Climate and Health

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3/23/2021

Overview

Overview

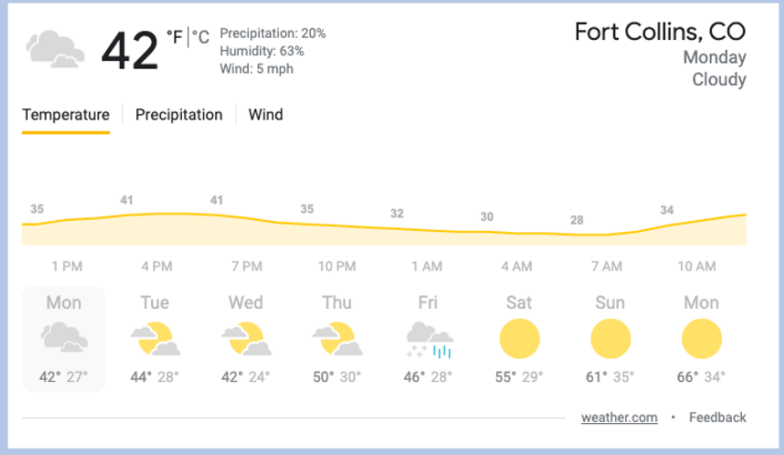
- Climate change in the US
- US Global Change Research Program
- Temperature and Human Health
- Climate-related Disasters and Human Health

Climate change

Weather versus climate

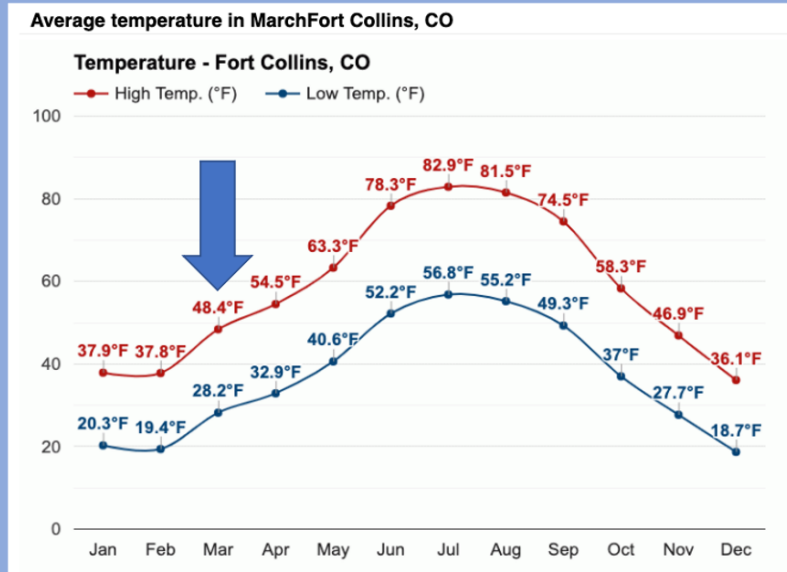
Climate is what you **expect**, **weather** is what you **get**.

Fort Collins **weather** for the week of March 22, 2021



Sources: weather.com and www.weather-us.com

Fort Collins **climate** for March



Average high temperature in March: **48.4°F**

The warmest month (with the highest average high temperature) is **July** (82.9°F).The month with the lowest average high temperature is **December** (36.1°F).

Average low temperature in March: **28.2°F**

The month with the highest average low temperature is **July** (56.8°F).The coldest month (with the lowest average low temperature) is **December** (18.7°F).

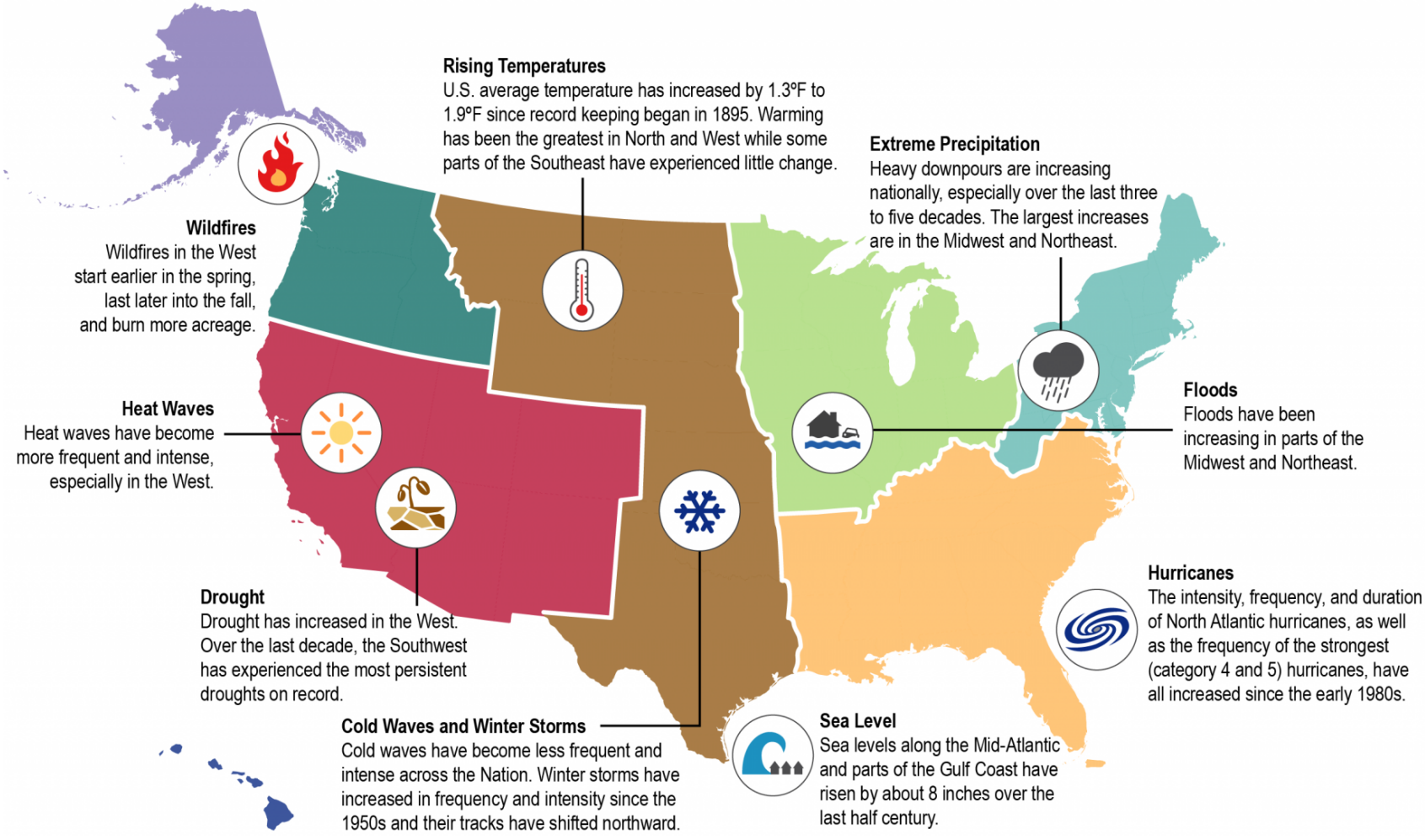
What is climate change

Climate change: "Changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system."

Source: https://health2016.globalchange.gov/

Why is climate changing?

