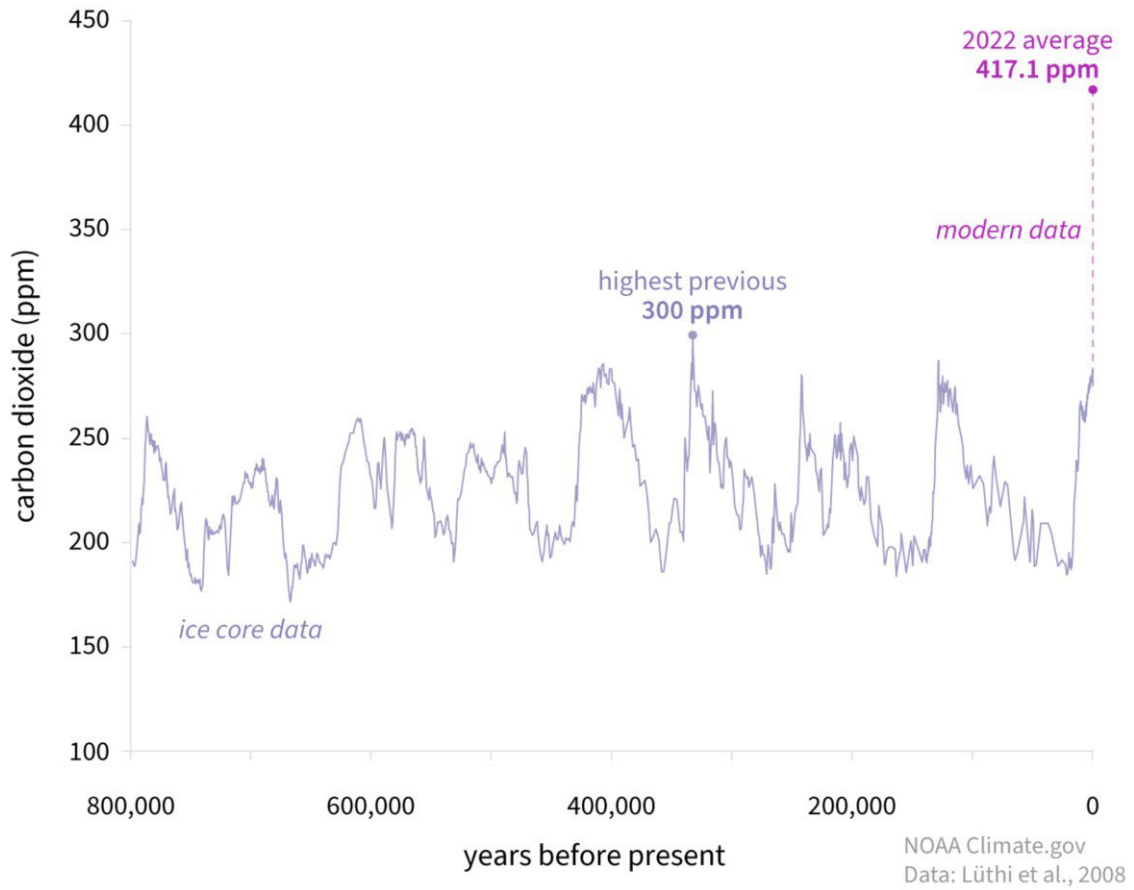
Why it matters



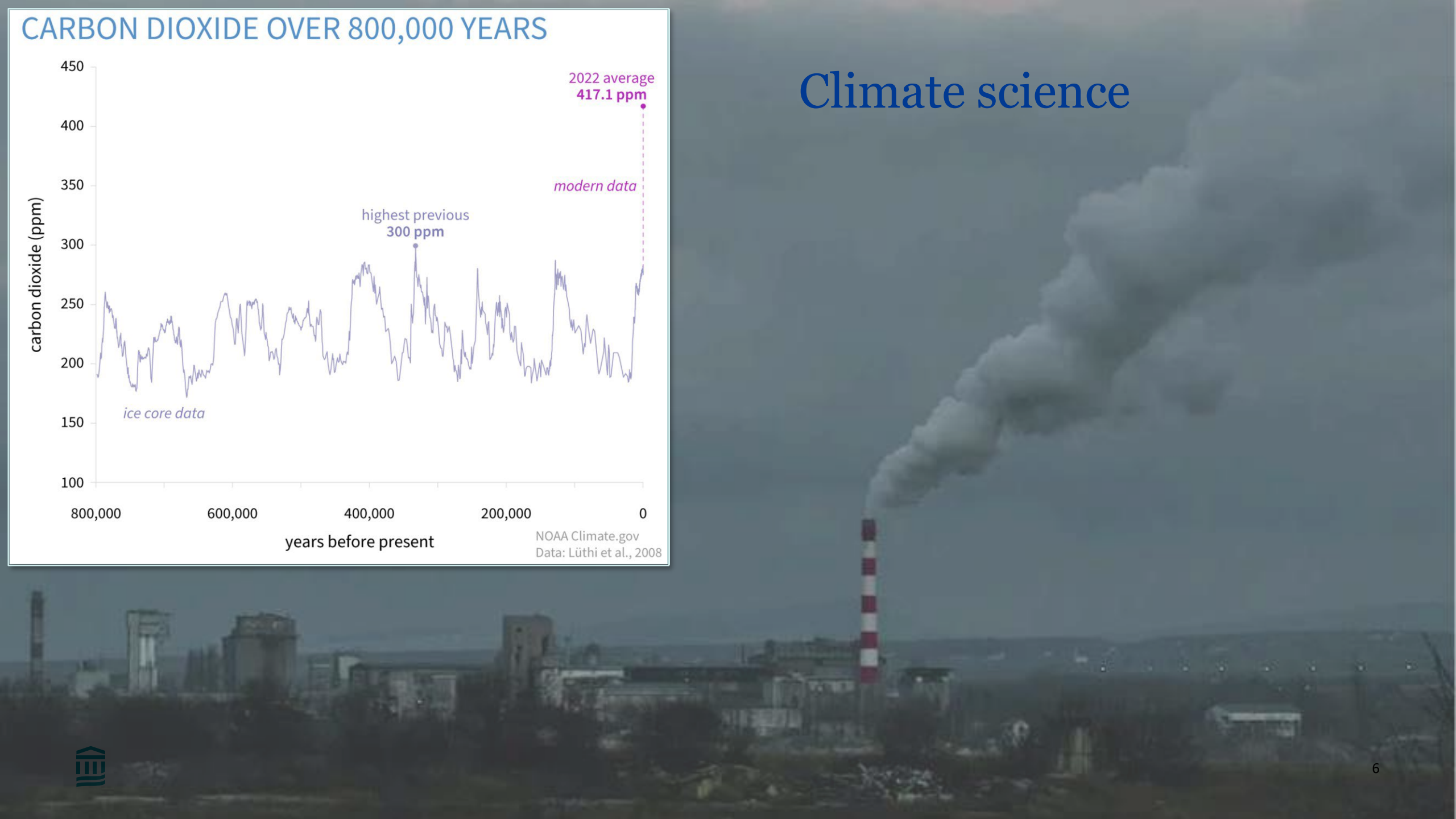
“The greatest threat to global public health is the continued failure of world leaders to keep the global temperature rise below 1.5C and to restore nature”



