Environmental Health Nexus Webinar

Climate Change and Health:

The Risks to Community Health and Healthcare Utilization

EH Nexus Webinar | March 17, 2022

Division of Environmental Health Science and Practice
National Center for Environmental Health

EH Nexus Webinar

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cdc.gov/nceh/ehsp/ehnexus

Webinar Logistics

All attendees are muted.
To adjust your audio settings in the webinar, click on **Audio Options**.

Please use the **Q&A window** to ask questions of the panelist.

Opening Remarks

Patrick Breysse, Ph.D., CIH
Director, National Center for Environmental Health
Agency for Toxic Substances and Disease Registry
Centers for Disease Control and Prevention

Suma Nair, Ph.D., M.S., RD
Director, Office of Quality Improvement
Health Resources and Services Administration
Bureau of Primary Health Care

Today's Presenters

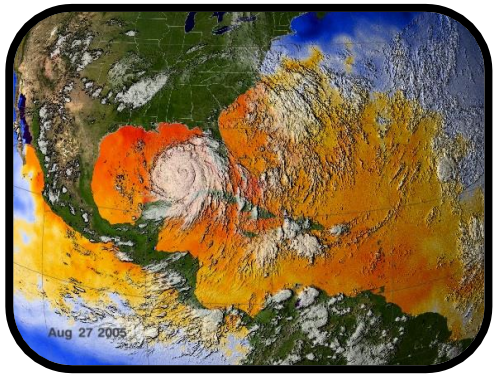
Arie Ponce Manangan, M.A.
Health Scientist

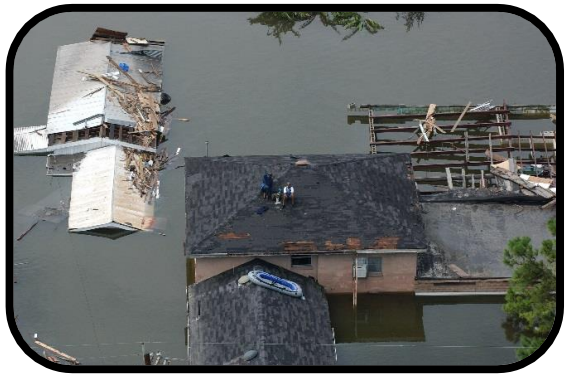
Elizabeth (Beth) Gillespie, M.D., FACP
Guest Researcher

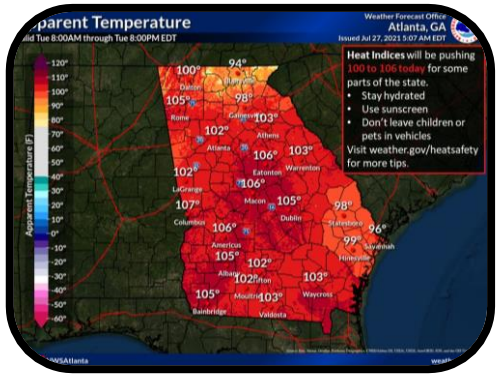
Climate and Health Program
Division of Environmental Health Science and Practice
National Center for Environmental Health
Centers for Disease Control and Prevention

Climate Change and Health

The Risks to Community Health and Health Care Utilization







Arie Manangan, M.A. (Health Scientist)

Climate and Health Program, Division of Environmental Health Science and Practice, (DEHSP), National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention (CDC)

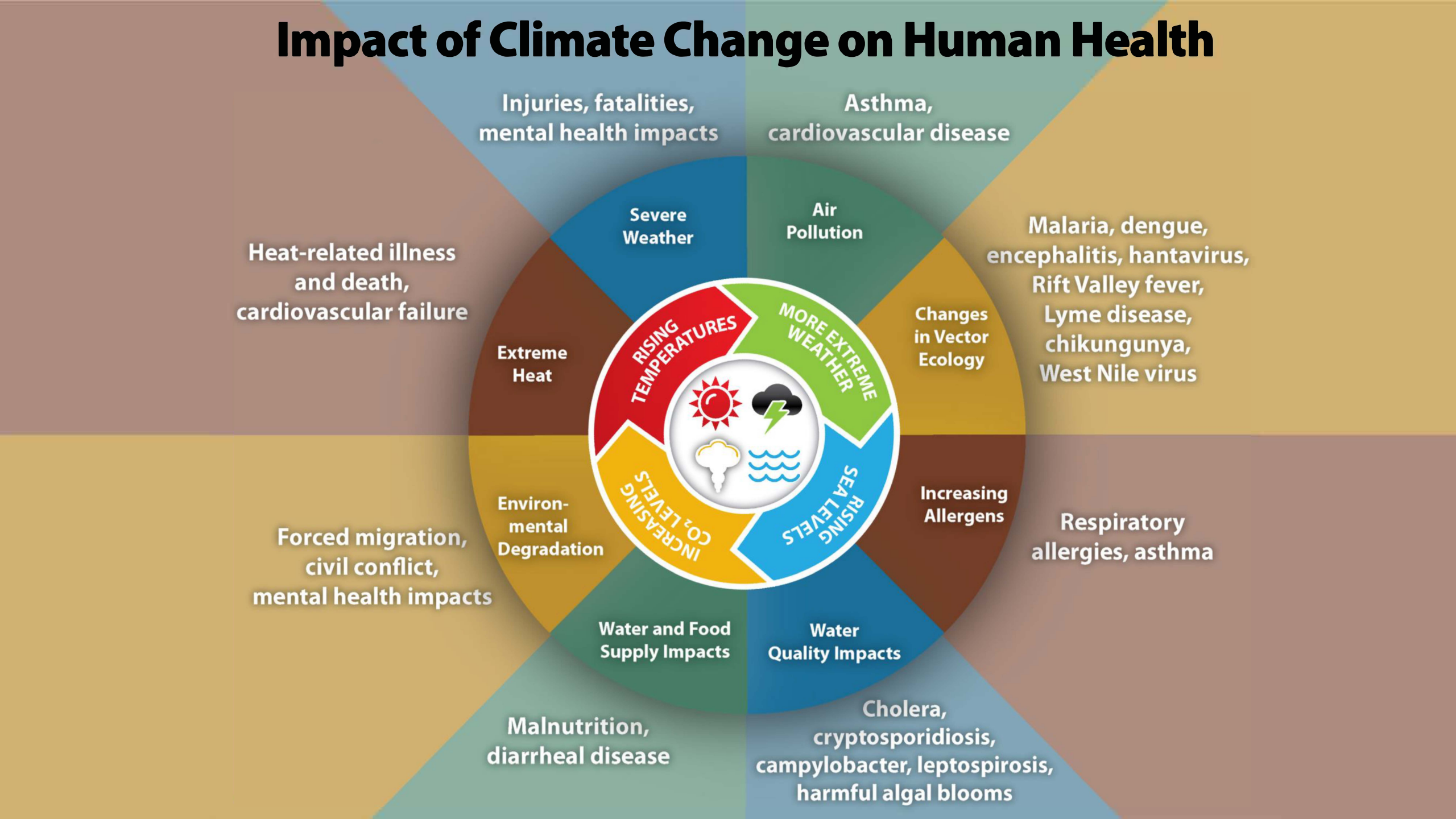
Elizabeth Gillespie, M.D., FACP (Academic Hospitalist)

Denver Health and Hospital Authority, University of Colorado School of Medicine
Climate and Health Program, Division of Environmental Health Science and Practice, (DEHSP), National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention (CDC)

Learning Objectives

- **Building Climate Resilience with the CDC's Climate and Health Program**
- **Climate-Related Hazards and Potential Health Effects**
- **Disproportionately Affected Populations and Under-Resourced Communities**
- **Utilizing Electronic Health Records to Characterize Individual and Community Health Risk**

Impact of Climate Change on Human Health



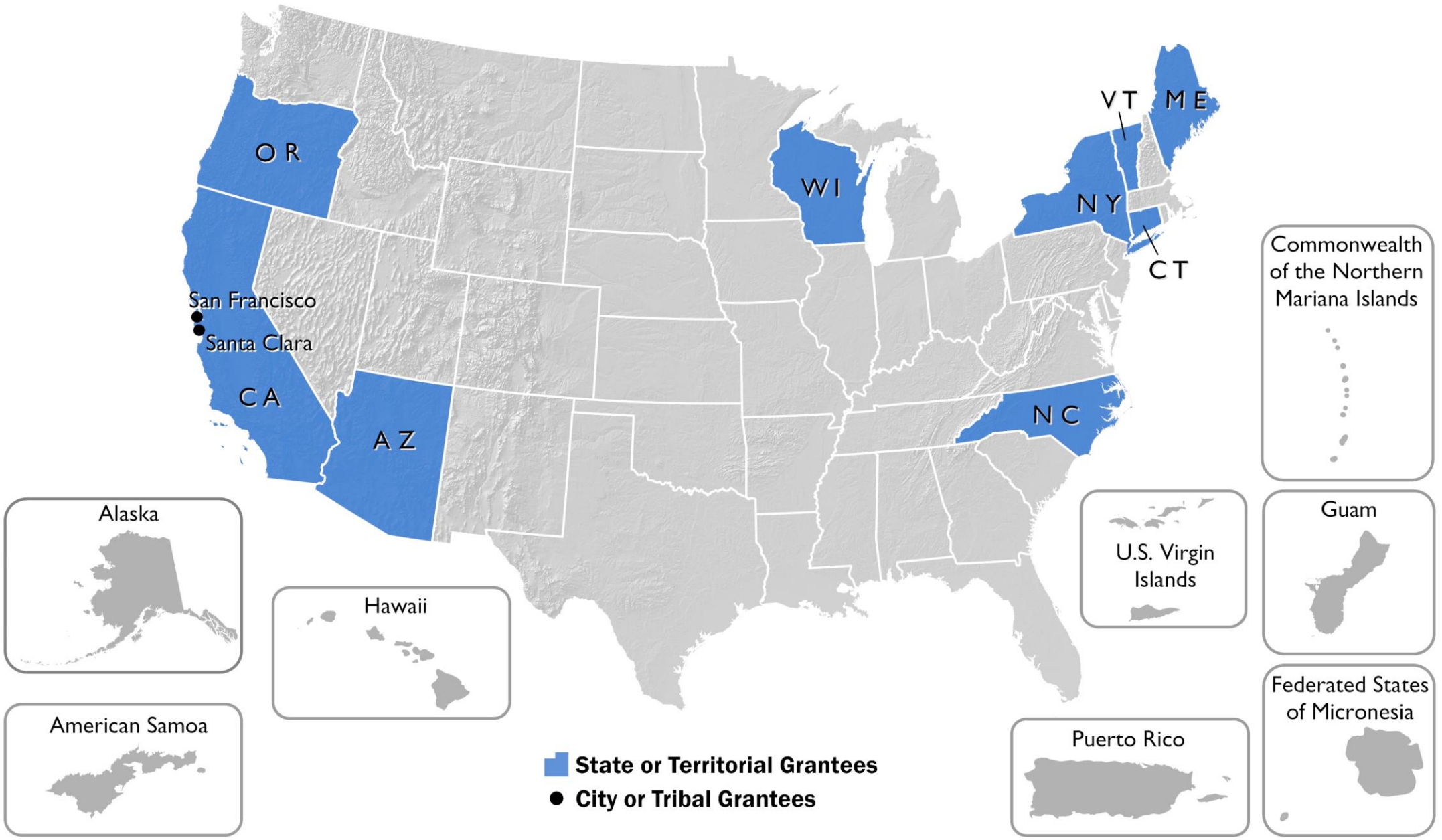
CDC's Climate and Health Program

- Funded by Congress in 2009
- **Serve as a resource** for federal, state, local, territory, and Tribal health agencies
- **Prepare public health practitioners** to address the health effects of climate change
- **Provide tools, guides, and processes** to help assess vulnerability to possible health effects
- **Serve as a leader** in planning for public health effects of climate change

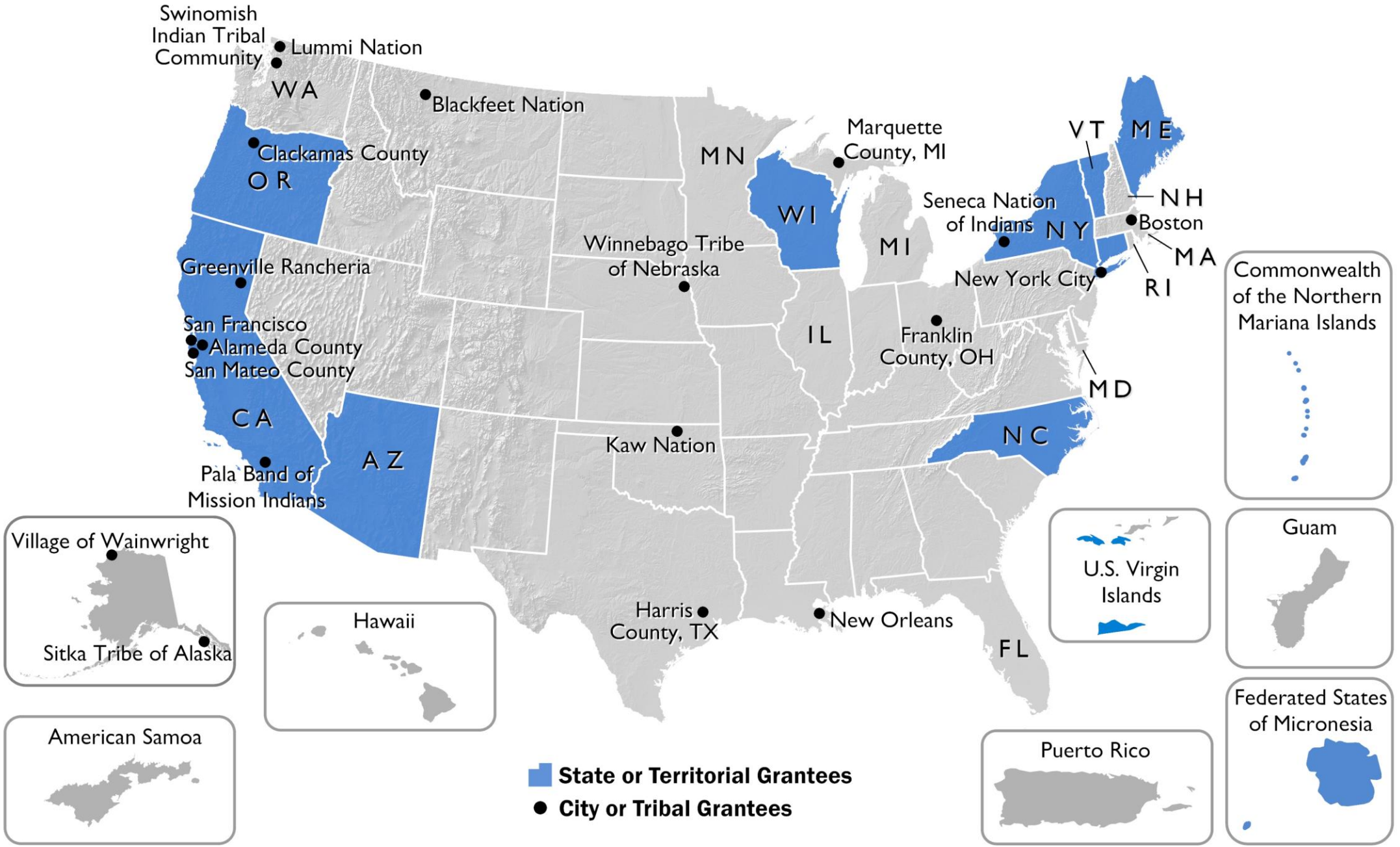
Climate Ready States and Cities Initiative

- **9 states and 2 cities currently funded**
- **5 step framework: Building Resilience Against Climate Effects (BRACE)**
- **New notice of funding opportunity awarded September 2021**
  - Builds on previous work
  - Emphasizes adaptation actions and evaluation
  - Health equity is a centerpiece

Current Climate and Health Grantees



Previous Climate and Health Grantees



CDC's Framework for Climate & Health Adaptation

BUILDING RESILIENCE AGAINST CLIMATE EFFECTS

1

Anticipate Climate Impacts and Assess Vulnerabilities

2

Project the Disease Burden

3

Assess Public Health Interventions

4

Develop and Implement a Climate and Health Adaptation Plan

5

Evaluate Impact and Improve Quality of Activities

AFFECTING HEALTH DIRECTLY

AIR POLLUTION

Increased wildfires, smog, pollen, and mold can lead to:

