LANCET COUNTDOWN: TRACKING PROGRESS ON HEALTH AND CLIMATE CHANGE

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2018 Lancet Countdown on Health and Climate Change Brief for the United States of America

November 28, 2018

Introduction

This Brief focuses on connections between climate change and health in the United States (U.S.) in 2017. It draws out some of the most nationally-relevant findings of the global 2018 *Lancet* Countdown on Health and Climate Change report with U.S.-specific data to highlight the key threats and opportunities climate change poses for the health of Americans.

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2018 Lancet Countdown on Health and Climate Change Brief for the United States of America

Executive Summary

This Brief focuses on connections between climate change and health in the United States (U.S.) in 2017. It draws out some of the most nationally-relevant findings of the global 2018 *Lancet* Countdown on Health and Climate Change report with U.S.-specific data to highlight the key threats and opportunities climate change poses for the health of Americans.

Climate Change Threatens Americans' Health Now

Increases in heat and heatwaves pose a serious threat to health and labor productivity. More Americans are being exposed to extreme heat as a result of above-average and record-setting temperatures in the U.S., and heatwaves have been getting more frequent and lasting longer. This puts people at risk for heat exhaustion and heat stroke while worsening chronic conditions such as lung, heart, and kidney disease, which increases healthcare utilization and costs. Increased heat has health implications for laborers and has contributed to the loss of approximately 1.1 billion labor hours in the U.S. between 2000 and 2017.

Increases in extreme weather events significantly threaten both health and health systems. In 2017, there were 16 extreme weather disasters in the U.S., from severe hurricanes to extensive wildfires, that each cost more than a billion dollars and together cost over $313 billion. While each type of disaster poses different threats to human health, they all can lead to death. The official death toll was estimated at 3,278 lives, though the actual number is likely much higher, highlighting the need for better surveillance.

Climate change is elevating the risk of mosquito-, tick-, and water-borne diseases. Climate-sensitive vector-borne illnesses transmitted by mosquitoes, ticks, and fleas, including Lyme disease and West Nile virus, tripled between 2004-2016. Longer warm water seasons and increased water temperatures support pathogens and bacteria, like *Vibrio*, which can cause gastrointestinal illnesses, food poisoning, skin infections, and even death.

Prevention of Further Dangerous Climate Change: Transitioning to Renewable Clean Energy

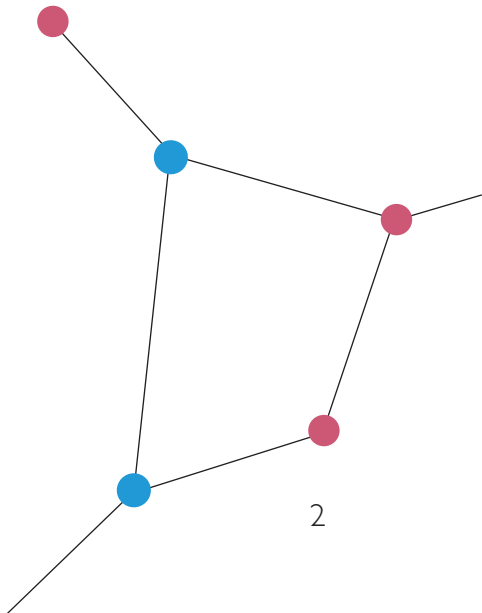
Hospitals can lead America's efforts to transform the energy system. Increasingly affordable renewable energy sources in the U.S. have created the opportunity for a transition towards solar and wind energy, which results in cleaner air and water with fewer greenhouse gas (GHG) emissions. While this change is already happening, it must accelerate. Healthcare systems are major energy consumers, are well-placed to lead, and should ensure that their own operations are powered by renewable energy in order to minimize harm from their activities. Healthcare should extend its commitment to "do no harm" by divesting from the fossil fuel industry and investing in innovative solutions that will improve health now and for future generations.

Adaptation to Climate Change: Public Health Department Preparation and Climate Change Adaptation Spending on Health

While public health departments across America are responding to climate change, health-related adaptation spending is inadequate for the challenge ahead.
Forward-thinking public health departments and cities across America are already developing short- and long-term strategies that will reduce the negative health impacts of climate change and enhance resilience. However, these efforts are not widespread and are significantly underfunded. Only 14% of total U.S. adaptation spending was directed towards the healthcare-related sectors in the 2016-2017 fiscal year.

Training the Next Generation and Educating the Public on the Health Impacts of Climate Change

Educating health professionals is key to preparedness.
Describing climate change in terms of human health reinforces that climate change is impacting Americans now. Evidence shows that health professionals are highly trusted to deliver this message. Training both current health professionals and the next generation to recognize, respond, facilitate preparedness, and educate others is essential to preparing for climate impacts on health.



About the Lancet Countdown

The *Lancet* is one of the world's leading medical journals. The *Lancet* Countdown: Tracking Progress on Health and Climate Change is a global, independent, interdisciplinary research collaboration between 27 leading academic institutions, the United Nations, and intergovernmental agencies. It draws on world-class expertise from climate scientists; ecologists; mathematicians; geographers; engineers; energy, food, livestock and transport experts; economists; social and political scientists; public health professionals; and medical doctors. The Countdown monitors and reports annually on the relationship between health and climate, and its implications for national governments.

The *Lancet* Countdown was launched following the 2015 *Lancet* Commission on Health and Climate Change, which concluded that unmitigated climate change would undermine 50 years of public health gains. In contrast, it found that responding to climate change could represent "the greatest global health opportunity of the 21st century."

The 2018 report presents data for 2017 on 41 indicators across five domains: climate change impacts, exposures, and vulnerability; adaptation planning and resilience for health; mitigation actions and health co-benefits; economics and finance; and public and political engagement. New indicators were developed and existing ones improved upon from the prior year.

About the American Public Health Association

The American Public Health Association (APHA) champions the health of all people and all communities. We strengthen the public health profession, promote best practices, and share the latest public health research and information. The APHA is the only organization that influences federal policy, has a nearly 150-year perspective, and brings together members from all fields of public health. Learn more at www.apha.org.

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U.S. Momentum to Curb Climate Change Continues

Despite the U.S.'s intended withdrawal from the Paris Agreement, city, regional, and business commitments are currently on track to achieve about half of the U.S. carbon emissions reduction commitment.[1] Initiatives such as the *Compact of Mayors, We Are Still In,* and *C40 Cities* are gaining momentum. *We Are Still In* represents entities in all 50 states, more than 154 million Americans, $9.46 trillion of the U.S. economy, and healthcare institutions.[2]

Climate Change is Harming the Health of Americans

Humans need clean air, safe water, and vibrant communities in order to thrive, and climate change threatens these foundations of health and well-being. While the health of all Americans is at risk, climate change worsens health inequities with unequally distributed harms to health. There are broad health risks, as outlined in Figure 1, stemming from exposures like extreme weather, heatwaves, exacerbation of air pollution, changes in vector ecology, and population displacement.[3,4] People of color are disproportionately exposed to these health risks, and vulnerable populations, including children, the elderly, the chronically ill, and the poor, are often most affected. The Lancet Countdown's findings reinforce those of the U.S. Global Change Research Program's Fourth National Climate Assessment: Volume I and the Climate and Health Assessment that show climate change is already harming Americans' health.[3,4]

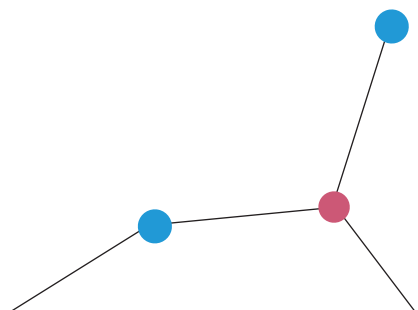


Figure 1: Climate Change is Harming the Health of Americans.