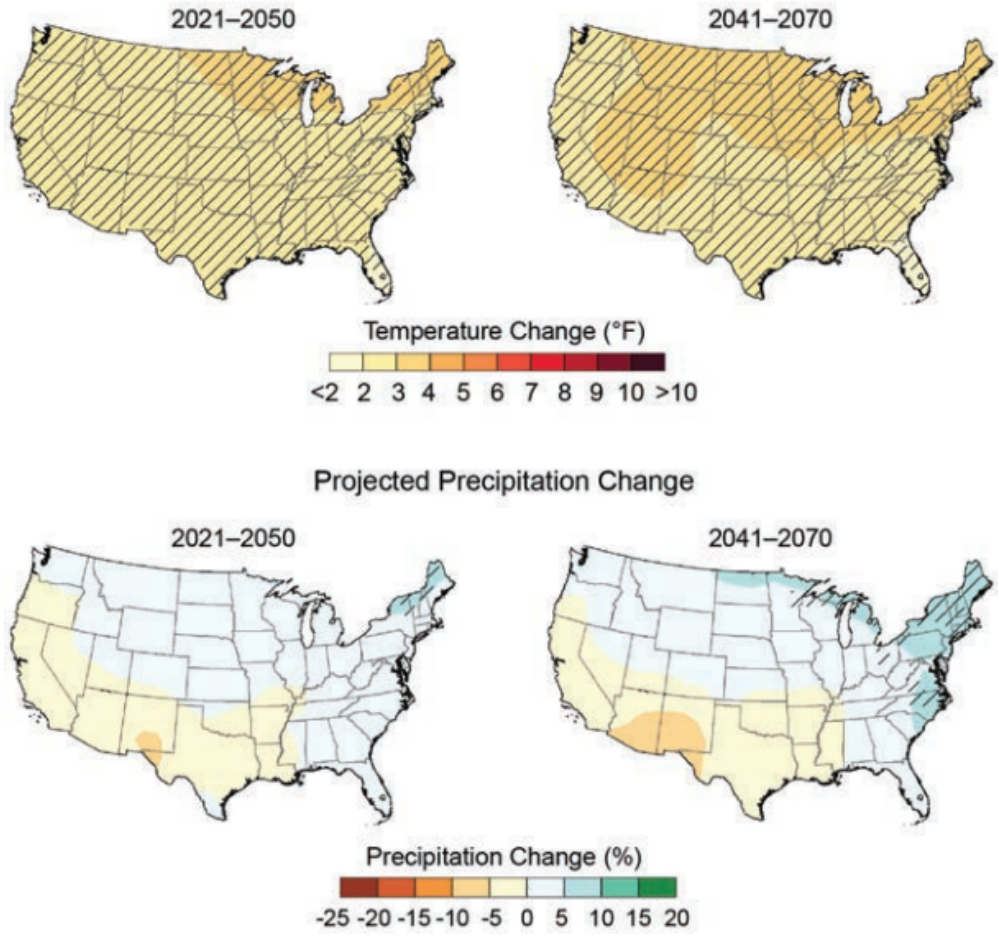
Observed climate trends in the US



Source: https://health2016.globalchange.gov/climate-change-and-human-health

Projected climate trends in the US

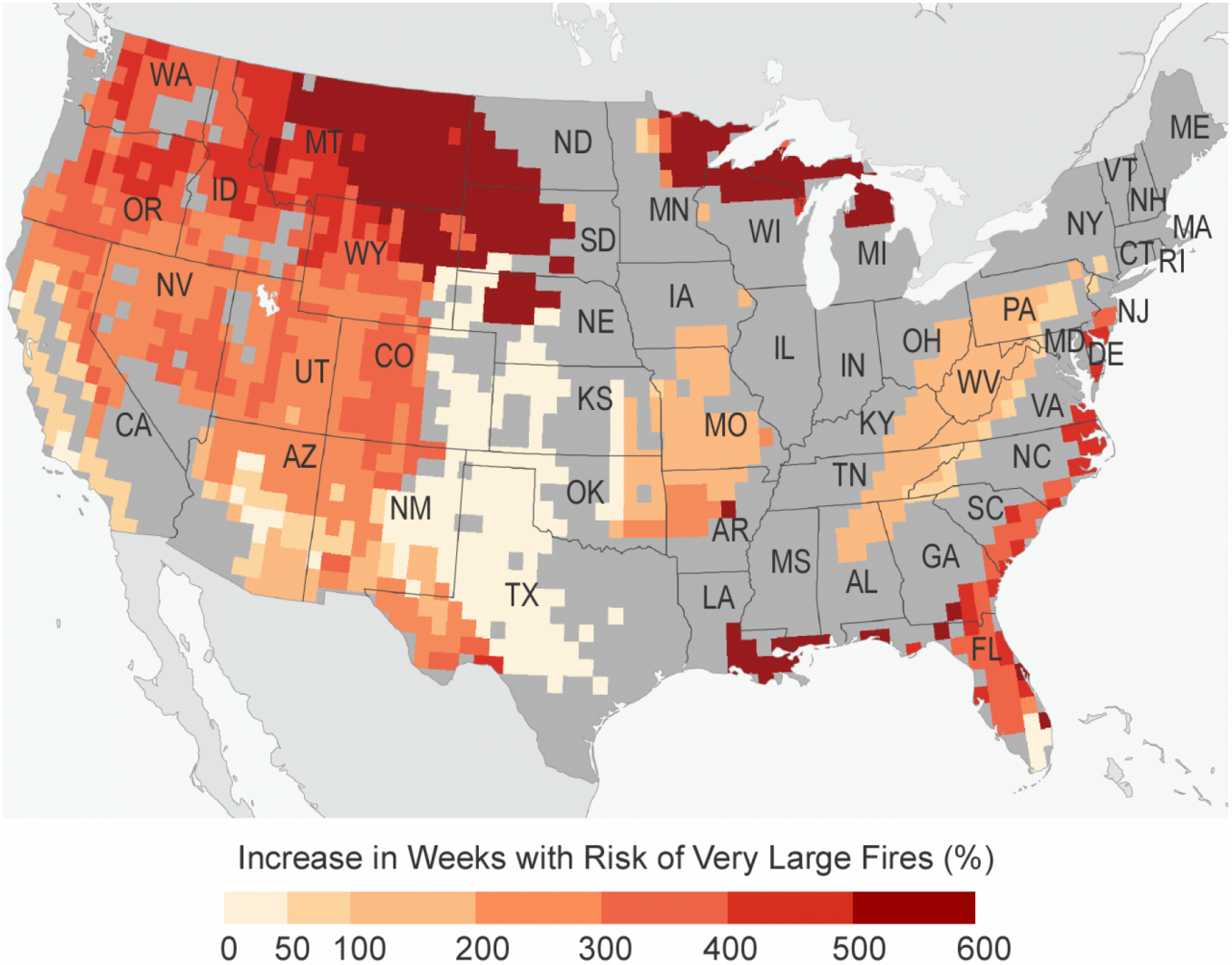
Projected changes in temperature and precipitation in the US under RCP6.0 scenario.



Source: https://health2016.globalchange.gov

Projected climate trends in the US

Projected changes in risk weeks with risk of large fires in the US by mid-century (2041–2070) under RCP8.5 scenario.



Source: https://health2016.globalchange.gov, adapted from Barbero et al. 2015

Projected climate trends in the US

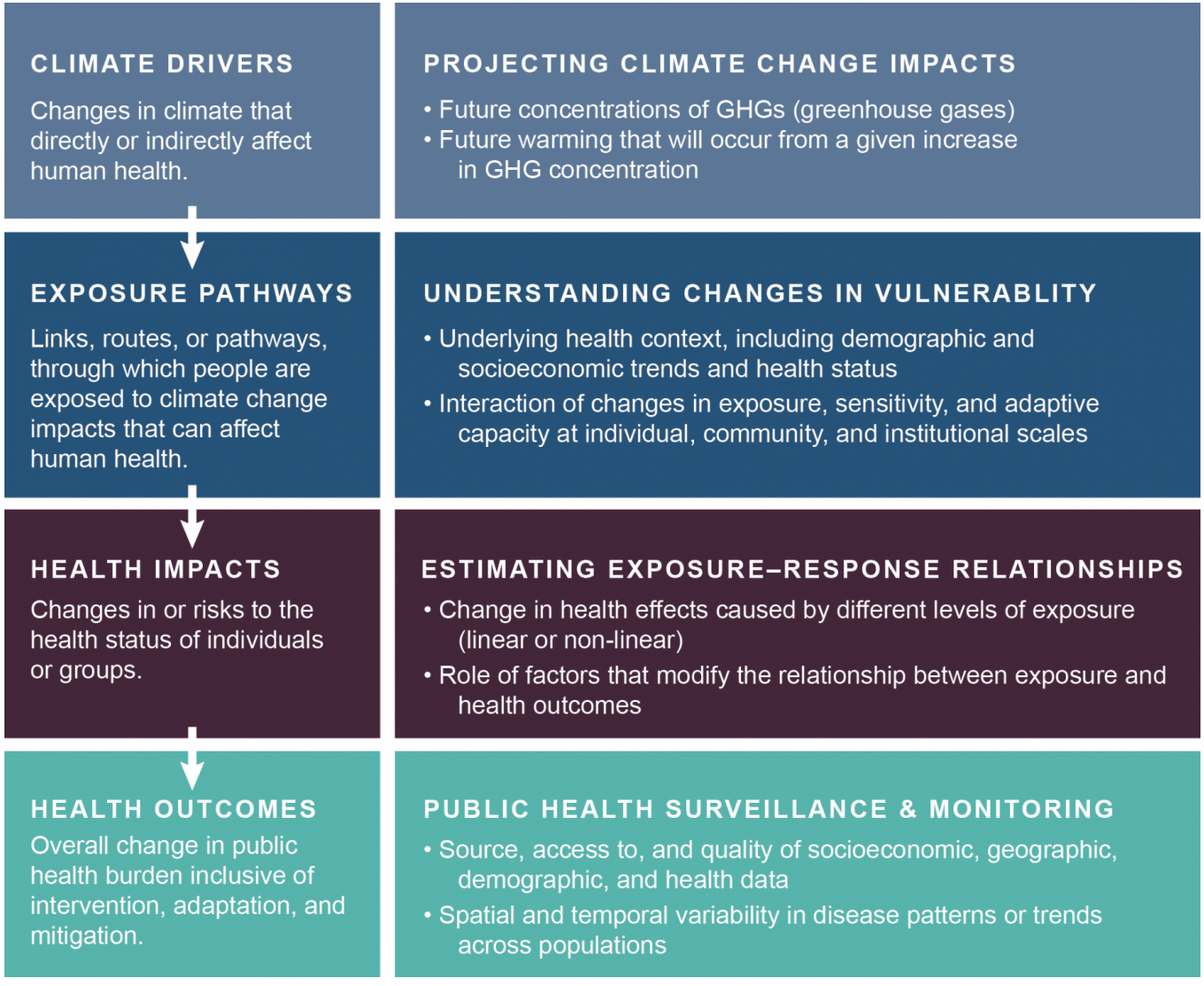
> *"Projections of future climate conditions are based on results from **climate models**—sophisticated computer programs that simulate the behavior of the Earth's climate system. These climate models are used to project how the climate system is expected to change under different possible scenarios."*

Source: https://health2016.globalchange.gov/

Projected health impacts

Source: https://health2016.globalchange.gov

Projected health impacts—Sources of uncertainty



Source: https://health2016.globalchange.gov

US Global Change Research Program

US Global Change Research Program (USGCRP)

About USGCRP

SHARE

- Who We Are
- What We Do
- Organization & Leadership
- Interagency Groups
- Legal Mandate
- Budget
- Related Federal Interagency Efforts
- Staff
- Job Opportunities
- Contact Us

The U.S. Global Change Research Program (USGCRP) is a federal program mandated by Congress to coordinate federal research and investments in understanding the forces shaping the global environment, both human and natural, and their impacts on society. USGCRP facilitates collaboration and cooperation across its 13 federal member agencies to advance understanding of the changing Earth system and maximize efficiencies in federal global change research.

Together, USGCRP and its member agencies provide a gateway to authoritative science, tools, and resources to help people and organizations across the country manage risks and respond to changing environmental conditions.

Source: https://www.globalchange.gov/about

US Global Change Research Program (USGCRP)

Includes thirteen agencies in the US government:

- Departments of Agriculture, Commerce, Defense, Energy, Health & Human Services, Interior, State, and Transportation
- Environmental Protection Agency
- National Aeronautics & Space Administration
- National Science Foundation
- Smithsonian Institution
- U.S. Agency for International Development

See https://www.globalchange.gov/agencies for the role each agency plays in the USGCRP.

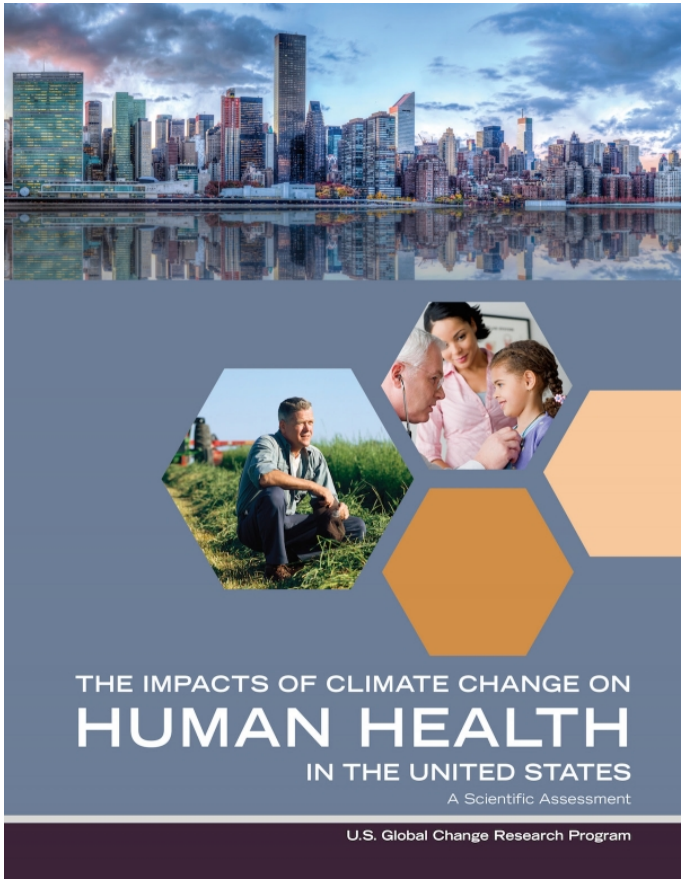
US Global Change Research Program (USGCRP)