CARBON DIOXIDE OVER 800,000 YEARS

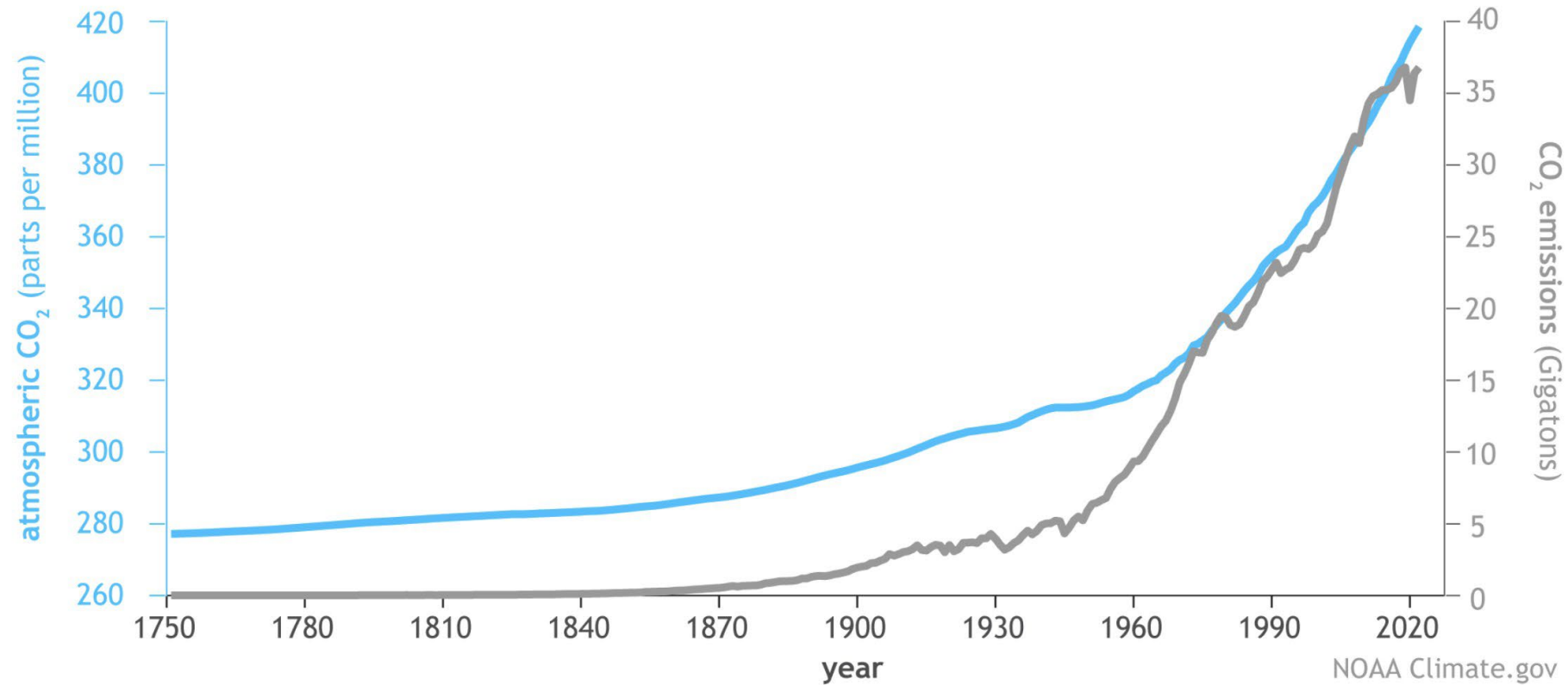


Climate science



Climate science

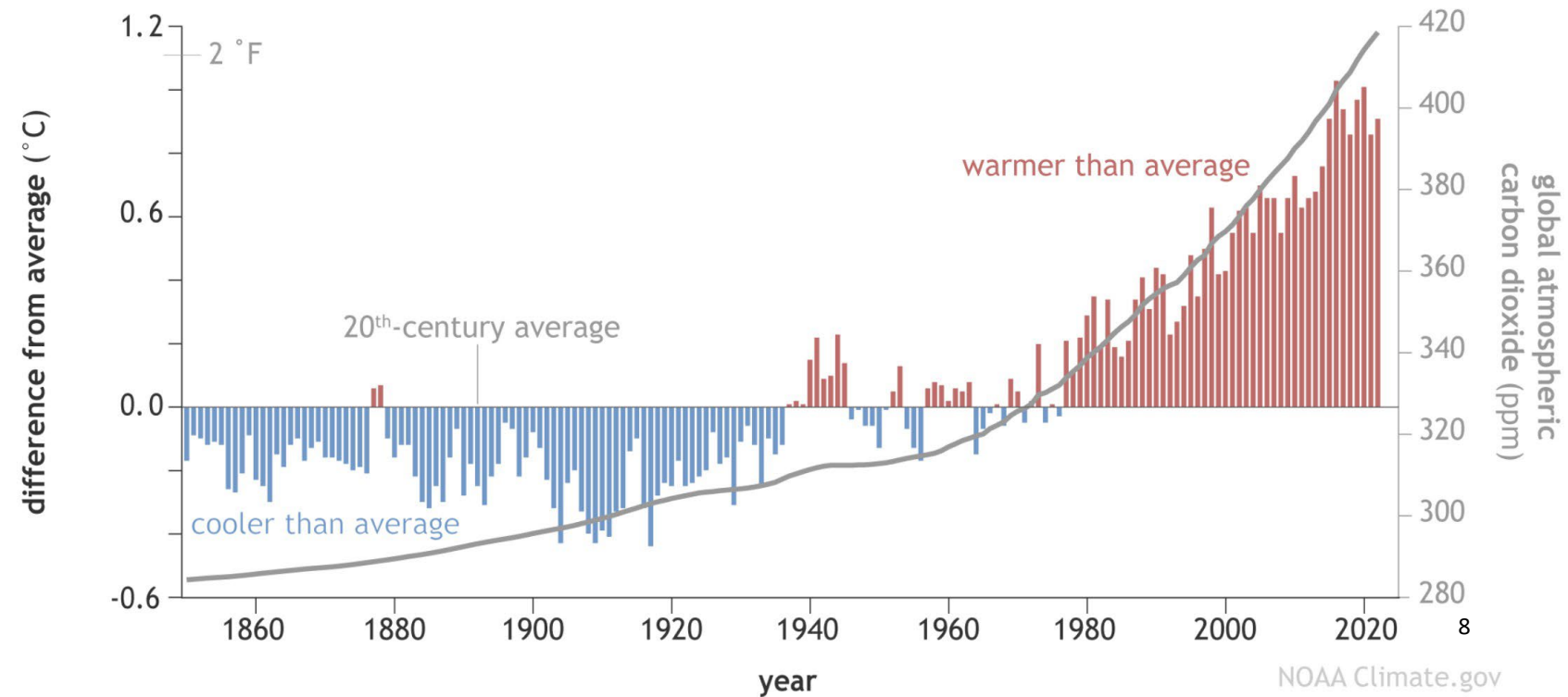
Global atmospheric carbon dioxide compared to annual emissions (1751-2022)