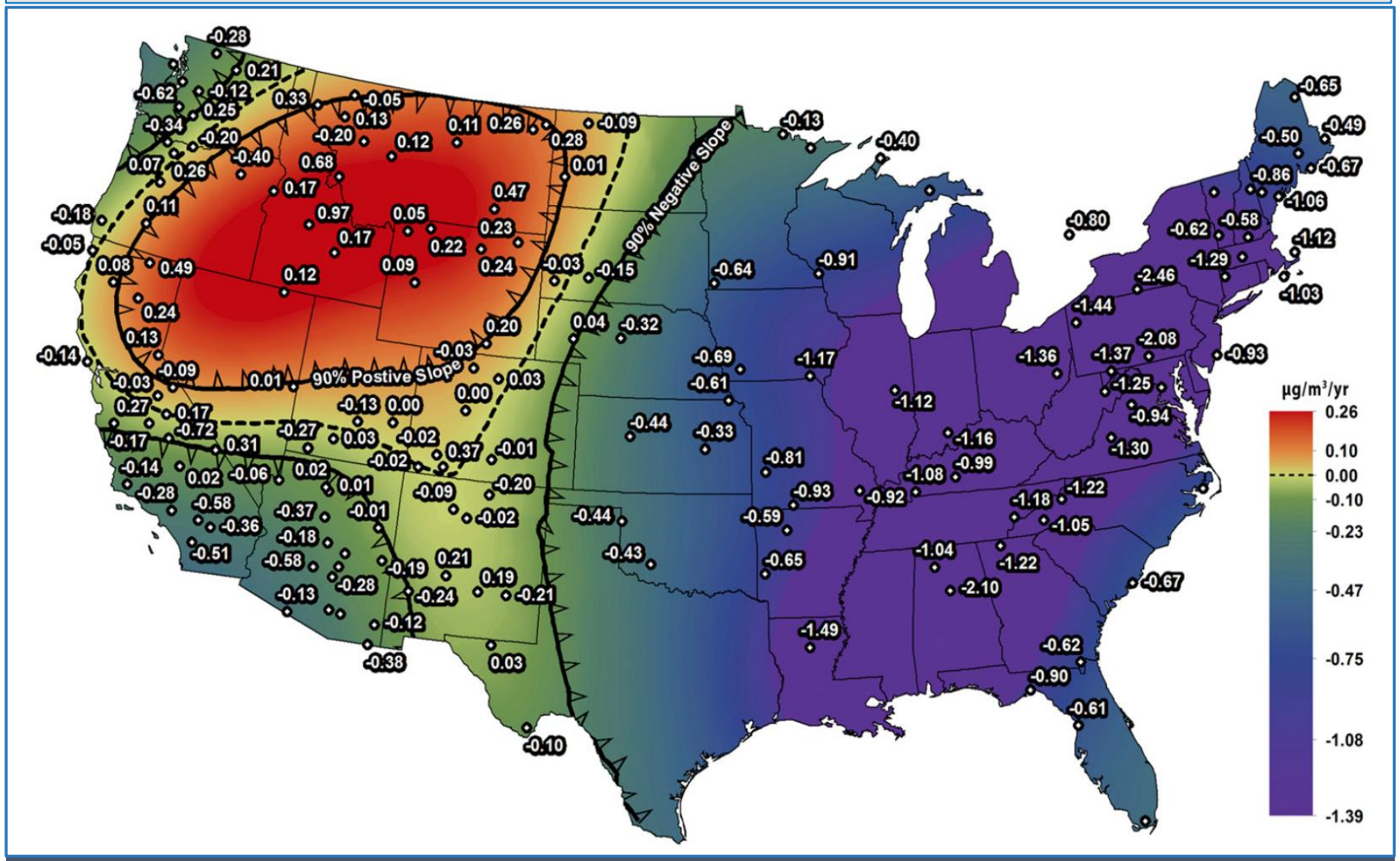
Asthma and Allergy attacks

People who are at higher risk: People with heart and respiratory conditions such as heart disease, asthma, or chronic lung disease

Mortality Burden Associated with Wildfire Smoke Exposure in the Western United States

Wildfires and Air Quality

Historical (1988–2016) $PM_{2.5}$ Trends

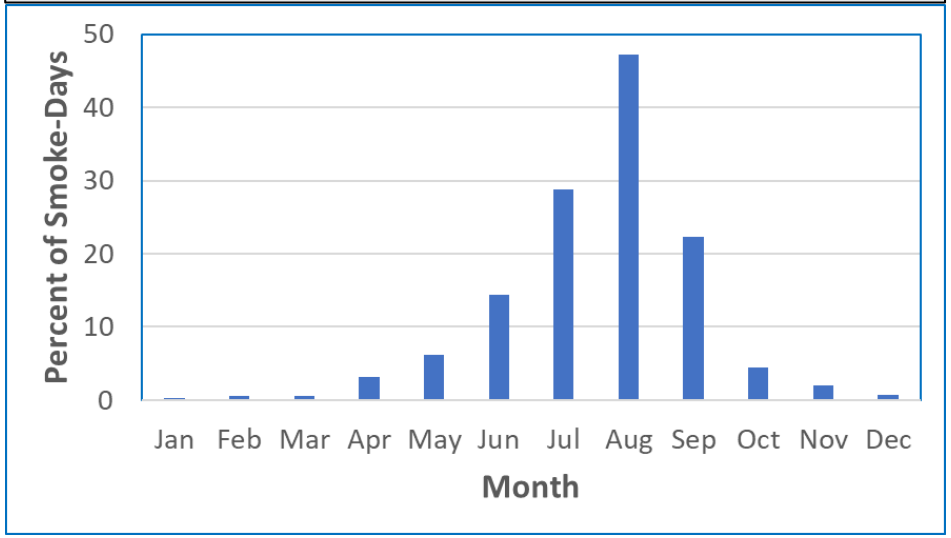


Source: L McClure CD and Jaffe DA. PNAS 115 (31): 7901–7906, 2018

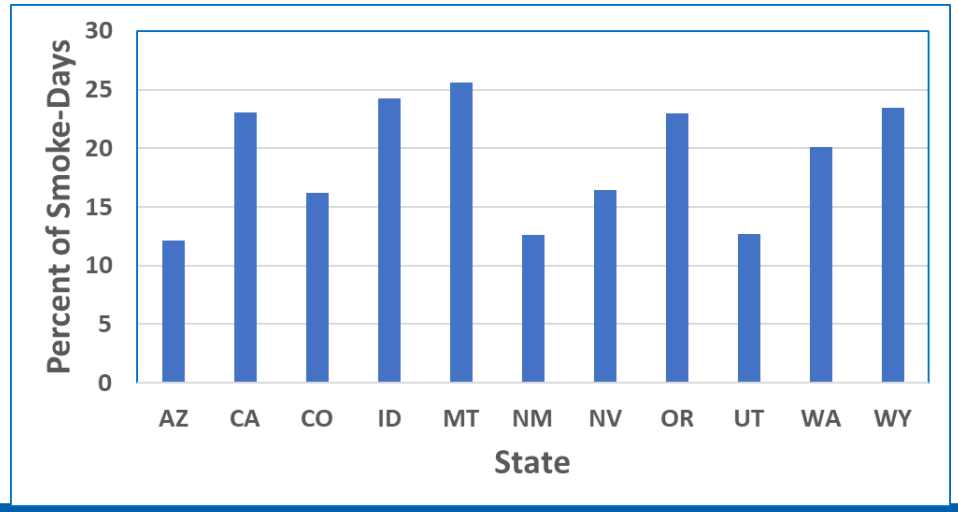
Increase in $PM_{2.5}$ annual concentration attributed to an increase in wildfire emissions

Smoke Exposure Summary

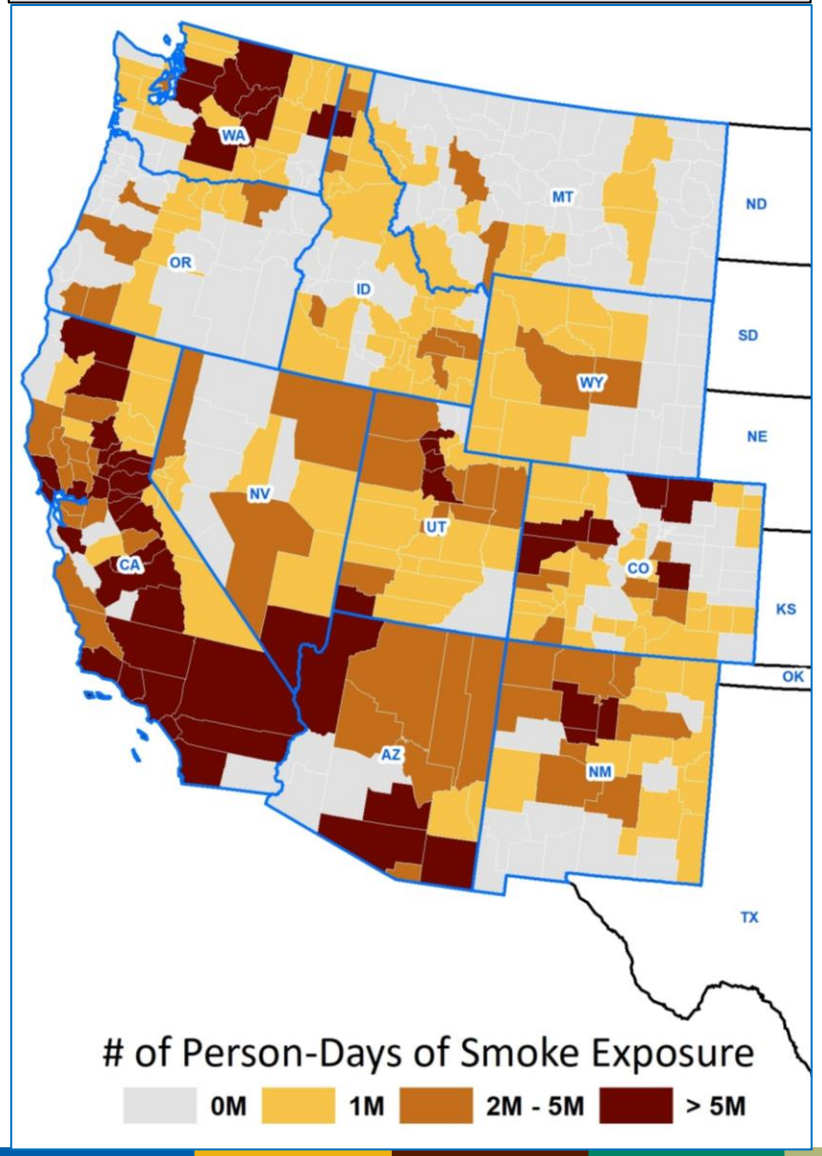
Distribution of Smoke-Days, by Month



Percent of Smoke-Days, by State (May–Nov.)



Population-level Exposure



DISRUPTING WELL-BEING

MENTAL HEALTH PROBLEMS

Increased frequency and severity of extreme weather events can lead to

Stress, depression, anxiety, PTSD, and suicidal thoughts

People who are at higher risk: Children, older adults, pregnant and postpartum women, people with mental illnesses, people with lower incomes, people experiencing homelessness, first responders, and people who rely on the environment for their livelihood

SPREADING DISEASE

INSECTS, TICKS, AND RODENTS

Higher temperatures, changes in rain patterns, and disrupted ecosystems help spread

Diseases carried by insects, ticks, and rodents

People who are at higher risk: People who spend more time outdoors in places where these insects and other disease-carriers live

AFFECTING HEALTH DIRECTLY

EXTREME WEATHER

Increased frequency and severity of heavy downpours, floods, droughts, and major storms can lead to

Injury, Illness, Displacement, and Death

People who are at higher risk: People who lack access to evacuation routes and people who cannot use stairs when elevators are out of service, people in wheelchairs, older adults, people with lower incomes, and people with disabilities, particularly if they are unable to access elevators and evacuation routes

SPREADING DISEASE

CONTAMINATED WATER

Higher water temperatures, heavier downpours, rising sea levels, and more flooding help spread

Gastrointestinal illness, Diseases from toxins in swimming areas and drinking water

People who are at higher risk: Children, the elderly, people with weakened immune systems, people in remote or under-resourced communities with inadequate water systems, and people in communities that are dependent on fish and shellfish

Climate Change is Expected to Make Hurricanes

More Powerful due to warming ocean temperatures

More Damaging due to sea-level rise

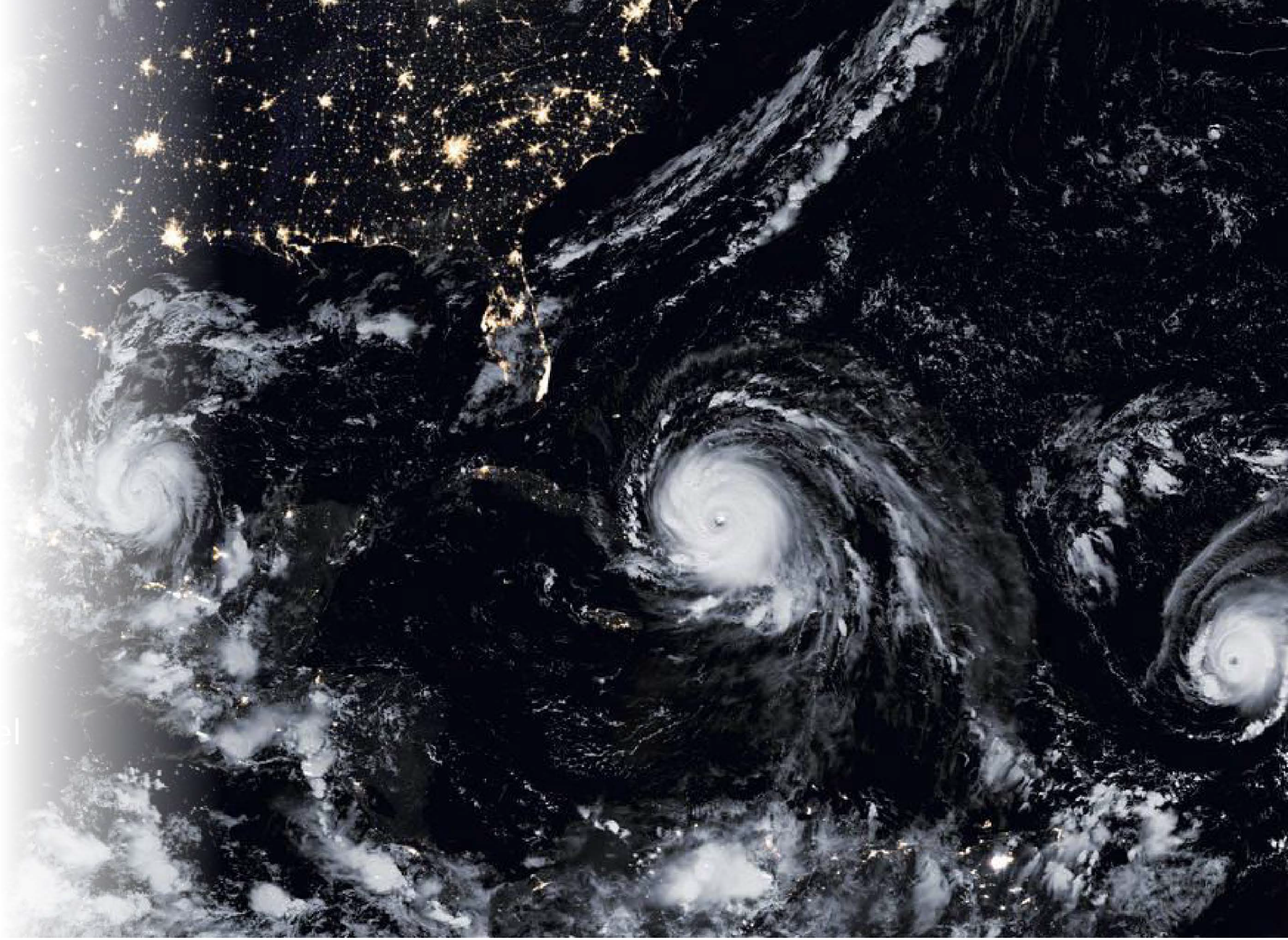
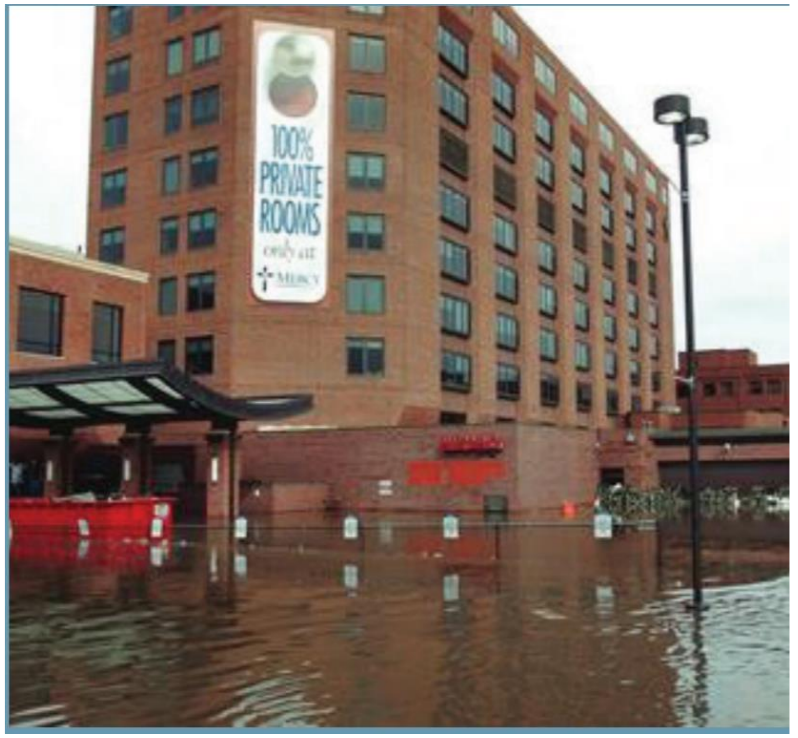


Image Credit: NASA Earth Observatory images by Joshua Stevens and Jesse Allen, using VIIRS day-night band data from National Polar-orbiting Partnership and Terra MODIS data from the Land Atmosphere Near real-time Capability for EOS (LANCE)

Flooding and Healthcare Infrastructure

A national assessment of flooding risk to medical infrastructure: hospitals, nursing homes, pharmacies, dialysis clinics