Key activities of USGCRP include:

- Advance global change science
  - Observe changes in the Earth system (including through indicators)
  - Improving understanding of earth systems
  - Modeling global change
- Prepare for climate change
  - US Climate Reslience Toolkit
- Assess the US Climate
  - National Climate Assessment (NCA) every four years (includes *Climate Science Special Report* and *Impacts, Risks, and Adaptation in the United States*)
- Coordinate internationally
  - Coordinate US participation in the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports
- Provide data and tools
  - Climate Data Initiative

Source: https://www.globalchange.gov/about

US Climate and Health Assessment



Documenting uncertainty in key findings

Likelihood

Very Likely	Likely	As Likely as Not	Unlikely	Very Unikely
≥9 in 10	≥2 in 3	≈ 1 in 2	≤ 1 in 3	≤1 in 10

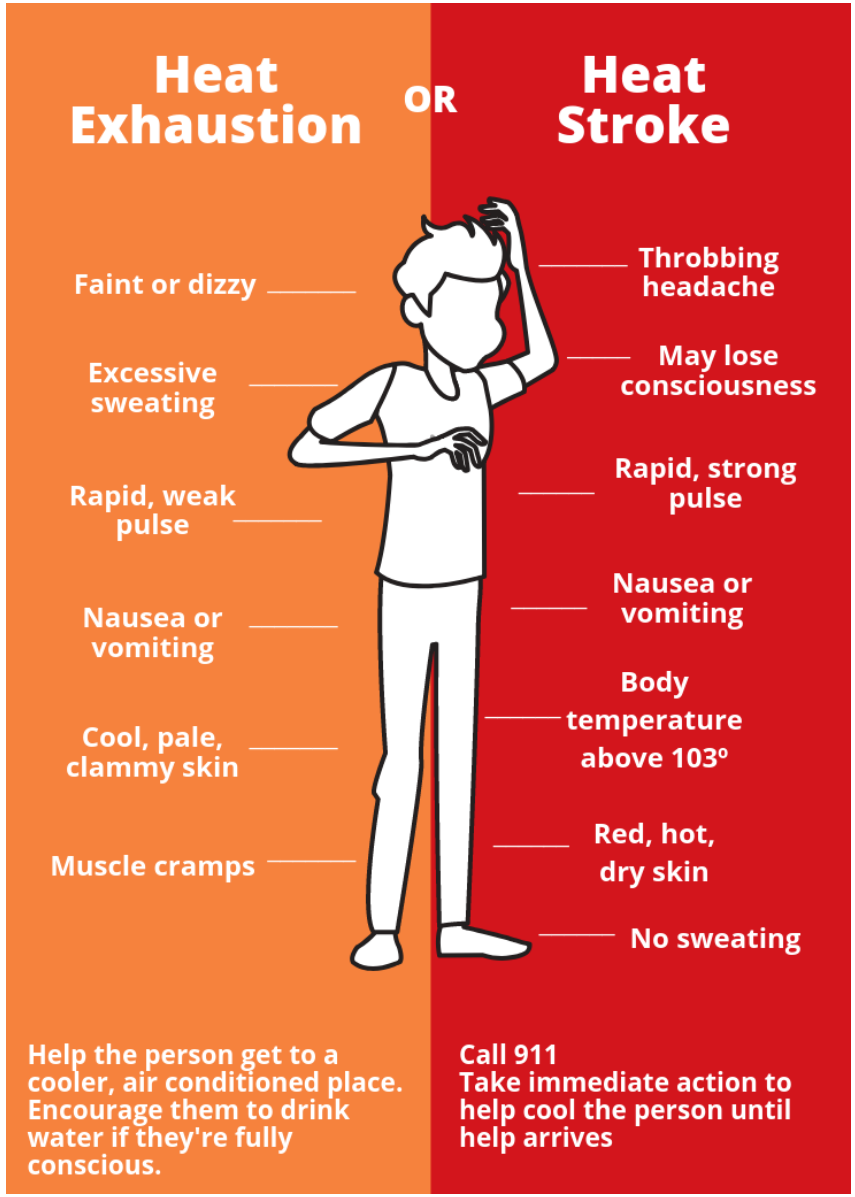
Confidence Level

Very High	High	Medium	Low
Strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus	Moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus	Suggestive evidence (a few sources, limited consistency, models incomplete, methods emerging, etc.), competing schools of thought	Inconclusive evidence (limited sources, extrapolations, inconsistent findings, poor documentation and/or methods not tested, etc.), disagreement or lack of opinions among experts