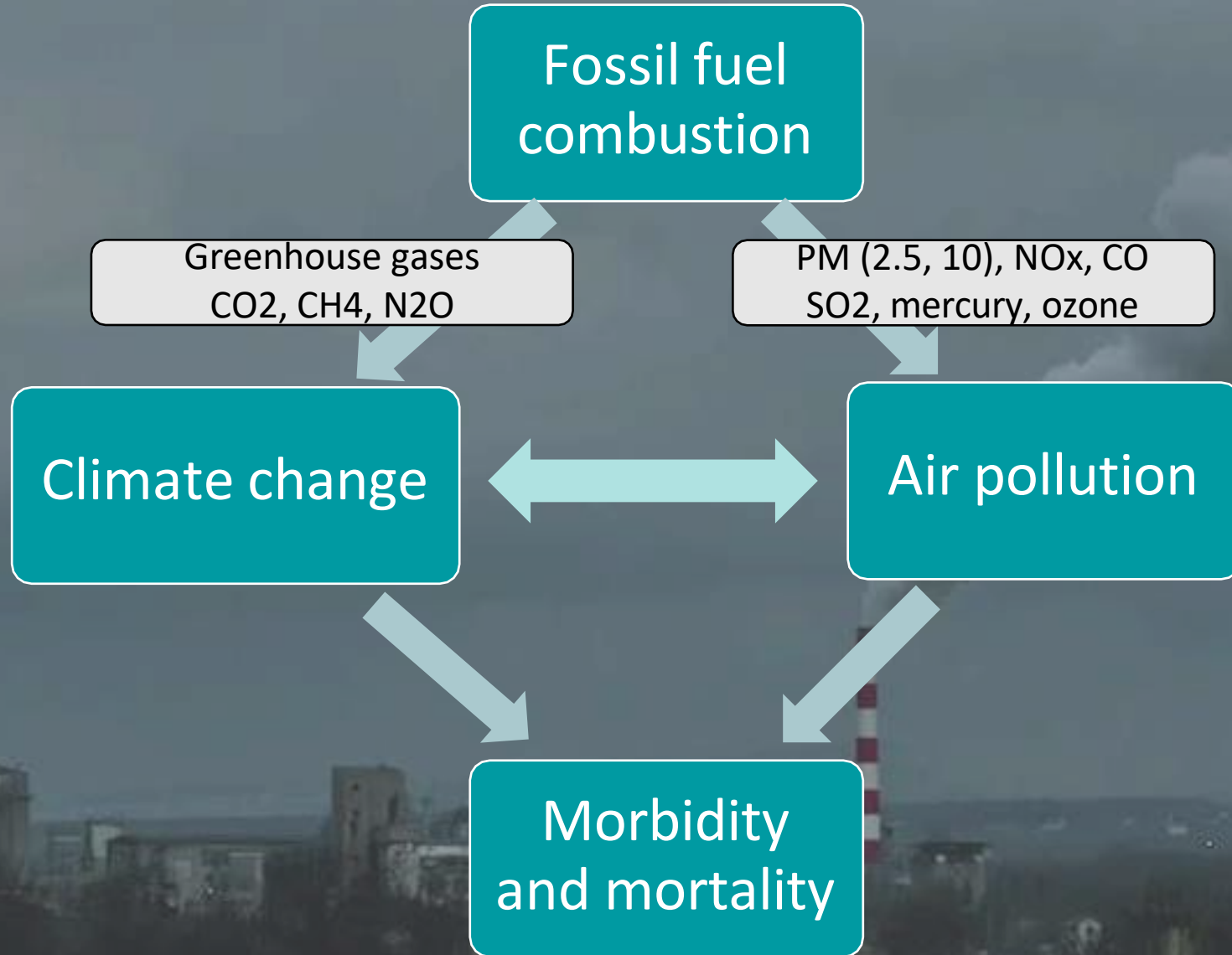


NOAA Climate.gov
Data: NOAA, ETHZ, Our World in Data

Climate science

Yearly global surface temperature and atmospheric carbon dioxide (1850-2022)



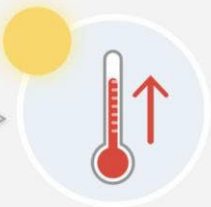


PM2.5 from fossil fuel combustion -> ~9 million premature deaths/yr globally

Increasing Levels of Carbon Dioxide and Short-Lived Climate Pollutants



Rising Temperature



Rising Sea Levels



Increasing Extreme Weather Events



Demographic, Socioeconomic, Environmental, and Other Factors That Influence the Magnitude and Pattern of Risks

Geography
Ecosystem change
Baseline air and water quality
Agricultural and livestock practices and policies

Warning systems
Socioeconomic status
Health and nutritional status
Access to effective health care

EXPOSURE PATHWAYS

Extreme Weather Events

Heat Stress

Air Quality

Water Quality and Quantity

Food Supply and Safety

Vector Distribution and Ecology

Social Factors

EXAMPLES OF HEALTH OUTCOMES



- Injuries
- Fatalities
- Mental health effects



Heat-related illness and death



- Exacerbations of asthma and other respiratory diseases
- Respiratory allergies
- Cardiovascular disease



- Campylobacter infection
- Cholera
- Cryptosporidiosis
- Harmful algal blooms
- Leptospirosis



- Undernutrition
- Salmonella food poisoning and other foodborne diseases
- Mycotoxin effects



- Chikungunya
- Dengue
- Encephalitis (various forms)
- Hantavirus infection
- Lyme disease
- Malaria
- Rift Valley fever
- West Nile virus infection
- Zika virus infection



Physical and mental health effects of violent conflict and forced migration (complex and context-specific risks)

Health impacts of heat

Heat-related illness



Severe

- **Heat stroke**
 - Elevated core temperature
 - CNS dysfunction

Mechanism

- Ischemia
- Heat cytotoxicity
- Inflammatory response
- DIC
- Rhabdomyolysis

Organ damage

- Brain
- Heart
- Intestines
- Kidneys
- Lungs
- Pancreas

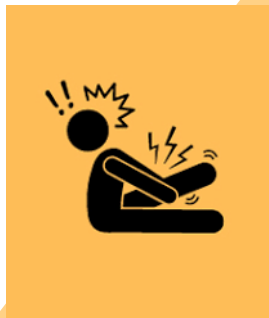


- *Disparities in heat mortality*
- *True heat mortality underdocumented*



Moderate

- **Heat exhaustion**
 - Weakness, nausea, HA; no AMS
 - Water or salt depletion
 - Mild temp elevation



Mild

- **Heat syncope**
 - Brief loss of consciousness from vasodilation
- **Heat edema**
 - Swelling of limbs from vasodilation
- **Heat cramps**
 - Muscle spasms, often excess loss of salt
- **Heat rash**
 - Blocked sweat glands, inflammation of skin

Health impacts of air pollution



- Study of Medicare data from 68 million
 - 2000-2016 death rates rose by 6-8% per 10 mcg/m³ PM_{2.5}
 - Excess deaths occurred even at 2.8 mcg/m³ PM_{2.5} (well below EPA standards)



Health impacts of air pollution

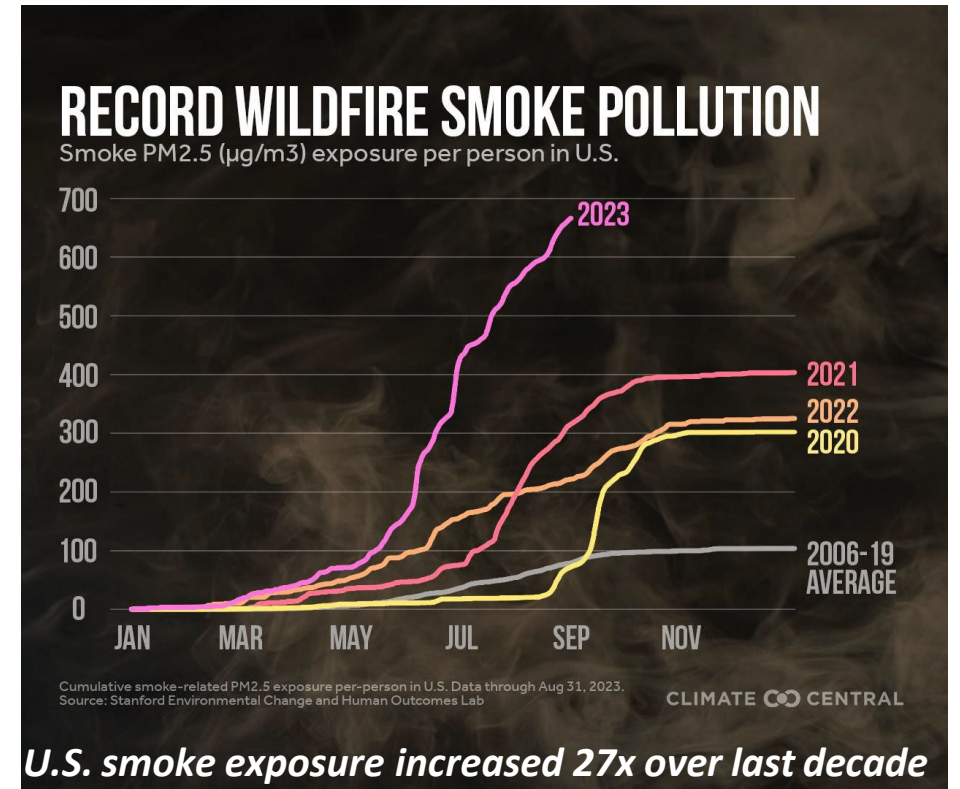
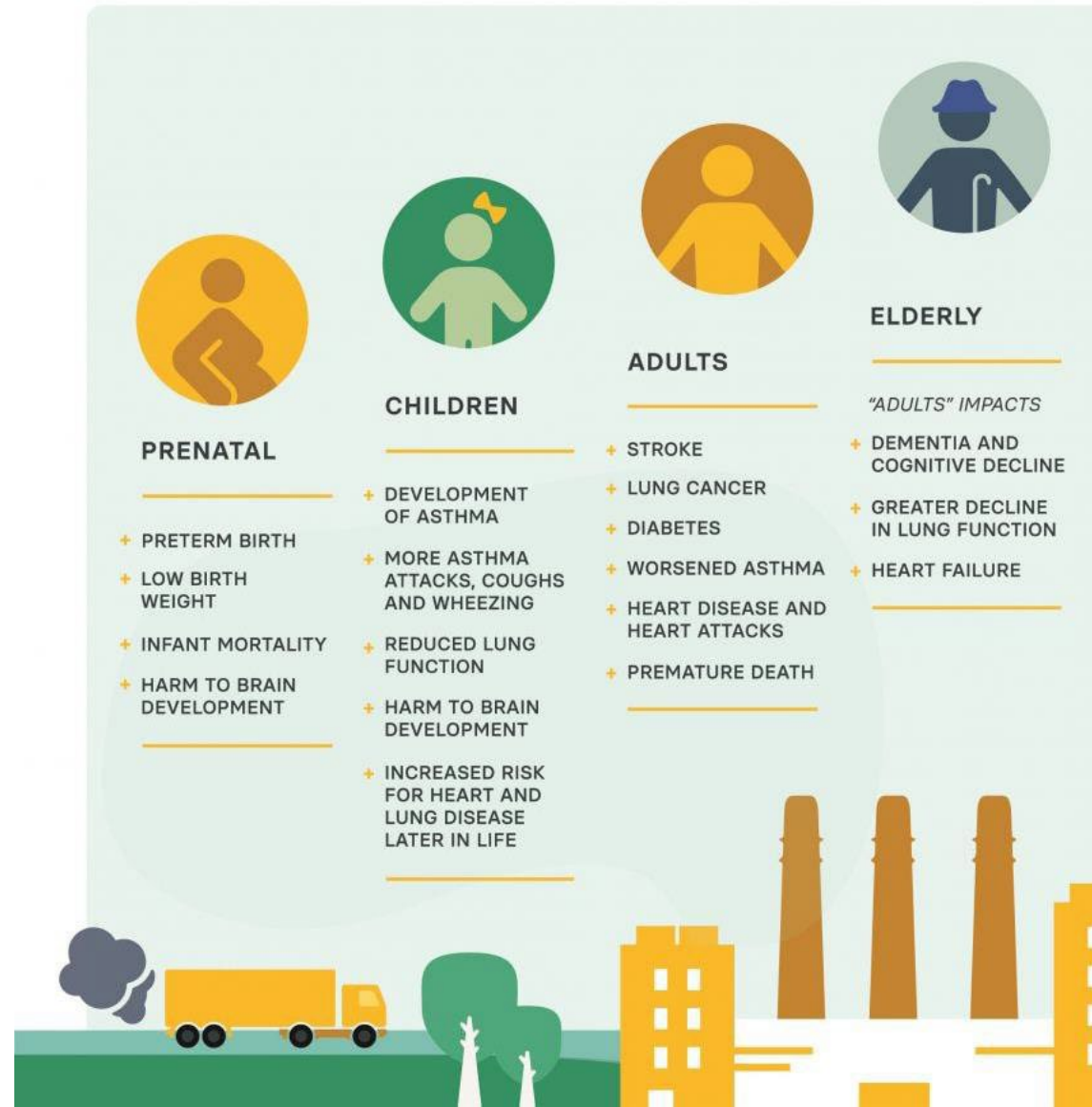


