

FACT SHEET

BITTER PILL: THE HIGH HEALTH COSTS OF CLIMATE CHANGE

Global climate change is happening—and happening faster every day. It’s fueling environmental changes like extreme weather and wildfires; it’s contributing to dangerous heat waves, air pollution episodes, and infectious disease outbreaks. Climate-sensitive events like these are influenced by climate change (to differing degrees) and are expected to increase in frequency, intensity, duration, and/or areal extent in the future.¹ Moreover, they pose a wide array of direct and indirect threats to human health. Some communities are more vulnerable to the ways that climate change harms our health, and others lack the economic capacity to prepare for and adapt to these effects, which are projected to increase in future decades.² These health effects have real consequences, both in people’s pain and suffering and in associated costs that are largely absent from our accounting of climate change-related damages.

A new analysis from researchers at the Natural Resource Defense Council (NRDC) and the University of California, San Francisco estimates that the health costs of 10 climate-sensitive events across the United States in 2012 totaled \$10 billion (in 2018 dollars). These costs resulted from about 900 deaths, 21,000 hospitalizations, and 18,000 emergency room visits.³



The projected health and economic burden of climate change will be enormous if carbon pollution continues unchecked and communities are not prepared. But these costs are not only a future concern, they are already happening. This new study, which was published in the peer-reviewed journal *GeoHealth*, examines 10 case study events from across the spectrum of climate-sensitive health hazards, such as extreme weather, heat waves, and increases in allergenic pollen.³ By linking health effect data with healthcare cost information, this work sheds new light on the present-day burden of climate-sensitive events on our health and the economy.

Our analysis combines estimates of illness and death (Table 1) and the associated costs of medical treatment and loss of life (Table 2) for 10 climate-sensitive case study events occurring during the 2012 calendar year. For each case study, our team used state-collected health surveillance data, federal reports, and other published data on the number of deaths, hospitalizations, and emergency room visits to calculate

health-related costs. Those include direct medical costs and expenses associated with lost wages, outpatient care, and prescribed medications (see Methods section on page 6 of this fact sheet). For these limited case studies alone, we estimated that the health-related costs were \$10 billion—a total that would certainly increase if we included all climate-sensitive events that affected health in the United States that year.

The analysis estimated that a disproportionate share of the illness-related costs of the events, about 64 percent, were paid for by Medicare and Medicaid. This aligns with our understanding that older adults and the economically disadvantaged are among those most vulnerable to the health effects of climate-sensitive events.⁴ Our research also suggests that, based on the data currently available, health-related costs added at least another 26 percent to the national price tag for 2012 severe weather-related damages, beyond impacts to property and crops.⁵

TABLE 1: ESTIMATED HEALTH IMPACTS FOR TEN CLIMATE-SENSITIVE CASE STUDY EVENTS (2012)

State	Climate-Sensitive Case Study	Premature Deaths	Hospital Admissions	Emergency Room Visits
Michigan	Lyme Disease	0	157	11
North Carolina	Allergenic Oak Pollen	4	183	1,149
Ohio	Extreme Weather	8	37	343
Wisconsin	Extreme Heat	27	155	1,620
Florida	Harmful Algal Blooms	0	11,066	3,857
Nevada	Ozone Air Pollution	97	114	194
Texas	West Nile Virus	89	1,628	2,680
Colorado	Wildfires	174	256	1,432
Washington	Wildfires	245	371	1,897
New Jersey & New York	Hurricane Sandy	273*	5,795	2,247
			807	2,426
TOTAL		917	20,568	17,857

Row and column totals may not equal component sums due to rounding.

*Hurricane Sandy mortality estimate also includes deaths reported to the U.S. Centers for Disease Control and Prevention (CDC) from Pennsylvania, West Virginia, Connecticut, and Maryland, and deaths not classified by state.