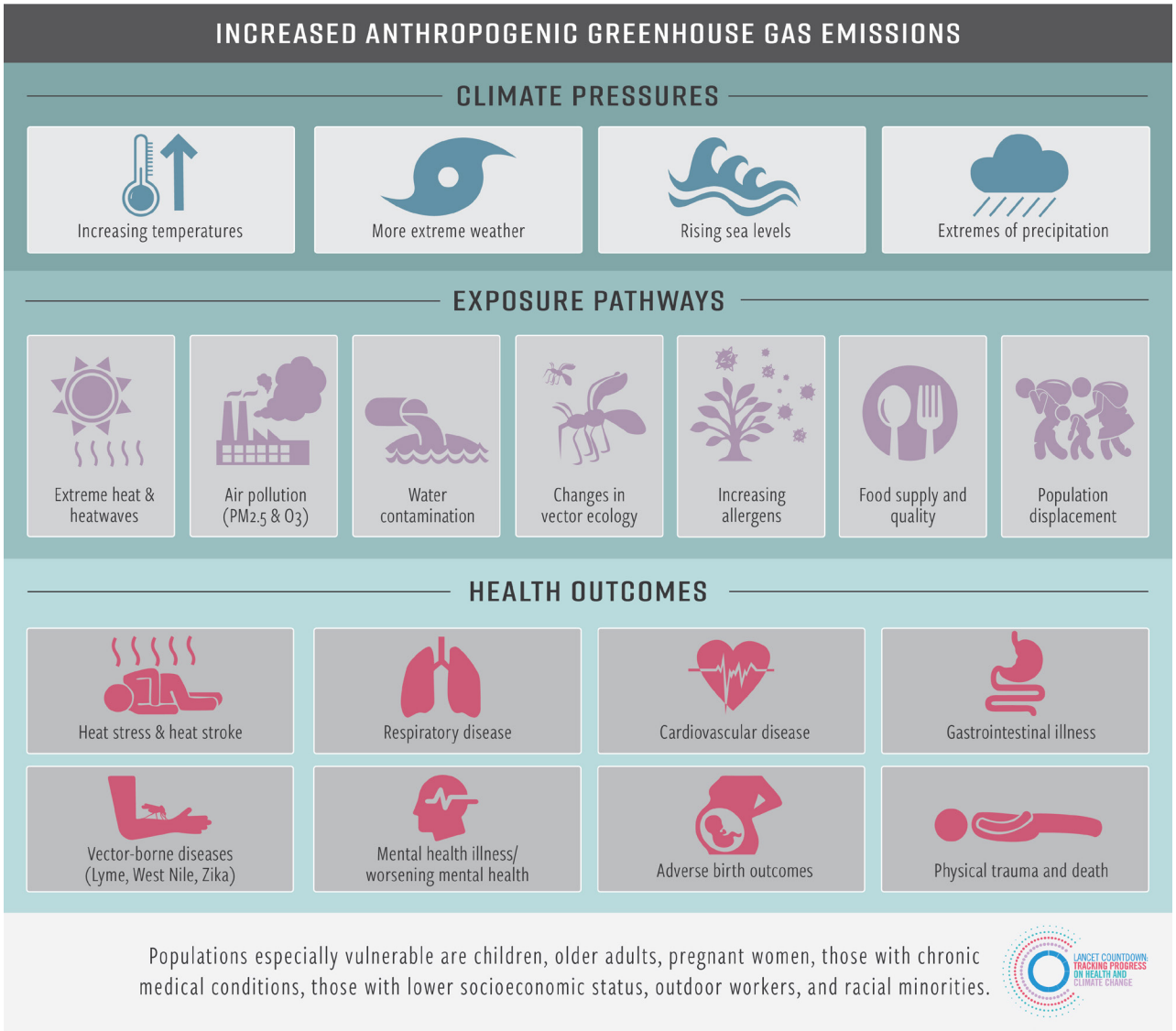


Figure created for Brief by M. Lee (Climate Nexus).

Negative Health Impacts of Heat

Data from the U.S.

Heatwaves are associated with increased rates of heat stress and heat stroke, increased aggression and violence, and other widespread health impacts as shown in Figure 2.[4] Emerging evidence demonstrates links between hotter temperatures and increased bacterial resistance to antibiotics,[5] declines in cognitive function,[6] worsening mental health conditions,[7] and increased suicides.[8] Exposure to extreme heat is the leading cause of weather-related deaths in the U.S.,[9,10] and one estimate predicts that by 2050, approximately 3,400 more Americans will die prematurely each year as a result of increased heat.[11]

These spikes in deaths, emergency department visits, and hospital admissions disproportionately affect pregnant women, the young and old, the chronically ill, minorities, low-income families, and outdoor workers.[4] The cost of hospitalizations, emergency department encounters, and outpatient visits related to just one heatwave event was estimated at $179 million.[12]

Figure 2: Extreme Heat is Harming the Health of Americans.

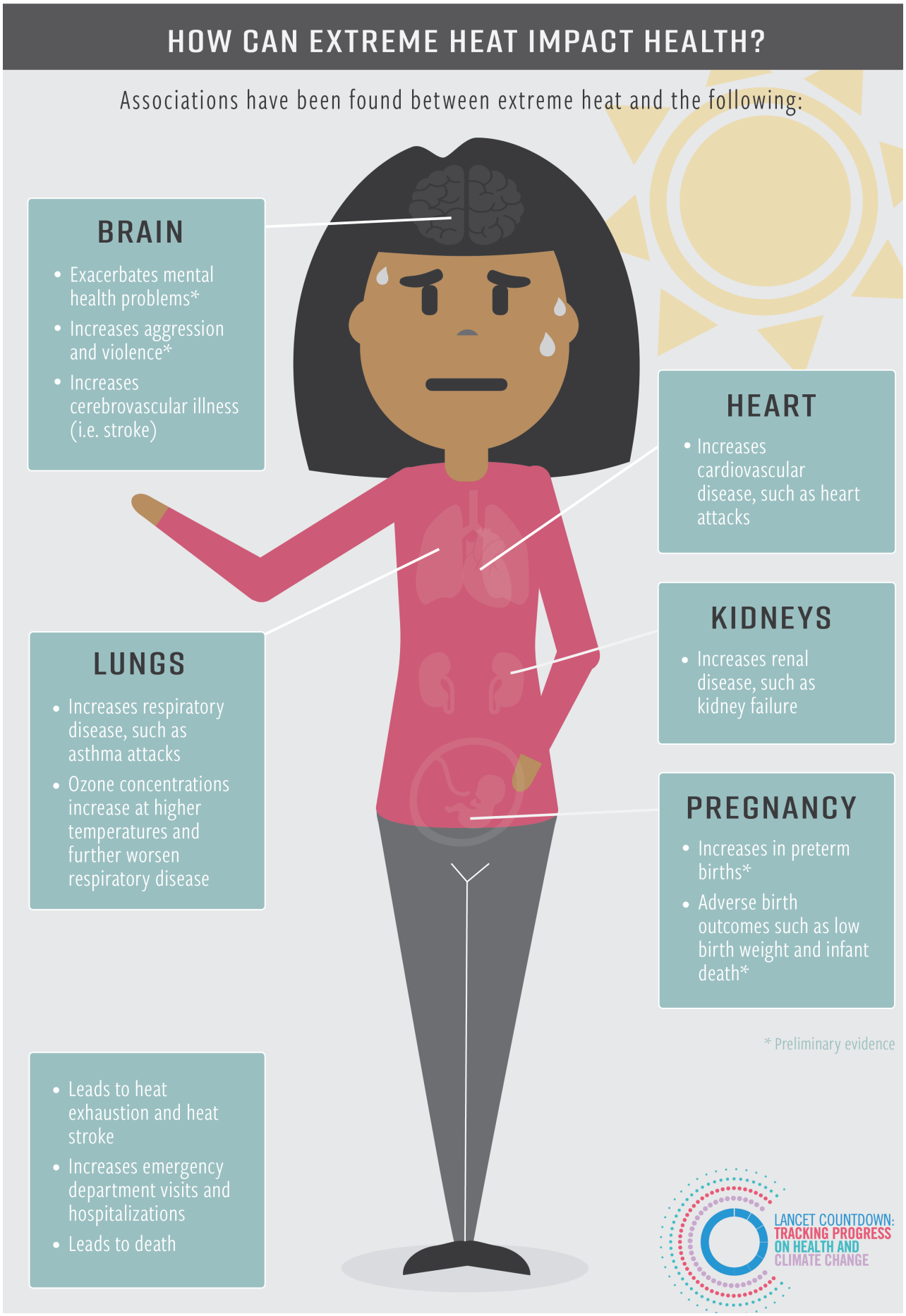


Figure created for Brief by M. Lee (Climate Nexus).

Heat exposure in the U.S. is increasing as hot days and extreme heatwaves become more frequent. While U.S. yearly temperatures can be variable, the trend reveals a steady 0.15°F per decade rise since 1895. In 2017, the majority of Americans experienced temperatures that were well above average or the warmest ever recorded (Figure 3)[13], with increasing frequency and intensity of heatwaves (Figure 4).[14]

Figure 3: 2017 Mean Annual Temperature Percentiles as Rankings Compared to Baseline Data (1985-2017).[13]

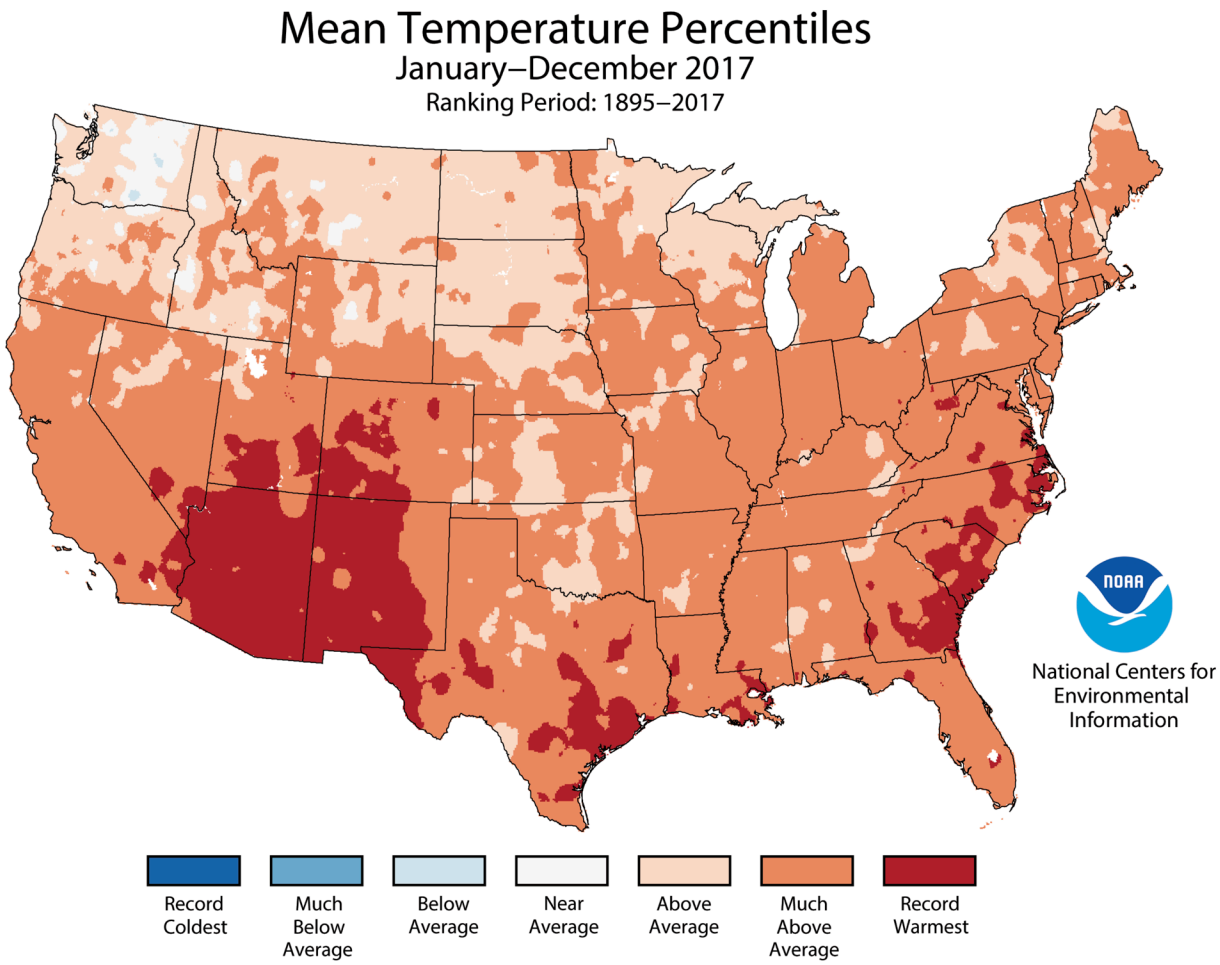


Figure Source: National Oceanic and Atmospheric Administration's National Centers for Environmental Information, 2018.

