

A Physician's Guide to Climate Change, Health and Equity

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Center for
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PARTNERS



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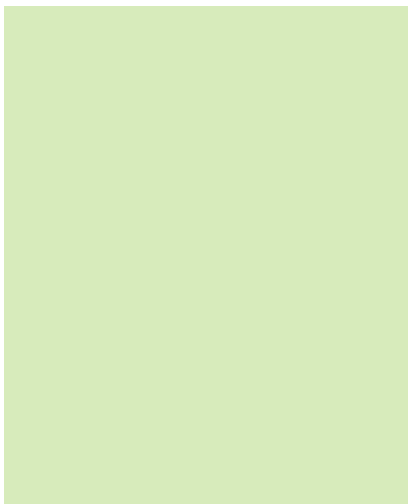
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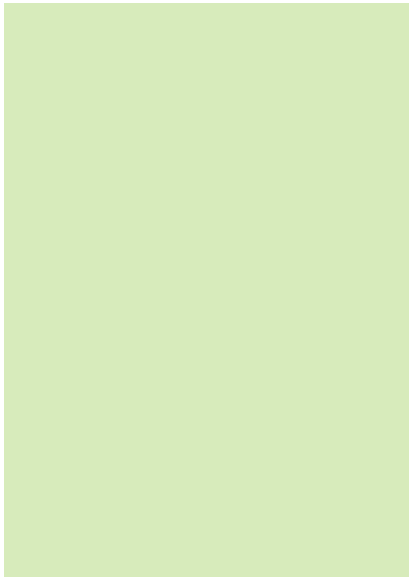
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A Physician's Guide to Climate Change, Health and Equity



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Dear Colleagues,

Welcome and thank you for being a Climate Change and Health Equity Champion! As a physician, you play an especially important role in protecting patients and communities against the increasing impacts of climate change on health.

Climate change is already affecting the health of our patients, ranging from heat-related illness to poor air quality to weather-related injury and rising food prices. However, we know that these impacts are not felt equally across communities. Low-income communities and communities of color are disproportionately affected by climate change. Existing inequities in chronic disease rates and socioeconomic conditions, such as poverty or lack of access to healthy foods or parks, can increase vulnerability to climate change health impacts:

- People with asthma or COPD are at higher risk from increased ozone levels and wildfire smoke.
- Those with cardiovascular disease or diabetes are at increased risk from extreme heat.
- Neighborhoods with a lot of pavement and few parks and trees experience “urban heat island” effects and associated heat-related illness.
- People living in poverty are less able to cope with rising food prices or buy home insurance to help deal with extreme weather events, such as storms or flooding.

We know how to fight climate change and create climate resilient communities. Many climate solutions are good for health:

- Clean energy reduces heart and respiratory disease from air pollution.
- Walking and biking bring all of the health benefits of physical activity.
- Urban greening reduces heat risk and provides many other health and community benefits.

Your voice as a Climate Change and Health Equity Champion is needed now more than ever. Physicians are trusted leaders in every community. Our patients and policymakers expect us to speak out about major threats to their health. We encourage you to use these resources, and others available to Champions, to reach out, talk about climate change and health, and advocate for solutions that reduce the risk of climate catastrophe and the harms of climate change.

We thank you for your commitment, and look forward to supporting you in efforts to ensure that our communities can thrive and be healthy in the face of climate change.

Thank you,

Dr. Margaret Juarez
Chair, NEPO

Lisa Folberg, MPP
President, CMA Foundation

Introduction: how to use this guide



Each issue in this guide can be used as a stand-alone resource, or in connection with other topics.

Thank you for your interest in climate change, health and equity! As a physician, your voice is critical in promoting actions that address climate change and its impacts on health, and that improve health equity. There are many ways physicians can make a big difference — with your patients, in your practice and health care institutions, and most importantly, in your community and the policy arenas.

A Physician's Guide to Climate Change, Health and Equity is a resource to inform and strengthen your voice in whatever forum you choose to act. The Guide explores the complex and multifaceted connections between climate change and health, disproportionate burdens and the impacts on health equity, and opportunities for solutions. It is not designed for you to read and absorb all at once: it is filled with a lot of detailed information and data. Rather, it is meant to be a resource that you can use to prepare for various conversations such as media interviews, visits with legislators or policymakers, community talks, as well as to create news articles, professional presentations or policy resolutions.

What's included

The guide is organized into three main sections, which include individual areas of focus that can be used as stand-alone resources, or in connection with other topic sheets.

The first topics covered in the guide provide a foundational understanding of climate change science, health equity and the physician role in climate change and health:

- Physician Action Guide
- Climate Change 101: climate science basics
- Climate Change and Health Equity
- Physician Surveys on Climate Change and Health

The guide then dives into specific climate change impacts and their effects on health and health equity, with a focus on California and the U.S. These impacts include drought, extreme heat, vector-borne disease, extreme weather, mental health, food security and others. We have also included topics of special focus, such as the impact of climate change on children, workers and pregnant women. Each of these topic sheets includes short sections on:

- Relevant health impacts
- Climate change risks
- Health equity issues
- What you can do to promote change



You may want to tailor your reading to the topics that are most pertinent to a particular audience, to your specialty area, or to the issue or concern that you plan to discuss with a local elected official.

You will also find links to more information, additional resources and to other topic sheets. For example, the topic sheet on drought has cross-references to the sheets on infectious disease, wildfires and food security, as drought worsens all of these risks. The sheets provide strategies to address the particular climate change threat at various levels — ranging from patient care to policy advocacy.

The final section focuses on co-benefit solutions for climate change and health, those strategies we can take to not only slow climate change, but improve health and health equity. These include co-benefit strategies for transportation, energy production, food systems & agriculture and urban greening & green infrastructure.