TABLE 2: ESTIMATED HEALTH COSTS FOR TEN CLIMATE-SENSITIVE CASE STUDY EVENTS, FOR ONE YEAR (2012)

State	Climate-Sensitive Case Study	Costs of Premature Deaths	Costs of Illness	Total Health Costs*
Michigan	Lyme Disease	-	\$8 million	\$8 million
North Carolina	Allergenic Oak Pollen	\$37 million	\$6 million	\$43 million
Ohio	Extreme Weather	\$73 million	\$10 million	\$83 million
Wisconsin	Extreme Heat	\$246 million	\$5 million	\$252 million
Florida	Harmful Algal Blooms	-	\$546 million	\$557 million
Nevada	Ozone Air Pollution	\$887 million	\$11 million	\$898 million
Texas	West Nile Virus	\$812 million	\$274 million	\$1.1 billion
Colorado	Wildfires	\$1.6 billion	\$23 million	\$1.6 billion
Washington	Wildfires	\$2.2 billion	\$55 million	\$2.3 billion
New Jersey & New York	Hurricane Sandy	\$2.5 billion**	\$647 million	\$3.1 billion
TOTAL COSTS (IN 2012 U.S. DOLLARS)		\$8.4 billion	\$1.6 billion	\$10.0 billion

Row and column totals may not equal component sums due to rounding.

*Total health costs include lost wages.

**Hurricane Sandy mortality estimate also includes deaths reported to the U.S. Centers for Disease Control and Prevention (CDC) from Pennsylvania, West Virginia, Connecticut, and Maryland, and deaths not classified by state.

\$10 BILLION IN HEALTH COSTS FROM TEN U.S. CLIMATE-SENSITIVE CASE STUDIES (2012)



WISCONSIN:
Extreme Heat (\$252 million)



MICHIGAN:
Lyme Disease (\$8 million)



OHIO:
Extreme Weather (\$83 million)



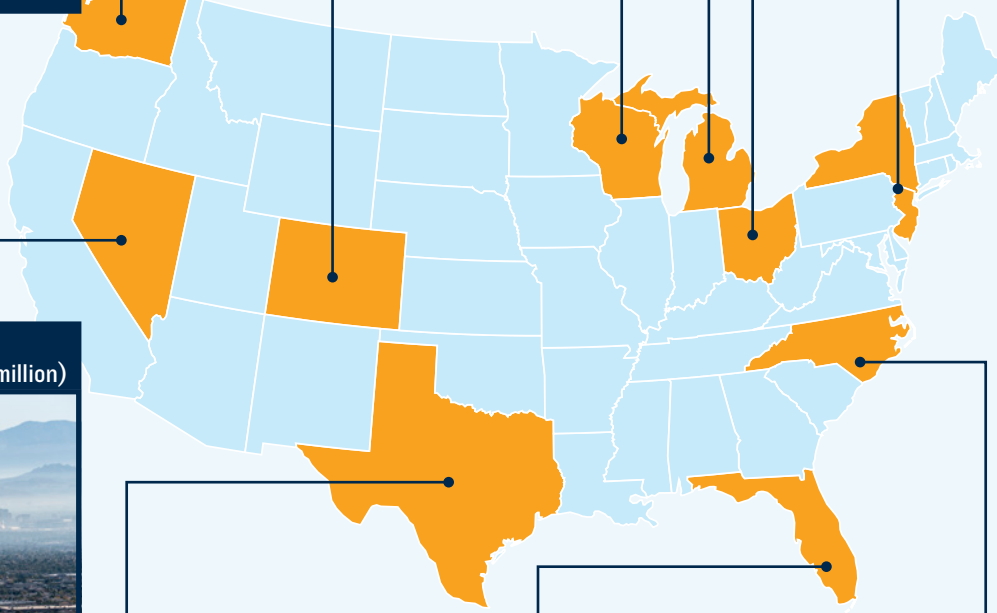
WASHINGTON & COLORADO:
Wildfires (\$2.3 billion WA,
\$1.6 billion CO)

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NEW YORK & NEW JERSEY:
Hurricane Sandy (\$3.1 billion)

NEVADA:
Ozone Air Pollution (\$898 million)

TEXAS:
West Nile Virus (\$1.1 billion)



FLORIDA: Harmful Algal Blooms
(\$557 million)



NORTH CAROLINA:
Allergenic Pollen (\$43 million)



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No 2012 case study events analyzed in Alaska, Hawaii, or Puerto Rico.

TEN U.S. CLIMATE-SENSITIVE CASE STUDIES IN 2012 RESULTED IN \$10 BILLION IN HEALTH COSTS*

1. Michigan (\$8 million): Lyme disease, an illness transmitted to humans by infected blacklegged ticks that can cause flu-like symptoms, joint pain, and long-term fatigue, is the most common tick-borne disease in the United States. A warmer climate has contributed to an expansion of tick habitat in the United States, along with changes in tick ecology. Researchers analyzed the costs of 157 Lyme disease-related hospital admissions and 11 emergency department visits.