Source: HHS

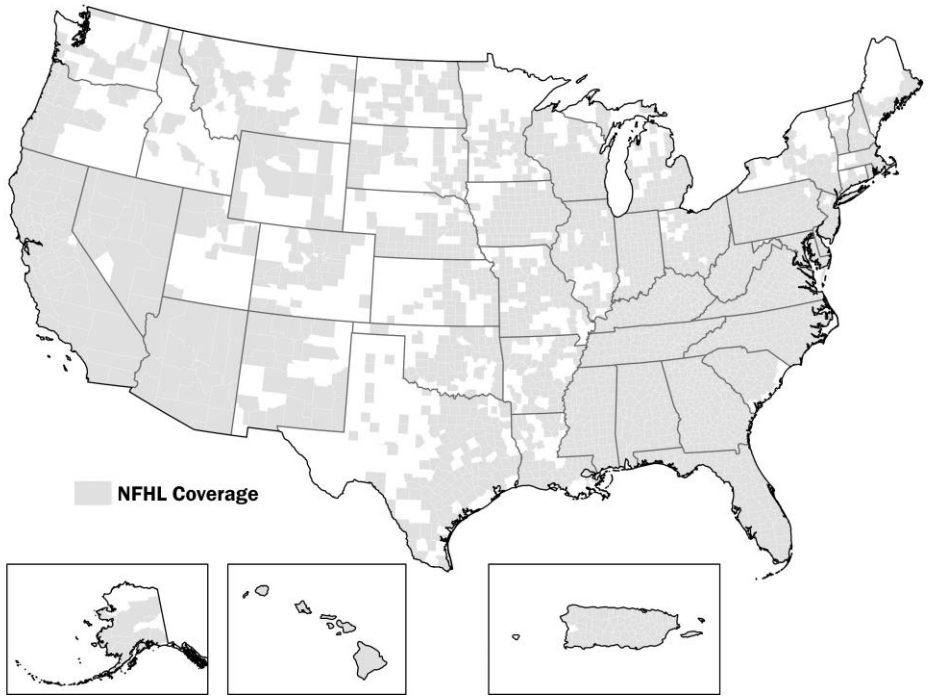


Source: HHS; The Cedar Rapids Gazette

Flood Hazard Data: FEMA National Flood Hazard Layer (NFHL) and EPA EnviroAtlas

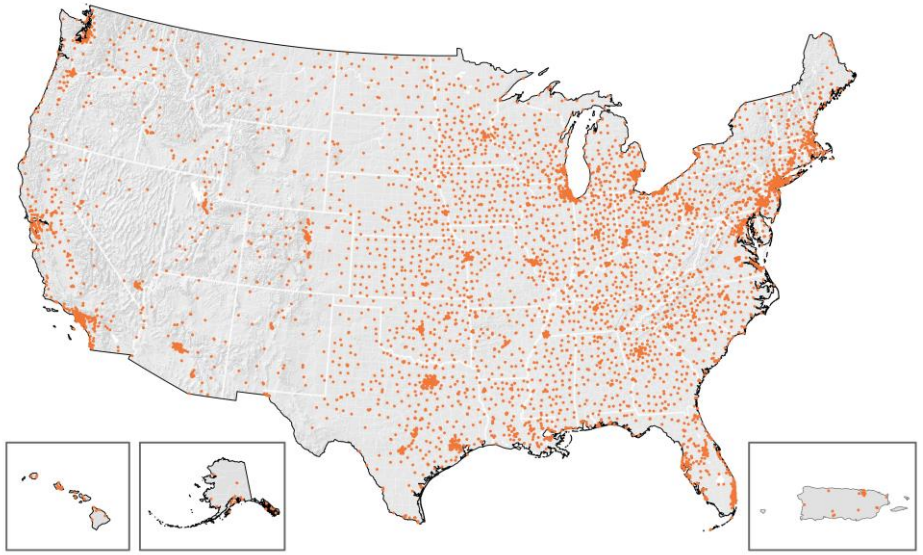
- FEMA NFHL - current effective flood hazard data
  - 100-year and 500-year floodplains
  - Partial coverage
  - AK, HI, PR

- Supplement NFHL with EPA EnviroAtlas Floodplain Data
  - Full CONUS coverage
  - 100-year floodplain

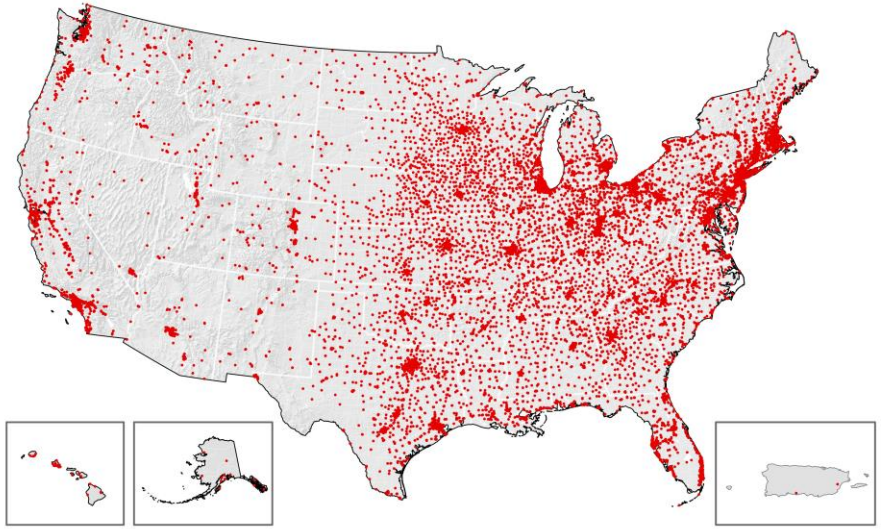


Sources
FEMA NFHL: https://www.fema.gov/national-flood-hazard-layer-
EPA: https://www.epa.gov/enviroatlas

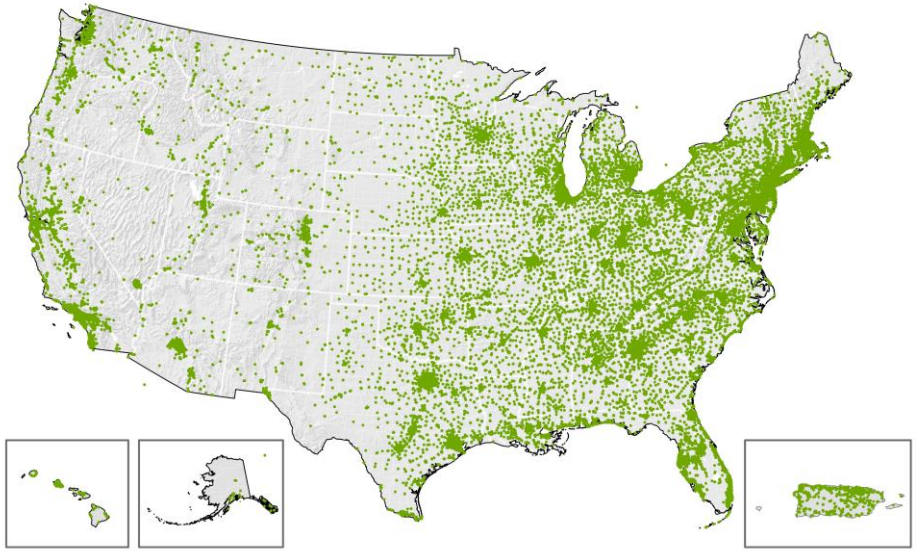
Medical Infrastructure Data



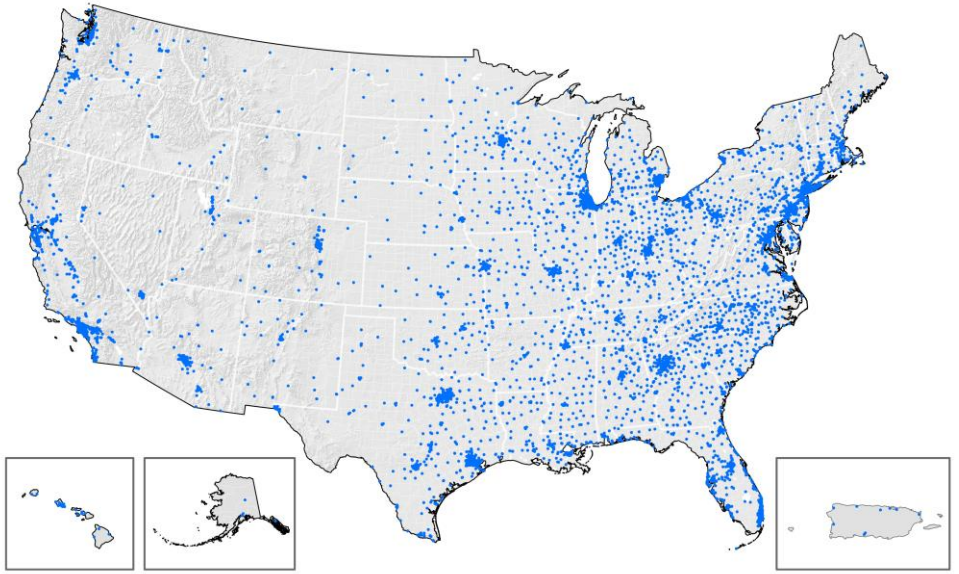
Hospitals: American Hospital Association



CMS: Nursing homes

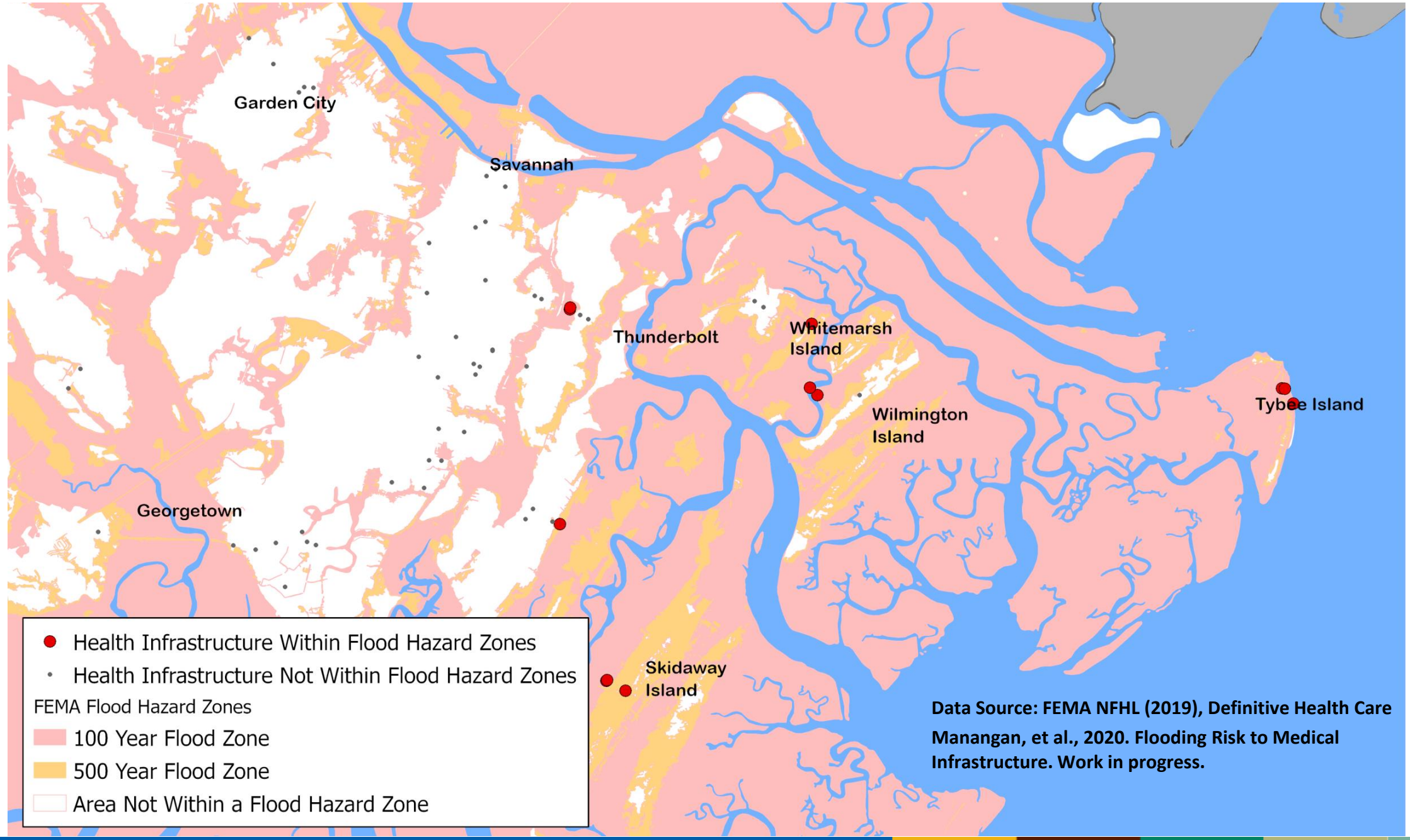


Pharmacies: OpenRX



CMS: Dialysis clinics

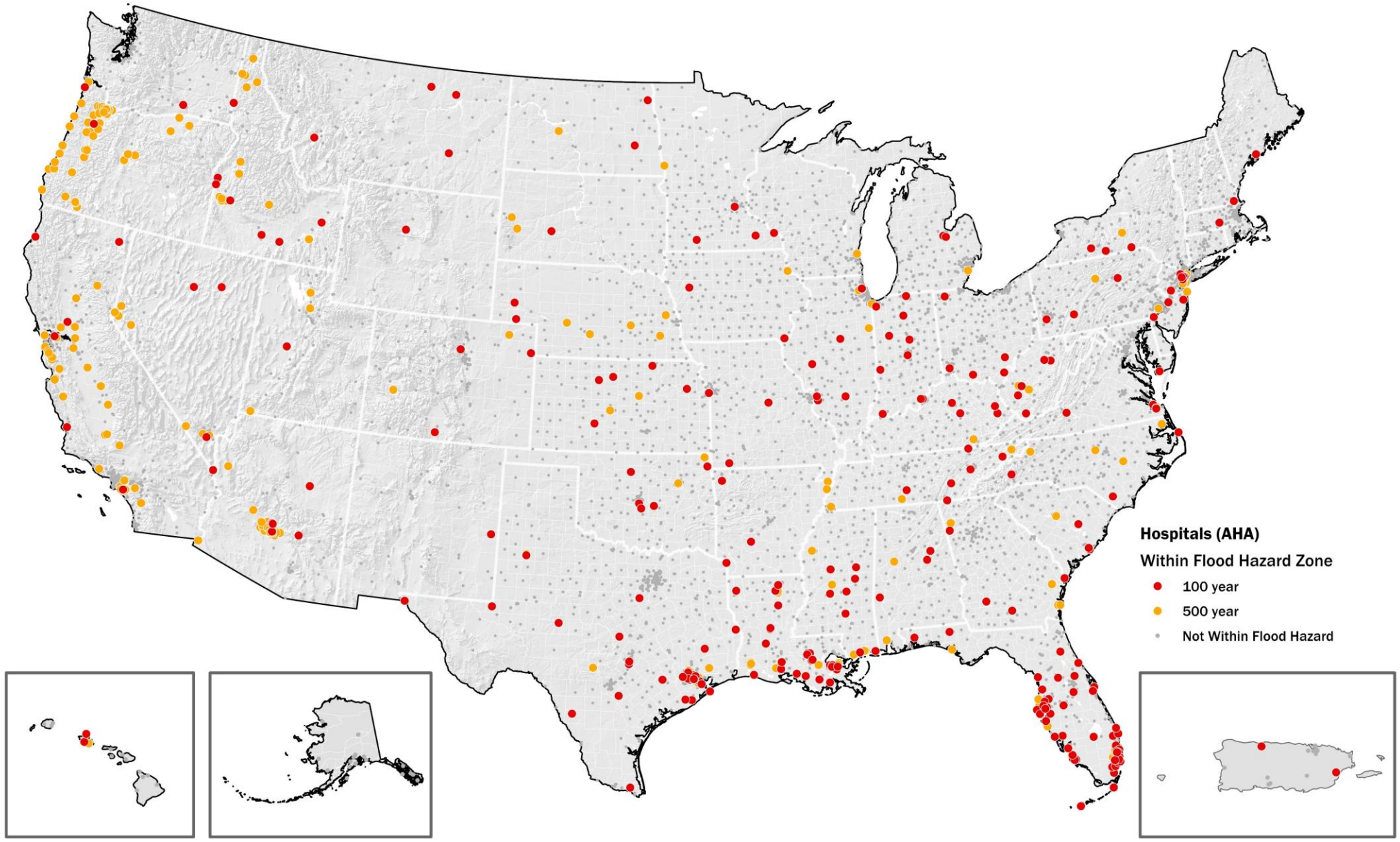
Medical Infrastructure Within Flood Hazard Zones (Savannah, Georgia)



Data Source: FEMA NFHL (2019), Definitive Health Care

Manangan, et al., 2020. Flooding Risk to Medical Infrastructure. Work in progress.