Figure 4: Heatwave Characteristics in 50 Large U.S. Cities Between 1961-2017.[14]

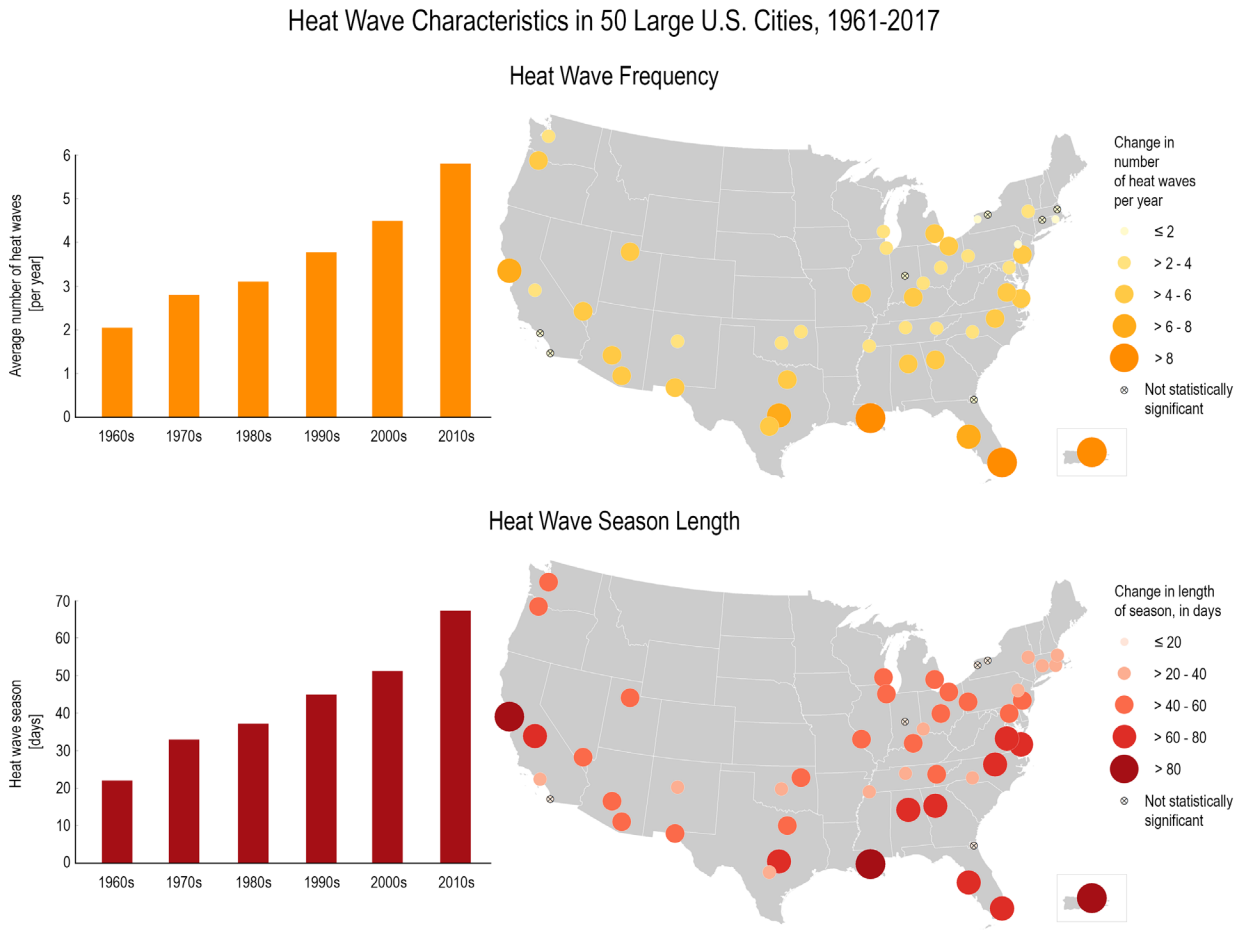


Figure Source: U.S. Global Change Research Program, 2018.

Adaptation to increased heat requires a multi-prong approach including heat alert systems, real-time data surveillance, public health education and access to cooling.[15] If America maintains its current electricity mix with 30% from coal, as many as 1,000 additional deaths may occur annually by mid-century from air pollution due to the electricity generation for air conditioning alone.[16] A transition towards less-polluting electricity sources is key.

Headline Finding: Health Effects of Temperature Change (Indicator 1.2)

The average summer temperature in the U.S. is steadily increasing, with the summer of 2016 having a mean increase of 2.2°F (1.2°C) from the 1986-2005 average.[17]

Headline Finding: Health Effects of Heatwaves (Indicator 1.3)

Heatwaves in the U.S. are lasting longer. The largest mean change since the year 2000 was in 2011, with a heatwave length increase of 3.6 days as compared to the 1986-2005 baseline.

Subsequently, 24 million more Americans were exposed to extreme heat in 2011 and 12.3 million more in 2016 when compared to this same baseline.[17]

Headline Finding: Change in Labor Capacity (Indicator 1.4)

Warming is reducing American labor productivity. Between 2000-2017, it is estimated the U.S. lost nearly 1.1 billion labor hours, particularly in industry and agriculture (Figure 5).[17]

Agricultural and construction workers have been shown to be at highest risk for occupational heat-related deaths.[18] One estimate shows that, compared to 2005, there could be an annual loss of 880 million labor hours and $44 billion in lost wages in 2050.[11]

Figure 5: Total Labor Hours Lost in the U.S. Due to Heat by Year and Sector.[17]

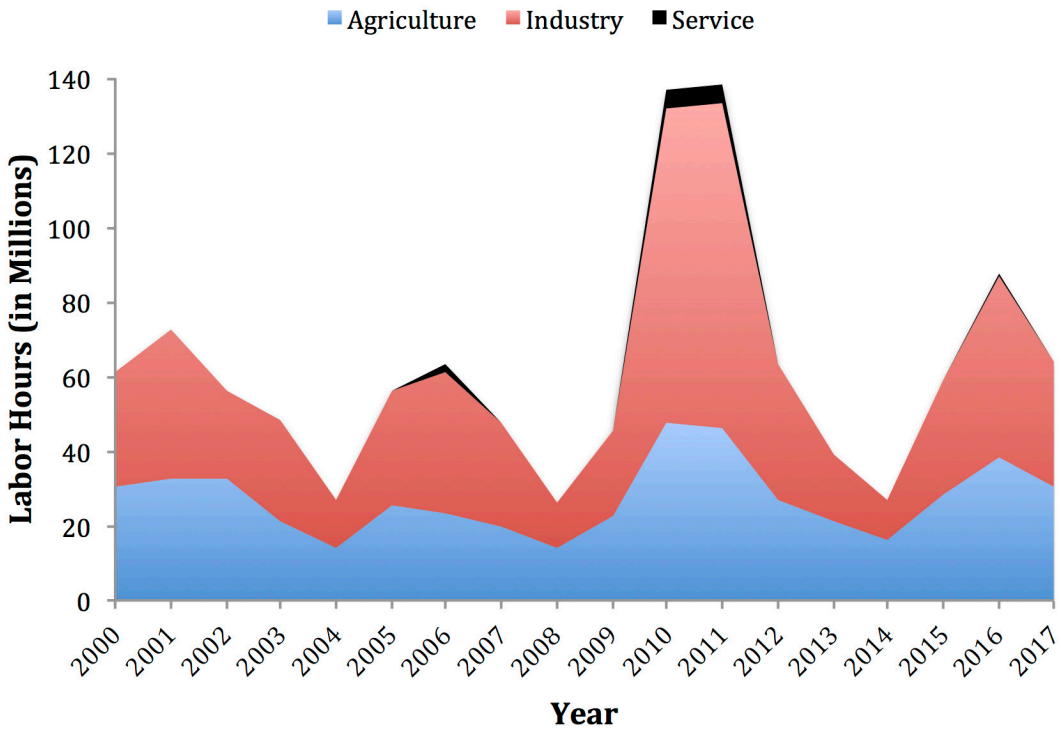


Figure Source: Lancet Countdown Indicator 1.4 (2018 Report).

Negative Health Impacts of Extreme Weather

Data from the U.S.