Using the Guide

Each issue in this guide can be used as a stand-alone resource, or in connection with other topics. When using the guide, pull from the various issue topics to paint a picture that conveys:

- The specific climate change problem(s)
- Its impacts on health and equity
- What can be done
- An “ask” or call to action

It is also critical to share your personal experiences of the effects of climate change on health: what have you witnessed in your practice? What are you hearing from patients and communities? How have you seen solutions put to work to improve health and slow climate change?

Focus areas

You may want to tailor your reading to the topics that are most pertinent to a particular audience, to your specialty area, or to the issue or concern that you plan to discuss with a local elected official. For example, if you are talking to hospital personnel or local emergency management staff, you might want to focus on topics that address extreme weather events, as well as mental health. As an OB/GYN, you will of course be interested in the sheet on pregnant women, but you may also want to focus on food security, since nutrition is a vital aspect of healthy pregnancy. For a discussion with a local Air Quality Management District or a legislator considering emissions limits, the Air Quality sheet will obviously be most handy, as will the co-benefits sheet on Transportation and Energy.

As Margaret Chan of the World Health Organization has stated, climate change is the defining public health issue of this century and we hope this guide equips you with the information and resources to take action. Working together, at all levels, we can make a difference and ensure healthy people, healthy places and a healthy planet for all.

We welcome your feedback on the guide, including opportunities to co-brand and tailor it to your stakeholder population. In addition, if you are interested in becoming more involved as a Climate Change and Health Champion, please contact us at info@climatehealthconnect.org.

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Physician Action Guide



As a physician, you play a vital role in protecting the health of patients and community, especially in the era of climate change.

“A climate crisis is also a health crisis, and we must first direct solutions and resources to our most vulnerable and already affected communities.”

–Linda Rudolph, MD, New York Times Letter to the Editor, May 2014

As a physician, you play a vital role in protecting the health of patients and communities, especially in the era of climate change. There are many ways that you can act as a Climate and Health Champion at home, in your practice, in your local community, and more widely. While action at all levels is important — from your own home to advocacy for national action — physicians have an especially important role to play in influencing community leaders and policy-makers who make decisions with larger impacts.



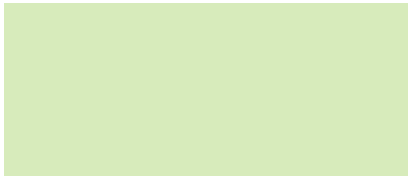
Personal Action

- Take steps to reduce your own carbon footprint.
 - Walk or bike instead of driving; drive a low- or no-carbon vehicle.
 - Reduce meat consumption; purchase local, fresh and seasonal food.
 - Be energy efficient at home and in your office: use energy efficient appliances, electronics, and light bulbs.
 - Purchase renewable energy if you can.



Patient Care

- Place climate change educational materials in your office.
 - Brochures, fact sheets, posters about climate change and health
- Look for appropriate ways to incorporate climate change and health into patient education materials (e.g, disease management plans, discharge materials, medication sheets, etc).
 - Educate patients on the effect of heat on storage and dosing of insulin.
- Make sure climate change impacts are addressed in disease management and care protocols.



DID YOU KNOW?

Physicians have an especially important role to play in influencing community leaders and policy-makers who make decisions with larger impacts.

- Advise asthma patients to check the [Air Quality Index](#) whenever it is hot or windy, or there are wildfires in the region.
- Incorporate a climate change assessment into home visits or home environment assessments. and refer patients for appropriate resources.
 - Heat vulnerability: lack of air conditioning, ventilation or shading within home; tree cover around the home: refer for weatherization, energy efficiency, tree planting and inform about places to stay cool in a heat wave.
- Connect patients to community resources for climate resilience.
 - [LIHEAP](#): Low-income home energy assistance program



Organizational & Professional Action

- Speak with your clinic and hospital facility operators about energy efficiency and procurement strategies for climate change mitigation and adaptation.
 - Minimize landfill and incineration use for waste disposal.
 - Procure supplies locally to reduce transport-related emissions.
 - Source clinic or hospital food locally and sustainably.
- Speak on the health impacts of climate change, and strategies to address them, with colleagues at brown bag lunches, grand rounds, professional meetings, conferences, etc.
 - Present what your clinic is doing to address the problem.
- Urge your professional organizations and affiliations to take up climate change as a priority health topic via a resolution, position paper or conference theme.
 - [American Academy of Pediatrics](#), [American College of Physicians](#), and others have papers and reports on climate change.



Community Involvement

- Speak on the health impacts of climate change, and strategies to address them, at your local churches, clubs, or community meetings.
 - School board, city council, parent-teacher association and chamber of commerce
- Include climate change and health information when your clinic participates in community events
 - Community health fairs, National Night Out, seasonal festivals
- Support action for healthy communities
 - [Safe Routes to School](#), bike lanes
 - Community gardens
 - Local climate action plans
 - Local zoning for walkable and bike-able neighborhoods



Write to and visit your local state legislator and city council members to help them understand that climate change is a health equity issue, and to form relationships for ongoing advocacy, Speak on local radio or television programs about climate change and health.



Policy & Advocacy Action

- Write to and visit your local state legislator and city council members to help them understand that climate change is a health equity issue, and to form relationships for ongoing advocacy.
- Provide testimony or comments on the health benefits of bills that take action on climate change, including relevant housing, transportation, water, agriculture bills.
- Participate in writing a Legislative Brief on Climate Change and Health.



Media opportunities

- Pen an Op-Ed in your local or regional newspaper on the connections between climate change and health equity.
- Capitalize on current events: Write letters to the Editor after relevant events, such as extreme weather events, about the connection between events, climate change and health.
- Speak on local radio or television programs about climate change and health.

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Climate Change 101: climate science basics



Physicians may be hesitant to talk about climate change because they aren't experts in climate science. In this section, you will find basic information about climate change — what it is, what causes it, and what we can do about it.