Flooding Risk to Medical Infrastructure: Hospitals

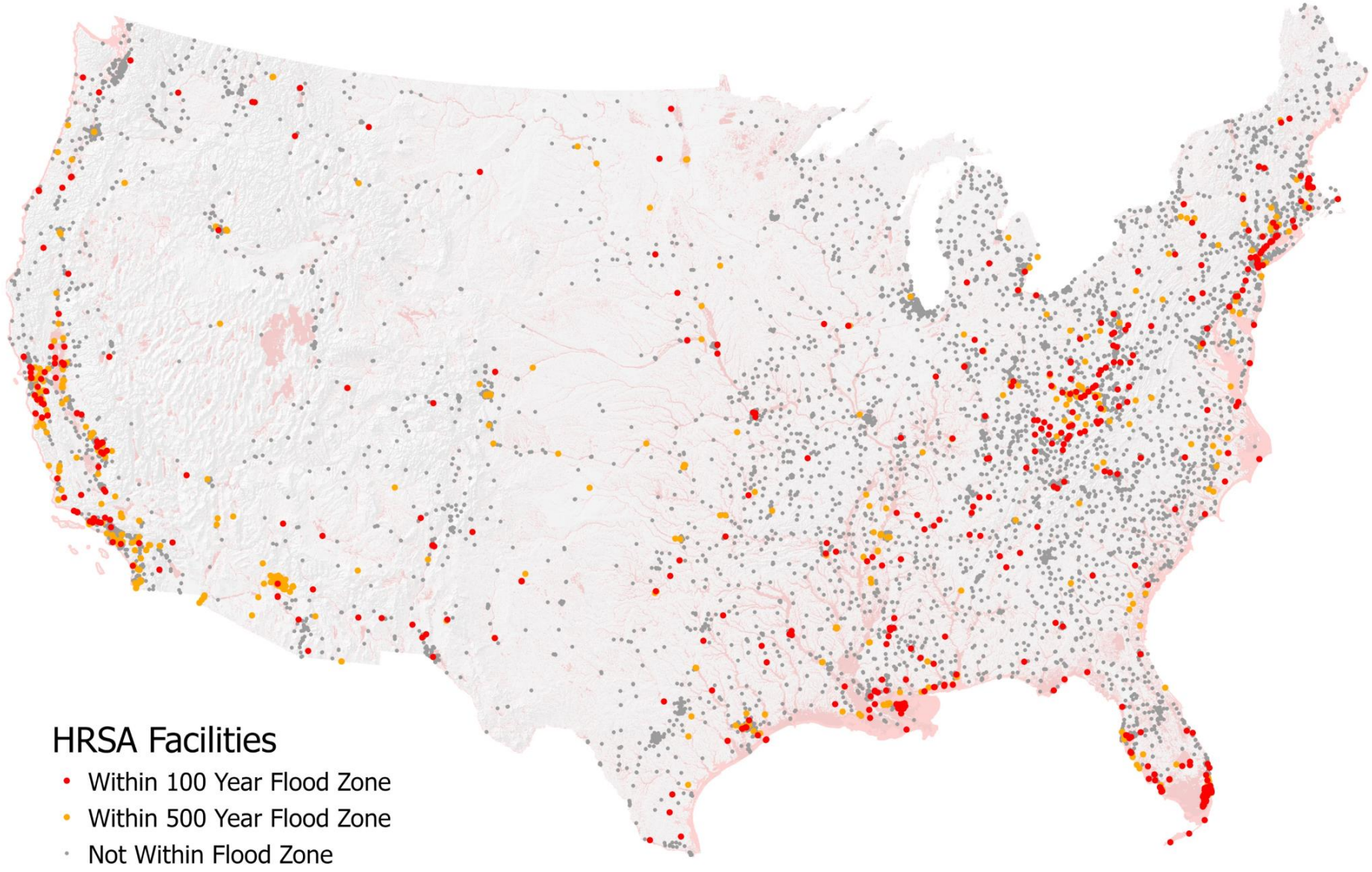


Facilities Within Flood Hazard Area (NFHL or EPA)

	Hospitals	Nursing Homes	Dialysis Clinics	Pharmacies
High or Moderate to Low Flood Risk (100-year or 500-year floodplain)	643	1,546	770	7605
Percent of Total	9.3%	10.2%	10.9%	12.1%
N	6881	15133	7047	62516

Manangan, et al., 2020. Flooding Risk to Medical Infrastructure. Work in progress.

Results: HRSA Facilities Within Flood Hazard Areas



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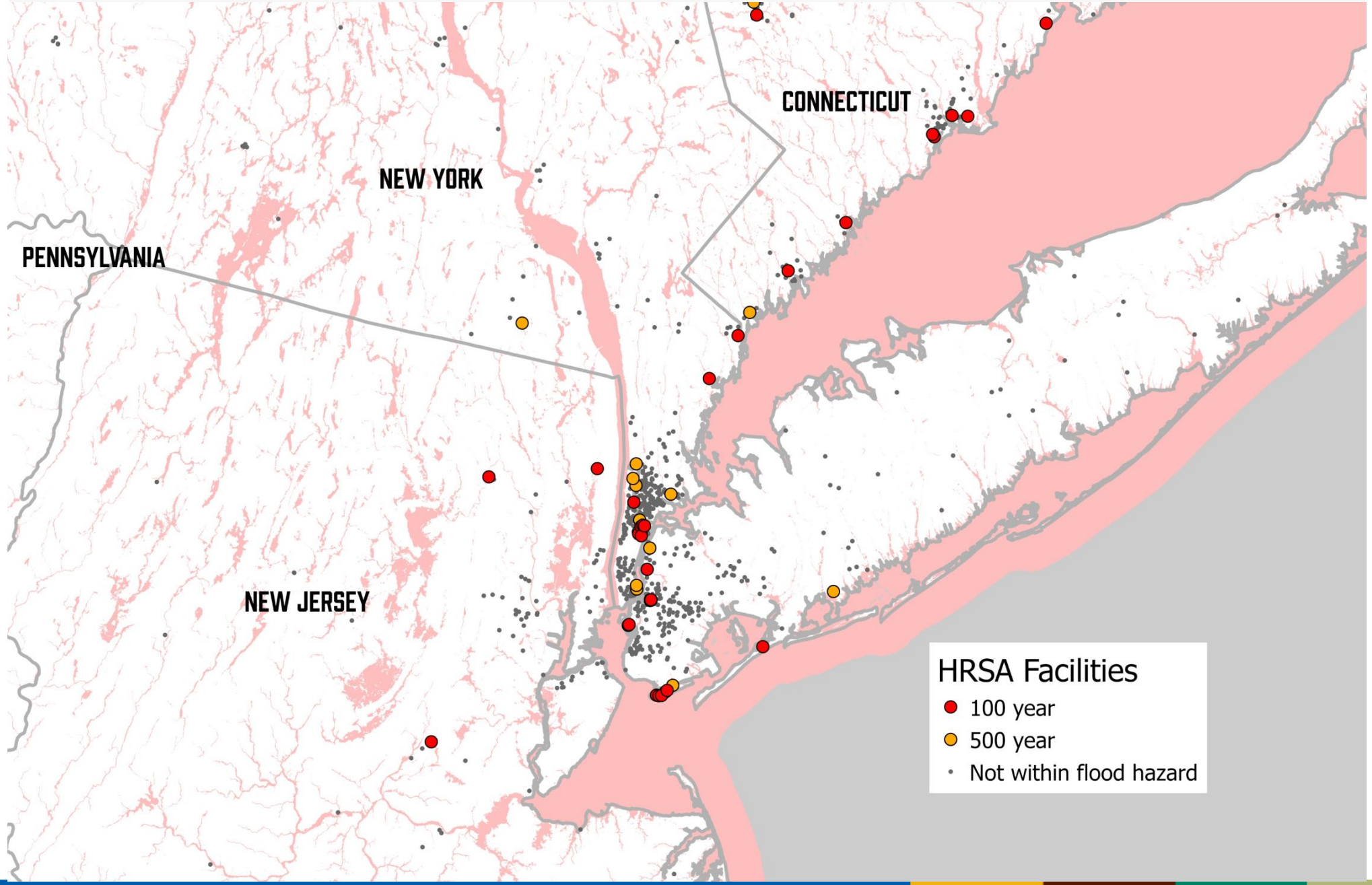

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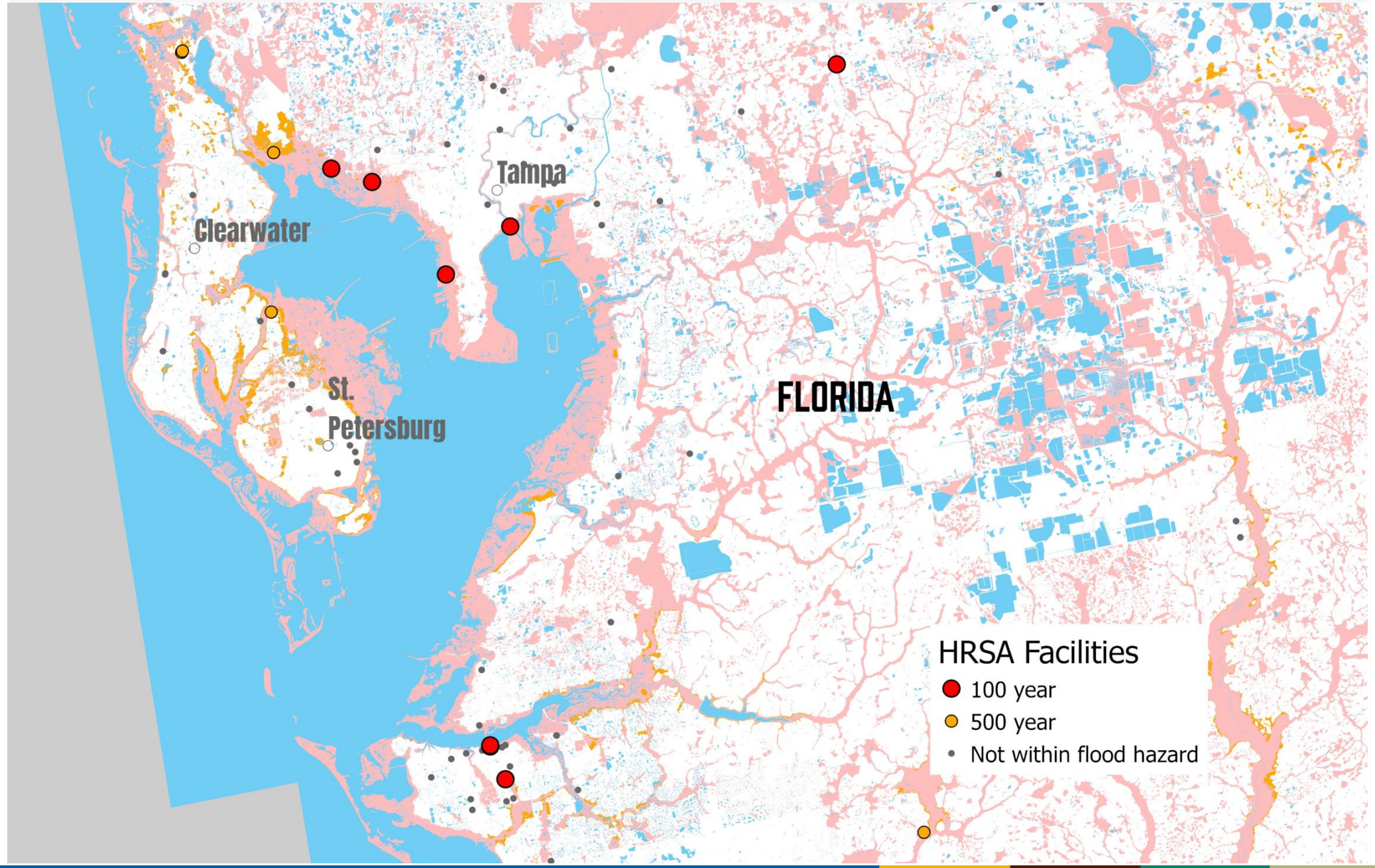
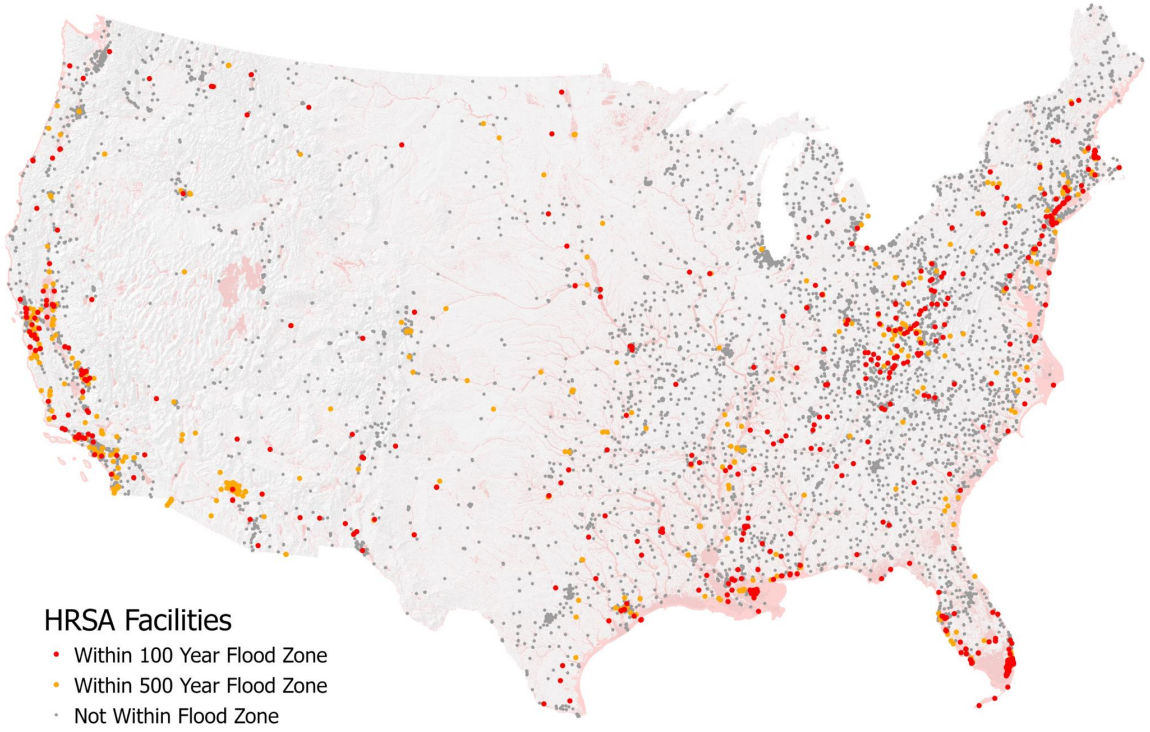
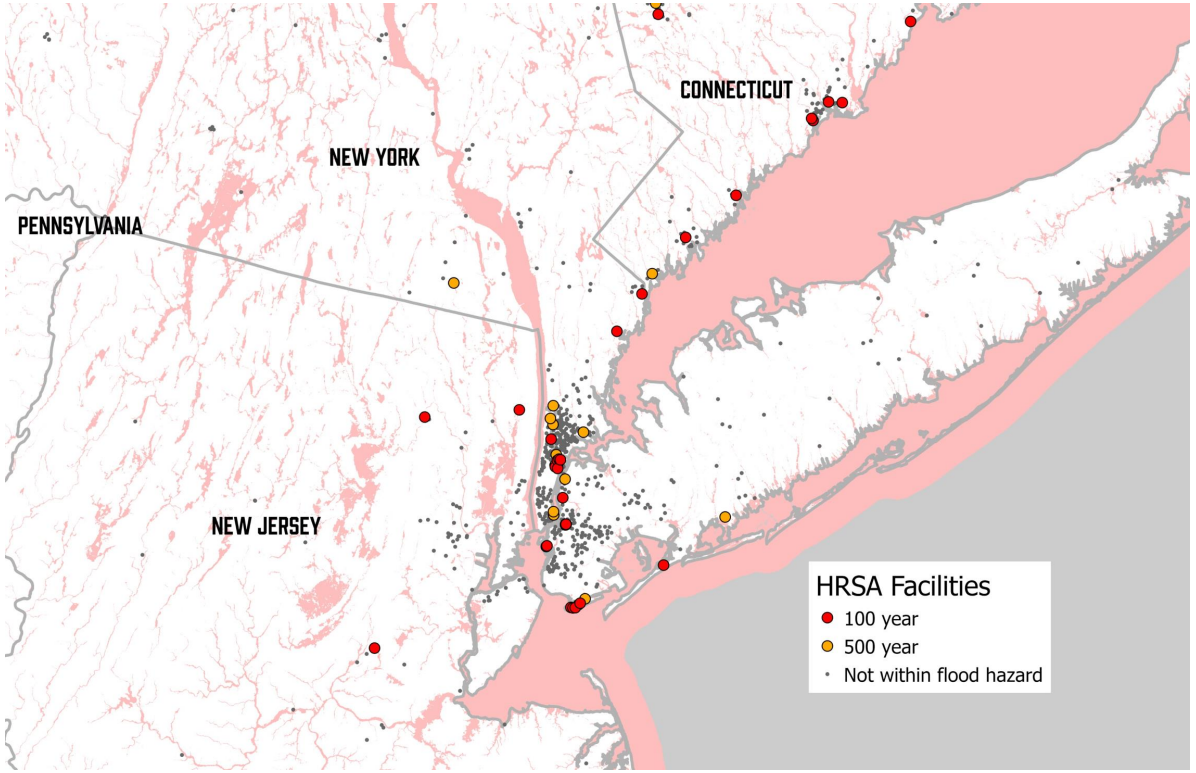