Depending on the type of event, extreme weather can directly impact health through associations with drownings, other injuries, infectious diseases, hypothermia and other problems. Health is also affected indirectly through prolonged infrastructure damage (e.g. mold), mental health issues (e.g. post-traumatic stress), population displacement, and disaster-related healthcare system failures.[19] The risks of extreme weather health impacts are especially high for children.[20]

Since 1980, there has been a steady rise in billion-dollar weather and climate disasters in the U.S. (Figure 6).[21] In 2017, a record-tying 16 events cost an estimated $313 billion USD with damage calculations that included insured and uninsured losses, such as structural and agricultural, but did not take health costs into consideration.[21] These damages significantly undermine people's physical and mental health, particularly for those who are not insured.[22,23]

Figure 6: Trends in Year-to-Date United States Billion-Dollar Disaster Event Frequency (through October 2018).[21]

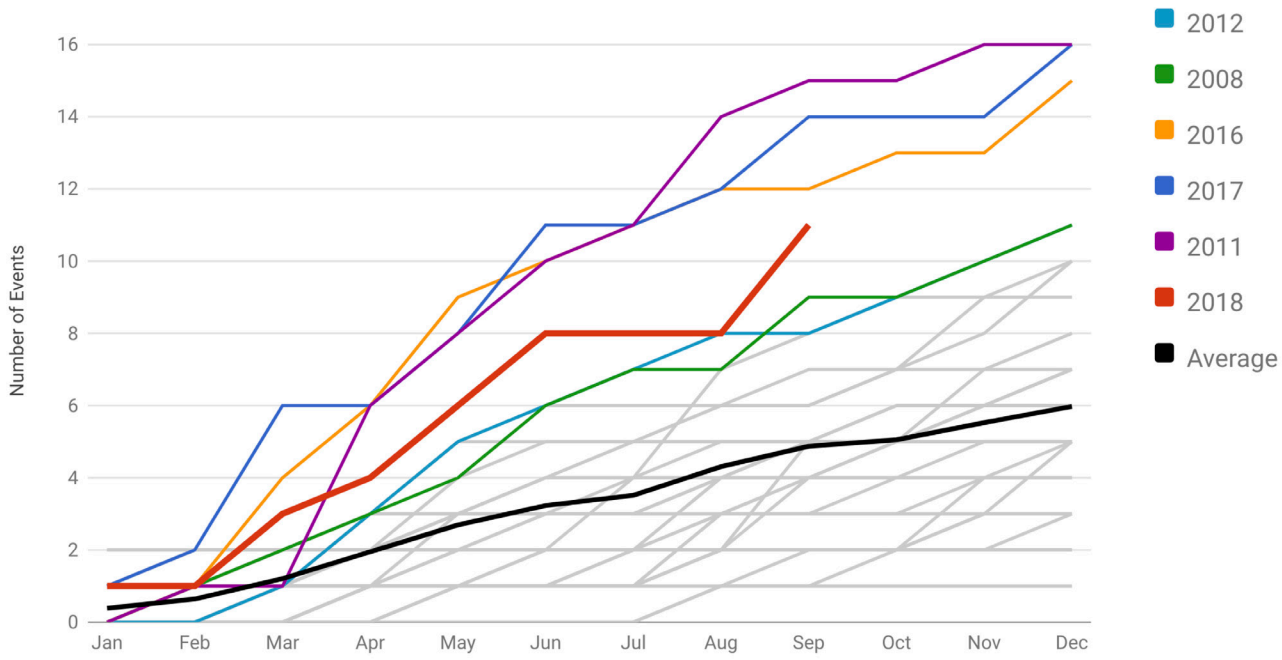


Figure Source: National Oceanic and Atmospheric Administration's National Centers for Environmental Information, 2018.

Headline Finding: Economic Losses due to Climate-related Extreme Events (Indicator 4.1)

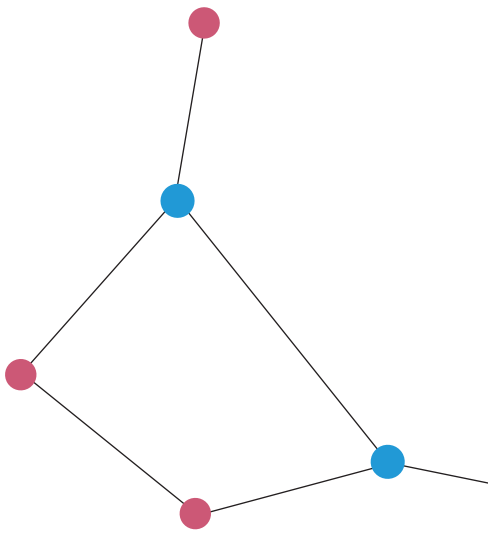
For climate-related extreme events in 2017, the U.S. experienced absolute economic losses valued at $80 billion USD for insured losses and $94 billion USD in uninsured losses.[17]

The *Lancet* Countdown Indicator 4.1 data was obtained from the Munich Re's NatCatSERVICE. It is lower than the 2017 billion-dollar National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI) data above. This highlights the complexity of accurately determining these figures.

Headline Finding: Lethality of Weather-related Disasters (Indicator 1.6)

The Emergency Events Database reports that in 2017, 284 lives were lost in the U.S. over the course of 23 events (floods, storms, and wildfires) with approximately 866,835 individuals affected and 109,108 with destroyed homes.[24]

Other estimates are considerably higher, reflecting differences in methods for counting disaster health impacts. This is particularly evident for events like Hurricane Maria (see Case Study).



Case Study on Hurricane Maria in Puerto Rico: Accurate Mortality, Population Displacement, and Shortages of Intravenous Fluids Across the U.S.

Accurate Mortality

Hurricane Maria made landfall in Puerto Rico on September 20, 2017, striking an area that had been hit by Hurricane Irma only two weeks before. While it caused an estimated $91.8 billion in damage, the true number of deaths depends on what is defined as attributable to the event.[21]

In December 2017, Puerto Rico's Department of Public Safety listed the official death toll as 64.[25] In Puerto Rico, every disaster-related death must be confirmed by the Institute of Forensic Sciences. This requires that bodies be brought to San Juan or that a medical examiner travel to the local municipality to verify the death. However, the Vital Statistics Office was without power and utilizing paper records. Furthermore, indirect deaths resulting from impacts such as water and electricity shortages, worsening chronic conditions, or delayed medical treatment may not be captured. These factors led researchers and media outlets to question the accuracy of the initial figure.[26]

In response, a group of researchers used a community-based survey methodology of randomized door to door visits of approximately 3,300 households to provide an estimate of the Hurricane-Maria-related deaths in Puerto Rico congruent with the Centers for Disease Control and Prevention (CDC) definition of an attributable death.[25] This avoided the pitfalls of the administrative process and death-certificates. They estimated a total of 4,465 excess deaths: adjustment for biases raised this estimate to 5,740 excess deaths (Figure 7). In addition, a separate commissioned study estimated 2,975 deaths.[27] Comprehensive estimates must also take delayed deaths into account. One study found a 16% increase in suicides in the first four months and a 26% increase in the first six months post-landfall compared to the year before.[28] Even the conservative estimates are approximately 0.1% of the total population in Puerto Rico, which would be the equivalent to losing the entire city of Cincinnati, Ohio on the mainland U.S.

Figure 7: Representation of Death Count Discrepancy in Puerto Rico after Hurricane Maria.[25,27]

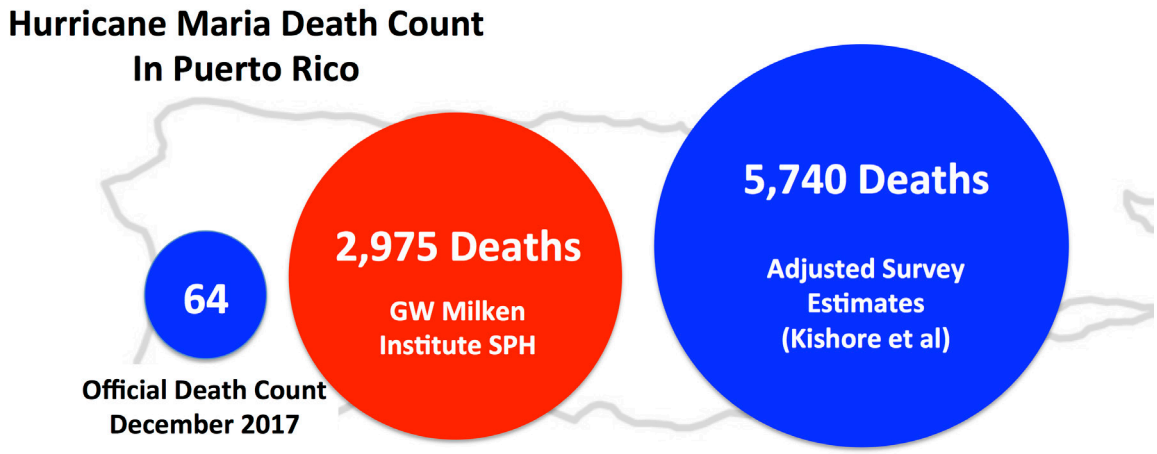


Figure created for Brief by R. Salas.