But you don't need to be a climate scientist to talk about the risks climate change poses to human health, or the health benefits of taking action on climate change. When physicians have a patient with a complex or rare illness, they often seek guidance from a sub-specialist with extensive training and education on that illness. Climate scientists are like sub-specialists — they are trained to understand climate patterns, and the sophisticated models that forecast those patterns in the future. If you were to consult with 100 climate scientists, you would find that:

97% of climate scientists agree:

- Climate change is happening now.
- It is being driven primarily by human activity.
- We can do something to reduce its impacts and progression.

What's the difference between weather, climate, climate variability and climate change?

- [Weather](#) is the temperature, humidity, precipitation, cloudiness and wind that we experience in the atmosphere at a given time in a specific location.
- [Climate](#) is the average weather over a long time period (30 – 50 years) in a region.
- [Climate variability](#) refers to natural variation in climate that occurs over months to decades. El Niño, which changes temperature, rain and wind patterns in many regions over about 2 – 7 years, is a good example of natural climate variability, also called natural variability.
- [Climate change](#) is “a systematic change in the long-term state of the atmosphere over multiple decades or longer.”¹
 - Scientists use statistical tests to determine the probability that changes in the climate are within the range of natural variability — similar to the statistical tests used in clinical trials to determine whether a positive response to treatment is likely to have occurred by chance. For example, there is a less than 1% chance that the warming of the atmosphere since 1950 could be the result of natural climate variability.



FAST FACT:

Carbon dioxide (CO₂) is the greenhouse gas responsible for greatest amount of warming to date.

What causes climate change?²

At its most basic, climate change is caused by a change in the earth's energy balance — how much of the energy from the sun that enters the earth (and its atmosphere) is released back into space. The earth is gaining energy as we reduce the amount of solar energy that is reflected out to space — just like people gain weight if there is an imbalance between calories in and calories out.

Since the Industrial Revolution started over 200 years ago, human activities have added very large quantities of greenhouse gases (GHG) into Earth's atmosphere. These GHG act like a greenhouse (or a blanket or car windshield) to trap the sun's energy and heat, rather than letting it reflect back into space. When the concentration of GHG is too high, too much heat is trapped, and the earth's temperature rises outside the range of natural variability. There are many GHG, each with a different ability to trap heat (known as its "[global warming potential](#)") and a different half-life in the atmosphere. GHG are sometimes called "climate active pollutants" because most have additional effects, most notably on human health.



! FAST FACT:

Together, electricity production, transportation and industrial processes account for more than 80% of the CO₂ released into the atmosphere.

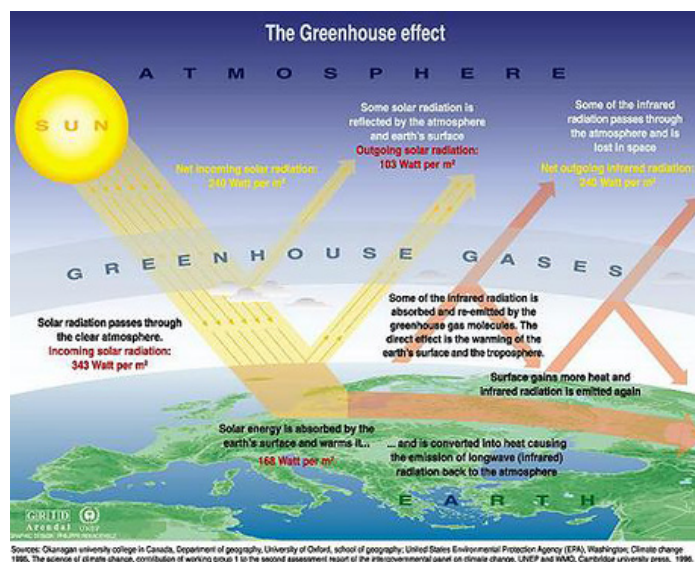


Photo credit: Marinebio

Carbon dioxide (CO₂) is the GHG responsible for greatest amount of warming to date. CO₂ accounted for 82% of all human-caused GHG emissions in the U.S. in 2013.³ The majority of CO₂ is released from the incomplete combustion of fossil fuels - coal, oil, and gas — used for electricity production, transportation and industrial processes. Together, these three activities account for more than 80% of the CO₂ released into the atmosphere.

Other important GHG include [methane](#), [nitrous oxide](#), [black carbon](#), and various [fluorinated gases](#). Although these gases are emitted in smaller quantities than CO₂, they trap more heat in the atmosphere than CO₂ does. The ability to trap heat is measured as [Global Warming Potential \(GWP\)](#). As the most common and abundant greenhouse gas, CO₂ has a GWP of 1, so all other GHG warming potentials are compared to it. Fluorinated gases, for example, have GWPs thousands of times greater than CO₂, meaning that pound-for-pound, these gases have a much stronger impact on climate change than CO₂.

Summary Table of Greenhouse Gas Emissions ^{4 5}

Name	% of U.S. GHG Emissions 2013	Sources	Lifetime in the Atmosphere	Global Warming Potential (GWP)
Carbon Dioxide (CO ₂)	82%	Electricity production, transportation, numerous industrial processes.	Approximately 50-200 years. Poorly defined because CO ₂ is not destroyed over time; it moves among different parts of the ocean-atmosphere-land system.	1
Methane (CH ₄)	10%	Livestock manure, food decomposition; extraction, distribution and use of natural gas	12 years	25
Nitrous oxide (N ₂ O)	5%	Vehicles, power plant emissions	115 years	298
Black carbon (soot, PM)	>1%	Diesel engines, wildfires biomass in household cook stoves (developing countries)	Days to weeks	3,200
Fluorinated gases: PFCs, HFCs, NF ₃ , SF ₆	>5%	No natural sources. These are synthetic pollutants found in coolants, aerosols, pesticides, solvents, fire extinguishers. Also used in the transmission electricity.	PFCs: 2600 – 50,000 years HFCs: 1-270 years NF ₃ : 740 years SF ₆ : 3200 years	PFCs: 7,000–12,000 HFCs: 12–14,000 NF ₃ : 17,200 SF ₆ : 22,800



Why Short-Lived Climate Pollutants Matter

The greenhouse gases with a high global warming potential but a short lifetime in the atmosphere are called “short-lived climate pollutants” (SLCP). Key SLCP include methane, black carbon, and the fluorinated gases. Because of the combination of a short half-life and high GWP, the climate change impacts of the SLCP are front-loaded — more of the impacts occur sooner, while the full weight of impacts from CO₂ will be felt later.