Source: https://health2016.globalchange.gov/documenting-uncertainty

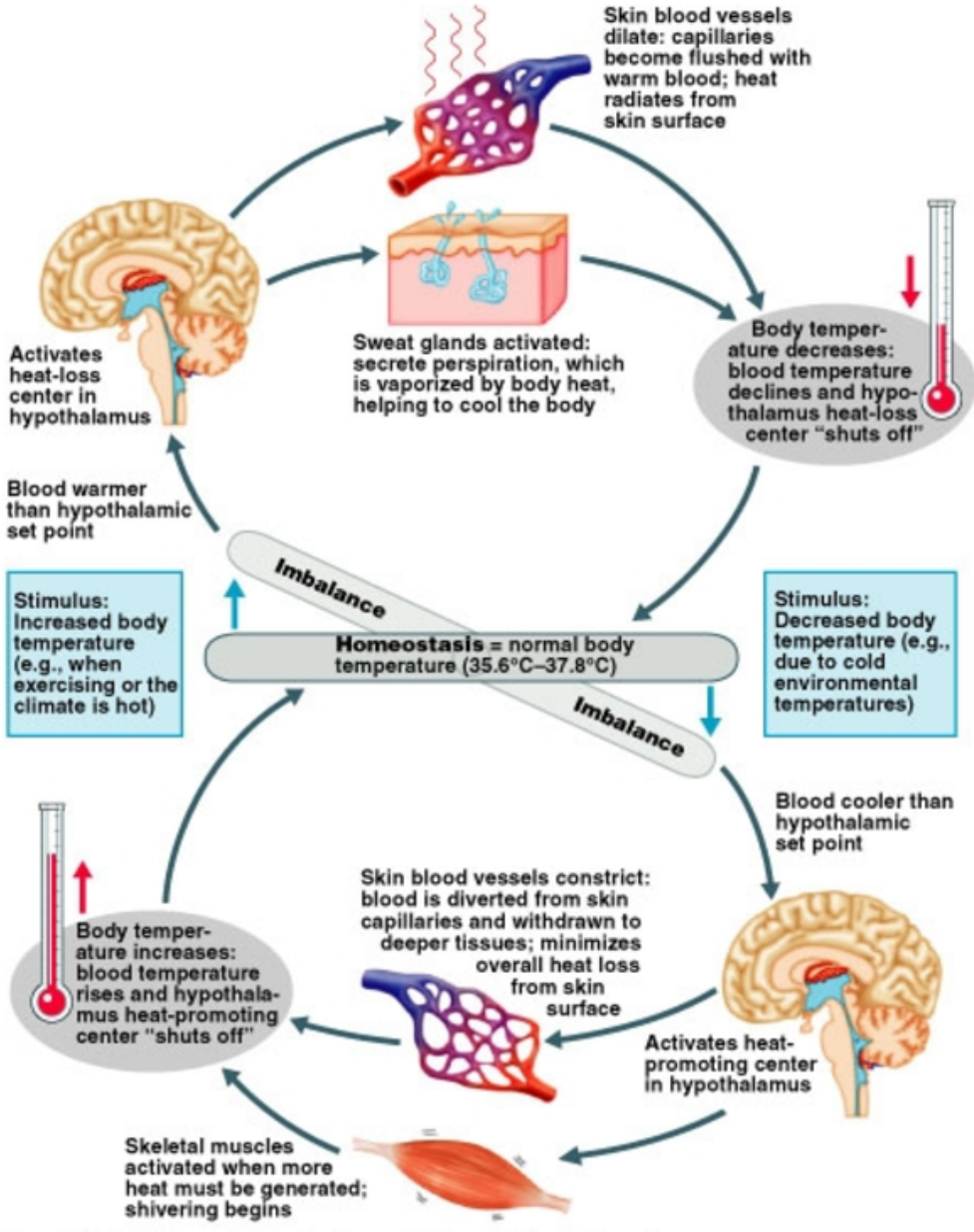
Temperature and Human Health

Temperature extremes and human health



Source: https://www.oregon.gov/oha

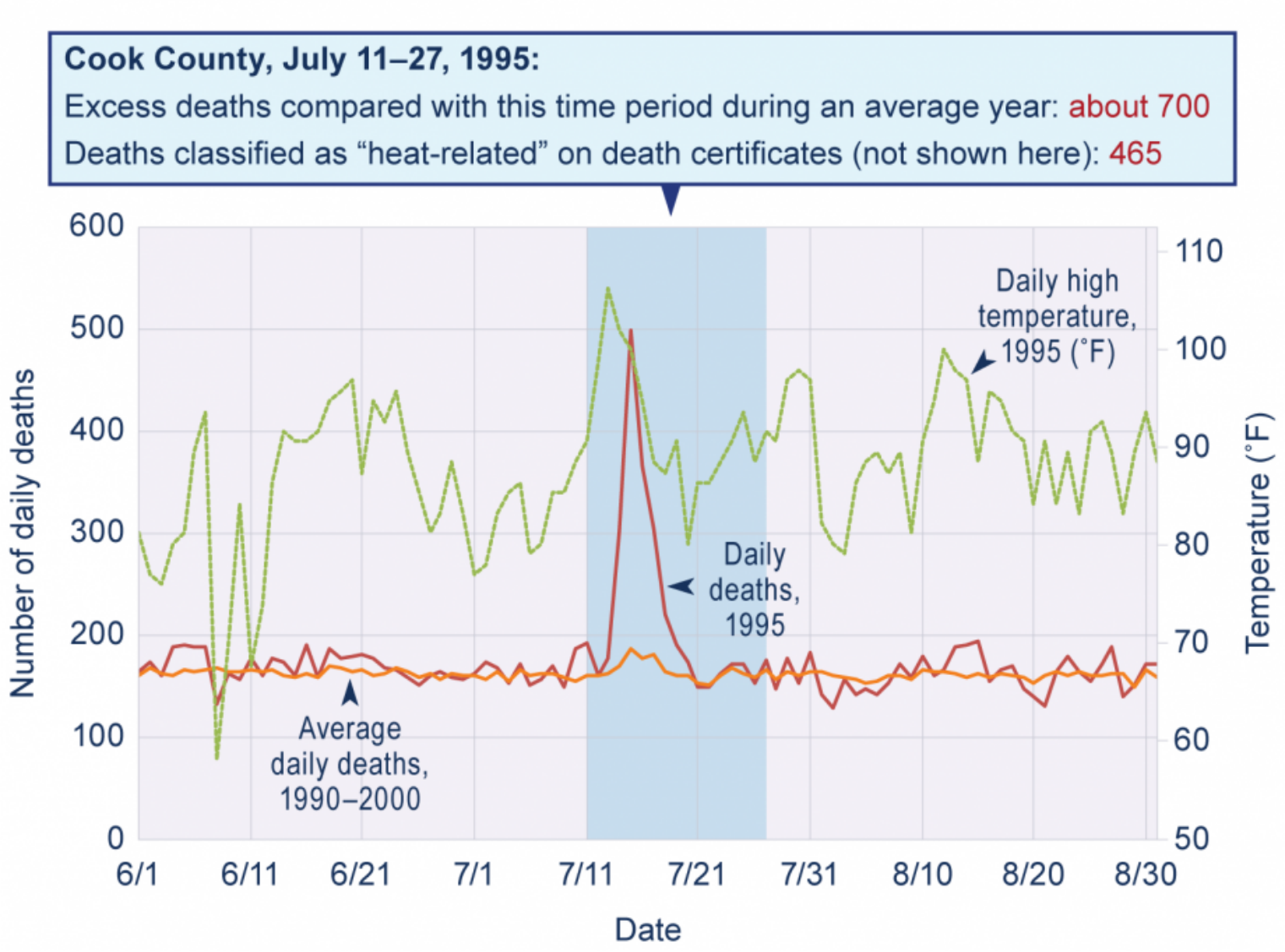
Thermoregulation



Source: pathwayz.org, credit Ben Himme

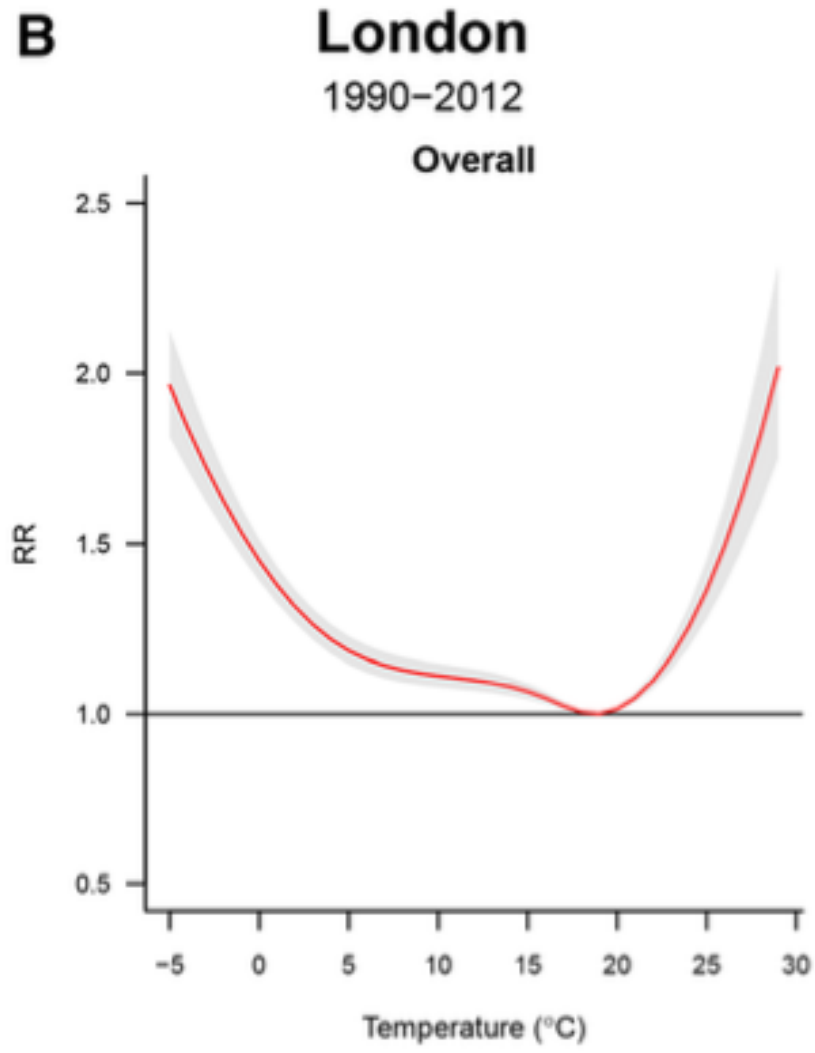
Temperature extremes and human health

Heat-Related Deaths in Chicago in the Summer of 1995



Source: https://health2016.globalchange.gov

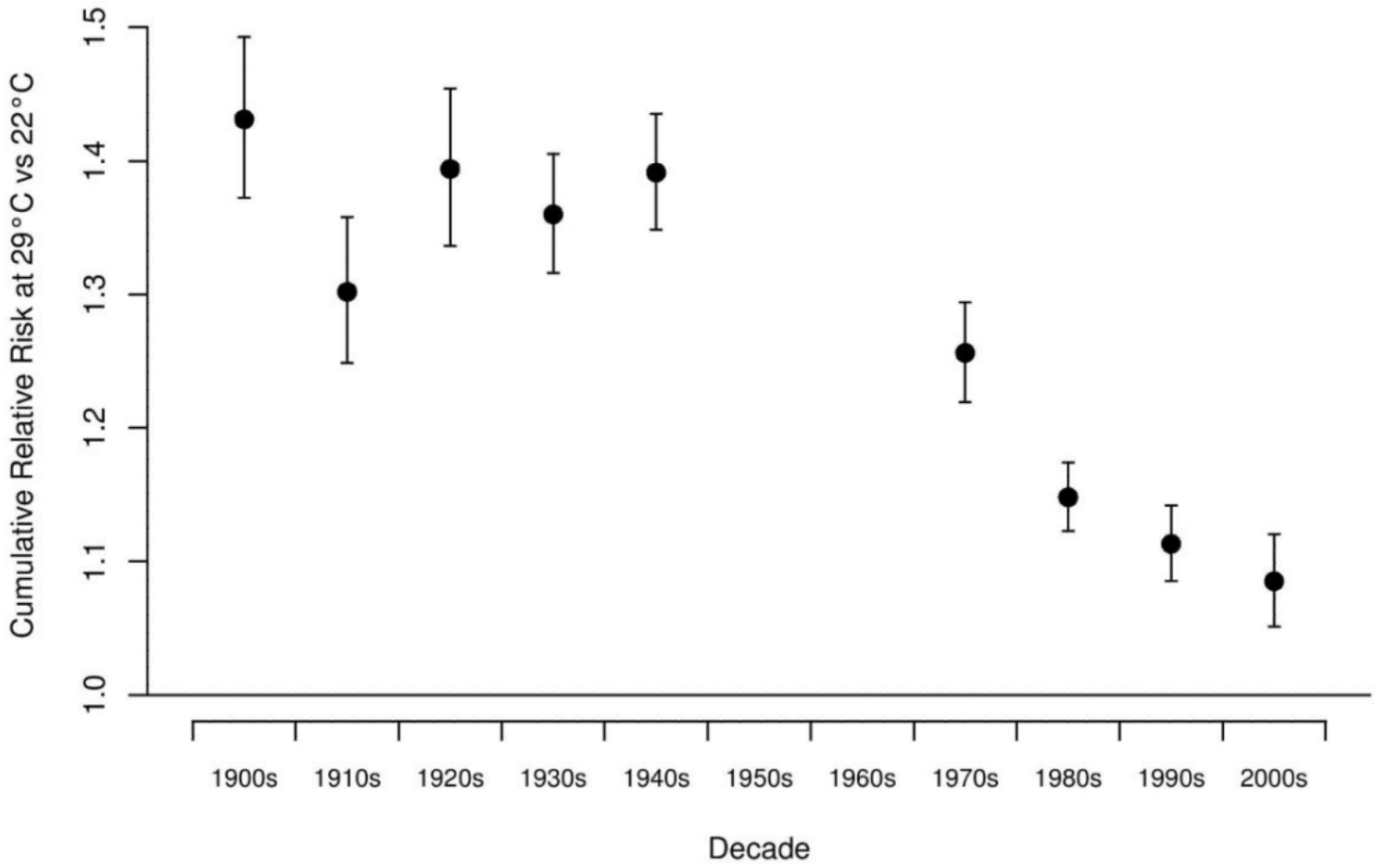
Temperature extremes and human health



Source: Vicedo-Cabrera et al., 2019, *Epidemiology*

Adaptation to temperature extremes

Overall cumulative relative risk at 29 degrees Celsius relative to 22 degrees Celsius on mortality in New York City by decade, 1900s-2000s.