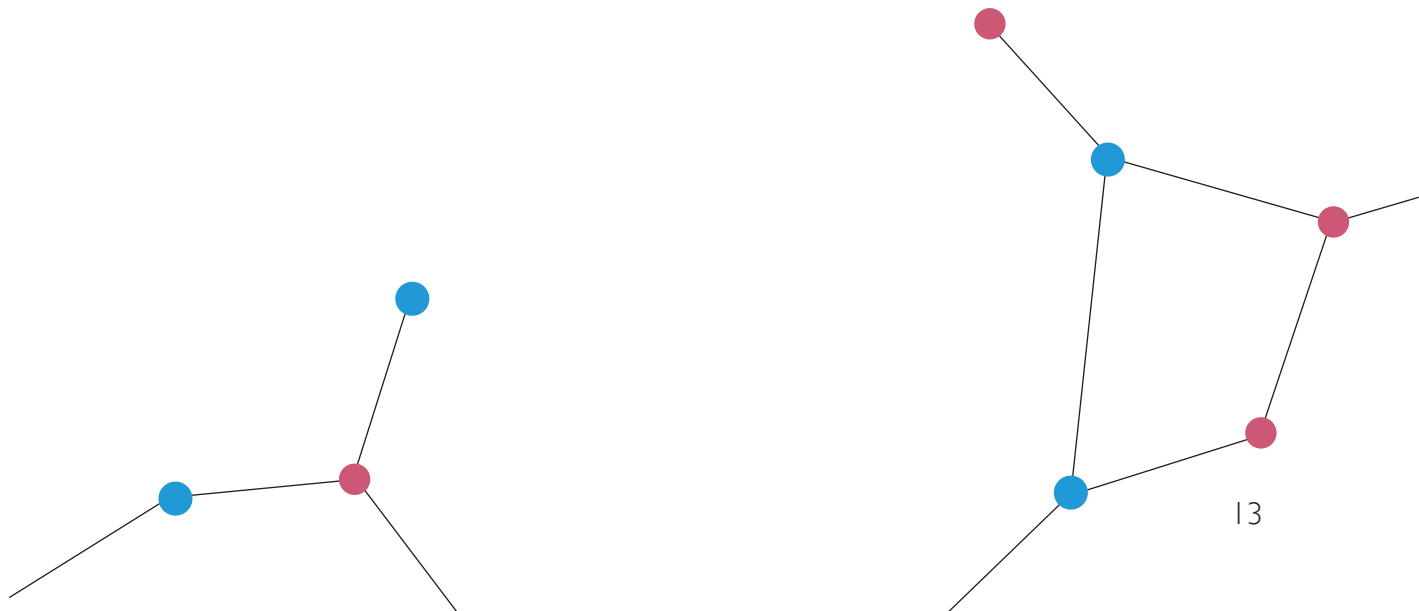
The stark discrepancies between death counts highlight the difficulty of characterizing the true impacts of extreme weather events on health and lives lost. This is a significant concern. Without being able to accurately determine how many people were impacted, the ability to allocate post-disaster resources and plan for future disasters is hindered.

Population Displacement

In addition to mortality impacts, Hurricane Maria is estimated to have displaced 10,600 people from Puerto Rico alone, with Puerto Rican Americans moving to every U.S. state.[29-31] These numbers are likely significant underestimates. Displaced populations have increased health risks and face new psychosocial challenges.[32–35]

Intravenous Fluid Shortages Across U.S.

Puerto Rico supplies 44% of the intravenous (IV) fluid for the U.S.[36] While the U.S. has suffered intermittent shortages since 2014, Hurricane Maria damaged the factory of a leading producer of IV fluid, leading to months-long shortages at hospitals across the country and beyond.[37] Hospitals and health professionals sought alternative solutions collaboratively to manage the crisis, such as utilizing oral rehydration therapy and changing the route of medication administration.[36,37] The widespread impact of this one storm in the U.S. exposed vulnerabilities in healthcare system supply chains and highlighted the need to create climate-resiliency.

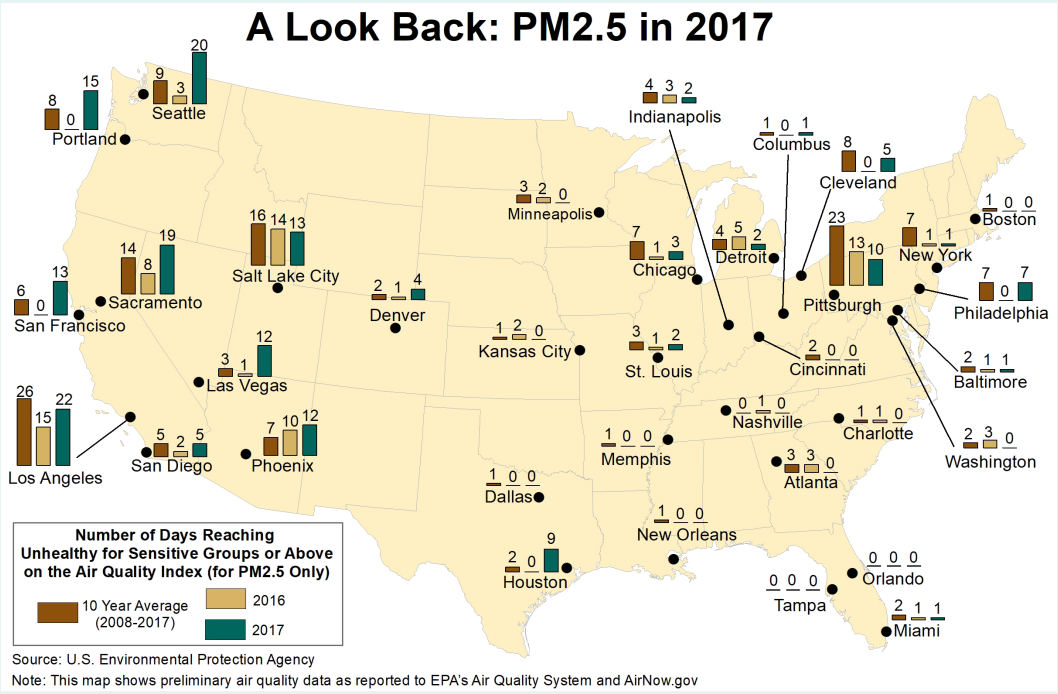


Negative Health Impacts of Wildfire Smoke Exposure

Data from the U.S.

The 2017 wildfire season in the U.S. was historically destructive. It burned 9.8 million acres and killed at least 44 people with extreme, difficult-to-extinguish wildfires,[13] which are expected to become more common as the climate changes.[38] Wildfire smoke releases fine particulate matter (e.g. $PM_{2.5}$) and ozone precursors which are harmful to cardiorespiratory health.[4,39] While $PM_{2.5}$ concentrations have been decreasing across the country since 1988, they are rising in some western U.S. states (Figure 8).[40,41]

Figure 8: Number of Days Reaching Air Quality Index (AQI) Levels Unhealthy for Sensitive Groups in Multiple Cities in 2016 and 2017 for $PM_{2.5}$.[41]



Note: The EPA's Air Quality Index (AQI) assess air quality on a yardstick that runs from 0 to 500, where higher numbers indicate greater levels of air pollution. For $PM_{2.5}$, the AQI has set a goal level of 100 or below. When levels become 101-150, it is felt to be unhealthy for sensitive groups, such as children, the elderly, and those with respiratory diseases. Any level above 151 is felt to be unhealthy for all individuals.[42]

Figure Source: U.S. Environmental Protection Agency, 2018.

In addition to the stress, direct trauma, and immediate deaths associated with wildfires, wildfire smoke has been associated with increased asthma and chronic obstructive pulmonary disease exacerbations. There is emerging evidence supporting an association between wildfire smoke exposure and cardiac and stroke visits, as well as an overall increased mortality.[4,43–47] Wildfire health damages in the U.S. in 2017 were likely higher than prior annual estimates for time periods with less active wildfires (2008-2012), which still accounted for a staggering $87-$150 billion per year.[48] While educating communities about clear evacuation plans, ensuring patients have adequate respiratory-related medications, and improving smoke forecasts to assist in outdoor travel planning will help populations cope, climate mitigation is urgently needed to prevent intolerable wildfire seasons in years to come.

Negative Health Impacts of Vector-borne Diseases

Data from the U.S.

Climate change is altering the ecology, geographic range, and abundance of vectors that carry diseases in the U.S. The most common vectors are ticks and mosquitoes, which can transmit vector-borne diseases (VBD) such as West Nile Virus, Zika, and Lyme. There was a tripling in vector-borne illnesses from mosquitoes, ticks, and fleas when comparing 2016 to 2004 (Figure 9).[49]

Figure 9: Number of Reported Vector-borne Diseases (Mosquito, Tick, and Flea) in U.S. States and Territories During 2004–2016.[50]

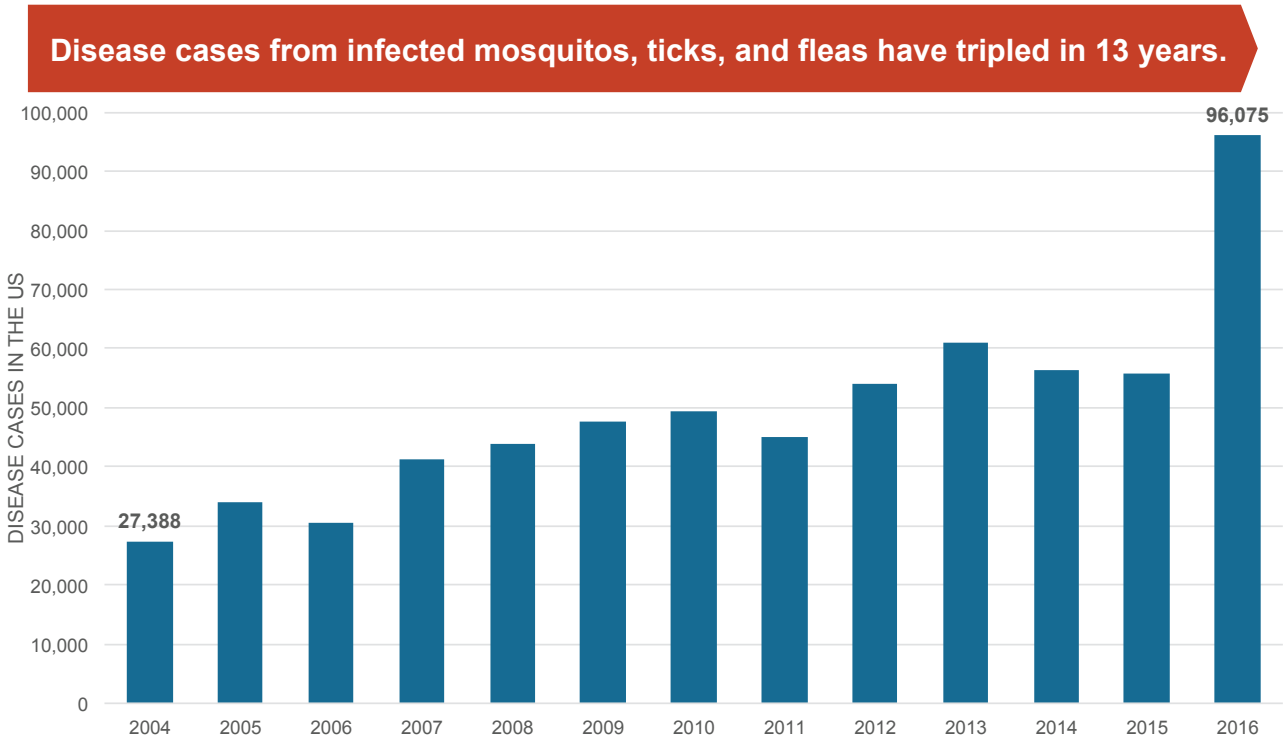


Figure Source: Center for Disease Control and Prevention, 2018.