Results: HRSA Facilities Within Flood Hazard Areas

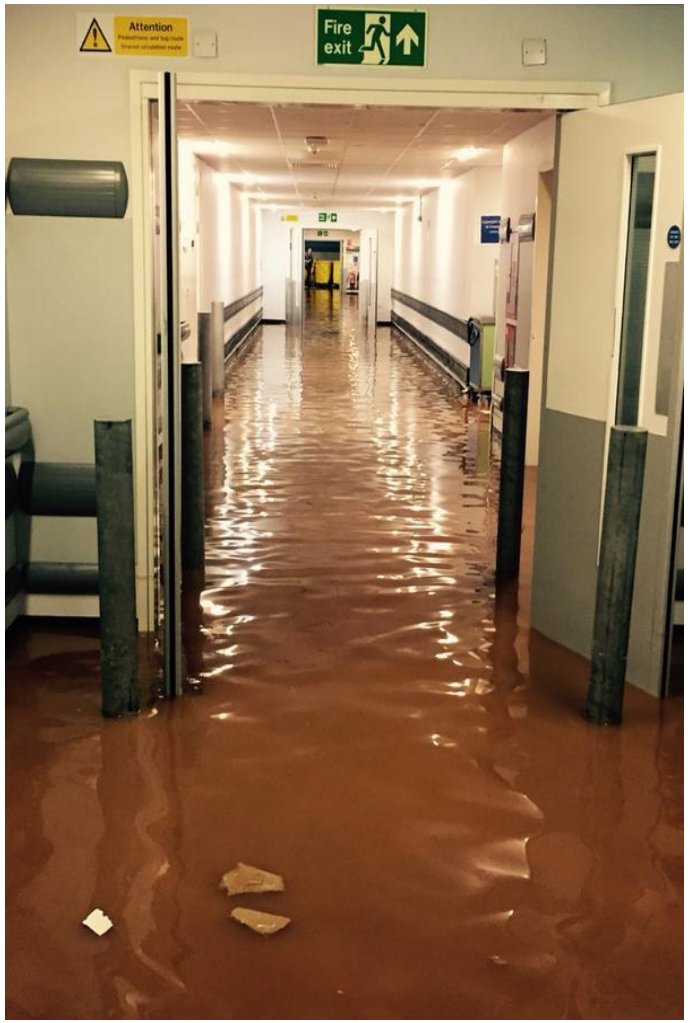
HRSA	100 year	500 year	No Floodplain	Total
Facilities	695	692	12,368	**13,755**
% Facilities	5.05%	5.03%	89.92%	-





Example Adaptation Strategies For Flooding

- Relocation of mission-critical and essential services
- Evacuation planning
- Medical staff training and education
- Backup power generation
- Site Modification (e.g., flood walls)



Lourdes Hospital from 2011 flood (FEMA)

AFFECTING HEALTH DIRECTLY

EXTREME HEAT

Higher heat, increased humidity, longer and more frequent heat waves can lead to

Dehydration and Heatstroke

People who are at higher risk: Outdoor workers, student athletes, people in cities, people without air conditioning, people with chronic diseases, pregnant women, older adults, and young children

Heat: A Climate and Health Priority

Heat has significant impacts on public health in the US

- During 2004–2018, an average of **702** heat-related deaths occurred each year.[1]
- During 2007–2017, an average of **67,512** emergency room visits due to heat occurred each year.[2]

Extreme heat events are becoming more frequent and intense

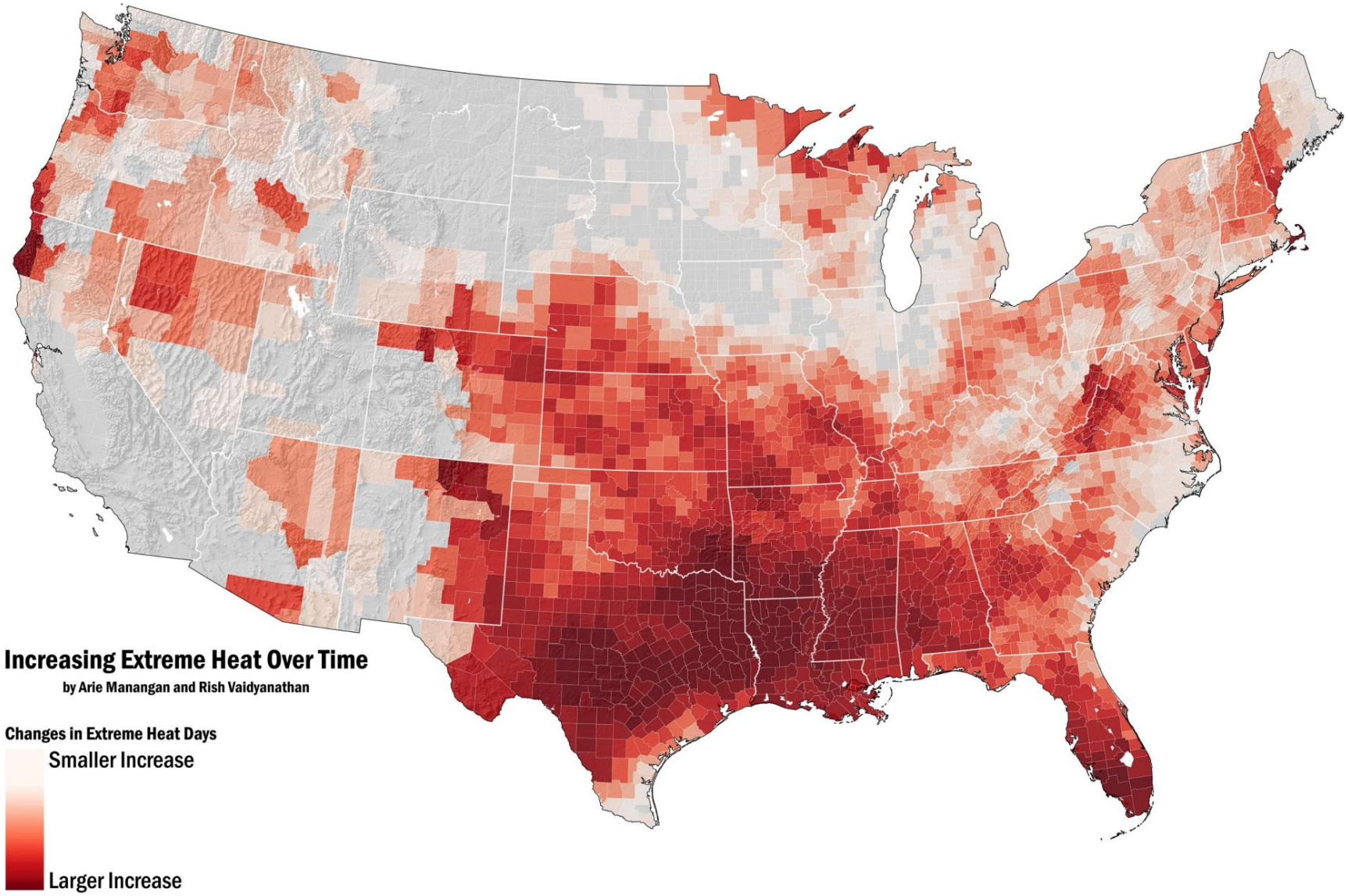
- Annual average temperature in the U.S. has increased by **1.2°F** from 1986–2016.
- Increases of **2.5°F** are projected for the period 2021–2050.

[1] Vaidyanathan A, Malilay J, Schramm P, Saha S. Heat-Related Deaths — United States, 2004–2018. MMWR Morb Mortal Wkly Rep 2020;69:729–734. DOI: http://dx.doi.org/10.15585/mmwr.mm6924a1external icon

[2] Based on recent results from a forthcoming MMWR

Extreme Summer Heat is Increasing

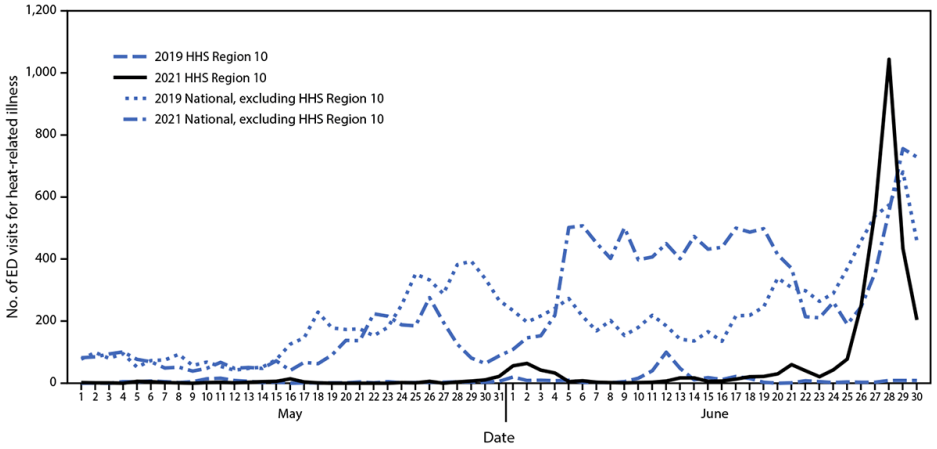
Extreme heat events will be more frequent and intense in coming decades.



AFFECTING HEALTH DIRECTLY

EXTREME HEAT

Pacific Northwest: June 2021



Morbidity and Mortality Weekly Report

Heat-Related Emergency Department Visits During the Northwestern Heat Wave — United States, June 2021

Paul J. Schramm, MS, MPH[1]; Ambarish Vaidyanathan, PhD[1]; Lakshmi Radhakrishnan, MPH[2]; Abigail Gates, MSPH[2]; Kathleen Hartnett, PhD[2]; Patrick Breysse, PhD[3]

On July 16, 2021, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Record high temperatures are occurring more frequently in the United States, and climate change is causing heat waves to become more intense (*1*), directly impacting human health, including heat-related illnesses and deaths. On average, approximately 700 heat-related deaths occur in the United States each year (*2*). In the northwestern United States, increasing temperatures are projected to cause significant adverse health effects in the coming years (*3*). During June 25–30, 2021, most of Oregon and Washington were under a National Weather Service excessive heat warning.* Hot conditions persisted in parts of Oregon, Washington, or Idaho through at least July 14, 2021. The record-breaking heat had the largest impact in Oregon and Washington, especially the Portland metropolitan area, with temperatures reaching 116°F (46.7°C), which is 42°F (5.6°C) hotter than the average daily maximum June temperature.

NSSP, 2019 to 2021 comparisons were restricted to EDs with consistent reporting during the study period§ and at least one visit for heat-related illness. Daily counts and rates (mean number of ED visits for heat-related illnesses divided by mean total number of ED visits multiplied by 100,000) were analyzed by age group (0–17, 18–25, 26–54, 55–64, 65–74, and ≥75 years) and sex. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

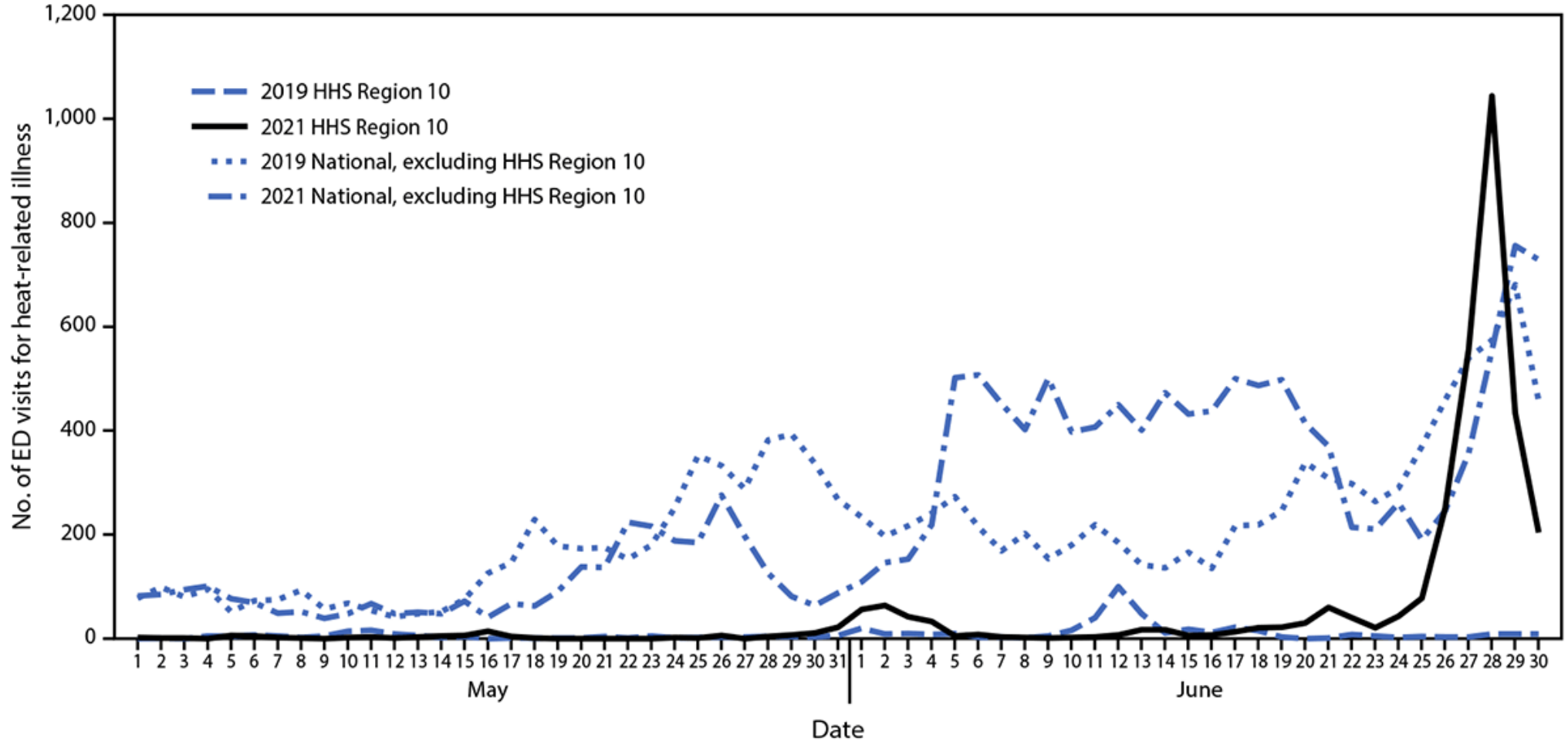
During May and June 2021, HHS Region 10 had 3,504 heat-related illness ED visits (median = seven per day [range = 0–1,090]). Approximately 79% (2,779) of these occurred during 6 days (June 25–30), when most of Oregon and Washington were under an excessive heat warning. A clear peak was detected on June 28, with 1,090 heat-related illness ED visits. After correcting for changes in reporting to facilitate comparison with 2019, the analysis found that 1,038 heat-related illness ED visits occurred on June 28, 2021 (Figure), compared with nine heat-related illness

"The mean daily number of heat-related illness ED visits...was more than seven times higher than that in June 2019, and during June 25–30, 2021 was 69 times higher than that during the same days in 2019…"

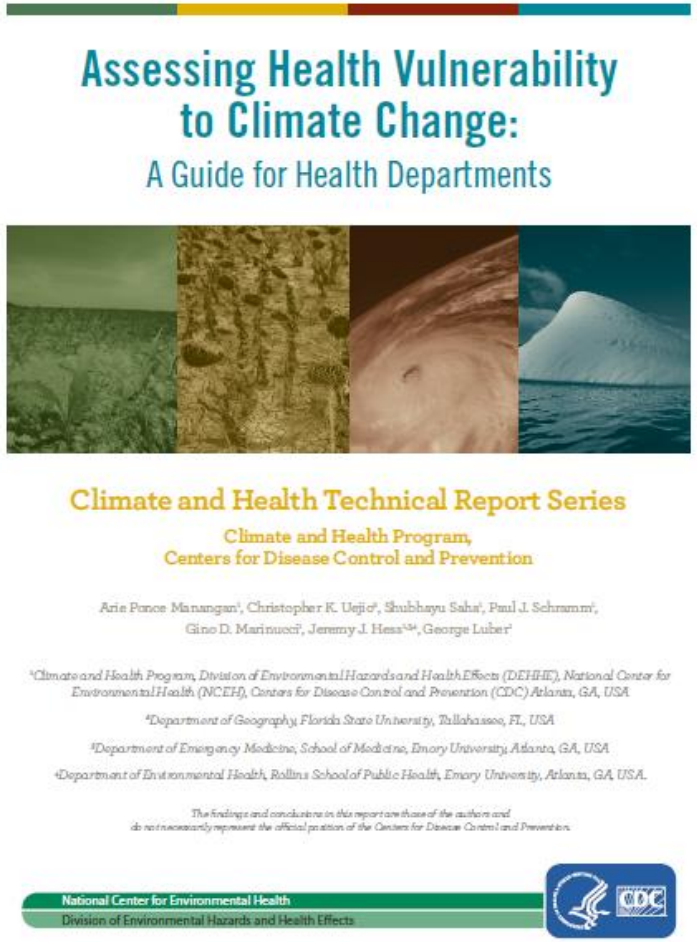
AFFECTING HEALTH DIRECTLY

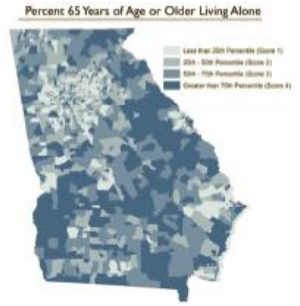
EXTREME HEAT

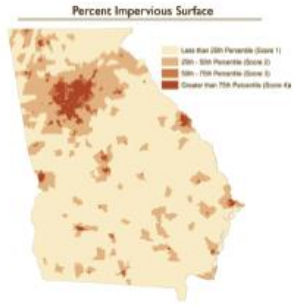
Pacific Northwest: June 2021

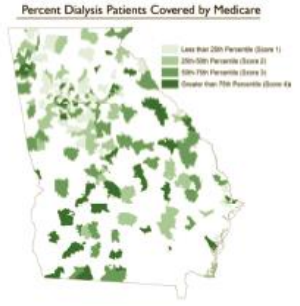


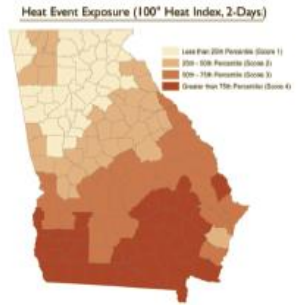
Focus on Health Equity and Vulnerability Assessment