UNEQUAL BURDEN

Blacks, Asians, Hispanics, Latinos, low-income populations are exposed to higher levels of PM_{2.5} than other groups.



Health impacts of air pollution



Health impacts of co-exposure: heat and air pollution

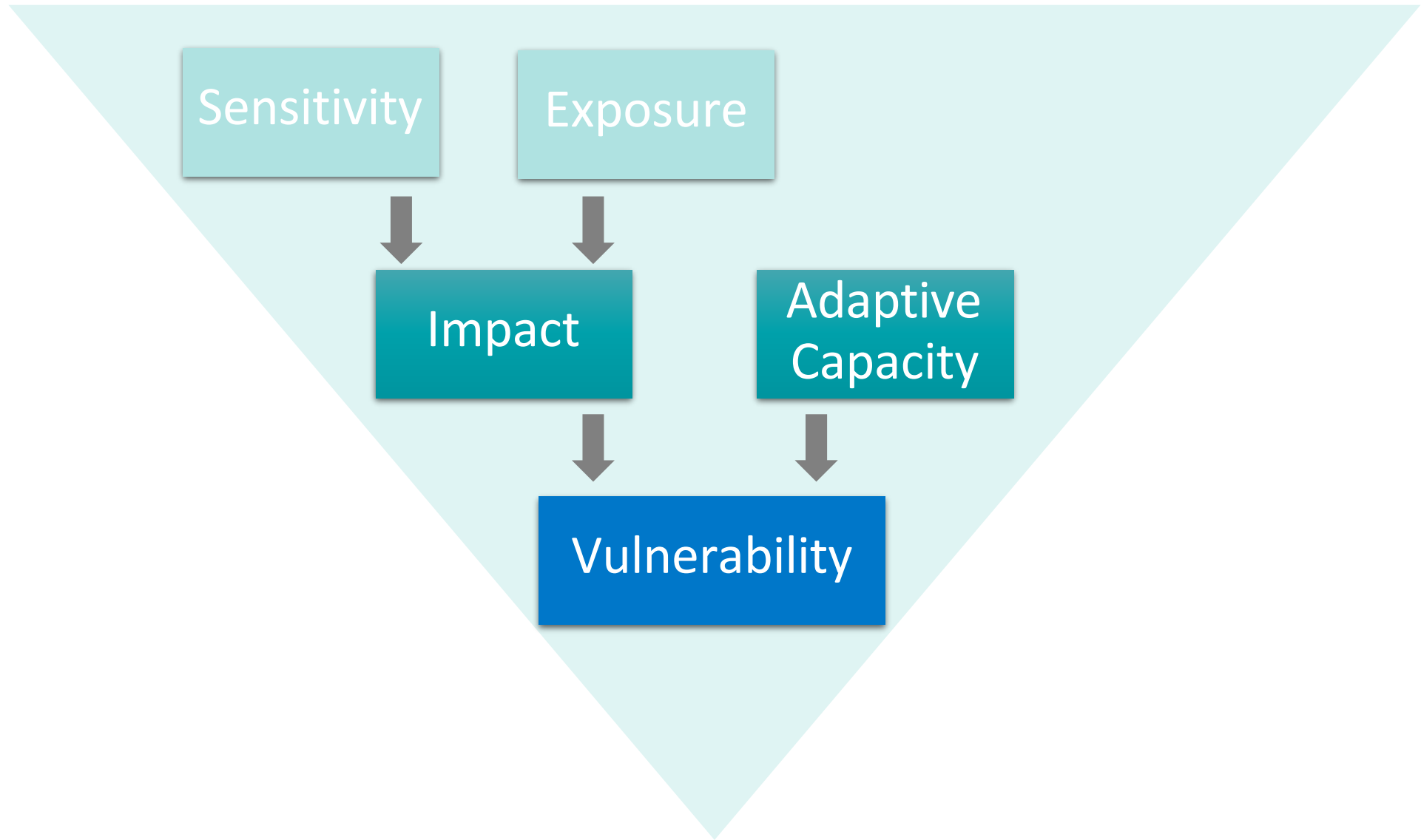
Case-crossover study 2014-2019 in CA, **mortality increase:**

- **Extreme temp** days - 6.1% [4.1–8.1]
- **Extreme PM_{2.5}** days - 5.0% [3.0–8.0]
- **Extreme temp + PM_{2.5}** days - 21.0% [6.6–37.3]
 - Cardiovascular mortality - 29.9% [95% CI, 3.3–63.3]
 - Respiratory mortality - 38.0% [-12.5 to 117.7]

Climate change Identifying risk



Identifying risk Vulnerability

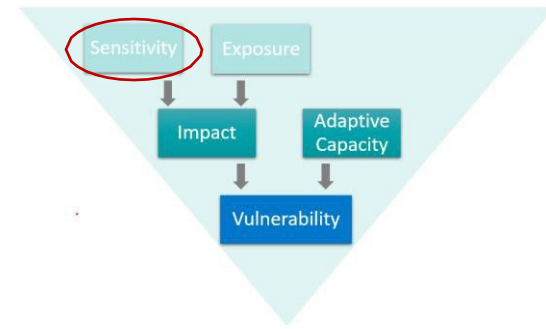


Medical factors

Sensitivity to heat

Comorbid conditions:

- CKD
- Asthma/COPD
- CVD
- Diabetes
- Neurologic disease (e.g., MS)
- Mental health disorders
- Alcohol/drug use
- (Pregnancy, age)



