

The Lancet Countdown on Health and Climate Change

Policy brief for the United States of America: Appendix.

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Introduction

This Appendix accompanies the 2019 Lancet Countdown on Health and Climate Change Policy Brief for the United States of America. It contains case studies and supplemental materials referenced in the Policy Brief.

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Case Study

2018 Camp Fire: California's Deadliest Wildfire

Wildfires are becoming more frequent and are intensifying with substantial health harms that are anticipated to continue growing without climate action.¹ **Climate change played a driving role in California's 2018 wildfire season, which was the deadliest (106 lives lost), most destructive (1.8 million acres burned), most expensive in U.S. history, and the costliest international disaster in 2018 (25-27 billion USD).**²⁻⁴ Similarly, other recent wildfires have tallied up billions

in health costs.⁵ The Camp Fire (Figure 1A) was the single deadliest wildfire in California's history, killing 86 residents of Paradise, California and nearby towns.^{3,6} The fire burned over 153,000 acres and claimed 4,000 homes, 4,293 other buildings, and 528 businesses.⁷ The smoke caused dramatic reductions in regional air quality with accompanying health harms to vulnerable residents.^{8,9}

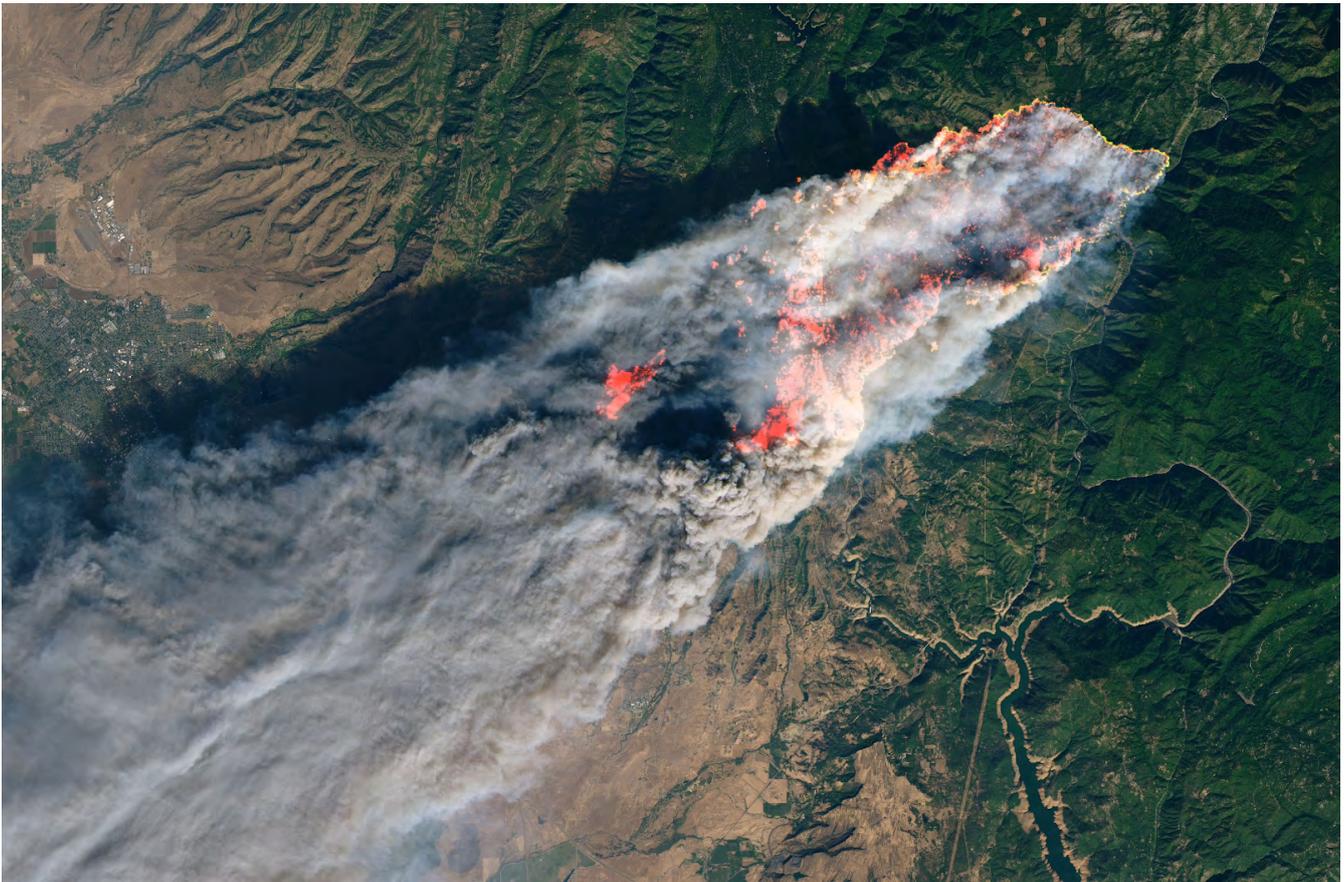


Figure 1A: The 2018 Camp Fire's smoke plume.¹⁰
Photo: NASA Landsat 8 Operational Land Imager.

News reports documented immediate health harms to people in the nearby and surrounding areas impacted by the Camp Fire.^{11,12} In addition, research has documented long-term health harms in populations exposed to previous wildfires.¹³ Direct fire exposure causes burns and inhalation injuries. Particulate air pollution can lead to early

death and can worsen heart and chronic lung diseases. Displacement and property loss increase the risk of depression, anxiety, post-traumatic stress disorder, and other adverse mental health conditions among children and adults.^{14,15}