We must transition to carbon-free transportation and energy systems, because CO₂ remains the greatest contributor to climate change. But reducing emissions of short-lived climate pollutants may “buy time” while we make the transition. Reducing global levels of SLCP significantly by 2030 will:⁶

- Reduce the global rate of sea level rise by 20% by 2050
- Cut global warming in half, or 0.6° C, by 2050 and by 1.4° C by 2100
- Prevent 2.4 million premature deaths globally each year
- Improve health, especially for disadvantaged communities

Many strategies to reduce SLCP also have immediate health benefits, such as:

- Reducing air pollution related hospitalizations
- Promotion of reduced meat consumption
- Stricter emissions standards, especially for diesel vehicles
- Cleaner household cook stoves in developing nations

Climate change is causing five critical global environmental changes:⁷

- **Warming temperature of the earth's surface and the oceans:** The earth has warmed at a rate of 0.13° C per decade since 1957, almost twice as fast as its rate of warming during the previous century.
- **Changes in the global water cycle ('hydrologic' cycle):** Over the past century there have been distinct geographical changes in total annual precipitation, with some areas experiencing severe and long-term drought and others experiencing increased annual precipitation. Frequency and intensity of storms increases as the atmosphere warms and is able to hold more water vapor.
- **Declining glaciers and snowpack:** Across the globe, nearly all glaciers are decreasing in area, volume and mass. One billion people living in river watersheds fed by glaciers and snowmelt are thus impacted.
- **Sea level rise:** Warmer water expands, so as oceans warm the increased volume of water is causing sea level rise. Melting glaciers and snowpack also contribute to rising seas.
- **Ocean acidification:** Oceans absorb about 25% of emitted CO₂ from the atmosphere, leading to acidification of seawater.

These global changes result in what we experience as changes in our local weather and climate:

- Greater variability, with “wetter wets”, “drier dries” and “hotter hots”
 - More frequent and severe extreme heat events
 - More severe droughts
 - More intense precipitation, such as severe rains, winter storms and hurricanes
- Higher average temperatures and longer frost-free seasons
- Longer wildfire seasons and worse wildfires
- Loss of snowpack and earlier spring runoff
- Recurrent coastal flooding with high tides and storm surges



DID YOU KNOW?

Oceans absorb about 25% of emitted CO₂ from the atmosphere, leading to acidification of seawater.

- More frequent and severe floods due to intense precipitation and spring snowmelt
- Worsening air quality: Higher temperatures increase production of ozone (a key contributor to smog) and pollen, as well as increasing the risk of wildfires.
- Longer pollen seasons and more pollen production

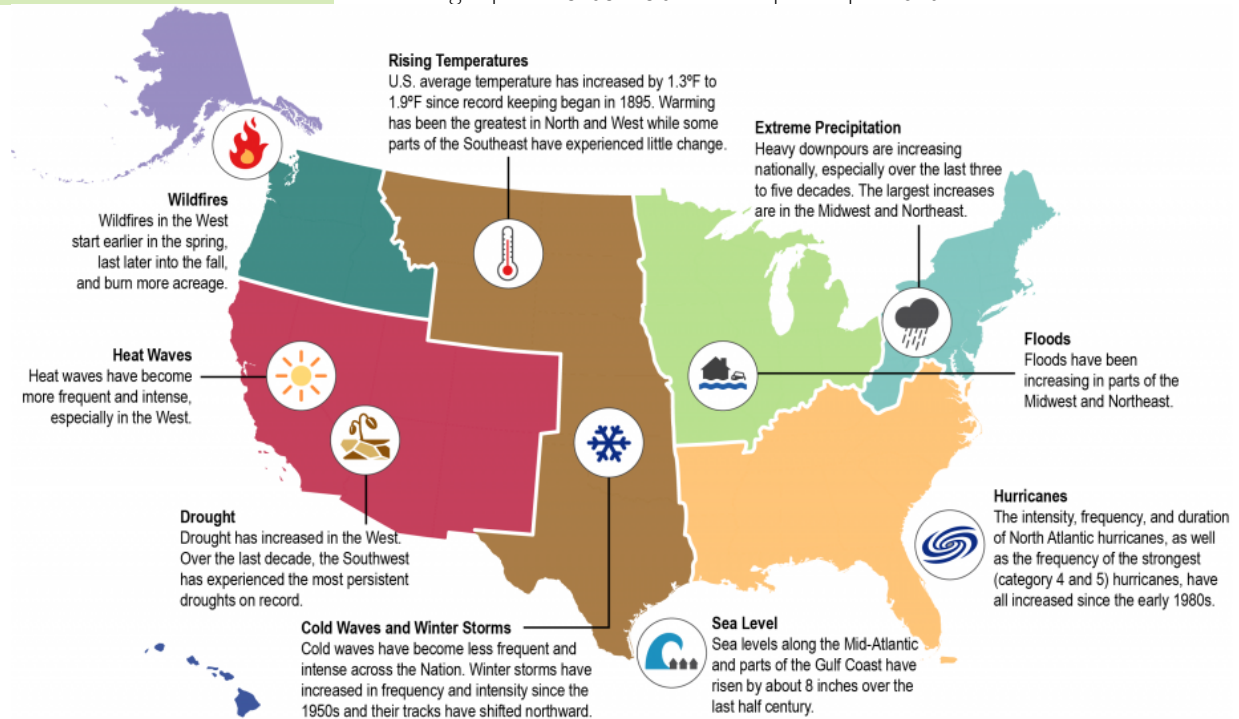
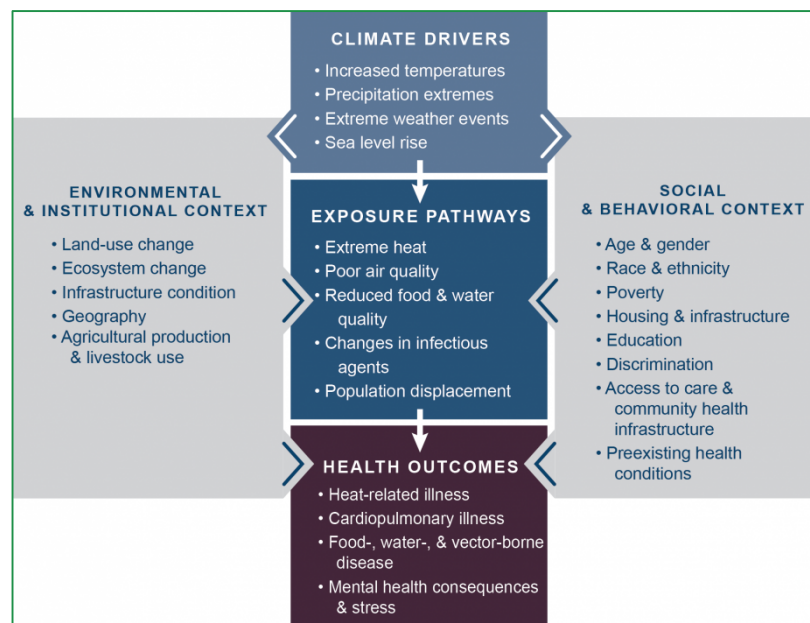