North America is one of the continents that is expected to experience the largest climate-driven increase in the percentage of people exposed to the mosquito *Aedes aegypti,* which transmits diseases such as Zika and dengue.[51] Mosquito-borne diseases have been especially prone to epidemic outbreaks. West Nile is the most commonly transmitted mosquito-borne infection, despite significant under-reporting.[52] In addition, there was a significant Zika epidemic in 2016, which was linked to birth defects.[49] Researchers are seeking to better understand the role that climate change plays, along with other factors like travel and development, in the spread of VBDs.

Headline Finding: Suitability for U.S. Outbreaks of Pathogenic *Vibrio*, a Water-borne Infectious Disease (Indicator 1.8)

The U.S. Northeast has had a 27% increase in the area of coastline with suitability for the pathogenic water-borne *Vibrio* bacteria in the 2010s versus the 1980s baseline (Figure 10).[17]

Figure 10: Percentage of Coastal Area in the Northeast U.S. that is Suitable for a *Vibrio* (*Vibrio parahaemolyticus*, *V. vulnificus*, and non-toxigenic *V. cholerae* (non-O1/non-O139)) Outbreak.[17]

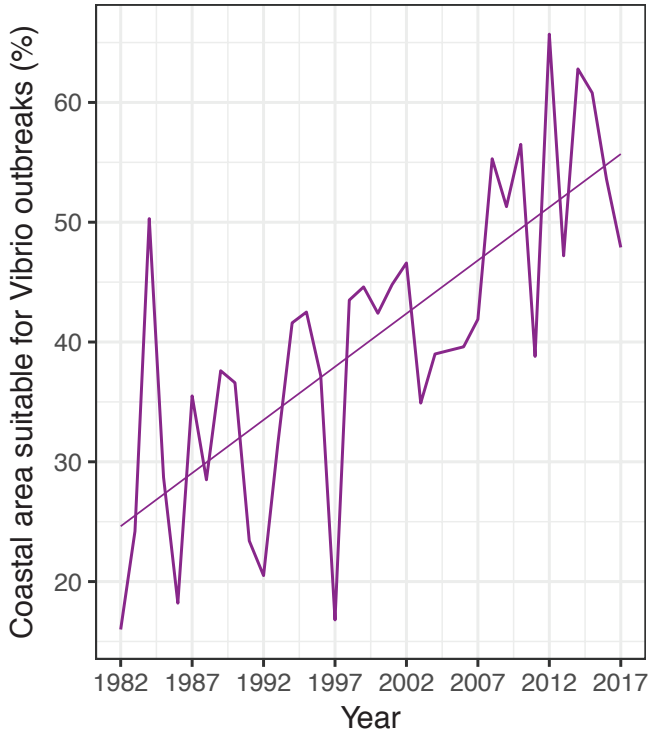


Figure Source: Lancet Countdown Indicator 1.8 (2018 Report).

Warmer sea surface temperatures (SST) are associated with increased prevalence of pathogenic *Vibrio* bacteria species. Thus, this indicator addresses the suitability of living conditions for *Vibrio* based on increasing coastline SST as an early warning sign that infections may increase in the future.[17]

Vibrio is a family of bacteria that includes species of concern in the U.S. that can cause various diseases in humans. According to the CDC, Vibriosis causes an estimated 80,000 illnesses and 100 deaths in the United States each year.[53] These infections span from life-threatening bloodstream infections, to gastroenteritis, to ear and wound infections (leading some to describe it as flesh-eating bacteria). As the suitability for this bacteria increases in certain areas of the U.S., human exposure may increase through direct contact (e.g. swimming) or ingestion (e.g. eating contaminated raw oysters).

Opportunities to Save Lives and Improve Health in the U.S.

Prevention of Further Dangerous Climate Change: Transitioning to Renewable Clean Energy

The U.S. ranks second in the world for carbon emissions from fossil fuel combustion.[54] The amount of per capita carbon emissions produced by states is outlined in Figure 11. To reach the Paris Agreement goal of net zero emissions between 2050 and 2100, the U.S. would need to rapidly phase out fossil fuel use, which would have profound benefits to health and save lives.

Figure 11: 2015 Per Capita Energy-Related Carbon Dioxide Emissions by State.[55]

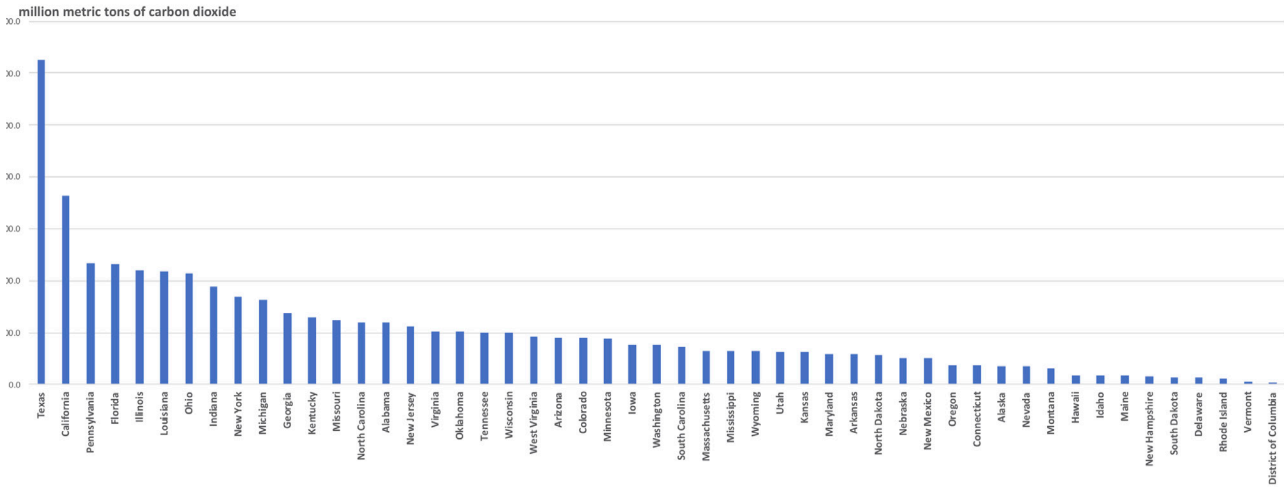


Figure Source: U.S. Energy Information Administration, 2018.

Responsible for approximately 10% of U.S. greenhouse gas emissions by most recent estimates, the U.S. health sector is a major contributor to climate change.[56] Furthermore, the mortality burden from air pollution generated by the health sector's fossil fuel use has been estimated to be comparable to mortality due to medical errors.[57] The U.S. health sector is beginning to shift away from fossil fuel energy sources and recently 28 healthcare organizations made a pledge to the U.S. Paris Agreement commitments.[58]

Headline Finding: Carbon Intensity of the Energy System in the U.S. (Indicator 3.1)

Since 1971, the carbon intensity of the total primary energy supply (TPES) in the U.S. has declined. In 2015, TPES reached a recorded low of 54.5 metric tons of CO_2 emitted for each terajoule (TJ) of primary energy (Figure 12).[17]

Figure 12: Carbon Intensity of the Energy System for the U.S. by Tons of CO_2 (tCO_2) Emitted for Each Unit (TJ) of Primary Energy Supplied. Indicator Based on Total CO_2 Emissions from Fossil Fuel Combustion Divided by Total Primary Energy Supply (TPES).[17]

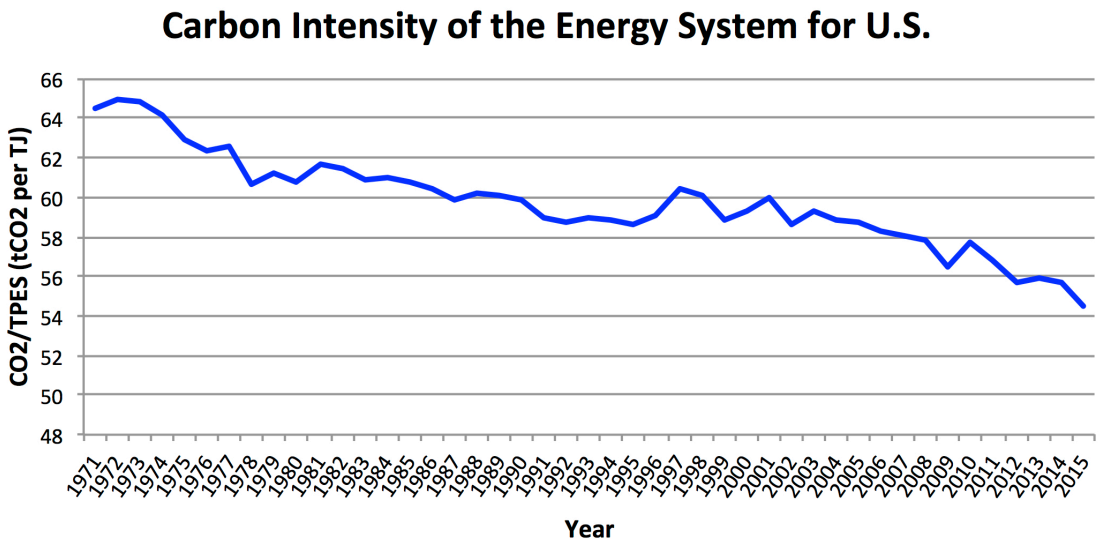


Figure Source: Lancet Countdown Indicator 3.1 (2018 Report).