While it will take time to assess the longer-term health harms from the Camp Fire, previous studies have linked prenatal exposure to wildfire smoke with lower birth weights,¹⁶ premature deaths in children,¹⁷ and exacerbation of existing health inequalities.^{18,19} In addition, there is a persistent risk of premature death and increased healthcare visits for lung, heart, and stroke disease from exposure to smoke PM_{2.5} long after a wildfire occurs.^{14,20-22}

It has been estimated that over 29 million people in the U.S. are at a significant risk of wildfire exposure and over 40% of this at-risk group is socially vulnerable.²³ The risk unequally tracks along racial and ethnic lines as wildfire vulnerability is 50% higher for African Americans, Latinx, and Indigenous peoples. Thus, as officials grapple with how to best protect the lives and health of people living in the U.S., climate action to reduce both GHGs and health inequities is critical.

Extended Case Study

Heat-Related Illness and Vulnerability in the Workplace

Workers Increasingly Exposed to Life-Threatening Heat

Exposure to extreme heat is the leading cause of weather-related deaths in the U.S. and is particularly dangerous for workers who perform moderate to heavy labor in hot and humid environments.^{24,25} According to the Bureau of

Labor Statistics (BLS), work-related heat exposure killed 783 U.S. workers and injured nearly 70,000 between 1992 and 2016²⁶- yet these numbers are likely a considerable underestimate.²⁷

Patient Case

During a sweltering day in June of 2016 on a live-fire training range at Fort Chaffee, Arkansas, the heat index climbed to 103°F before Sgt. Sylvester Cline was evacuated off the field to cool down.²⁸ He became unwell after training for nine hours in the heat, yet his illness was not recognized soon enough. During transport to the base clinic, Sgt. Cline, a veteran soldier and father of five, vomited, collapsed, and became unresponsive. Cardiopulmonary resuscitation was started

immediately. Yet despite extensive medical efforts, he was pronounced dead two hours after being diagnosed with heat stroke. Reported cases of heat stroke or heat exhaustion, heat stroke's precursor, among active-duty service members have increased 60% over the past decade, from 1,766 cases in 2008 to 2,792 cases in 2018, with casualties across all branches of the military.²⁹