2. North Carolina (\$43 million): Allergenic pollen levels are affected by climate, as warmer weather, higher humidity, and heightened levels of carbon dioxide in the atmosphere stimulate growth and extend the pollen production season. This research tallied health costs from increased pollen levels in North Carolina in 2012, including 1,149 oak pollen-attributable asthma emergency room visits and 183 hospital visits plus 4 deaths from asthma.

3. Ohio (\$83 million): Climate change has fueled an increase in the intensity and frequency of extreme weather and precipitation events over the past century, contributing to increased flood risks. We analyzed the health impacts of water discharges from combined sewer system overflows, which happen during heavy precipitation. In Ohio in 2012, an estimated 343 emergency room visits resulted from either gastrointestinal illness and skin infections after direct exposure to contaminated water, or asthma exacerbations due to aerosolized lung irritants and other pathogens. The analysis also incorporated 8 extreme weather-related deaths and 37 hospital admissions in Ohio in 2012.

4. Wisconsin (\$252 million): Extreme heat exposure is the leading cause of weather-related mortality in the United States over the last 30 years. In July 2012, Wisconsin residents experienced record high temperatures over a span of one week, when several century-old daily maximum temperature records and record-high minimum temperatures were tied or broken. This research analyzed costs from an estimated 27 deaths, 155 hospitalizations, and 1,620 emergency room visits that summer.

5. Florida (\$557 million): Higher sea surface temperatures and other climate change-related environmental conditions promote the growth of harmful algal blooms. These events pose numerous threats to human health (particularly causing respiratory, digestive, and neurological effects). This research analyzed algal bloom-associated health costs from an estimated 11,066 hospitalizations and 3,857 emergency room visits in Florida in 2012.

6. Nevada (\$898 million): During the summer of 2012, Nevada experienced some of its hottest and driest weather to date, worsening ground-level ozone smog. Ozone concentrations in the state exceeded federal standards in 2011-2013. The research team applied estimates of 97 deaths, and estimated 114 hospitalizations and 194 emergency room visits due to ozone air pollution in 2012.



7. Texas (\$1.1 billion): West Nile is a mosquito-transmitted virus that can cause fever, disorientation, and in rare cases, fatal encephalitis or meningitis. In 2012, the United States experienced an unexpected resurgence in the incidence of West Nile virus. In Texas, drought created stagnant water pools and climate change contributed to elevated temperatures, enabling expanded mosquito habitat and higher reproductive rates and elevating disease transmission risks. In Texas, there were an estimated 89 deaths, 1,628 hospitalizations, and 2,680 emergency room visits linked to West Nile Virus that year.

8. Colorado (\$1.6 billion) and 9. Washington (\$2.3 billion): Climate change leads to higher temperatures, changes in seasonal rainfall patterns, and lower soil moisture—which means more wildfires and longer fire seasons in the western United States. Researchers examined costs from direct wildfire deaths and health impacts attributed to wildfire smoke in both states in 2012 (174 deaths, 256 hospitalizations, and 1,432 emergency room visits in Colorado, and 245 deaths, 371 hospitalizations, and 1,897 emergency room visits in Washington).

10. New Jersey and New York (\$3.1 billion): Hurricane Sandy struck the coastline of the northeastern United States on October 29, 2012, delivering up to one foot of rain within two days and causing power outages for more than 20 million customers. Evidence indicates that sea level rise due to climate change amplified the hurricane's storm surge. This research tallied health costs for an estimated 273 hurricane-related deaths along with 6,602 hospitalizations and 4,673 emergency room visits. Health problems included storm injuries, pregnancy complications, carbon monoxide poisoning, heart attacks, stroke, kidney ailments, dehydration, and mental health problems including anxiety, substance abuse, and mood disorders.

We have conservatively estimated a price tag of \$10 billion (2018 dollars) for these 10 case studies combined. However, the total health-related costs of the 10 events during 2012 could actually be as high as \$25 billion using the range of mortality cost valuation methods cited by the federal government.⁶ For more information about the methods used to estimate the health costs of climate-related events and citations for the 10 case studies, please refer to our Methods, on page 6 of this factsheet.

* Supporting source citations for each case study can be found in the *GeoHealth* paper, Limaye et al. (2019) at: <https://doi.org/10.1029/2019GH000202>.