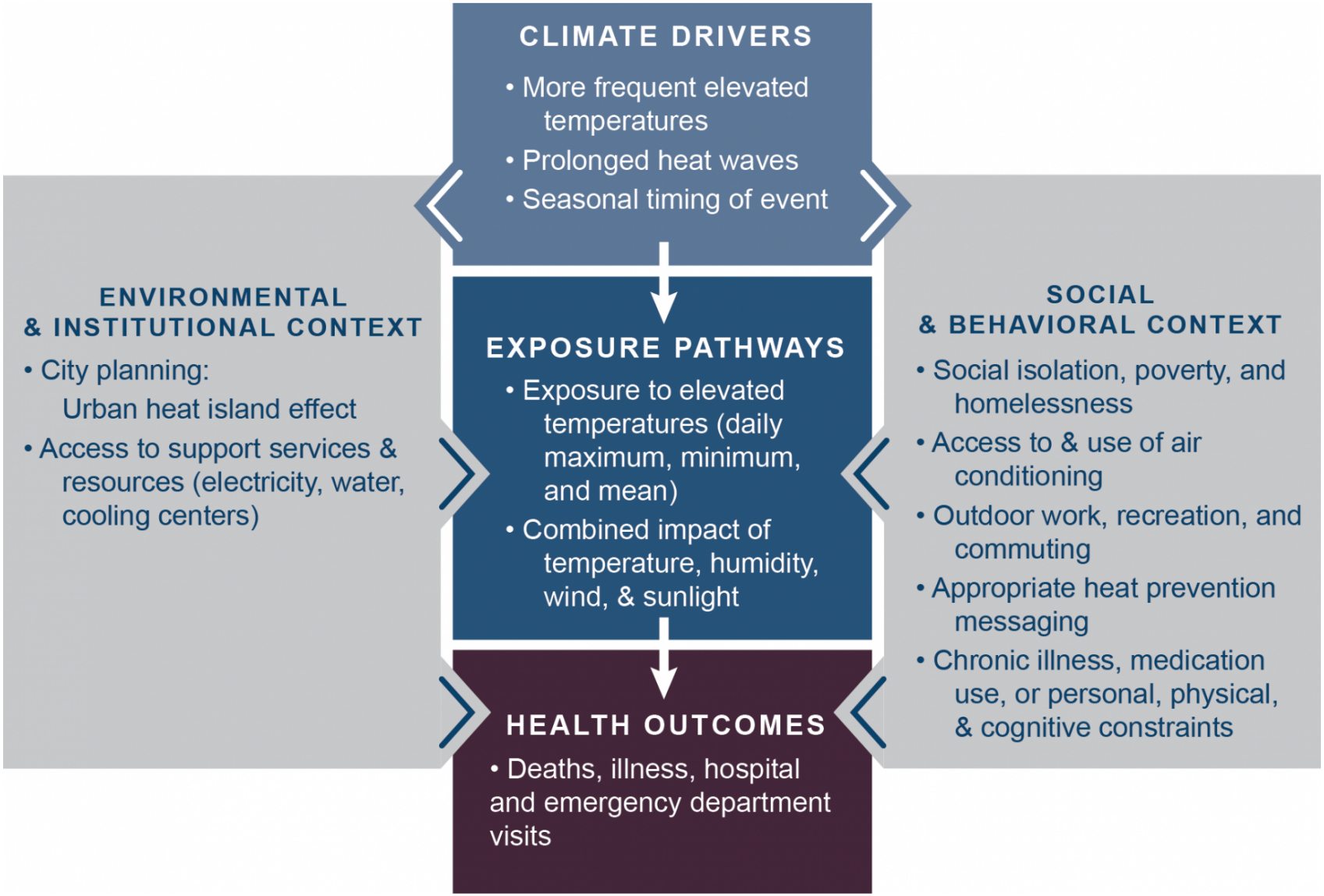


Adaptation to temperature extremes

People resting in Battery Park during a 1911 heat wave.

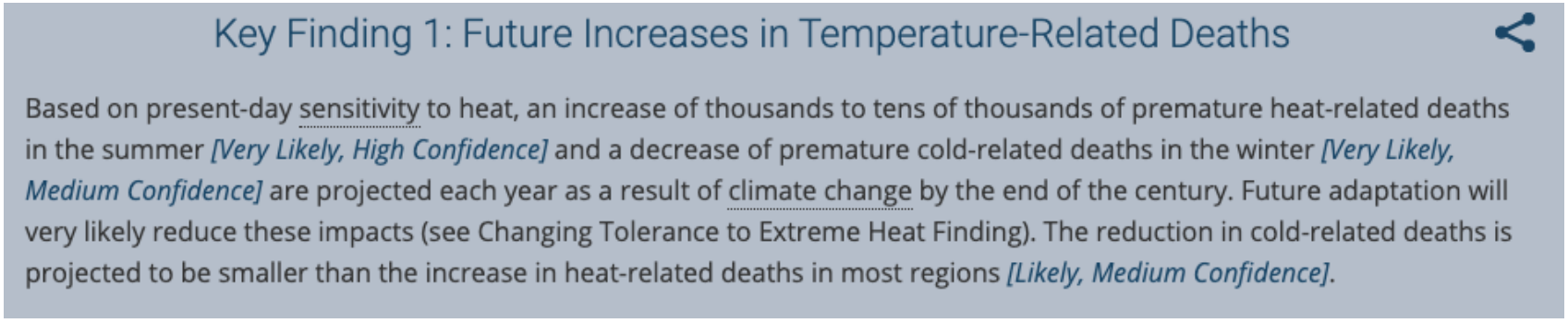
Source: www.history.com, credit to Bain News Service / The Library of Congress

Pathways for extreme heat and health



Source:
https://health2016.globalchange.gov/temperature-related-death-and-illness

Key findings

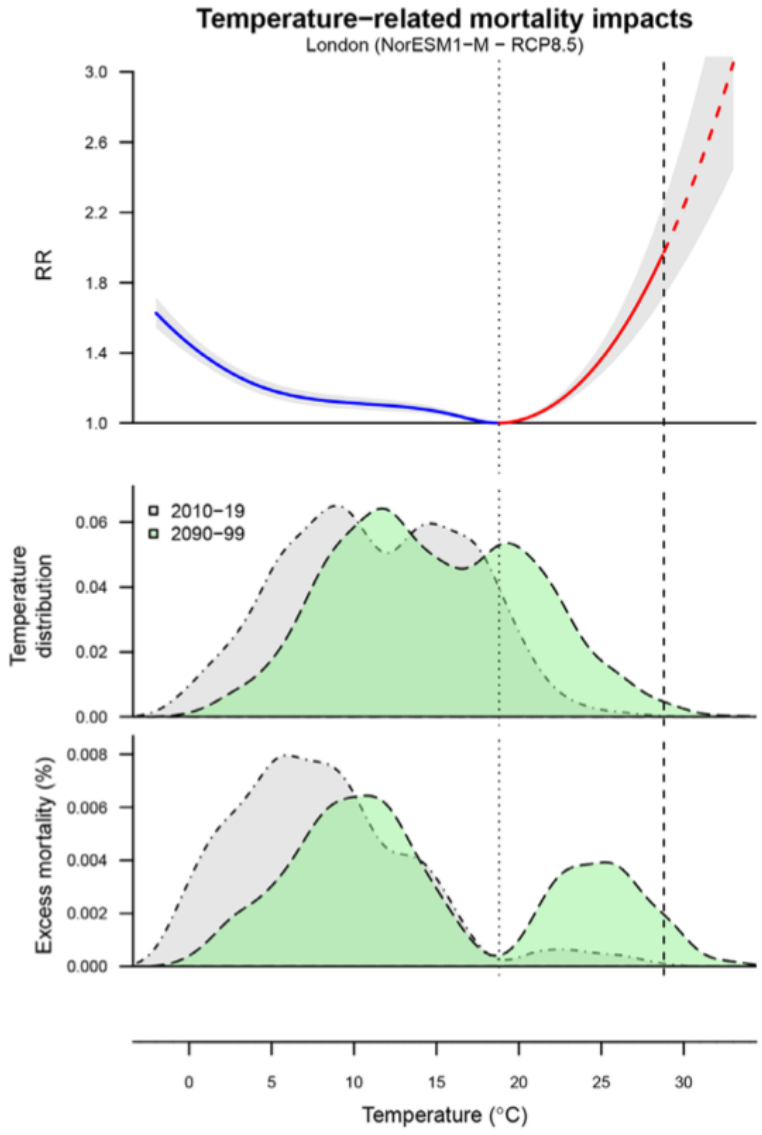


Key Finding 1: Future Increases in Temperature-Related Deaths

Based on present-day sensitivity to heat, an increase of thousands to tens of thousands of premature heat-related deaths in the summer *[Very Likely, High Confidence]* and a decrease of premature cold-related deaths in the winter *[Very Likely, Medium Confidence]* are projected each year as a result of climate change by the end of the century. Future adaptation will very likely reduce these impacts (see Changing Tolerance to Extreme Heat Finding). The reduction in cold-related deaths is projected to be smaller than the increase in heat-related deaths in most regions *[Likely, Medium Confidence]*.

Source:
https://health2016.globalchange.gov/temperature-related-death-and-illness

Key findings



Source: Vicedo-Cabrera et al., 2019, *Epidemiology*

Key findings

Key Finding 2: Even Small Differences from Seasonal Average Temperatures Result in Illness and Death

Days that are hotter than usual in the summer or colder than usual in the winter are both associated with increased illness and death *[Very High Confidence]*. Mortality effects are observed even for small differences from seasonal average temperatures *[High Confidence]*. Because small temperature differences occur much more frequently than large temperature differences, not accounting for the effect of these small differences would lead to underestimating the future impact of climate change *[Likely, High Confidence]*.

Source:
https://health2016.globalchange.gov/temperature-related-death-and-illness

Key findings

Key Finding 3: Changing Tolerance to Extreme Heat

An increase in population tolerance to extreme heat has been observed over time *[Very High Confidence]*. Changes in this tolerance have been associated with increased use of air conditioning, improved social responses, and/or physiological acclimatization, among other factors *[Medium Confidence]*. Expected future increases in this tolerance will reduce the projected increase in deaths from heat *[Very Likely, Very High Confidence]*.

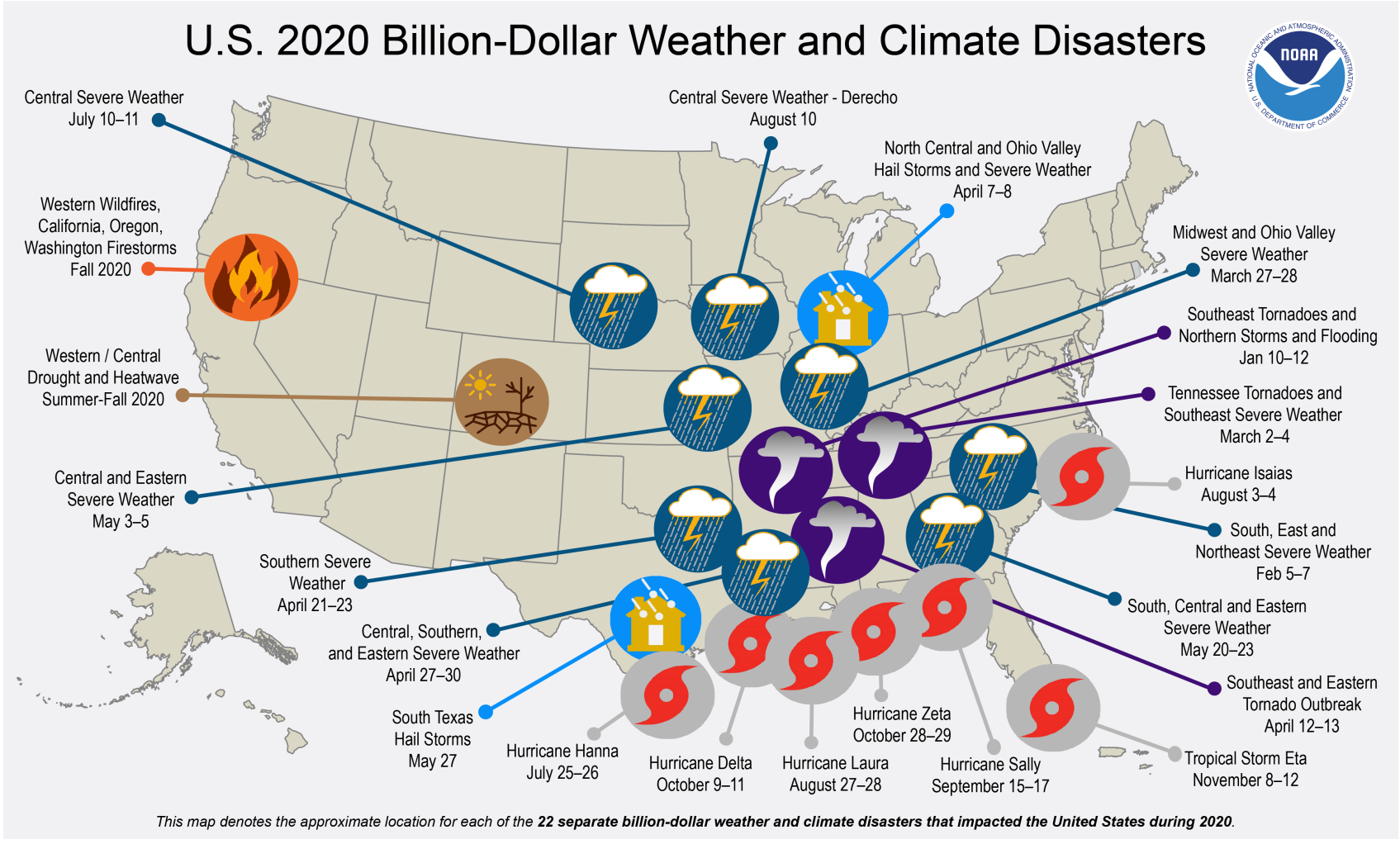
Key Finding 4: Some Populations at Greater Risk

Older adults and children have a higher risk of dying or becoming ill due to extreme heat *[Very High Confidence]*. People working outdoors, the socially isolated and economically disadvantaged, those with chronic illnesses, as well as some communities of color, are also especially vulnerable to death or illness *[Very High Confidence]*.