Photo credit: US Global Change Research Project Climate and Health Assessment

In turn these regional and local climatic changes result in the environmental, social and economic changes that are associated with human health impacts. These impacts will be covered in greater detail throughout the guide, but the graphic below provides an overview of the pathways linking climate change and human health outcomes.



! FAST FACT:

There is a less than 1% chance that the warming of the atmosphere since 1950 could be the result of natural climate variability.

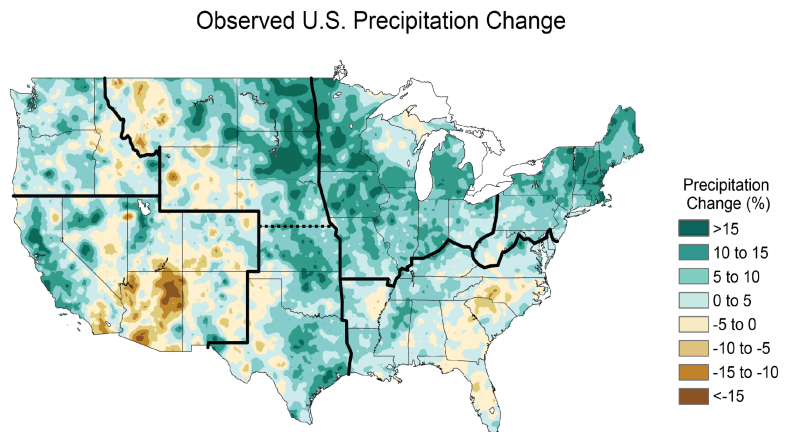
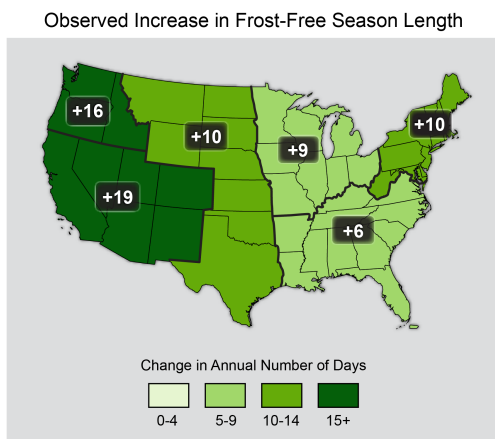
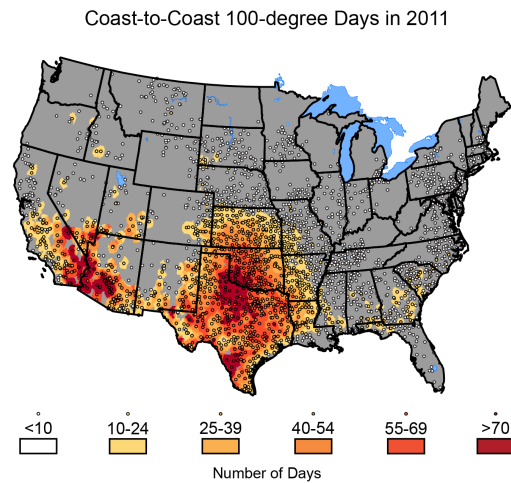
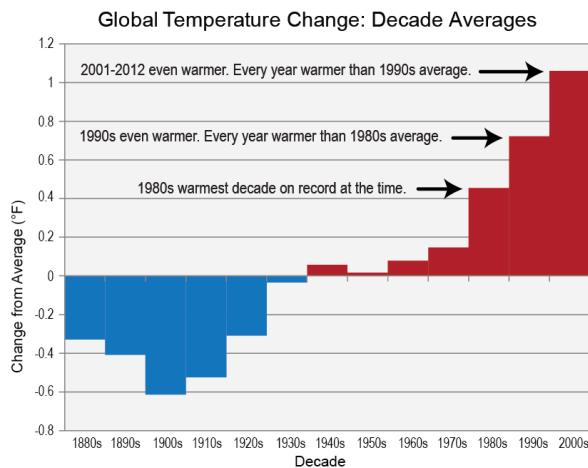


FAST FACT:

Climate change will appear differently in different regions of the U.S.

Climate change in the U.S.

Climate change will appear differently in different regions of the U.S., just as different patients may experience the same illness differently, depending on pre-existing health status, socioeconomic factors and environmental context. Below are a few snapshots of measured changes associated with climate change in the U.S.⁸ For a more comprehensive view of how climate change is affecting the U.S. and specific regions, see the [National Climate Assessment](#). California-specific impacts will be covered in greater detail throughout the Guide.