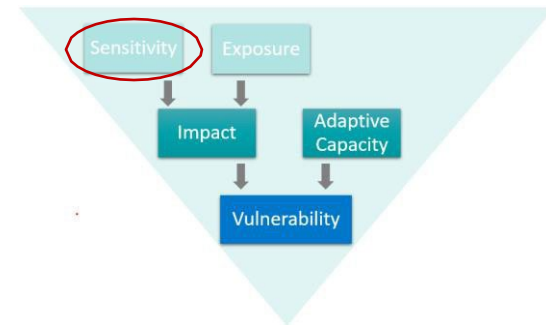
Medical factors

Sensitivity to heat

Medications:

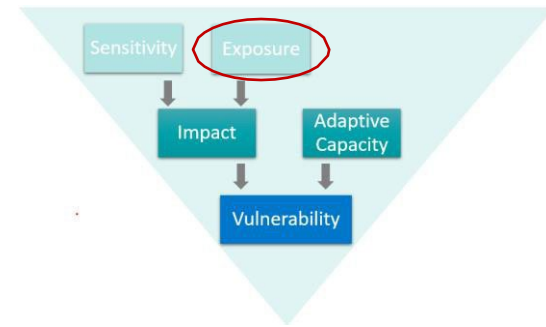
- Antipsychotics
 - Chlorpromazine, clozapine, olanzapine, quetiapine
- Hypnotics
- Antidepressants
 - SSRI, SNRI, TCA
- Diuretics
- Anticholinergics
- Other cardiovascular meds
 - ACEIs, ARBs, beta blockers

**No trials to guide decision-making re: medications*



Environmental and occupational history

Exposure to heat (pollution)



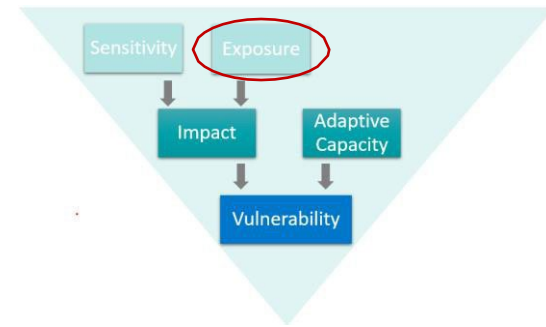
Note home location:

- Near refinery/factory
- Near major highways
- Not near green spaces
- Urban



Environmental and occupational history

Exposure to heat (pollution)



Note **job features**:

- Indoor or outdoor
- Dust/inhalant exposures

Outdoor examples:

- Firefighters/emergency responders
- Athletes
- Military
- Construction/landscapers
- Agricultural workers

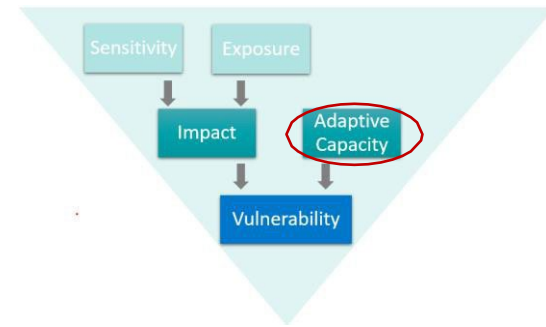
Indoor examples:

- Kitchen
- Construction
- Remote worker without A/C



Environmental and occupational history

Adaptive capacity



Note home **living arrangement**:

- Floor level
- Ventilation and affordable A/C
- Accessibility
- Live alone or have caregivers/dependents



Environmental and occupational history

1. “Do you have a way to stay cool on hot days, and warm on cold days?”
2. “What is your current (and longest-held) work, either in or out of the home?”



The built environment



Redlining



Low tree canopy



Urban heat islands



Indoor and outdoor air pollution



Chelsea demographics

- 67% Latina/o/x, 79% POC
- 70% speak non-English at home
- 18% (42% Latinx) below poverty level pre-pandemic (v. 11% MA)
- 45% Medicaid (v. 15% MA)
- 7% no insurance (v. 3% MA)



Case example: Chelsea's built environment



Redlining



Low tree canopy



Urban heat islands



Indoor and outdoor air pollution

Historically redlined community

- 2.2 sq. miles, 16,000 residents/mi²
- 10% crowded housing (v. 2% MA)
- Substandard housing with high flood risk, poor ventilation

Multiple industrial factories

- New England Produce Center
- Kayem meat-packing headquarters
- 4 petroleum co., 7 major oil storage terminals
- Waterfront salt piles

Car, ship, plane emissions

- Tobin Bridge (*85K vehicles/day*)
- Flight path for Logan
- Ports



Case example: Chelsea's built environment



Redlining



Low tree canopy



Urban heat islands



Indoor and outdoor air pollution

Benefits of tree canopy:

- Improved mental health and school performance
- Lower crime
- Improved air quality
- Decreased urban heat islands, soil erosion

- 3% of Chelsea land is parks/recreation (*national median 15%*).
- 750 Chelsea residents per acre recreational open space (*American Planning Association recommends 100 residents per acre*).