Source:
https://health2016.globalchange.gov/temperature-related-death-and-illness

Climate-related Disasters and Human Health

Climate-related disasters



Source: https://www.ncdc.noaa.gov/billions/

Role of epidemiology in disasters

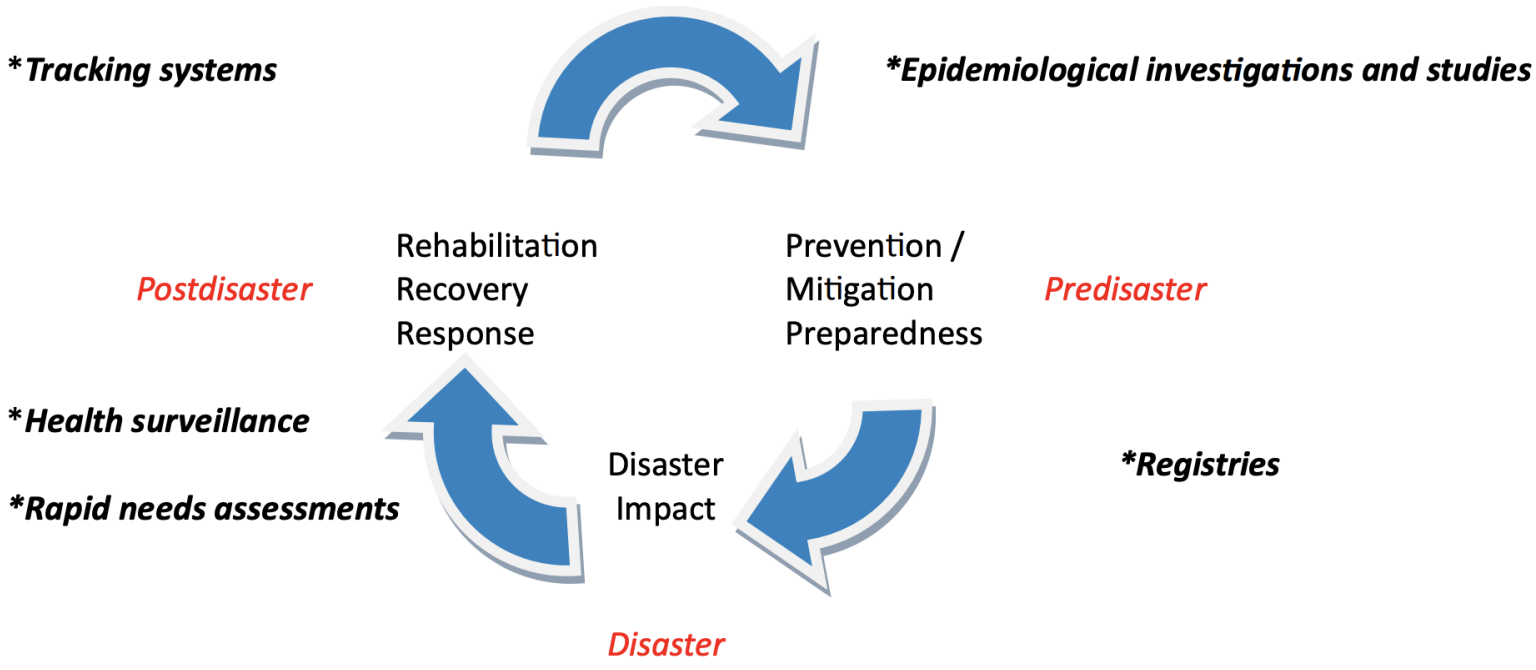
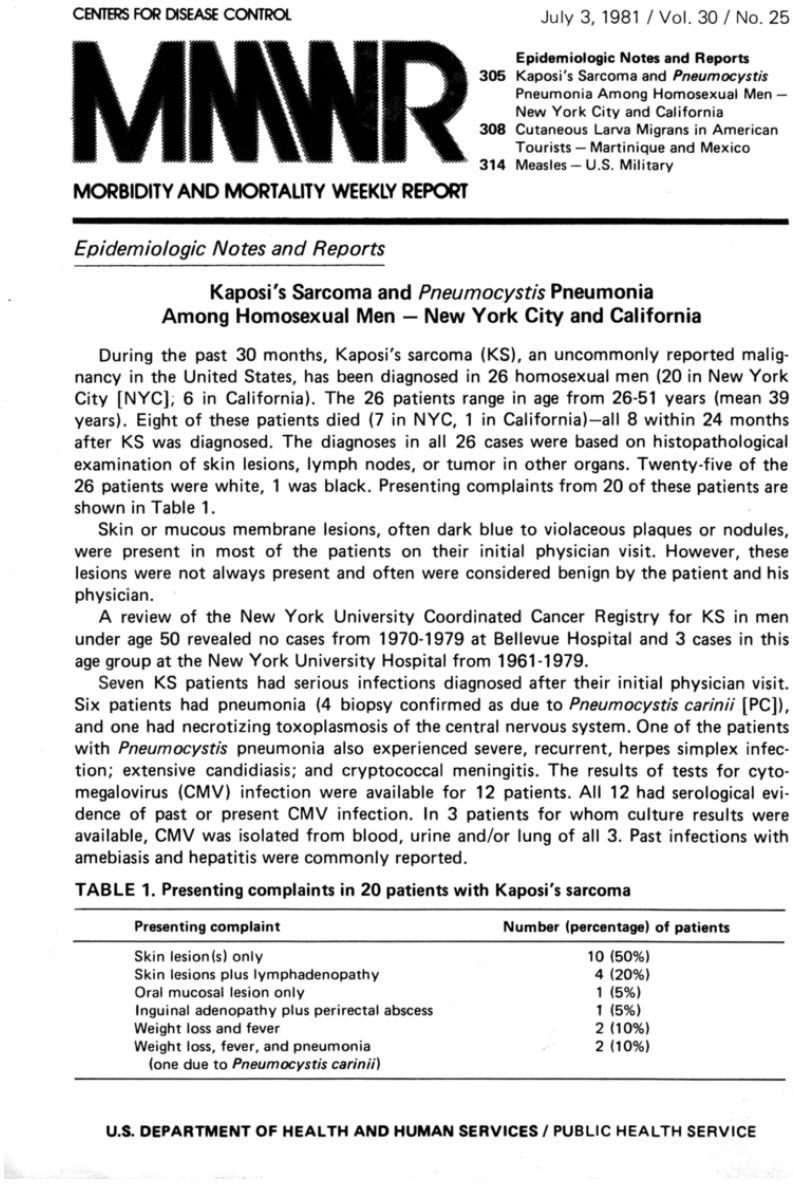


FIGURE 2—Disaster epidemiology actions and the disaster management cycle.

Source: Malilay et al., 2014, "The Role of Applied Epidemiology Methods in the Disaster Management Cycle", *American Journal of Public Health*

US CDC Morbidity and Mortality Weekly Report

For many American disasters, results from disaster epidemiology are reported in the US CDC's Morbidity and Mortality Weekly Report (MMWR).



CENTERS FOR DISEASE CONTROL

July 3, 1981 / Vol. 30 / No. 25

MMWR

MORBIDITY AND MORTALITY WEEKLY REPORT

Epidemiologic Notes and Reports

Kaposi's Sarcoma and *Pneumocystis* Pneumonia Among Homosexual Men — New York City and California

During the past 30 months, Kaposi's sarcoma (KS), an uncommonly reported malignancy in the United States, has been diagnosed in 26 homosexual men (20 in New York City [NYC]; 6 in California). The 26 patients range in age from 26-51 years (mean 39 years). Eight of these patients died (7 in NYC, 1 in California)—all 8 within 24 months after KS was diagnosed. The diagnoses in all 26 cases were based on histopathological examination of skin lesions, lymph nodes, or tumor in other organs. Twenty-five of the 26 patients were white, 1 was black. Presenting complaints from 20 of these patients are shown in Table 1.

Skin or mucous membrane lesions, often dark blue to violaceous plaques or nodules, were present in most of the patients on their initial physician visit. However, these lesions were not always present and often were considered benign by the patient and his physician.

A review of the New York University Coordinated Cancer Registry for KS in men under age 50 revealed no cases from 1970-1979 at Bellevue Hospital and 3 cases in this age group at the New York University Hospital from 1961-1979.

Seven KS patients had serious infections diagnosed after their initial physician visit. Six patients had pneumonia (4 biopsy confirmed as due to *Pneumocystis carinii* [PC]), and one had necrotizing toxoplasmosis of the central nervous system. One of the patients with *Pneumocystis* pneumonia also experienced severe, recurrent, herpes simplex infection; extensive candidiasis; and cryptococcal meningitis. The results of tests for cytomegalovirus (CMV) infection were available for 12 patients. All 12 had serological evidence of past or present CMV infection. In 3 patients for whom culture results were available, CMV was isolated from blood, urine and/or lung of all 3. Past infections with amebiasis and hepatitis were commonly reported.

TABLE 1. Presenting complaints in 20 patients with Kaposi's sarcoma

Presenting complaint	Number (percentage) of patients
Skin lesion(s) only	10 (50%)
Skin lesions plus lymphadenopathy	4 (20%)
Oral mucosal lesion only	1 (5%)
Inguinal adenopathy plus perirectal abscess	1 (5%)
Weight loss and fever	2 (10%)
Weight loss, fever, and pneumonia (one due to *Pneumocystis carinii*)	2 (10%)

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES / PUBLIC HEALTH SERVICE

Hurricane Floyd, 1999

In September 1999, Hurricane Floyd caused extensive damage—especially from widespread flooding—in eastern North Carolina.