DID YOU KNOW?

Mitigation strategies that offer feasible and cost-effective ways to reduce greenhouse gas emissions include the use of clean and renewable energy for electricity production; walking, biking, and using low-carbon or zero-emission vehicles; reducing meat consumption; less flying; changing agricultural practices; limiting deforestation; and planting trees.

There is a lot we can do about climate change.

In general, climate solutions fall into two big buckets — “mitigation” and “adaptation.” Increasingly, government and community organizations also talk about measures to increase climate “resilience.” These concepts are not distinct, and are all inter-related. From the [Global Change Research Project](#):⁹

- **Mitigation** refers to “measures to reduce the amount and speed of future climate change by reducing emissions of heat-trapping gases or removing carbon dioxide from the atmosphere.”
- **Adaptation** refers to measures taken to reduce the harmful impacts of climate change or take advantage of any beneficial opportunities through “adjustments in natural or human systems.”
- **Resilience** means the “capability to anticipate, prepare for, respond to, and recover from significant threats with minimum damage to social well-being, the economy, and the environment.”

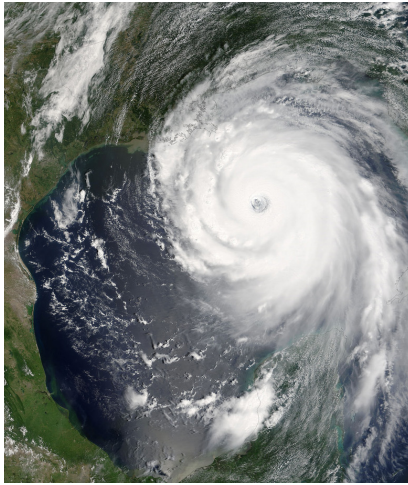
Mitigation

Mitigation is essential because scientists agree that the higher global temperatures rise, the greater the adverse consequences of climate change. Also, if emissions are unchecked, there is a greater danger of abrupt climate change or surpassing “tipping points.” For example, [collapse of the West Antarctic Ice Sheet](#) could lead to very rapid sea level rise, or melting of permafrost could lead to large releases of methane that would further increase warming through a positive feedback loop. Catastrophic climate change could surpass our capacity to adapt. For example, a recent study suggests that heat levels in parts of the Middle East may exceed the body’s survival threshold unless we reduce greenhouse gas emissions levels quickly.¹⁰

There are many mitigation strategies that offer feasible and cost-effective ways to reduce greenhouse gas emissions. These include the use of clean and renewable energy for electricity production; walking, biking, and using low-carbon or zero-emission vehicles; reducing meat consumption; less flying; changing agricultural practices; limiting deforestation; and planting trees.

Our Carbon Budget

In 2015, [nearly 200 nations agreed in Paris](#) that the risks are significantly reduced if we can keep global temperatures from rising more than 1.5° Celsius above pre-industrial levels. Currently, average global temperatures are around 1°C higher than pre-industrial levels, and if greenhouse gas emissions continue at the current rates (“business as usual”), the Earth’s temperature will rise about 4° C by the end of the century. To stay below 1.5° rise requires that from now forward, total global emissions cannot exceed 240 billion tons of carbon into the Earth’s atmosphere. This is referred to as our “carbon budget.”¹¹ At current emissions rates, this carbon budget will be used up within the next 6 to 11 years. Therefore, drastic action is needed to significantly reduce emissions as soon as possible.



FAST FACT:

The impacts of climate change are already evident — in extreme weather, more explosive wildfires, higher temperatures, and changes in the distribution of disease-carrying vectors.

Adaptation

Adaptation strategies are needed to reduce the harmful impacts of climate change and allow communities to thrive in the face of climate change. The impacts of climate change are already evident – in [extreme weather](#), more explosive [wildfires](#), higher temperatures, and changes in the distribution of [disease-carrying vectors](#). Because GHG persist in the atmosphere for a long time, more serious climate impacts would be experienced even if we halted all GHG emissions today.

[Cool roofs](#), planting trees, and air conditioning are all effective adaptation strategies to reduce the impacts of rising temperatures and more frequent [heat waves](#). Seawalls and restoration of wetlands are both strategies to address [sea level rise](#). Emergency preparedness planning that takes climate changes into account is one way to adapt to the increased frequency of climate resilience: the capacity to anticipate, plan for and reduce the dangers of the environmental and social changes brought about by climate change, and to seize any opportunities associated with these changes.¹² For more on climate change resilience see [Climate Change and Health Equity](#).

Climate and Health Co-Benefits

Although climate change is the greatest health challenge of our century, action to address it has the potential for huge health benefits. Consideration of the health and equity impacts of various mitigation and adaptation strategies can help optimize the health benefits of climate action. For more information on the health co-benefits of climate actions, see the following “Climate Action for Healthy People, Healthy Places, Healthy Planet” briefs:

- [Transportation, Climate Change and Health](#): Reducing vehicle miles traveled through walking, biking, and public transit increases physical activity, significantly reduces chronic disease risks and reduces greenhouse gas emissions.
- [Energy, Climate Change and Health](#): Switching from coal combustion to clean, safe, renewable energy is one of the most important things we can do for our health and for the climate.
- [Food & Agriculture, Climate Change and Health](#): Shifting to healthy diets and local, sustainable food and agriculture systems, offers significant health, climate, and environmental benefits.
- [Urban Greening & Green Infrastructure, Climate Change and Health](#): Urban greening reduces the risk of heat illness and flooding, lowers energy costs, and supports health. Green spaces provide places to be physically active and trees sequester CO₂, improve air quality, capture rainwater and replenish groundwater.

[†] The carbon budget includes the remaining amount of all GHG that can be emitted to keep the earth's temperature below the target of 1.5° Celsius. In order to provide a single, standardized measurement, the global warming potentials of all GHG are converted to their CO₂ equivalent and this figure (240 billion tons) is the carbon budget.