Case example: Chelsea's built environment



Redlining



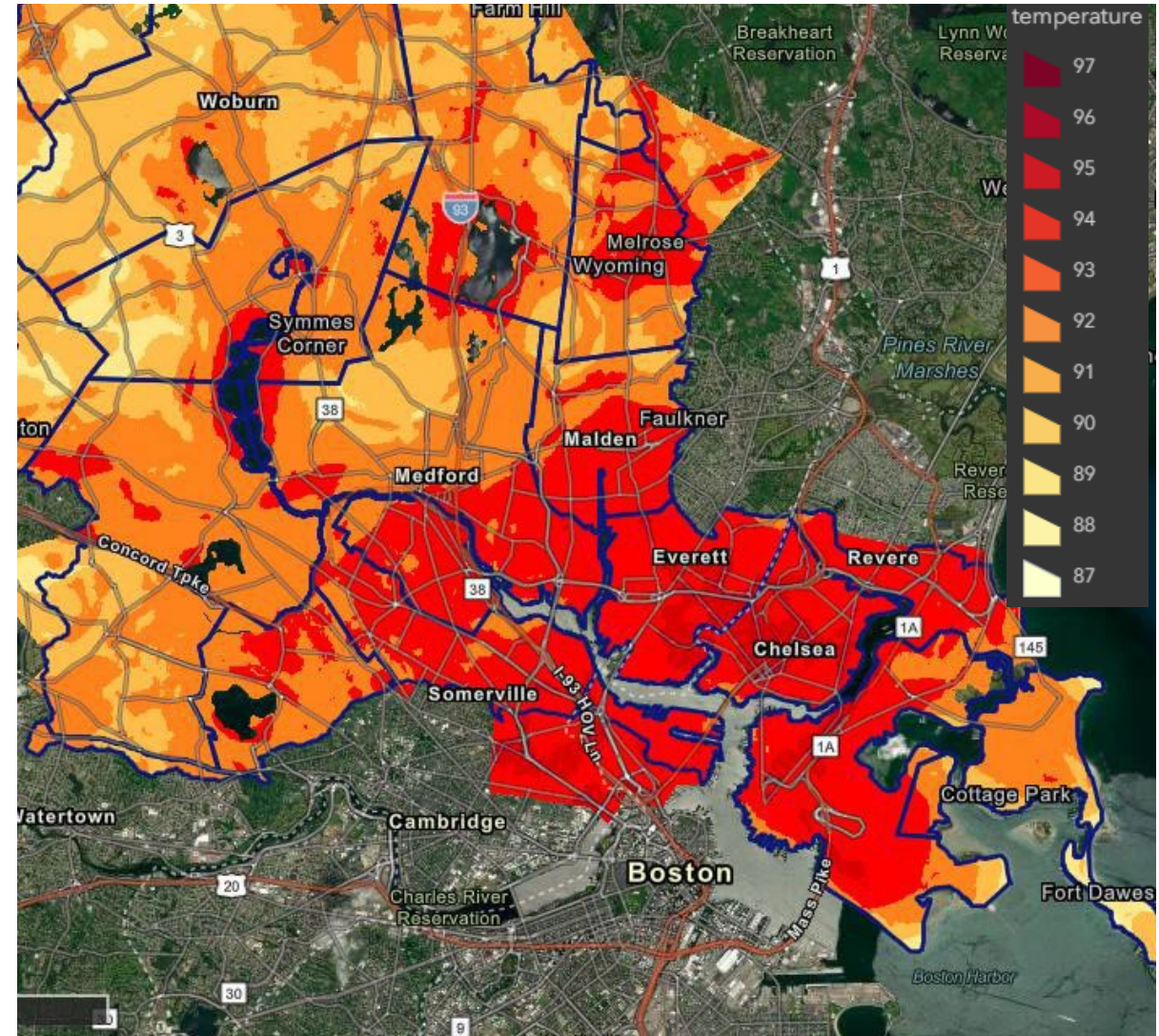
Low tree canopy



Urban heat islands



Indoor and outdoor air pollution



Case example: Chelsea's built environment



Redlining



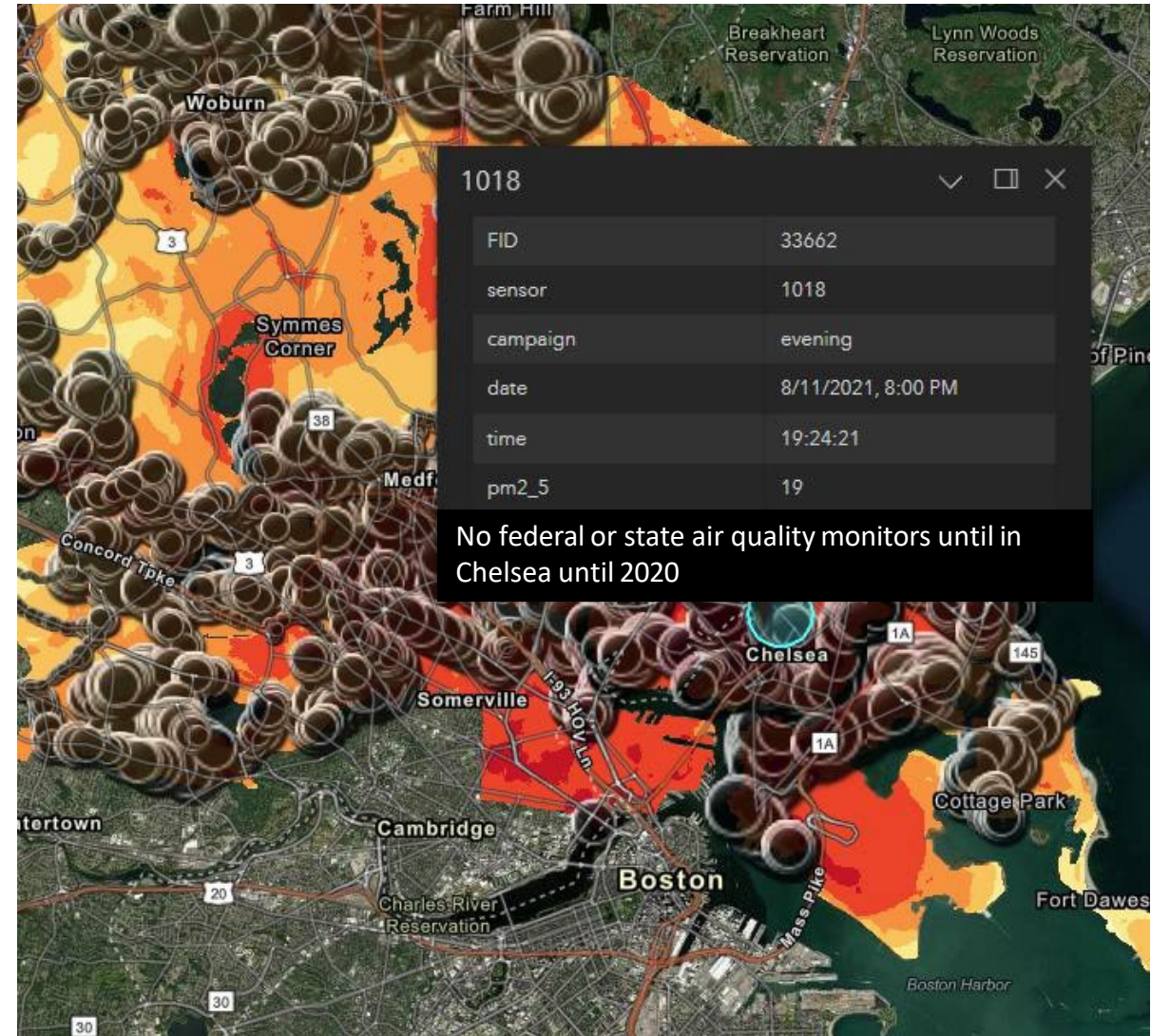
Low tree canopy



Urban heat islands



Indoor and outdoor air pollution



Climate change
Reducing risks, increasing resilience



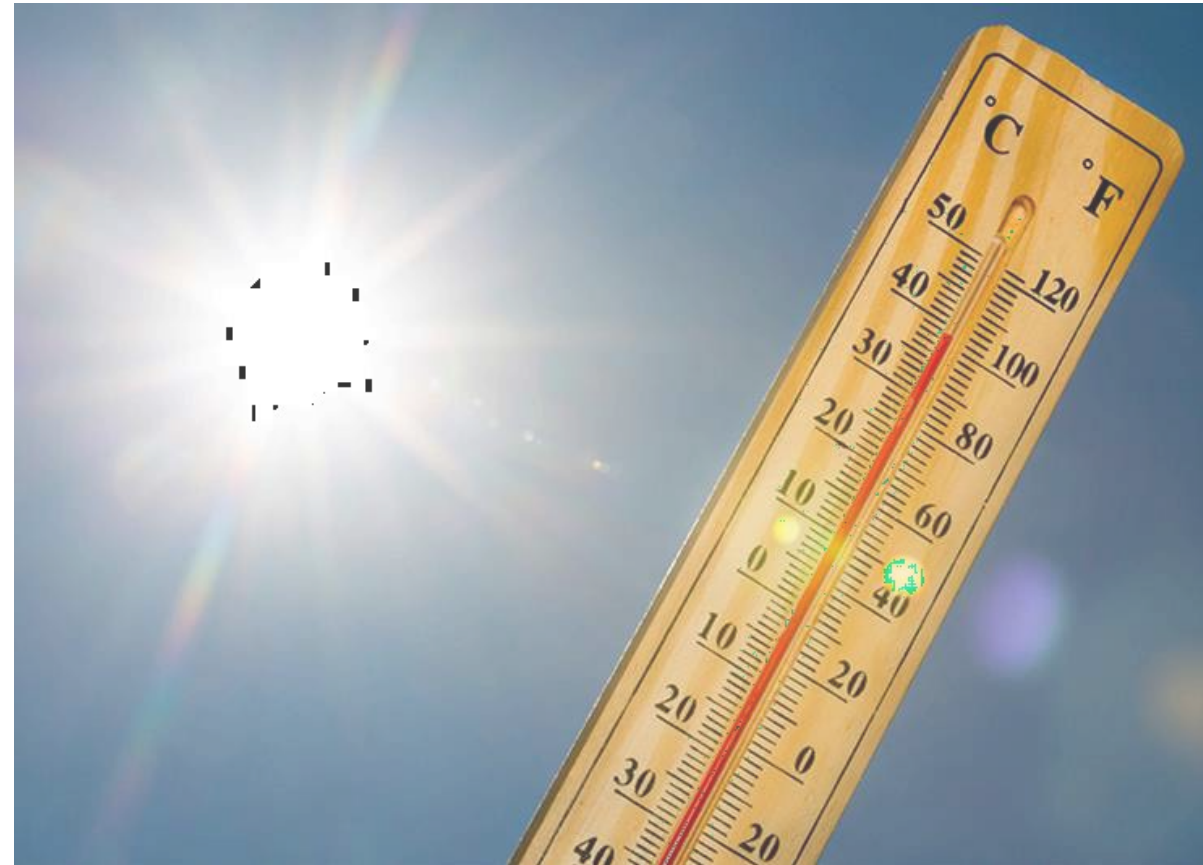
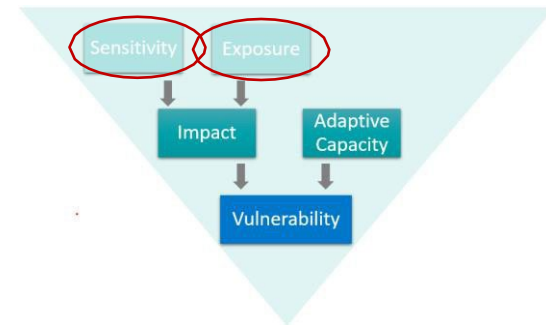
Interventions to reduce impact Heat