Source: US Army Corps of Engineers

Hurricane Floyd, 1999

In May 2000, a report on the storm's health impacts in North Carolina, including attributable mortality, was published in the CDC's MMWR.

TABLE 1. Deaths related to Hurricane Floyd, by cause of death — North Carolina, 1999

Cause of death	Number*	(%)
Drowning	36	(69)
In motor vehicle	*24*	
In boat	*7*	
As pedestrian	*4*	
In house	*1*	
Motor-vehicle crash (excluding drowning)	7	(13)
Myocardial infarction	4	(8)
Fire (burns and trauma from escape attempts)	2	(4)
Hypothermia	1	(2)
Electrocution	1	(2)
Fall	1	(2)

*n=52.

Source: US CDC, 2000, "Morbidity and Mortality Associated With Hurricane Floyd—North Carolina, September–October 1999", *Morbidity and Mortality Weekly Report*

Hurricane Floyd, 1999

"The medical examiner determined that 52 deaths were associated directly with the storm. Decedents ranged in age from 1 to 96 years (median: 43 years); 38 (73%) were males. . . . Seven deaths occurred during transport by boat; flotation devices were not worn by any of the decedents."

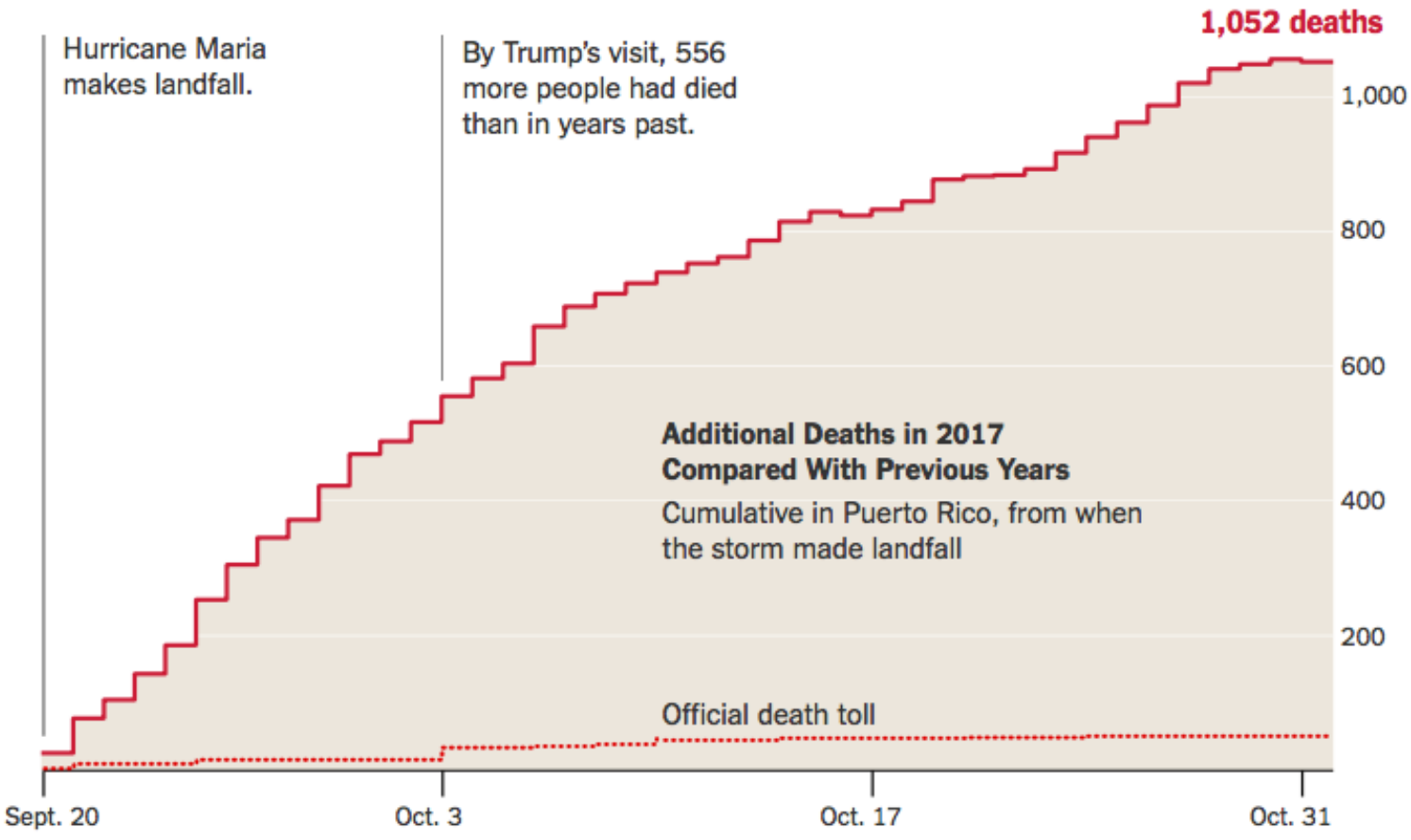
Source: US CDC, 2000, "Morbidity and Mortality Associated With Hurricane Floyd—North Carolina, September–October 1999", *Morbidity and Mortality Weekly Report*

Direct and indirect deaths

- **Direct deaths:** "Caused by environmental forces of the hurricane and direct consequences of these forces."
- **Indirect deaths:** "Caused by unsafe or unhealthy conditions because of loss or disruption of usual services, personal loss, or lifestyle disruption."

Source: Issa et al., 2018, "Deaths Related to Hurricane Irma — Florida, Georgia, and North Carolina, September 4–October 10, 2017", *Morbidity and Mortality Weekly Report*

Hurricane Maria, 2017



Source: New York Times

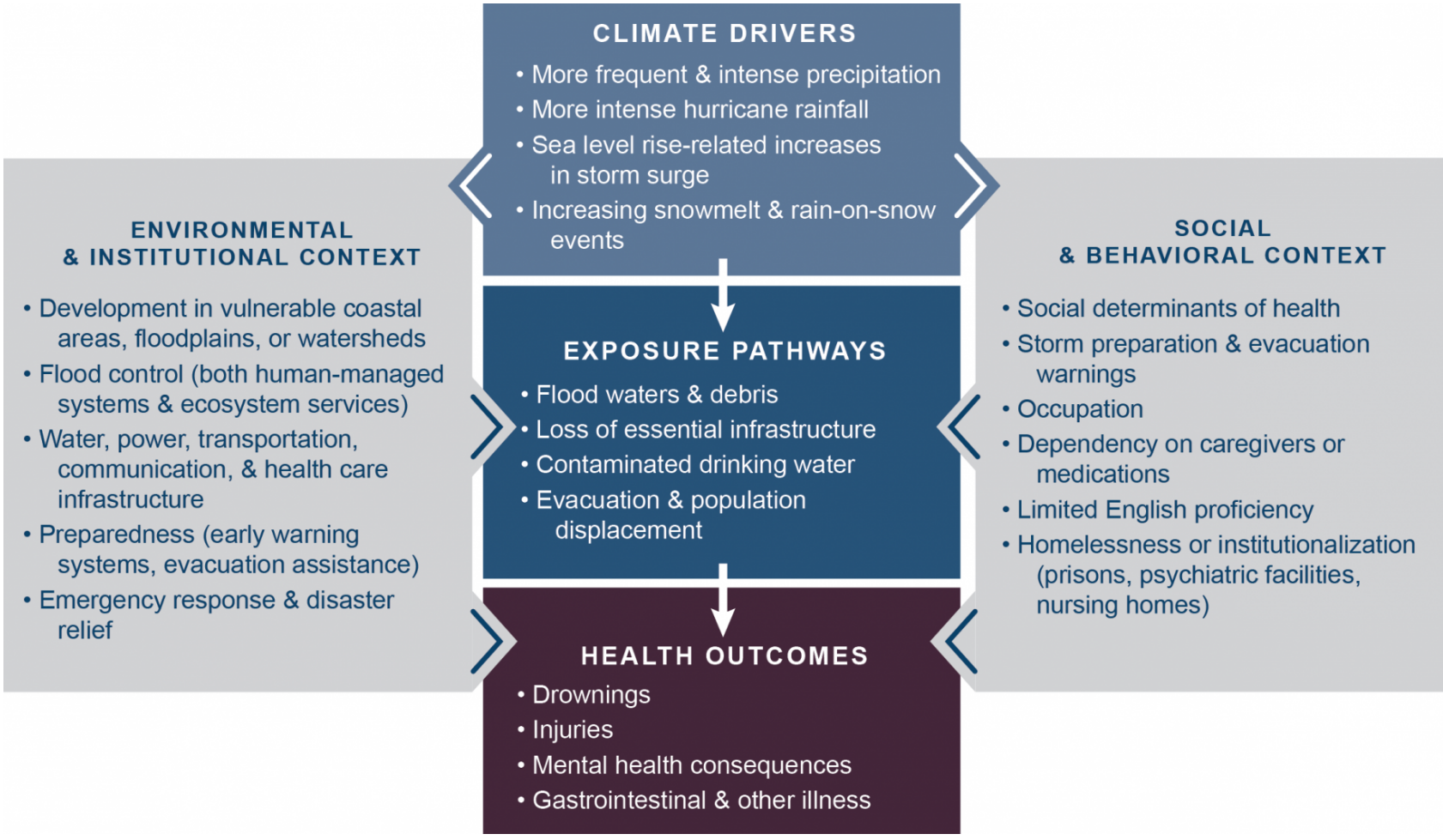
2004 Florida hurricane season

Comparison of observed storm-dependent mortality and official mortality for the 2004 hurricane season in Florida

	Charley	Ivan	Frances/Jeanne
Period of increased mortality (days)	62	47	59
Average deaths/day during 2004	36.3	12.5	70.5
Expected deaths per day	32.5	10.3	63.7
Deaths above expected	133	90	401
Official death count	37	39	68
% explained by official death count	28	40	17