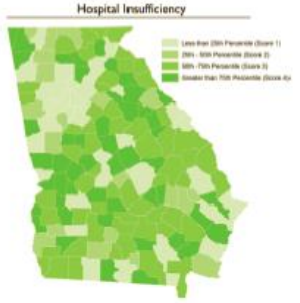






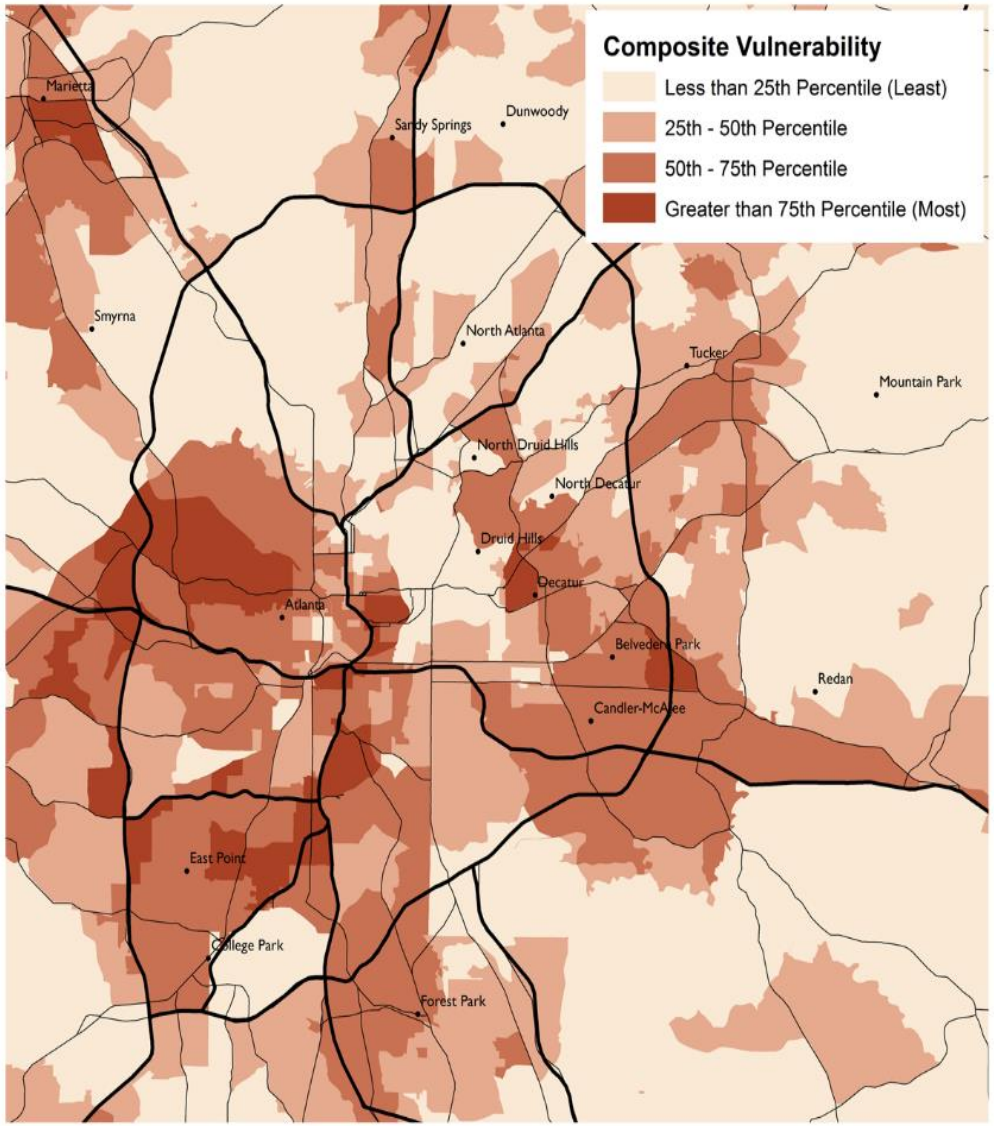


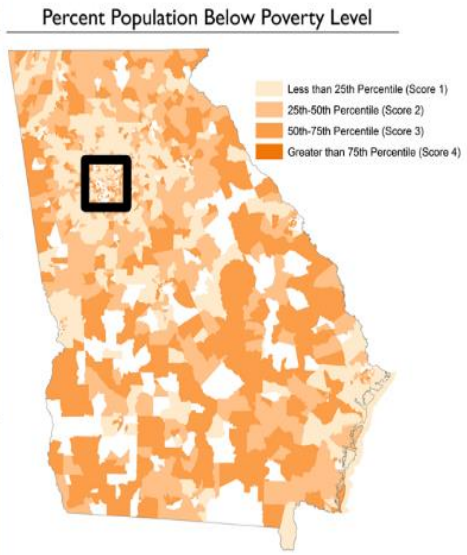


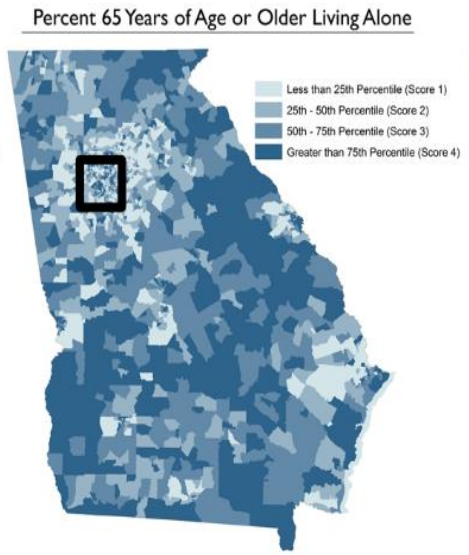


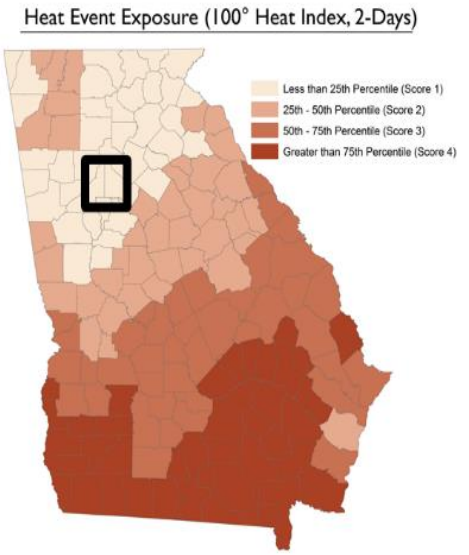
Guidance for health departments to identify communities that will be disproportionately affected by climate change

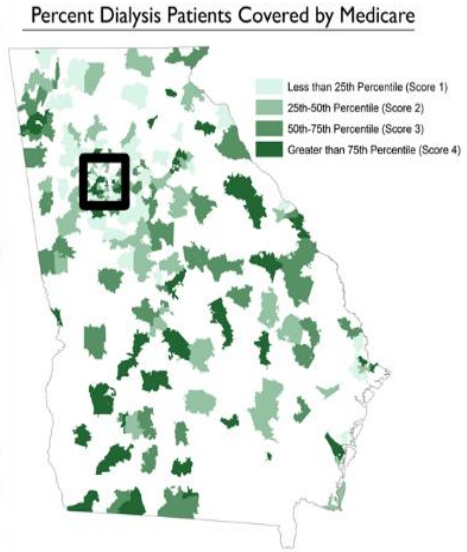
Heat Vulnerability to Climate-Related Health Effects

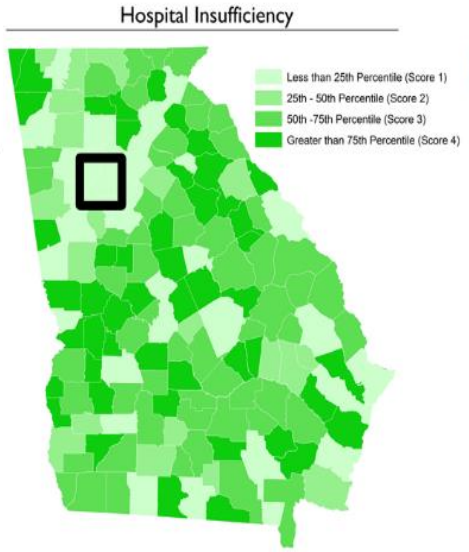


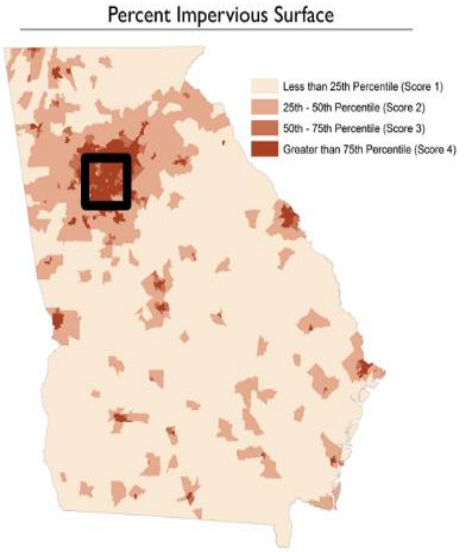








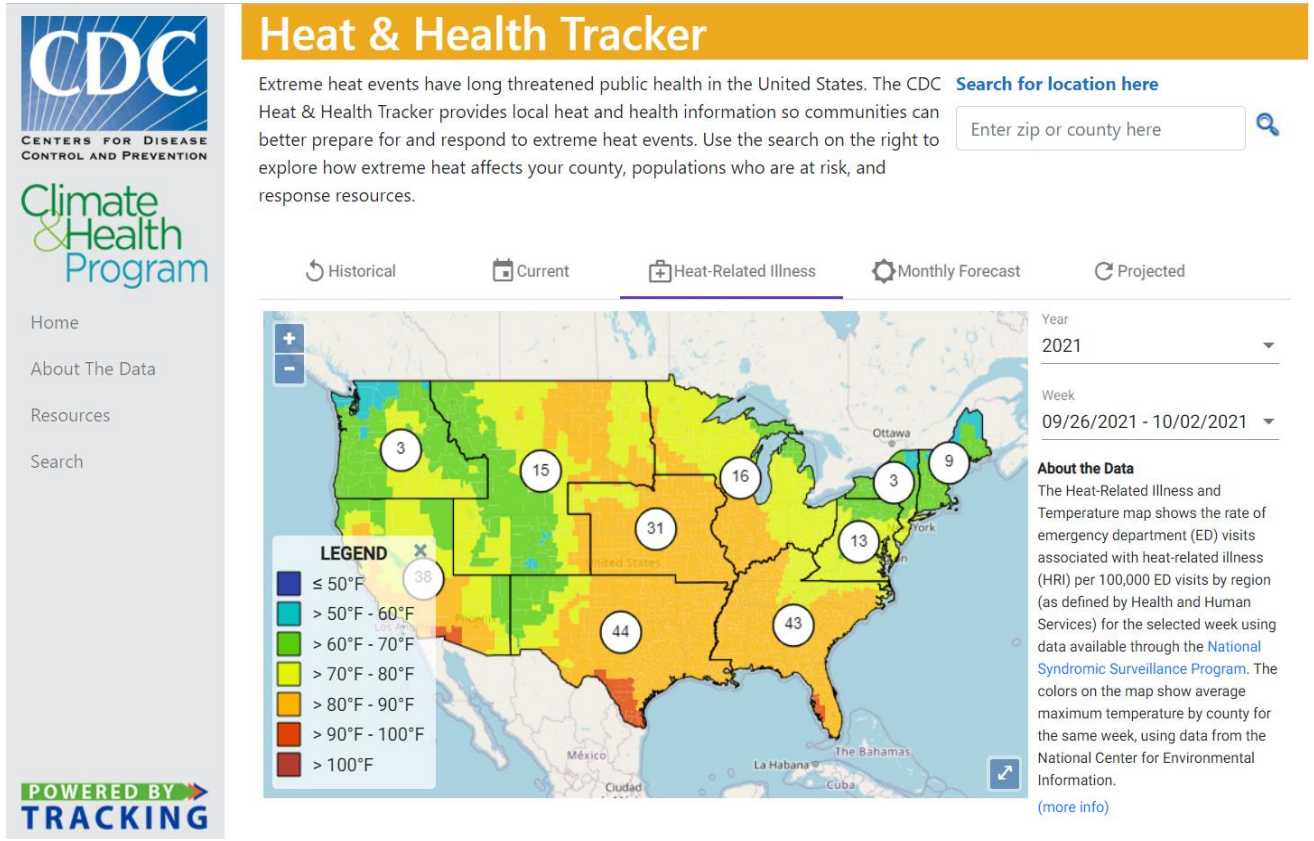




CDC's Heat & Health Tracker

What is it?

A publicly-available, online tool that provides heat and health data and information at the local level to help communities better prepare for and respond to extreme heat events.



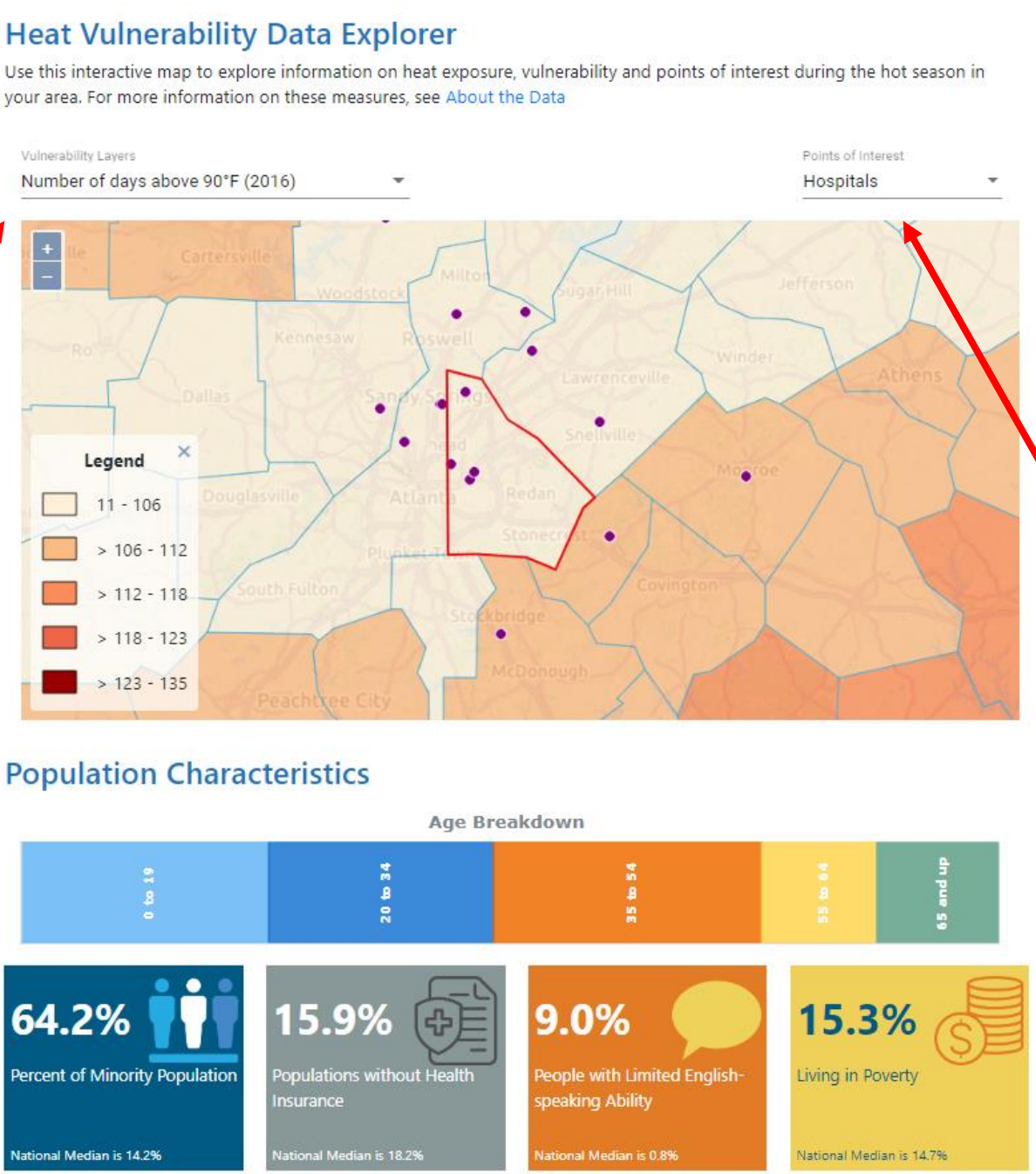
Climate & Health Program

POWERED BY TRACKING

https://ephtracking.cdc.gov/Applications/heatTracker/

CDC's Heat & Health Tracker

- Number of days above 90 degrees
- Total population
- Social Vulnerability Index
- % pop with limited English-speaking ability
- % of pop over 65 years and living alone
- % land used for development
- % impervious surfaces



- Daycare centers
- Emergency medical service stations
- Fire stations
- Hospitals
- Nursing homes
- Parks
- Public Schools

What Communities Can Do

Extreme Heat

- Develop Heat Response Plan
- Cooling Centers

Mental Health Problems

- Behavioral Health Plans
- Access to mental health services and counseling

Air Pollution

- Active and Mass Transportation
- Reduce Energy Waste

Storms & Flooding

- Prepare Infrastructure
- Sanitation & Water Management

Measuring Community Level-Healthcare Utilization During Extreme Heat

Using Electronic Health Records to Characterize Individual and Community Health Risk