Decrease sensitivity

- Manage comorbidities
- Counsel medications

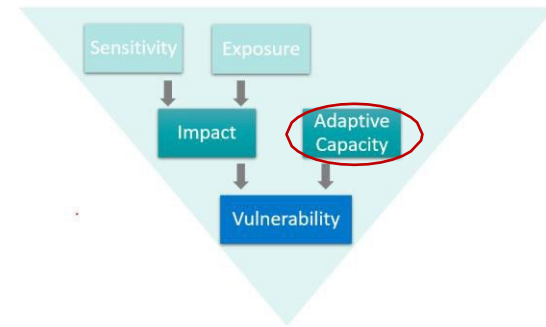
Decrease exposure

- Check forecast
- Limit outdoor activities, especially 11am-3pm
- Lightweight clothing
- Keep indoor temperatures <80°F (A/C, fan), or
- Move to cool location (until excessive heat warning expires)
- Avoid cooking with heat
- Cover windows from sun



Interventions to improve adaptive capacity

Heat



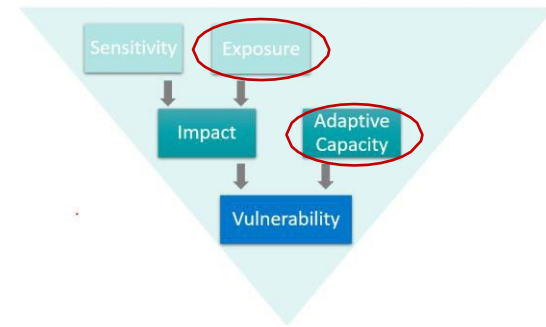
Improve adaptive capacity

- Advise thermostat
- Ensure cooling mechanisms are in place
- Confirm alternatives for shelter (family, friends, or public spaces)
- Counsel on cooling centers, public water facilities
- Ensure support systems
- Ensure accessible transportation



Interventions to decrease vulnerability

Indoor air pollution



Decrease exposure and sensitivity

- Avoid smoking or fireplace use
- Electrification (benefits to health immediate)



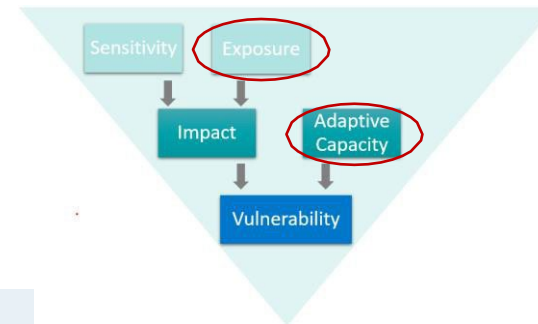
Improve adaptive capacity

- Use vents with cooking, fires
- Use air purifiers (HEPA filter) or A/C



Interventions to decrease vulnerability

Outdoor air pollution



Decrease exposure and sensitivity

- Modify activities based on AQI

Improve adaptive capacity

- Respirator (NIOSH-approved: N95 or P100)

Air Quality Index	Who Needs to be Concerned?	What Should I Do?
Good 0-50		It's a great day to be active outside.
Unhealthy for Sensitive Groups 51-100	Sensitive groups	Sensitive groups: Avoid prolonged or heavy exertion. Consider moving activities indoors or rescheduling to a time when air quality is better. Everyone else: Avoid prolonged or heavy exertion. Consider moving activities indoors or rescheduling to a time when air quality is better.
Unhealthy 101-150	Sensitive groups	Sensitive groups: Avoid all physical activity outdoors. Move activities indoors or reschedule to a time when air quality is better. Everyone else: Avoid prolonged or heavy exertion. Consider moving activities indoors or rescheduling to a time when air quality is better.
Very Unhealthy 201-300	Everyone	Everyone: Avoid all physical activity outdoors.
Hazardous 301-500	Everyone	Everyone: Remain indoors and keep activity levels low. Follow tips for keeping particle levels low indoors.



Interventions Education

[Climate Resilient Health Clinics | AmeriCares](#)



Providers	Patients	Administrators
Heat		
Wildfires		
Hurricanes		
Floods		
General Guidance		

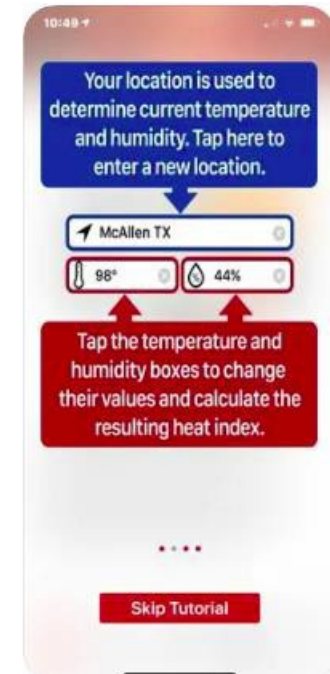
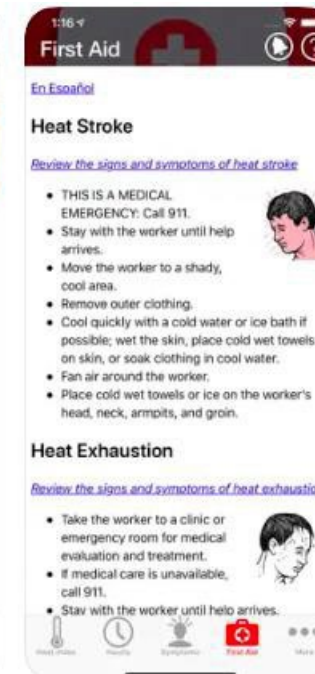


Adaptive Capacity Resources

- Warning systems
- Cooling centers
- Utility fees
- A/C
- N95 respirator
- Air purifier
- Housing inspections
- Medicolegal partnerships
- Electrification

OSHA-NIOSH Heat Safety Tool for workers and supervisors:

<https://www.osha.gov/heat/heat-app>



- Download for iPhone or Android
- English and Spanish
- Calculates heat index
- Displays risk level
- Reminders on protective measures

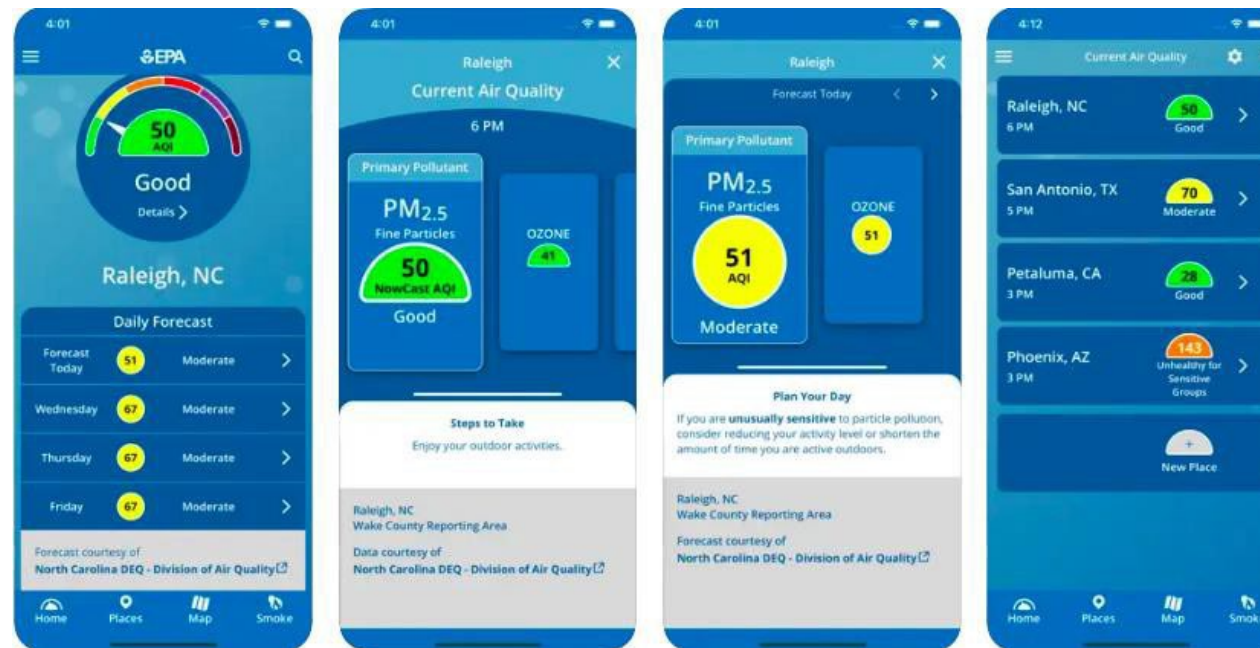


Adaptive Capacity Resources

- **Warning systems**
- Cooling centers
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- Electrification