The Number of Workers Killed or Injured by Heat Likely Greater than Reported

Inaccurate medical documentation and incomplete reporting limit our knowledge of how many workers are truly injured or die from heat. Heat can worsen pre-existing conditions, and it can be difficult to isolate heat's effect in medical records.³⁰ Additionally, workers may underreport heat injuries to authorities in fear of losing their jobs or other punitive action, a particular concern for undocumented workers and people in poverty.^{31,32} Other issues result from dependence on

employer reporting and exemptions for federal agencies and small firms.^{33,34}

Strong evidence suggests that heat exposure is associated with an increased risk of outdoor and indoor workplace injuries.³⁵⁻³⁸ Even with incomplete documentation, heat-related injuries are one of the largest contributors to worker compensation claims,³⁹ which total approximately \$250 billion per year in the U.S. alone.⁴⁰

Health Risks Vary by Sector and Worker Health Status

The risk heat poses to workers varies by labor sector. At the individual level, a worker's heat risk is influenced by their health status, immigration status, ethnicity, race, and socioeconomic status.⁴¹ Construction workers are most at risk, accounting for roughly 36% of the heat-related deaths nationwide.⁴² Compared to workers from other industries, construction workers are 13 times more likely to die from a heat-related illness, and the health risks of construction work are projected to grow with rising temperatures.^{42,43}

One in five heat-related deaths occurs in the agricultural sector, and the U.S. Centers for Disease Control and Prevention (CDC) reports that

agricultural workers die from heat-related illness at a rate nearly 20 times greater than all U.S. civilian workers. Other occupations at risk of environmental heat exposure and heat illness include landscapers, road maintenance crews, military personnel, firefighters, relief workers, truck drivers, oil-field workers, waste management workers, and forestry and fishing workers.^{39,44,45} Indoor workers are also vulnerable, accounting for roughly 20% of heat-related illnesses.³⁹ For indoor workers, high outdoor temperatures can exacerbate the heat from indoor heat sources, such as laundry, engines or other machinery, particularly when indoor engineering has not accounted for the added risk of high outdoor heat.^{39,45}

Health Risks of Heat Are Even Higher for Certain Worker Populations

There are certain sub-populations of workers living in the U.S. that are at an even higher risk. For example, individuals who are not U.S. citizens, and especially the Latinx workforce, are found to be at a higher risk of dying from heat than U.S. citizens.⁴⁶ In addition, according to the National Agricultural Workers Survey, 2-3 million, or 72%, of all farm workers in the U.S. are born outside the U.S.,^{24,44,47} suggesting that these workers are disproportionately exposed to heat risk.

Migrant workers and day laborers often have poor or inadequate housing, a lack of access to air conditioning, or an inability to pay for

the electricity to keep it running.³² These factors limit their ability to cool down at home and increase their risk of heat exposure. Compounding these heat risks, it has been shown that migrant workers can have limited health insurance coverage, less family support, a lack of transportation, and limited knowledge of health services in the community, all of which contribute to decreased healthcare access and use.⁴⁸ Lastly, workers with limited English proficiency face additional challenges including limited health literacy as well as higher rates of medical errors and worse clinical outcomes.^{49,50}



Figure 2A: Agricultural workers during the summer months in Iowa.

Photo: Preston Keres at U.S. Department of Agriculture (Public Domain).