Denver Mayor Currigan, Dr. Sam Johnson; c. ~1965

Beth Gillespie, M.D., FACP

Academic Hospitalist, Denver Health and Hospital Authority, Assistant Professor, University of Colorado School of Medicine
Fellow, University of Colorado Climate Science Policy Fellowship
Climate and Health Program, Division of Environmental Health Science and Practice, (DEHSP), National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention (CDC)

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All images: denverhealth.org

Heat exposure in Denver County

Heat & Health Tracker

Denver County, CO

Heat Vulnerability Data Explorer

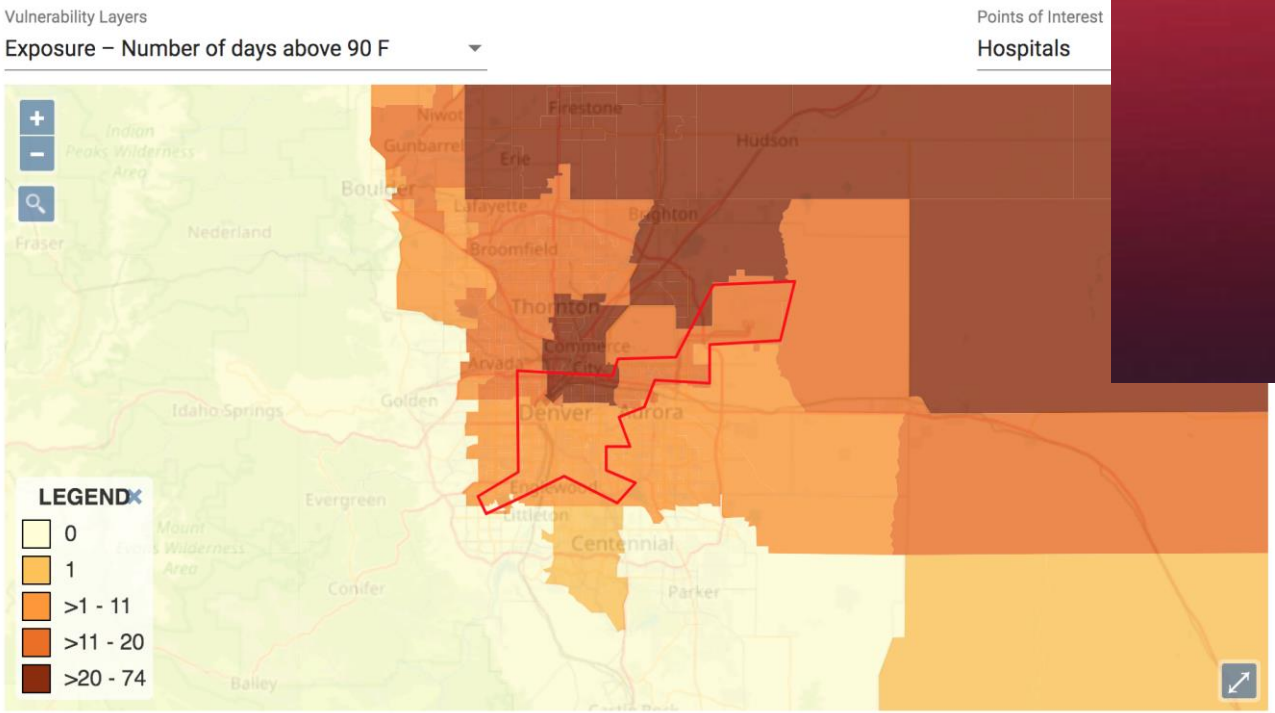


Image source: CDC Heat and Health Tracker

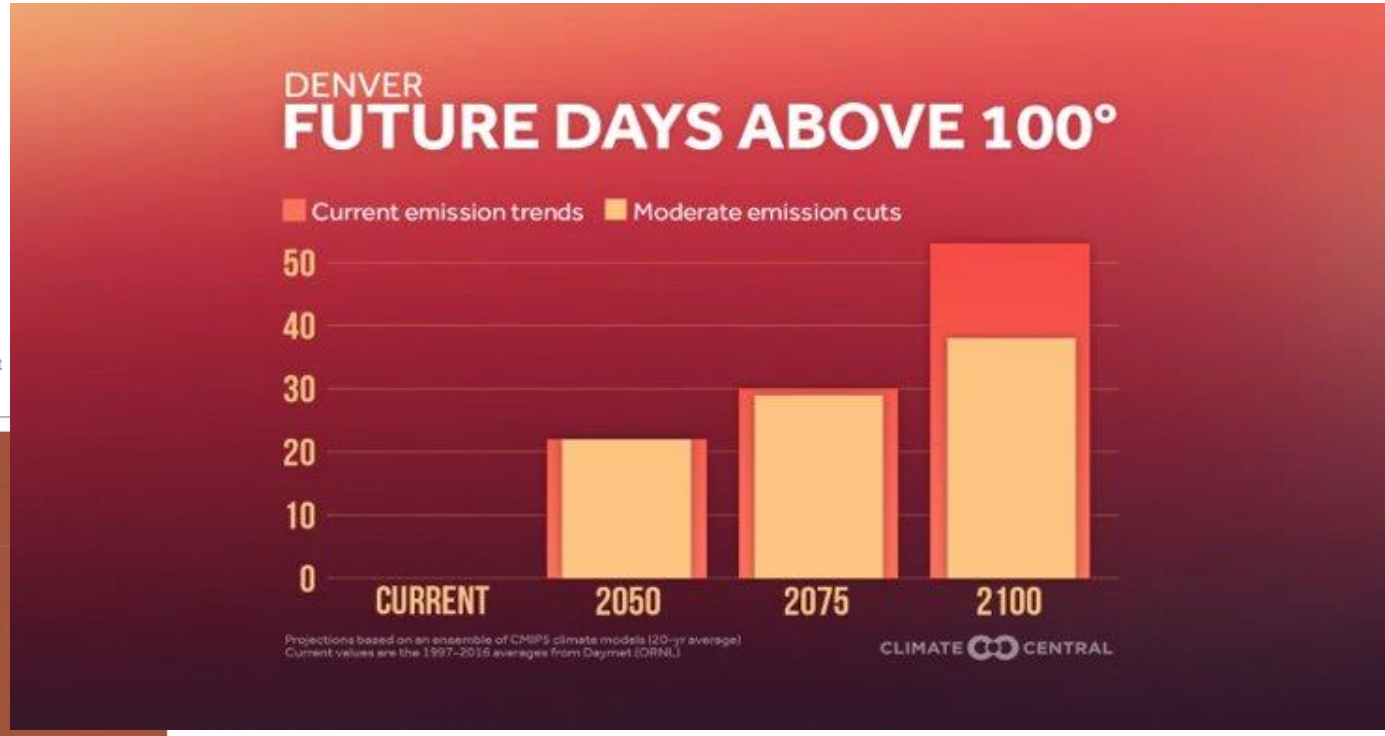


Image source: climatecentral.org

Denver Results, National Survey - Yale Program on Climate Change Communication:

"Climate change… because all this adjusting to weather is not good and cause a person to get sick"

"work environment is not clean and is very hot"

"Anxiety caused by climate lunacy (the world will end in 12 years unless we act NOW? Our species will go extinct unless we act NOW….Stop the constant barrage of idiotic opinions passing as knowledge"

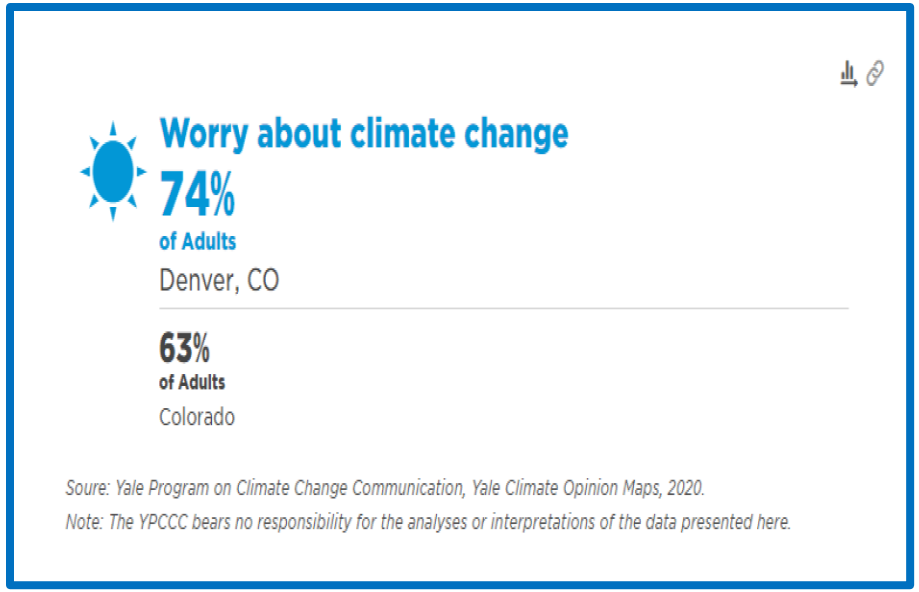
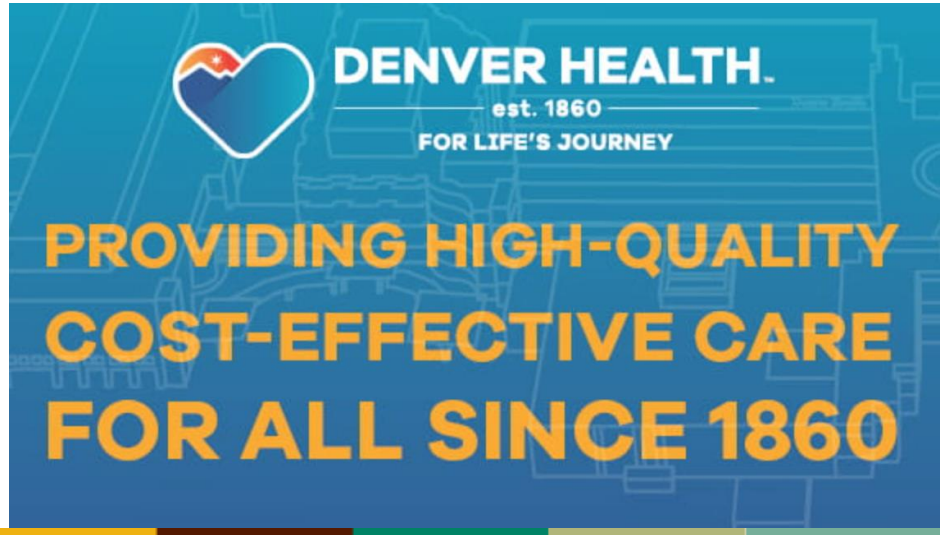


Image source: dashboards.mysidewalk.com/denver-health-assessment

Social Determinants of Health, High Temperatures, and Health Outcomes

- Design: Retrospective, Cross Sectional, Cohort
- Population: Denver County residents ages >/= 4 years receiving health care at Denver Health hospital and clinics
- Study Time period: April 1, 2016, through Dec 31, 2020
- High temperature period: May 1–Sept 31, 2016–2020
- Team: Art Davidson[1], Josh Durfee[1], Abbie Steiner[1], Ken Scott[1]
- Funding: Denver Health Office of Research Pilot Grant



[1]Denver Public Health

Image source: denverhealth.org

Health network relative heat vulnerability

Mean Denver Health patient heat vulnerability score compared to that of remaining Denver County residents

1.4

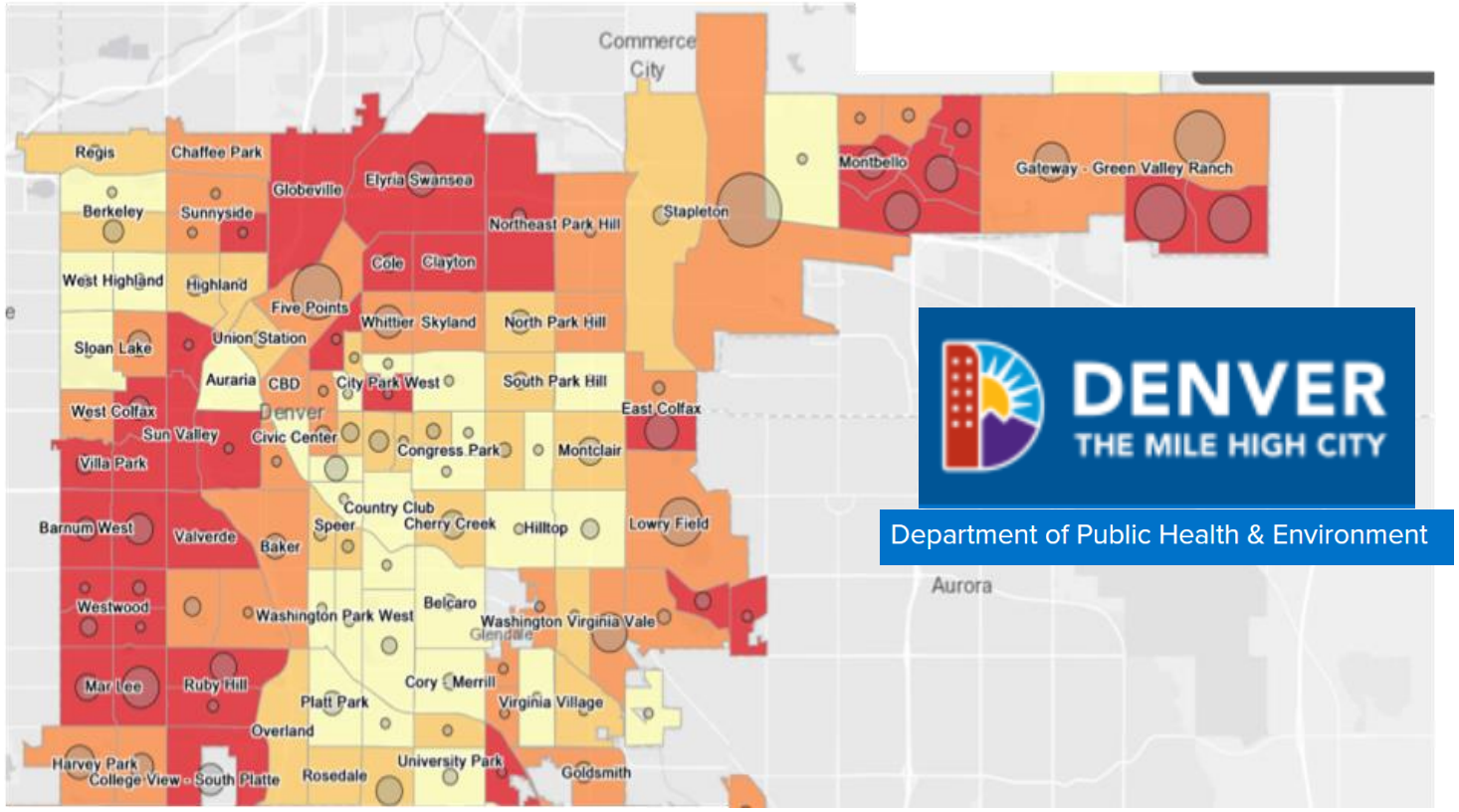


Image source: [Heat Vulnerability (denvergov.org)]

Study Aim

- ***Aim:*** **Compare rates of healthcare utilization among DH patients in chronic disease groups, depending on exposure to heat (Tmax > 90^{o}F)**
  - Building "the model"—odds ratio for high heat utilization versus non-high heat utilization
  - Model to be adjusted for:
    - age,
    - gender,
    - race/ethnicity, and
    - residential heat vulnerability.
- ***Hypothesis 1:*** **Denver Health patients living in higher heat vulnerability areas have increased heat-exposed acute utilization**
- ***Hypothesis 2:*** **Patients with heat-sensitive conditions have higher heat-sensitive acute utilization**

Data sources

- **CHORDS (Colorado Health Observation Regional Data Service)**

Data table	Description
CENSUS LOCATION	Stores patients' geocoded address. Every person ID in other tables has a record here
DEMOGRAPHICS	Includes basic descriptive data (DOB, gender, race, ethnicity)
ENCOUNTERS	Includes records from encounters between patients and medical personnel, indexed by encounter ID and person ID
DIAGNOSIS	Lists final diagnoses from encounters table (does not include chief complaint/ problem list

- **Daily temperature data (NOAA, EPA stations)**
- **Denver County heat vulnerability indices**

  Built environment, demographics, human health
- **American Community Survey (2016-2020) –**