Headline Finding: Zero-Carbon Emission Electricity in the U.S. (Indicator 3.3)

Since 1971 there has been a steady rise in low-carbon emission electricity, with a total of 1,411 Terawatt Hours (TWh) installed by 2016 (Figure 13).[17]

Figure 13: Absolute Total Low-Carbon Electricity Generation in Terawatt Hour (TWh).[17]

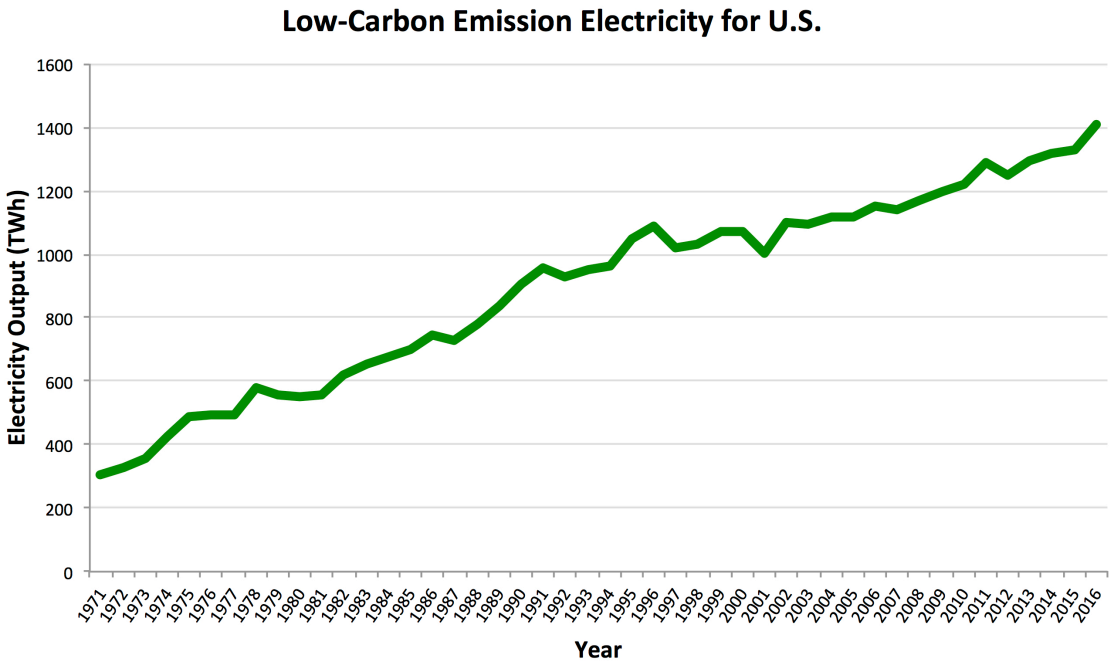


Figure Source: Lancet Countdown Indicator 3.3 (2018 Report).

Low-carbon energy includes power from sources such as wind, solar, nuclear, and hydropower. The increasing trend seen here must accelerate quickly in order to reach the Paris Agreement commitment. A recent report stresses the significant opportunity of aggressively reducing U.S. GHG emissions even beyond Paris Agreement commitments, to keep warming below 2.7°F (1.5°C), as this would maintain the viability of some coral reefs, reduce heat illness and maintain food yields, amongst other benefits to health.[59,60]

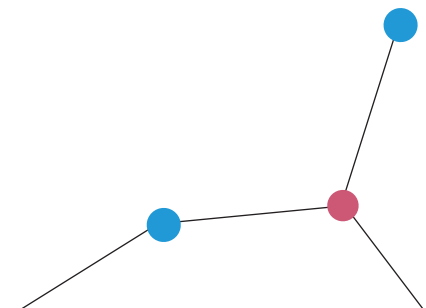
The following U.S. health systems have committed to 100% renewable electricity: Boston Medical Center, Gundersen Health System, Kaiser Permanente, Partners HealthCare, Rochester Regional Health System, University of California Health, and University of Vermont Medical Center.[61]

Headline Finding: Funds Divested from Fossil Fuels (Indicator 4.5)

Globally, healthcare organizations committed to divest $3.28 billion from fossil fuels in 2017, which is 0.77% of the cumulative global total of $33.6 billion across all sectors.[17]

Divesting from fossil fuels is a way for health-related organizations to demonstrate that they are "doing no harm" with their investments. It also protects investments against future potential losses as the world transitions to a low-carbon economy.[17]

Some U.S. healthcare organizations have already divested from fossil fuels including: American Public Health Association, Chicago Medical Society, Dignity Health, Gundersen Health System, Health Care Without Harm, Practice Greenhealth, Society for the Psychological Study of Social Issues, and SSM Health.[61] The American Medical Association has passed a resolution to divest.[62]



Adaptation to Climate Change

Public Health Department Preparation and Climate Change Adaptation Spending on Health

Local health departments and other city departments across the U.S. recognize the importance of adaptation to reduce the negative health impacts of climate change within their communities (Figure 14).[63,64] Public health adaptation reflects short- or long-term strategies aimed at reducing the negative health impacts and working across sectors for resilience to climate change.[65] Critical components of local health sector adaptation include cross-sectoral collaboration and educating policy makers about the connection between climate change and health.[66]

Figure 14: Representative Local Public Health Departments and Cities in the U.S. Preparing for Climate Change Health Impacts.[63]

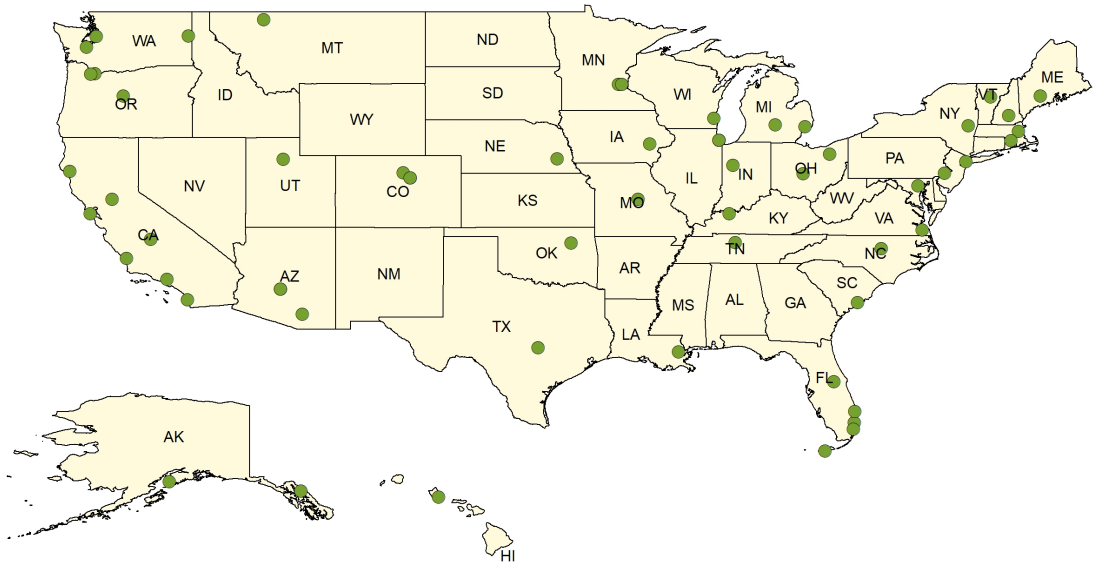


Figure created for Brief by National Association of County and City Health Officials (NACCHO).

Headline Finding: Spending on Adaptation for Health and Health-Related Activities in the U.S. (Indicator 2.7)

For the 2016-2017 financial year, the U.S. spent $67.2 billion on Adaptation and Resilience to Climate Change (A&RCC), which was a 5% increase from 2015-2016. Of this total spending, the U.S. spent:

- **5% ($3.5 billion) on climate change health adaptation, which was an 8% increase from 2015-2016. Health adaptation is defined as adaptation occurring within the formal healthcare sector only.**
- **14% ($9.4 billion) on climate change health-related adaptation for climate change, which was a 5% increase from 2015-2016. Health-related adaptation is defined as within the healthcare sector plus disaster preparedness and agriculture.[17]**

Though it is important to invest in U.S. climate change adaptation across all sectors, committing funds specifically to health and health-related adaptation is critical to save lives. Climate change adaptation requires more substantial funding to protect the health of Americans.

Training the Next Generation and Educating the Public on the Health Impacts of Climate Change

Correlates with Lancet Working Group 5: Public and Political Engagement

Healthcare professionals need to be educated about the ways climate change is harming Americans' health and well-being. These professionals include physicians, nurses, public health workers, and professionals in other health sciences.

The International Federation of Medical Students Association (IFMSA) has created a *2020 Vision for Climate-Health in Medical Curricula* as a call to action to include an element of climate-health in every medical school curriculum by 2020.[67] The Global Consortium on Climate and Health Education (GCCHE), hosted at the Columbia University Mailman School of Public Health, has developed *Climate and Health Core Competencies* for health professional students which can act as an institutional guide.[68]

Recent polls show that nearly half of Americans (49%) are "extremely or very sure" that climate change is happening versus only 7% who are "very sure" climate change is not occuring.[69] Given that the bedrock of public health is education about threats to health, it is critical that health providers inform their patients, communities, and policy makers about the health harms of climate change.