Lack of Regulation Leaves Hundreds of Thousands Vulnerable

Currently there is no dedicated federal standard specifically addressing occupational heat exposure. The National Institute for Occupational Safety and Health (NIOSH) develops recommendations for preventing disease and hazardous conditions in the workplace. NIOSH generated three criteria documents (in 1972, 1986, and 2016) advising the Occupational Safety and Health Administration (OSHA) to develop a heat standard, but no standards have been created.^{27,51}

California and Washington are the only states to mandate heat-safety practices for outdoor workers,^{51–53} and Minnesota regulates indoor worker heat standards.⁵⁴ NIOSH recently estimated that two in every 1,000 workers are at risk of heat stress,⁵⁵ suggesting that at least 260,000 workers outside of California, Washington, and Minnesota are at risk for heat-related illness and death in the absence of a federal standard to protect them.⁵⁶

Recommendation: Urgent Action is Needed to Protect the Health of U.S. Workers

Even with rapid implementation of interventions to reduce greenhouse gas (GHG) emissions, extreme temperatures will likely have a growing impact on U.S. workers in this century. The U.S. Environmental Protection Agency (EPA) estimates that under high emission scenarios, approximately 1.9 billion labor hours might be lost per year by 2090, costing an estimated \$160 billion in lost wages, double the losses that

would occur under a low emissions scenario. In addition to reducing GHG emissions, a renewed commitment to worker health – including the creation of OSHA workplace heat exposure standards – is needed to protect workers in a changing climate.

Supplemental Section

Rising Energy Consumption in the U.S. and Need for Indoor Climate Control

Since about 1980, the overall number of days requiring indoor heating has decreased and days requiring cooling technology has increased from the 20th century average (Figure 3A).⁵⁷ While an increasing number of hot days is an outcome of climate change, the warming of the planet is also weakening the northern jet stream, leading to an increasing number of “polar vortex” incidents where arctic air extends further south creating record cold temperatures.⁵⁸ As a result, people in the U.S. are using more energy to maintain a comfortable temperature that promotes health.

Following a decade of declining energy use, the U.S. energy consumption increased by 4% between 2017 and 2018. This was the highest year-on-year increase in energy consumption in three decades, reaching a record annual high of 101.3 quadrillion British thermal units (BTU).⁶⁰ This increased energy consumption occurred in the setting of a unique phenomenon- the combined number of U.S. heating and cooling days in 2018 reached its highest point since the 1950s.⁶¹

The U.S. energy system’s current reliance on fossil fuels leads to negative health impacts.¹³ Given the current electricity mix (~30% generated from coal), an additional 1,000 deaths could occur from the air pollution generated from increased air conditioning energy consumption alone.⁶² As energy demands increase, it is important to ensure that U.S. energy sources are not harming people’s health, and that the country’s electrical grids can handle the increased strain to power society, including hospitals and electricity-dependent medical equipment.