RECOMMENDATIONS

The increasing health effects and costs of climate change cannot be ignored. To broaden our understanding of these health risks and improve our ability to reduce and prepare for future climate-related health costs, we need:

Reduced Carbon Pollution. Carbon pollution must be rapidly reduced to limit the most serious health effects related to climate change. NRDC strongly supports robust federal, state, and local efforts to limit the carbon pollution that is causing dangerous climate change.

Adaptation and Preparedness in Communities. Only about one-third of U.S. states currently include public health measures in their climate change adaptation plans.⁷ The U.S. Centers for Disease Control and Prevention (CDC) runs a program called the Climate-Ready States & Cities Initiative, which should be expanded to all states. Climate-adaptive strategic planning should become a priority at the local, state, regional, and national levels. Some examples include employing heat early warning systems and health advisories, opening public cooling centers, providing better disease surveillance, redesigning communities to withstand floods and storms, and reducing wildfire risks.

Improved Health Surveillance and Tracking. Scientists are looking more carefully at the impacts of climate change on health in recent years, yet the quantification of climate-sensitive health-related costs remains limited, in part because of insufficient health surveillance and the data

necessary to characterize health costs. Increased funding can support expanded, coordinated tracking and monitoring of climate-sensitive health outcomes and environmental indicators related to climate change. To this end, it is crucial to fully fund the CDC's National Environmental Public Health Tracking Network and support a more coordinated federal effort to better track the health and economic impacts of climate change.⁸

Better Analyses of Climate-Related Health Costs. More comprehensive analyses of the health costs of climate change are needed at the local, national, and international levels to inform policy making. Economic policy metrics like the Social Cost of Carbon should better account for the substantial and growing health costs of climate change by capturing the broad range of climate-sensitive health impacts and related costs.⁹

The projected health and economic burden of climate-sensitive events will be enormous if climate change continues unchecked and communities are not prepared for what's to come. Measures to reduce carbon pollution are urgently needed, even as enhanced climate adaptation and public health preparedness can reduce climate-related health costs. As this analysis suggests, investments in preparedness and climate adaptation today could help us avoid or reduce tens or even hundreds of billions of dollars in future health costs and unprecedented human suffering. By supporting strategies to help ourselves and our communities prepare for these climate-sensitive events, we can better thrive in the face of climate change.



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METHODS FOR ESTIMATING THE HEALTH COSTS OF CLIMATE CHANGE-RELATED EVENTS

Because of the challenges of identifying reliable data sources, and a lack of consensus on methods for assigning value to the cost of illness, there is currently no single, widely accepted method to estimate the cost of the human health impacts of climate change. To estimate the health costs of 10 selected climate-sensitive events, we identified events that occurred during 2012 and derived health-associated costs of event-related premature deaths, hospitalizations, emergency room visits, and outpatient visits. Deaths and illness reported in journal literature or agency reports were used to estimate associated costs, using a combined Cost of Illness and Value of a Statistical Life (VSL) approach.

Our team searched peer-reviewed literature, state and federal agency reports, and other online data sources to identify climate-sensitive events that specified illness and death data within the study period. Although specific links between these individual episodes and climate change have not been fully described, and the pace and extent to which climate change will exacerbate these events varies between the different types, these case studies represent the kinds of exposures and health impacts projected to worsen in frequency, intensity, duration, and/or extent in the future due to climate change.

We calculated the mortality and illness for each event based on data reported, or extrapolations based on values inferred using a ratio (i.e., hospitalization-to-emergency department visits, and hospitalization-to-outpatient visits) derived from the Healthcare Cost Utilization Project and the Medical Expenditure Panel Survey.¹⁰ Illness costs reflect hospitalizations, emergency department visits, outpatient visits, and other medical expenses. Mortality costs are based on the VSL, using a value of \$9.1 million in 2018 dollars, which is the central value from a range of the U.S. Environmental Protection Agency's economic valuation studies.¹¹ The estimated total health-related costs from the 10 events could be as high as \$25 billion, if all possible sources of variability in the estimated health effects and the methods used to value their costs are included.

For more information on these methods, see the full peer-reviewed journal article:

Vijay Limaye et al. "Estimating the health-related costs of 10 climate-sensitive U.S. events during 2012," *GeoHealth*, 3 (2019), <https://doi.org/10.1029/2019GH000202>.

ENDNOTES

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