EPA AirNow mobile app:

<https://www.airnow.gov/airnow-mobile-app/>



- Download for iPhone or Android
- English (not in Spanish, see PCOI)



Adaptive Capacity Resources

- Warning systems
- **Cooling centers**
- Utility fees
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Boston.gov (<https://www.boston.gov/departments/emergency-management/keeping-cool-heat>)

PLACES TO STAY COOL



Boston Centers for Youth & Families (BCYF) cooling centers

BCYF community centers become cooling centers during periods of extreme heat.



Pools and Tot Sprays map

View a map of places to cool down in the City of Boston.



State-owned pools

The Massachusetts Department of Conservation and Recreation owns and operates pools and spray decks in and around Boston.

Adaptive Capacity Resources

- Warning systems
- Cooling centers
- **Utility fees**
- A/C
- N95 respirator
- Air purifier
- Housing inspections
- Medicolegal partnerships
- Electrification

- [LiHEAP](#) (Low-Income Home Energy Assistance Program)
 - Federal funds for households with:
 - High home energy burden (% income that goes to energy bills)
 - < 60% income state area median
 - Same eligibility to prevent heat shut off
 - Members who are elderly, disabled, or young children
 - Residents who qualify for LiHEAP also qualify for weatherization, energy assessment, and minor energy-related home repairs
 - May not be year-round, eg Nov-April for heat; not cooling
 - Federal program requires SSN (any household member)
 - Undocumented residents encouraged to apply (donor funds)



Adaptive Capacity Resources

- Warning systems
- Cooling centers
- Utility fees
- **A/C**
- **N95 respirator**
- **Air purifier**
- Housing inspections
- Medicolegal partnerships
- Electrification

- HHS OCCHE (Protecting Vulnerable Patient Populations from Climate Hazards)
 - Need SSN
- Medicaid's Flexible Services Program
 - Includes home modifications
 - Requires risk of homelessness or nutritional deficiency
- Elder Services
 - E.g., >60 y.o. or younger with disability
 - Case by case for in-house privately raised funds



Adaptive Capacity Resources

- Warning systems
- Cooling centers
- Utility fees
- A/C
- N95 respirator
- Air purifier
- **Housing inspections**
- **Medicolegal partnerships**
- Electrification

- City housing inspection services
 - Enforce building, health, sanitation, safety regulations
 - Barriers include:
 - Lack of cooling requirements in codes (vs heating, ventilation)
 - Unofficial living agreements
- Medicolegal partnerships (MLP)
 - Allies healthcare providers with lawyers to address basic needs (housing, food, education, healthcare, stability)
 - National Center for MLP



Adaptive Capacity Resources

- Warning systems
- Cooling centers
- Utility fees
- A/C
- N95 respirator
- Air purifier
- Housing inspections
- Medicolegal partnerships
- **Electrification**

- **Local retrofit programs; Rebates and incentives**
 - **Healthy and Green Retrofit Pilot Program** (Boston)
 - Lottery for building owners of 2–4-unit homes
 - \$50,000 forgivable loans to electrify/decarbonize
 - Energy assessment, advisor, management/oversight construction
 - **Large Building Green Energy Retrofits Program** (Boston)
 - Large, aging, affordable housing developments
 - \$10 million funding ARPA, \$50,000 per unit
 - **Mass Save incentives**
 - MA homeowner/renter: electrification, weatherization
- **Green and Resilient Retrofit Program** (IRA, Dept of Housing and Urban Development or HUD)
 - Improving Energy Efficiency or Water Efficiency or Climate Resilience of Affordable Housing
 - \$837 million in grants, \$4 billion in loans for owners of properties: multifamily Section 8, Low-income Elderly, Low-income Persons with Disabilities
- **Non-profit community organizations; Education and toolkits**
 - Clean Water Action
 - Climate and clean energy campaign
 - Weatherization and high-efficiency heating/cooling for renters, landlords, low- and moderate-income households, language-isolated households, and small businesses
 - Rewiring America
 - Mothers Out Front



Adaptive Capacity Resources

- Warning systems
- Cooling centers
- Utility fees
- A/C
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- Housing inspections
- Medicolegal partnerships
- Electrification



Ambulatory referral to MGH EQUITY COMM HLTH ✓ Accept ✗ Cancel

Class: Internal Referral Internal Referral

Referral: Priority: Within 3 days (urgent) Within 2 weeks Within 1 month
Elective

To Provider:

To Provider Specialty:

Process Instructions: Community Health Workers are able to accept referrals for patients from MGH Chelsea, Revere, Charlestown and Everett as there is capacity. Patient referrals will be reviewed, and status updates will be provided.

Referring Patient to: SDH Navigation CHW Care Coordination CHW Chronic Disease Management

SDH Navigation Food Housing Utilities Transportation Legal Child Care Elder Care Disability Care Connection Insurance Paying for Medications Pharmacy Adult Education/Job Search Primary Care Connection Behavioral Health Connection Financial Benefits Digital access – internet Digital access – device Other (please specify)

- Collaborative team approach
 - Community Health Workers
 - APPs
 - Mobile vans
 - Community organizations
- Trainee curricular programs
- IRA funds

Climate change Advocacy



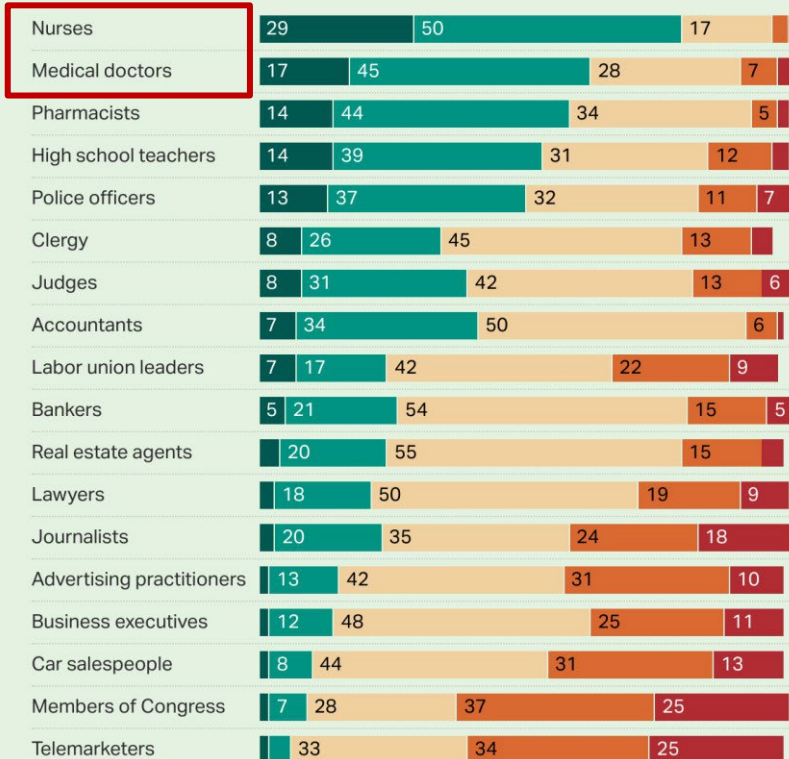
A word about advocacy

Using your trusted voice

Americans' Ratings of Honesty and Ethics of Professions

Please tell me how you would rate the honesty and ethical standards of people in these different fields -- very high, high, average, low or very low?

■ % Very high ■ % High ■ % Average ■ % Low ■ % Very low



Those with no opinion are not shown.

NOV. 9-DEC. 2, 2022

GALLUP



A word about advocacy

Find your people