Evidence shows that primary care providers are among the most trusted voices to deliver this message (Figure 15)[70], while nurses are the most trusted profession in the country across all sectors.[71] It has been shown that educating Americans about the health impacts of climate change can increase public engagement and decrease political polarization.[72]

Figure 15: Degree of Trust in Sources of Health Impacts of Climate Change.[70]

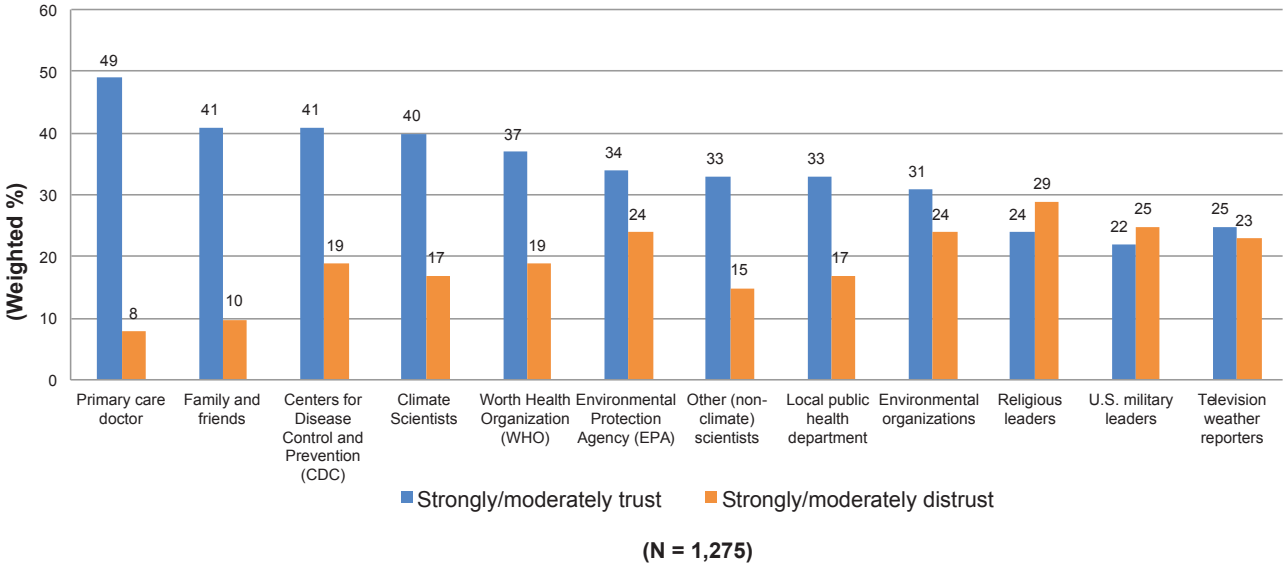


Figure Source: Recreated from Maibach EW et al, 2018.

Recommendations to Improve Health and Save Lives

Climate Change Threatens Americans' Health Now

- U.S. federal and state funds should be committed for improved preparation, including surveillance and targeted interventions, that will reduce the burden of disease from heat, extreme weather, and infectious disease. This specifically includes protection of labor workers from heat-related disease and death and robust monitoring of the health impacts of extreme weather.

- Robust U.S.-based climate and health research and education funding mechanisms should be created. This will allow researchers and educators to address the steep knowledge gaps and generate evidence-based health adaptation strategies.

Prevention of Further Dangerous Climate Change: Transitioning to Renewable Clean Energy

- The U.S. needs local, regional, and state-level policies, combined with renewed federal leadership, to ensure GHG emissions are reduced to levels that meet or surpass Paris Agreement commitments.

- Health organizations and health professionals should advocate for state laws that transition away from fossil fuels, following the precedent set by Hawaii and California that requires state utilities to generate electricity from 100% carbon-free sources by 2045. This will create cleaner air and water, mitigate climate change, improve health, and save lives.

- U.S. health and healthcare organizations should seek to rapidly reduce their own GHG emissions and transition to renewable energy sources, thus improving the health of their communities and reducing costs.

Adaptation to Climate Change: Public Health Department Preparation and Climate Change Adaptation Spending on Health

- U.S. federal and state bodies should dedicate funding for climate change preparation in health and health-related sectors to improve emergency preparedness, supply chain resilience, and protect vulnerable communities.

Training the Next Generation and Educating the Public on the Health Impacts of Climate Change

- Climate change and health education should be rapidly integrated into U.S. health professional curricula and continuing medical education.

- The trusted voices of the U.S. health sector should be unified and elevated in order to better explain the health impacts of climate change and motivate aggressive GHG reduction. This is an opportunity to create a safer and healthier America and a more promising future for today's children.

Lancet Countdown Indicator Data Sources and Clarifications (In Order Presented)

1. Indicator 1.2: Weather data from European Centre for Medium-Range Weather Forecasts (ECMWF) and population data from NASA Gridded Population of the World v4. Summer is defined as June, July, and August for the Northern Hemisphere.

2. Indicator 1.3: Weather data from European Centre for Medium-Range Weather Forecasts (ECMWF) and population data from NASA Gridded Population of the World v4. Heatwaves are defined as periods of four or more consecutive summer days where the minimum daily temperature is greater than the 99th percentile of the reference period 1986-2005.

3. Indicator 1.4: Calculated utilizing weather data from European Centre for Medium-Range Weather Forecasts (ECMWF), population data from NASA Gridded Population of the World v4, and demographic data from UN World Population Prospects (WPP).

4. Indicator 4.1: Munich Re's NatCatSERVICE.

5. Indicator 1.6: EM-DAT at the Center for Research on the Epidemiology of Disasters (CRED) at the Université Catholique de Louvain, Belgium.

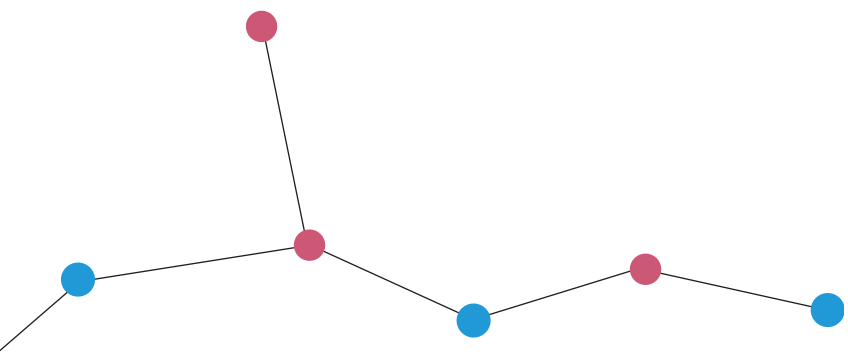
6. Indicator 1.8: As noted in Watts et al (2018) Lancet Countdown global report in Appendix 2.

7. Indicator 3.1: International Energy Agency (2017) CO2 Emissions from Fuel Combustion: CO2 Indicators.

8. Indicator 3.3: International Energy Agency (2017) World Extended Energy Balances.

9. Indicator 4.5: 350.org.

10. Indicator 2.7: Adaptation and Resilience to Climate Change (A&RCC) dataset, created by data research firm kMatrix and other stakeholders, that measures climate change adaptation and resilience spending through a system called "profiling."



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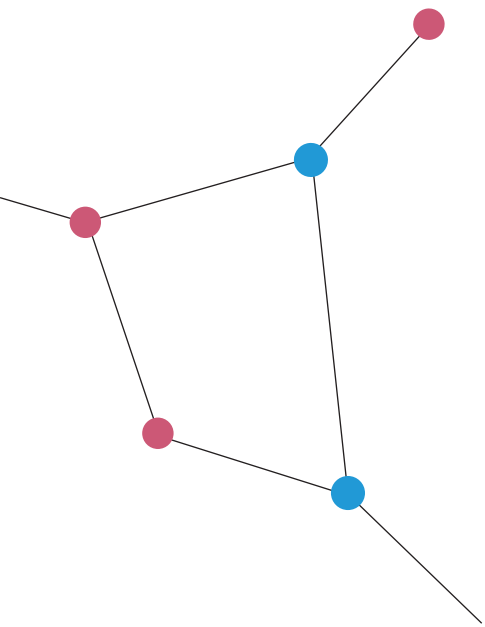

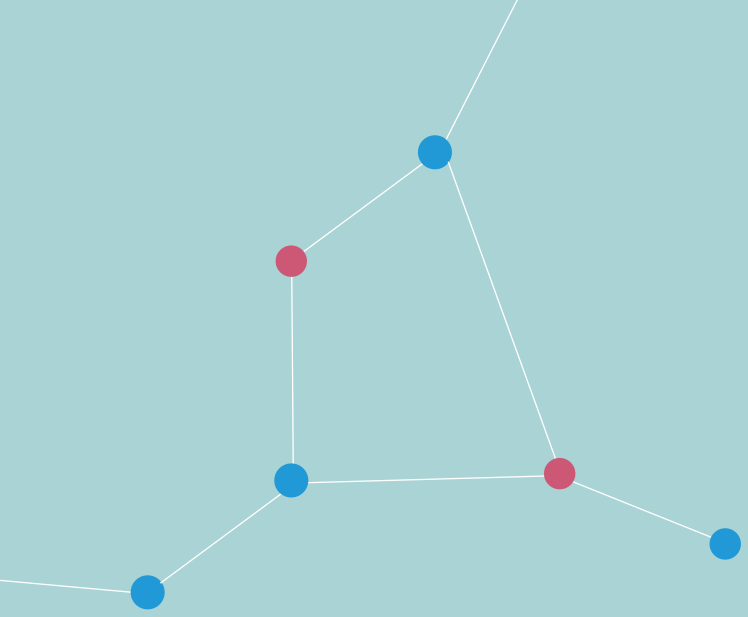

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