Annual Change in Heating and Cooling Degree Days in the Contiguous United States

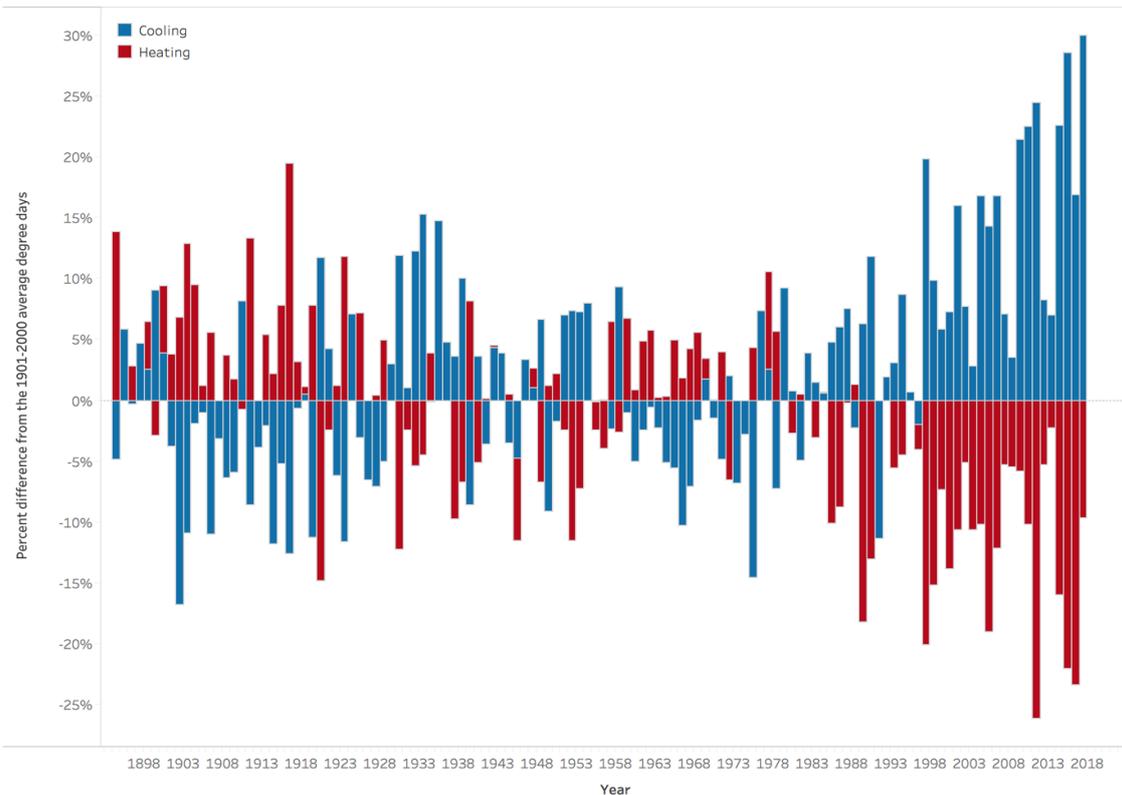


Figure 3A: Annual heating and cooling degree days in the contiguous U.S.^{57,59}

This figure highlights the difference between the number of degree days in each year and the average number of degree days throughout the 20th century defined as 1901-2000. A cooling degree day occurs when the average daily temperature is above a 65°F baseline, while a heating degree day is below the 65°F baseline. In addition, U.S. Census Bureau data is utilized for population-weighting; thus, the same temperature leads to a higher number of degree days in a more densely populated area (e.g., Chicago will be higher than rural Iowa).

The Consequences of Climate Change on Clinical Practice and Healthcare Delivery: Opportunities for the Healthcare Sector

There is a growing recognition in the medical community that climate change has consequences for clinical practice and healthcare delivery.^{63,64} This represents a critical opportunity to better understand how to best protect the health of patients, how climate change impacts healthcare systems, and how to ensure our healthcare systems are resilient in the face of climate change.

Clinicians need to consider their patients' climate-specific risk factors, such as heat and asthma action plans. For example, clinicians could assess how certain medications may increase a patient's risk of developing life-threatening heat stroke (e.g., medications commonly prescribed for high blood pressure, heart failure, or mental health)^{65,66} and how extreme heat may render medications less effective (e.g., asthma inhaler left in a hot car during a heatwave).⁶⁷

Additionally, healthcare system leaders need to ensure their facilities can continue providing care as climate change intensifies extreme weather events, including flooding, hurricanes, droughts, or prolonged periods of heat (Figure 4A). Such events threaten medical supply chains (e.g., intravenous saline shortages)⁶⁸ and potentially stress energy grids due to increased air conditioner use during heatwaves, increasing the risk of a power outage.⁶⁹ These impacts require proactively understanding risks and putting into place clinical practice recommendations, public health interventions, and solutions that address health system and medical supply chain vulnerabilities.



Figure 4A: Physicians Hospital damaged by levee failure flood during Hurricane Katrina in New Orleans, Louisiana in 2005.⁷⁰

Photo: Bart Everson (Wikimedia Commons), converted to black and white.

The U.S. health sector is estimated to be responsible for 10% of the country's GHG emissions.⁶⁸ Thus, U.S. healthcare organizations should seek to rapidly reduce their own GHG emissions through improved energy efficiency and transitioning to renewable energy sources

to reduce harms associated with healthcare delivery. Healthcare organizations should also divest from the fossil fuel industry, consistent with their mission to "first, do no harm."

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