DID YOU KNOW?

Because greenhouse gasses (GHG) persist in the atmosphere for a long time, more serious climate impacts would be experienced even if we halted all GHG emissions today.



For More Information

- Intergovernmental Panel on Climate Change Fifth Assessment Report
<https://www.ipcc.ch/report/ar5/syr/>
- U.S. Global Change Research Project National Climate Assessment
<http://nca2014.globalchange.gov>
- U.S. Environmental Protection Agency Climate Change site
<https://www3.epa.gov/climatechange/>
- Climate Change in California
 - Our Changing Climate 2012: Summary report from the Third Assessment of Climate Change in California
<http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf>
 - Cal Adapt: Web-based tool allowing users to identify climate change risks throughout the state <http://cal-adapt.org>
 - California Climate Change: Official State of California site with resources on statewide climate change and initiatives to reduce greenhouse gas emissions <http://climatechange.ca.gov>

Page 1 photo: H. Raab / flickr.com; page 2 photo: Bill Dickinson/flickr.com; page 3 photo: Tam Thi L C/ flickr.com; page 4 photo: NPS; page 8 photo: Penn State; page 9 photo: NASA/Kathryn Hansen; page 10: Lotus R/flickr.com.





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- ¹² Island Press & The Kresge Foundation. (No Date). Bounce forward, urban resilience in the era of climate change. Island Press. <http://kresge.org/sites/default/files/Bounce-Forward-Urban-Resilience-in-Era-of-Climate-Change-2015.pdf>



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Climate Change and Health Equity

“We have been mortgaging the health of future generations to realize economic and development gains in the present.”

–The Rockefeller Foundation-
Lancet Commission on
Planetary Health

The health risks and impacts of climate change are not equally or fairly distributed across people, communities or nations. Some of the smallest and least developed countries bear the largest and most harmful burden, despite the fact that they contribute little to the problem compared to large, industrialized nations. Within the U.S., inequities in living conditions, power, and health place low-income communities and some communities of color at greater risk of the health impacts of climate change. Climate change thus exacerbates existing health inequities. We can reduce these inequities through careful attention to the design of climate mitigation and adaptation strategies, and efforts to build healthy, equitable, climate resilient communities.

Health inequities in the U.S.

Across the U.S., low income communities and communities of color suffer substantially higher disease burdens and lower life expectancies than wealthier and white populations:¹ The rate of diabetes among the poor is 1.5 times that of those who are not poor, deaths from heart disease and stroke are higher for non-Hispanic Blacks than any other ethnic group, and adults with a high school education or less are eight times more likely to report their health as “fair or poor” than those with a college education. In the Bay Area of California, a child born in impoverished West Oakland will die 10 years sooner than a child born a few miles away in the affluent Berkeley Hills.²

Health inequities are “**preventable differences in health outcomes that are the result of systemic, avoidable, and unjust social and economic policies and systems that create barriers to health resources and opportunities.**”³ Health inequities arise largely as a result of the physical, social, working, economic, and service environments in which we live, learn, work, pray and play.

These “[social determinants of health](#)” shape our health behaviors and health outcomes, and contribute far more to health status than medical care alone. They in turn are shaped by forces beyond the control of the individual: economics and the distribution of money, power, social policies and politics at the global, national, state and local levels.⁴ Living conditions differ by place, race, and income, as a result of factors such as historical disinvestment in some communities, discriminatory practices and policies over time, [structural racism](#), and higher pollution burdens in communities of color. At a fundamental level, the social determinants of health are related to the unequal distribution of power and wealth. Although this is slowly changing, low-income communities and communities of color are often disenfranchised and lack the political or economic power to win investments that promote health resilience.



Existing health inequities (and the living conditions that contribute to them) provide the context in which people experience the health impacts of climate change.

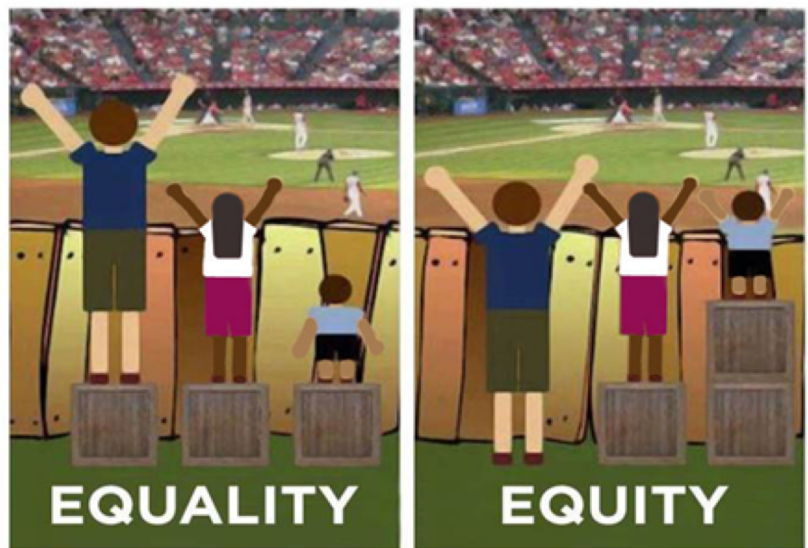


! FAST FACT:

In the Bay Area of California, a child born in impoverished West Oakland will die 10 years sooner than a child born in the affluent Berkeley Hills.²

Health equity vs. health disparity:

Health equity is achieved when everyone has the opportunity to achieve their highest health potential, without limits imposed by social inequities.⁵ Health inequities are different than health disparities in that they are rooted in unfair or unjust conditions. Achieving health equity means that we, as society, must create the conditions in which all people have the opportunity to achieve their highest health potential. Creating those conditions requires strategies that are fair, but not necessarily equal.