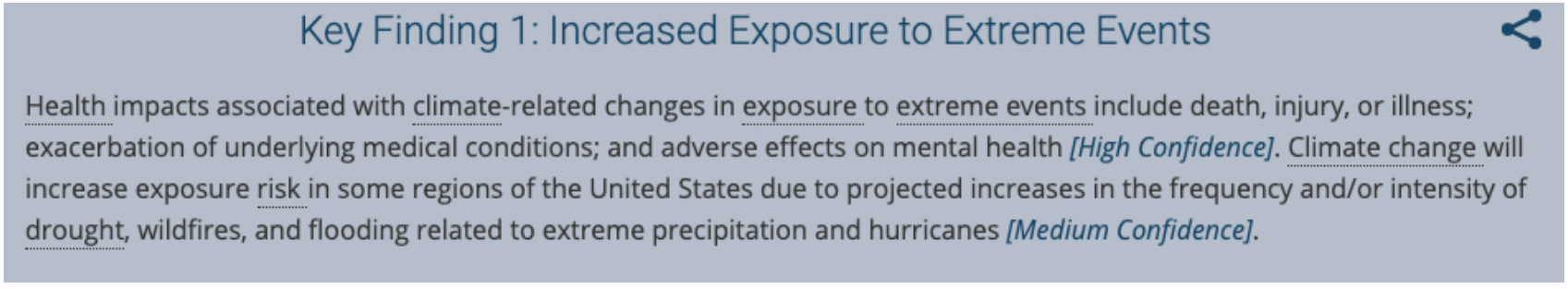
Source: McKinney et al., 2011, "Direct and indirect mortality in Florida during the 2004 hurricane season," *International Journal of Biometeorology*

Pathways



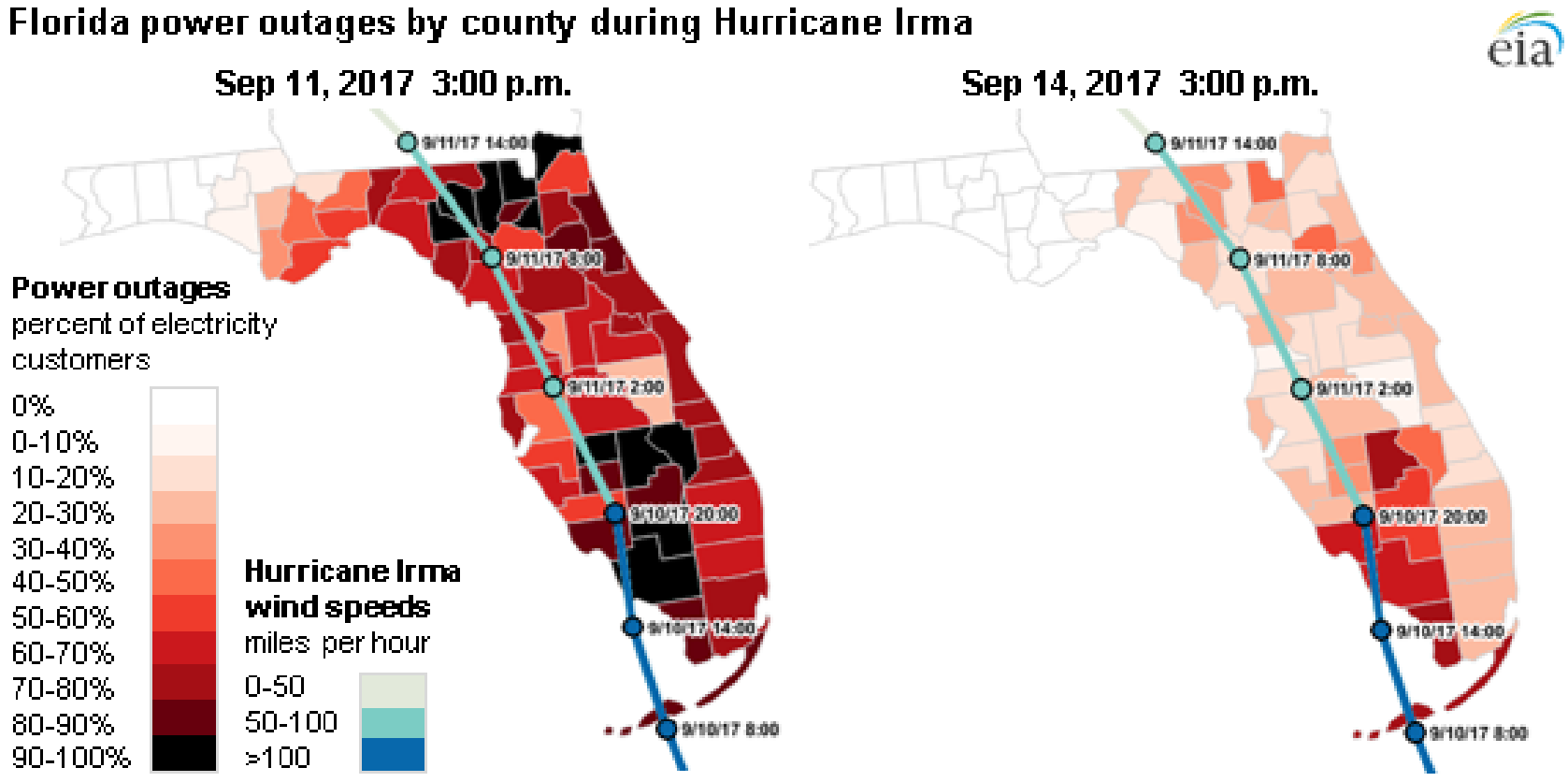
Source: https://health2016.globalchange.gov

Key findings



Source: https://health2016.globalchange.gov

Key findings



Source: U.S. Energy Information Administration based on data from Florida Division of Emergency Management and NOAA National Hurricane Center

Key findings

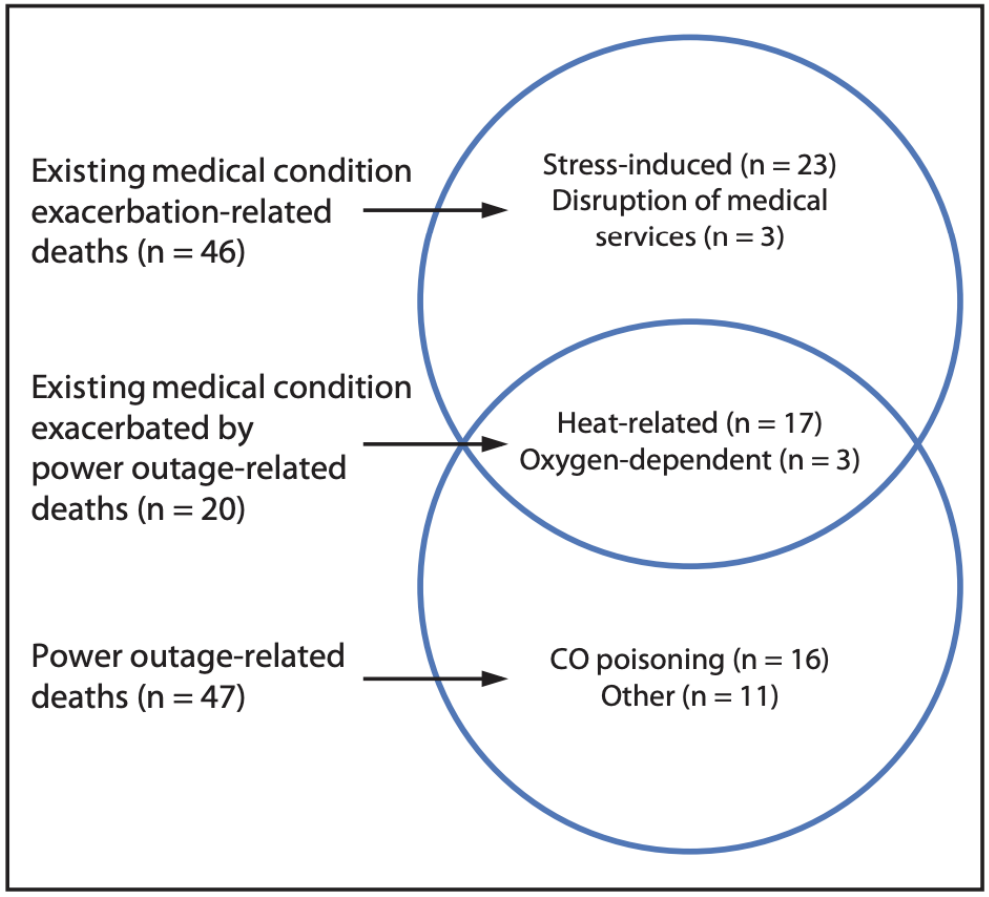
Six Dead At Florida Nursing Home After Irma Knocks Out Power

Wednesday, September 13th 2017, 9:49 am
By: News On 6

Source: newsonsix.com

Key findings

FIGURE. Overlapping circumstances of deaths associated with existing medical condition exacerbation and power outages caused by Hurricane Irma — Florida, Georgia, and North Carolina, September 4–October 10, 2017*,†



Source: Issa et al., 2018, "Deaths Related to Hurricane Irma — Florida, Georgia, and North Carolina, September 4–October 10, 2017," *Morbidity and Mortality Weekly Report*

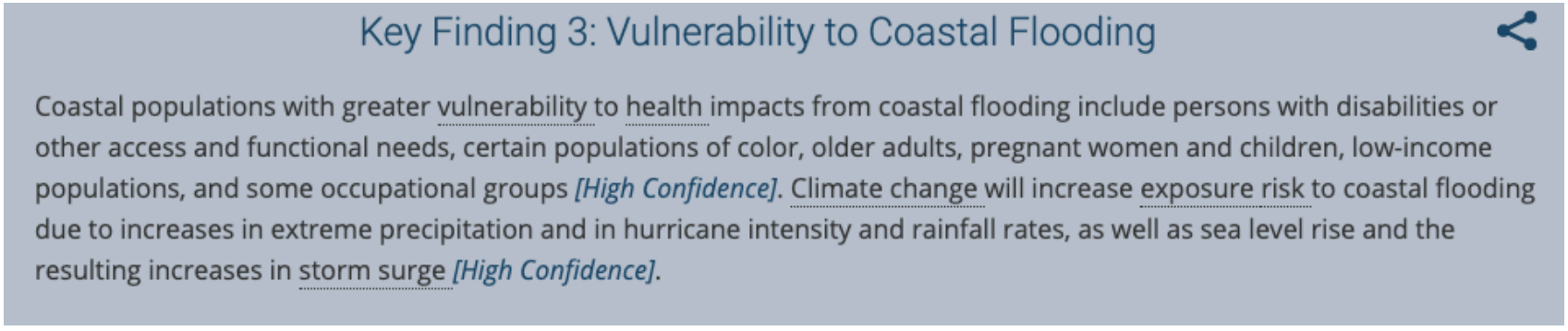
Key findings

Key Finding 2: Disruption of Essential Infrastructure

Many types of extreme events related to climate change cause disruption of infrastructure, including power, water, transportation, and communication systems, that are essential to maintaining access to health care and emergency response services and safeguarding human health *[High Confidence]*.

Source: https://health2016.globalchange.gov

Key findings



Source: https://health2016.globalchange.gov

Conclusion

Other topics on climate and health

The US Climate and Health Assessment covers several other topics on climate and human health:

- Air quality impacts
- Vector-borne disease
- Water-related illness
- Food safety, nutrition, and distribution
- Mental health and well-being
- Populations of concern

Questions

Questions?