  5-year estimates for Denver County

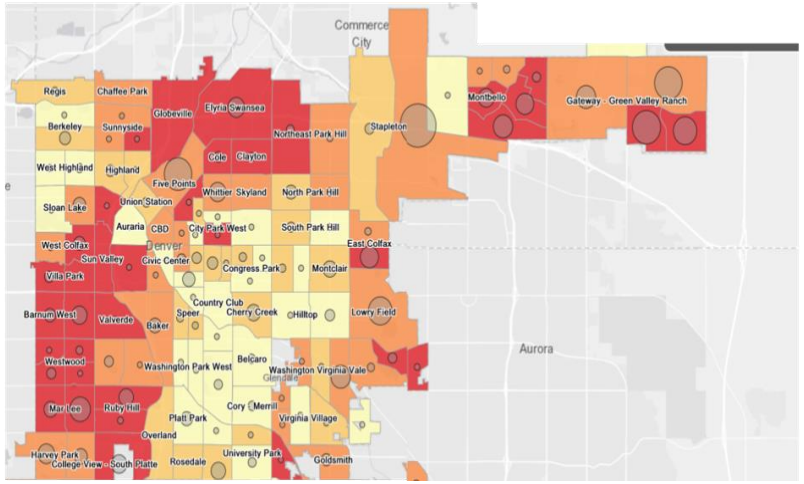
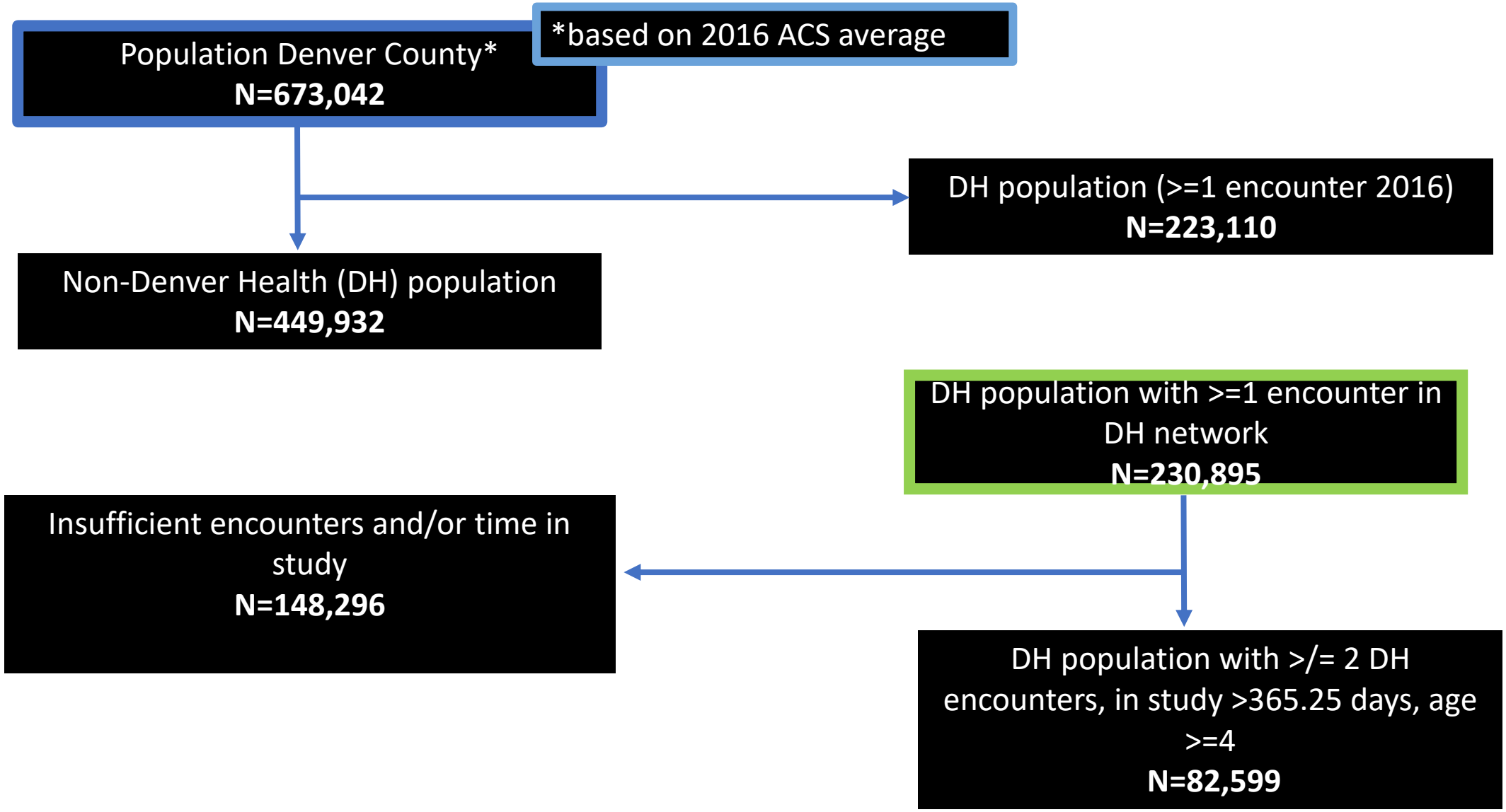
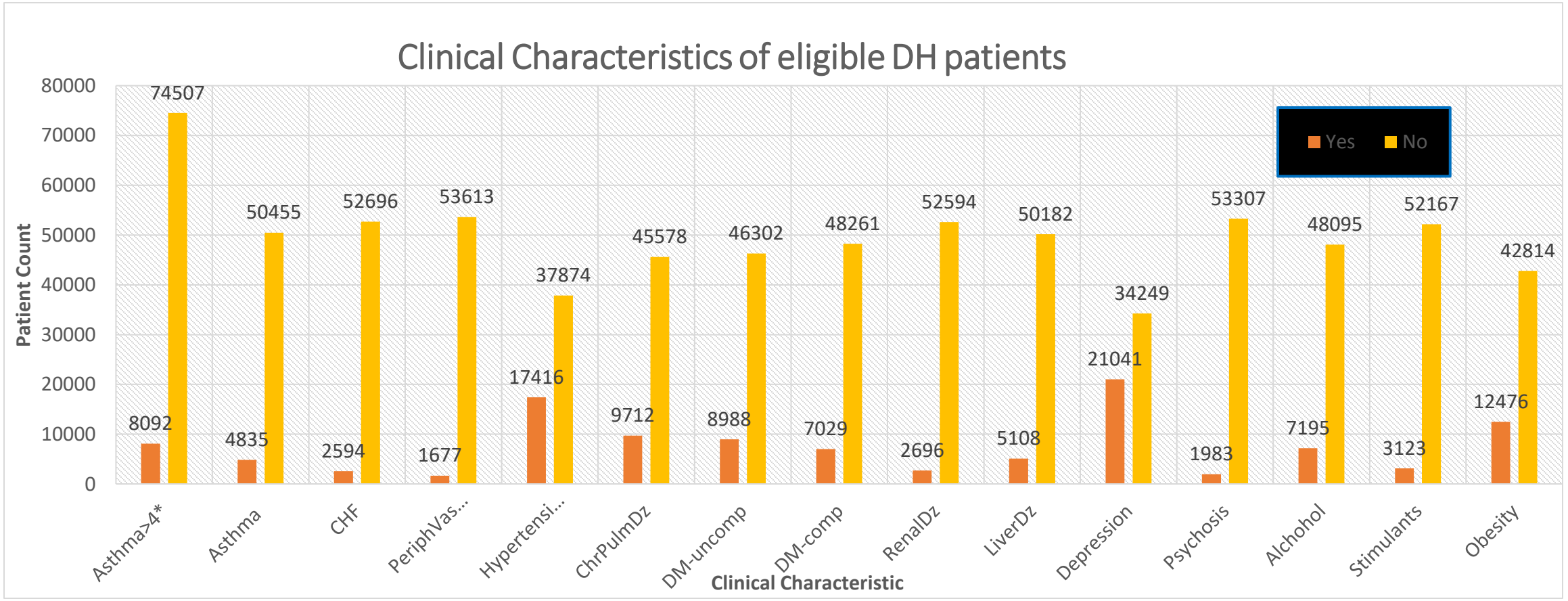


Image source: [Heat Vulnerability (denvergov.org)]

Consort Diagram



Results



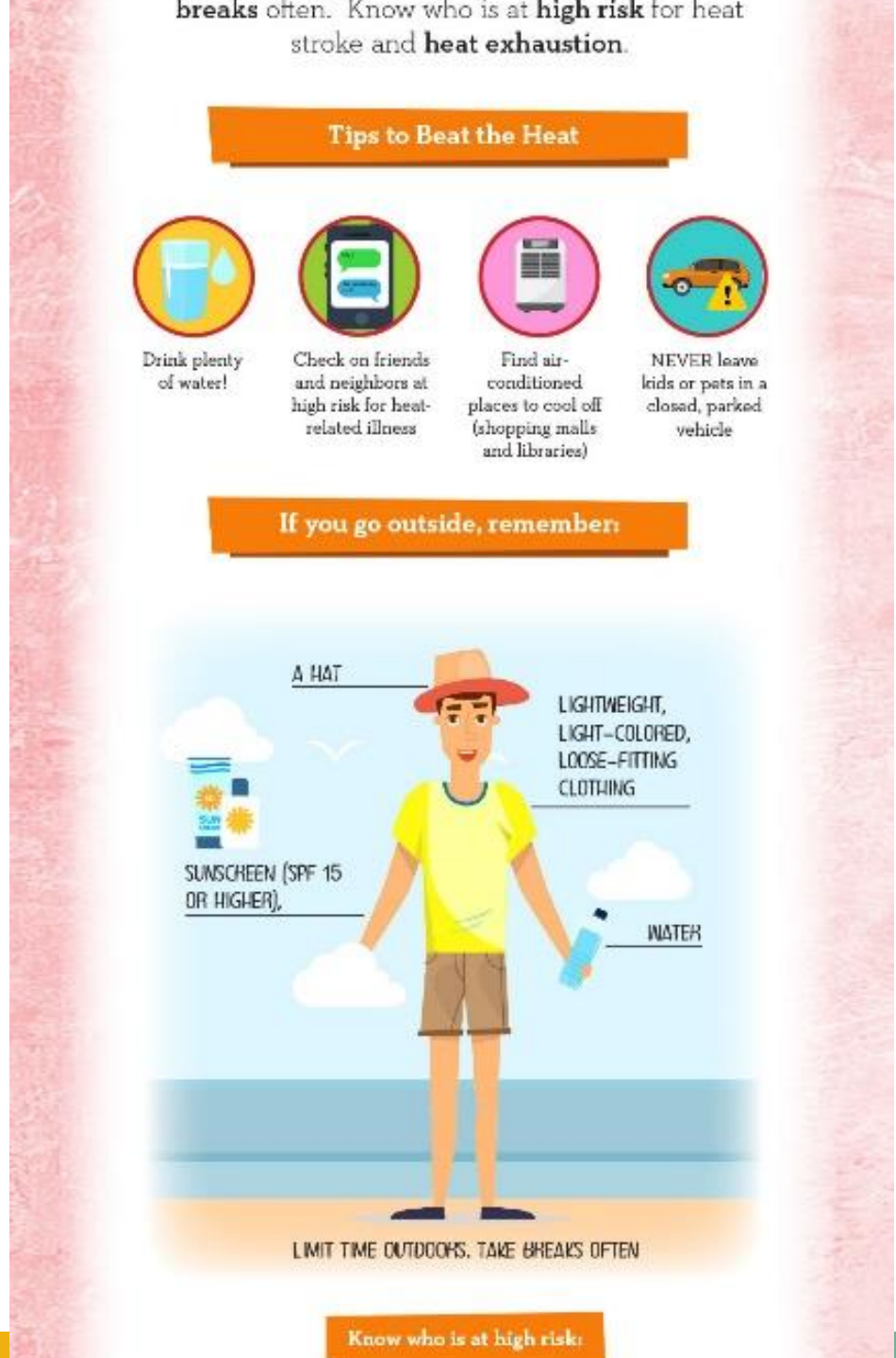
Footnote

CHF=congestive heart failure
PeriphVas = Peripheral vascular disease
ChrPulmDz = Chronic Pulmonary Disease
DM = Diabetes
RenalDz = Renal disease
LiverDz = Liver disease

Next Steps

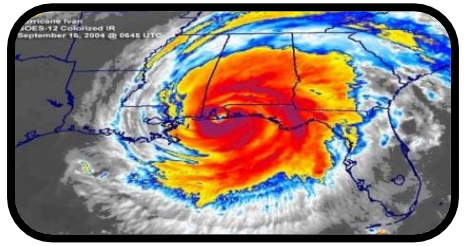
- Develop final model testing Hypotheses 1 and 2:
  - *Hypothesis 1:* Denver Health patients living in higher heat vulnerability areas have increased heat-exposed utilization
  - *Hypothesis 2:* Patients with heat-sensitive conditions have higher heat-sensitive utilization
- Identify disease groups most associated with heat-sensitive acute care utilization
- *Potential next steps*:
  - Evaluate utilization patterns of patients with specific ICD-10 codes
  - Community outreach to representatives of higher risk disease groups
  - Evaluate best practices for targeted education, targeted social services

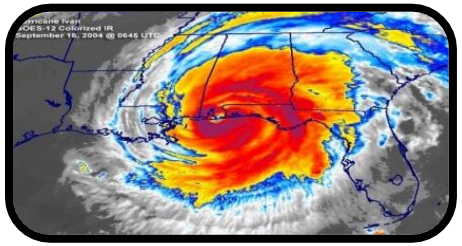
Image source: CDC (https://www.cdc.gov/disasters/extremeheat/index.html)



Conclusion

- Building Climate Resilience with the CDC's Climate and Health Program
- Climate-Related Hazards and Potential Health Effects
- Disproportionately Affected Populations and Under-Resourced Communities
- Utilizing Electronic Health Records to Characterize Individual and Community Health Risk





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The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official view of the Centers for Disease Control and Prevention.

Q&A

All attendees are muted.
To adjust your audio settings in the webinar, click on **Audio Options**.

Please use the **Q&A window** to ask questions of the panelist.

Today's Presenters

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Health Scientist

Elizabeth (Beth) Gillespie, M.D., FACP
Guest Researcher

Climate and Health Program
Division of Environmental Health Science and Practice
National Center for Environmental Health
Centers for Disease Control and Prevention

Closing Remarks

Patrick Breysse, Ph.D., CIH
Director, National Center for Environmental Health
Agency for Toxic Substances and Disease Registry
Centers for Disease Control and Prevention

Suma Nair, Ph.D., M.S., RD
Director, Office of Quality Improvement
Health Resources and Services Administration
Bureau of Primary Health Care

Thank you for joining us today!

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EHNexus@cdc.gov

Impact of Climate Change on Human Health

A graphic describing the climate-related exposures (e.g. air pollution, extreme heat, poor water quality, changes in disease vectors) and their associated health effects (e.g. Respiratory allergies, heat-related illness, cholera, Malaria). The CDC is focused on climate change because the impacts to human health are very broad, from increasing the risk of vector borne diseases such as West Nile Virus and Lyme disease, to bringing more intense heatwaves and a greater frequency of severe weather events that can cause flooding. These changes in climate-related exposures translate into increasing health risks, as seen in the outer circle of this diagram.

Figure. Current Climate and Health Grantees

A map of the currently funded climate and health grantees, which includes the state health departments: Arizona Department of Health Services, California Department of Public Health, Connecticut Department of Public Health, Wisconsin Department of Health Services, Maine Department of Health and Human Services, North Carolina Department of Health & Human Services, New York State Department of Health/Health Research, Inc., Oregon Health Authority Public Health Division, Vermont Agency of Human Services.

There are currently two city health departments that are funded by the CDC Climate and Health program: County of Santa Clara, Department of Public Health, San Francisco Department of Public Health.

Figure. Previous Climate and Health Grantees

A map of previously funded climate and health grantees, which additionally includes the state health departments of: Minnesota, Wisconsin, Illinois, Florida, and New Hampshire. Additionally, the Climate and Health program has previously funded cities, tribes, and US territories. This is addition to the previously funded states of: Arizona Department of Health Services, California Department of Public Health, Connecticut Department of Public Health, Wisconsin Department of Health Services, Maine Department of Health and Human Services, North Carolina Department of Health & Human Services, New York State Department of Health/Health Research, Inc., Oregon Health Authority Public Health Division, Vermont Agency of Human Services.

There are currently two city health departments that are funded by the CDC Climate and Health program: County of Santa Clara, Department of Public Health, San Francisco Department of Public Health.

Map of Wildfires and Air Quality in the U.S.

A map showing Wildfires and Air Quality in the U.S. Previous studies have shown that wildfires are increasing, and the associated air quality has been worsening, as reflected in this map of data published in 2018 showing that PM2.5 concentrations have increased over a 28-year period, particularly in the northwestern U.S.

Graph of the Distribution of Smoke-Days by Month

A graph showing the month with the highest percentage of smoke-days. The later summer month of July, Augusta, and September had the high distribution of smoke days per month. August had the highest percentage of smoke days.

Graph of the Distribution of Smoke-Days per State

The states with the highest percentage of smoke days are Montana, Idaho, California, and Wyoming. Generally, the states with the highest percentage of smoke days were located in the Northwestern US and California.

Map of the Population-Level Smoke Exposure in the Western U.S.

The largest populations exposed to smoke are in Southern California, Southern Arizona, and Central Washington State.

Extreme Summer Heat is Increasing

A map showing this increase in heat events. This map of U.S. counties represents the change in the number of heat waves days per year.

Counties in dark red exhibited the greatest increase in the number of heat wave days, as compared to counties in light red. Counties in gray did not exhibit a statistically significant change in the number of heat wave days.

Heat-Related Emergency Department Visits During the Northwestern Heat Wave

The figure, four line graphs, shows emergency department visit numbers for heat-related illness in U.S. Department of Health and Human Services Region 10 and nationwide, May 1–June 30, 2019 and 2021. The mean daily number of heat-related illness emergency department visits was more than seven times higher than that in June 2019, and during June 25–30, 2021 was 69 times higher than that during the same days in 2019.

Heat Vulnerability to Climate-Related Health Effects

An example of a climate and health vulnerability assessment, which utilizes not only data on the social determinants of health, but also measures of environmental determinant, and measures of health response capacity.

Colorado Heat and Health Tracker and Future Temperature Days Above 100 degrees

This graph shows projections by Climate Central. Based on 1997-2016 averages, there were no days above 100. We already broke 100 XX times last year, and number of high temperature days are projected to increase to over 20 by 2050 and over 35 by 2100, with even more occurring without emission cuts.

Clinical Characteristics of Eligible Denver Health Patients

This bar graph represents the number of patients in each health category of interest. All categories were chosen based on known risk factors for heat-related illness, based on previous scientific literature. Categories include asthma, congestive heart failure.