Climate vulnerability and climate resilience

Climate [vulnerability](#) is the degree to which people or communities are at risk of experiencing the negative impacts of climate change.⁸ The flip side of climate vulnerability is climate [resilience](#), which is the capacity to anticipate, plan for and reduce the dangers of the environmental and social changes brought about by climate change, and to seize any opportunities associated with these changes.⁹ Because many communities currently lack the power, resources and opportunities that promote health and economic well-being, the concept of resilience also implies promoting the ability to not just remain the same in the face of climate change or after an extreme event, but also to become stronger and healthier — to “[bounce forward](#).”

Geographical location is, of course, an important consideration in climate vulnerability. Low-lying coastal communities are clearly at greater risk of coastal flooding from sea level rise and tidal storm surges than communities at higher altitudes. Three additional factors are most significant in determining the level of climate vulnerability or resilience in individuals and communities.



DID YOU KNOW?

At a fundamental level, the social determinants of health are related to the unequal distribution of power and wealth. Although this is slowly changing, low-income communities and communities of color are often disenfranchised and lack the political or economic power to win investments that promote health resilience.



- **Pre-existing health status:** The existing health inequities that burden low-income communities and communities of color result in greater risk for some climate health impacts.
 - People who depend on medications or electric medical devices are at greater risk during a climate-related disaster.
 - Those with asthma or COPD are at greater risk of respiratory illness from increased [ozone](#), [wildfire smoke](#), and [increased pollen](#).
 - People with cardiovascular disease and diabetes experience increased complications from [extreme heat](#).
- **Living and working conditions:** The same physical, social, economic, and services environments that are associated with poor health outcomes for low-income communities and communities of color also increase vulnerability to the health impacts of climate change.
 - People living in areas with high levels of air pollution — for example near ports, freeways, or power-plants — are more vulnerable to increased ozone levels due to rising temperatures.
 - Park-poor and tree-poor neighborhoods with lots of pavement and buildings are at increased risk of the [urban heat island effect](#).
 - Poor quality housing may increase exposure to heat (e.g. through lack of adequate ventilation or cool building materials) or to [vector-borne diseases](#) (e.g. through lack of window screens to keep out mosquitos)
 - Lack of transportation options may make it hard to evacuate timely in preparation for an extreme weather event or wildfire.
 - Outdoor workers, such as agricultural, landscape, and construction workers, are at higher risk of heat illness.
 - The “digital divide” that is experienced by low-income individuals means they may lack access to information about climate-related weather events, risks, and resources.
 - People living in poverty are less able to cope with various climate change impacts (e.g. [rising food prices](#)).
 - Low-income families are less likely to have the insurance or financial resources to rebuild their lives after a severe weather event like Hurricane Katrina or Super Storm Sandy. They are also more likely to live in areas where aging infrastructure is vulnerable to extreme weather events.
- **Lack of power and voice:** Low-income communities and communities of color are often historically disenfranchised, lacking the political and economic power and voice to ensure that their perspectives, needs and ideas are taken fully into account by decision makers. This lack of power shapes living conditions, health behaviors and pre-existing health status, and constrains the ability of low-income communities and communities of color to both respond to climate change impacts and contribute to mitigation strategies.

Characteristics of vulnerability and resilience may coexist at the same time. For example, a neighborhood may be exposed to high levels of air pollution but also have a strong local food system and a high-quality community clinic. An individual might have multiple chronic disease co-morbidities, but also have a very strong and supportive social network.



DID YOU KNOW?

Health inequities are “preventable differences in health outcomes that are the result of systemic, avoidable, and unjust social and economic policies and systems that create barriers to health resources and opportunities.”



Intergenerational equity^{6 7}

In conversations about climate change we are often moved to consider creating a better future for our children or our children’s children and generations to come. These invocations motivate us to act out of a sense of personal connection to our descendants, but they also push us to consider the principles of intergenerational equity in regards to climate change. At its simplest, intergenerational equity says that the fundamental rights and interests of future generations must be treated with equal value as the rights and interests of those living today. Future generations will inherit the earth and its atmosphere from those of us living today and we, in turn, are holding the earth and its atmosphere in trust for them. Starting from a framework of intergenerational equity, the need to prioritize sustainability practices in regards to energy production and use becomes more clear and urgent. By living and using the earth’s resources in a sustainable manner today, we can better ensure their availability for use by future generations.

Prioritizing intergenerational equity can be a rallying point for cooperation between governing bodies around climate change, a shared value that helps the international community set aside blame and work together for a better future. Intergenerational equity also challenges us to take action **NOW** because it calls into question the use of economic discounting when weighing the costs and benefits of climate action. Because discounting prioritizes the present over the future, it places the benefits of fossil fuel burning today over the negative climate change impacts of tomorrow. Likewise, it overemphasizes the costs of climate action today compared to its future benefits. The result is the same: a business-as-usual approach to climate action that puts the rights and interests of future generations at risk for the sake of those living in the present. By challenging these economic appraisals, intergenerational equity changes the value equation, placing the health and wellbeing of future generations on par with our interests and rights today.

SB535: Ensuring that Disadvantaged Communities Benefit from California’s Cap-and-Trade Program

Environmental justice advocates in California successfully pushed for legislation that is now resulting in the allocation of hundreds of millions of dollars of investments in low income communities and communities of color. SB535 (de Leon) – the [California Global Warming Solutions Act of 2006: Greenhouse Gas Reduction Fund](#) – requires that 10% of expenditures from the Greenhouse Gas Reduction Fund are spent in disadvantaged communities, and 25% must benefit those communities. Disadvantaged communities are [identified by CalEPA](#), using an index that incorporates multiple indicators of exposure to toxics and a variety of other demographic and socio-economic indicators. All GGRF-funded projects must reduce greenhouse gas emissions. Examples of investments include:¹⁰

- \$65 million for the construction of over 2,000 affordable housing units near transit stations, reducing the number of vehicle miles traveled and providing better access to transit for low-income families.



DID YOU KNOW?

Some of the smallest and least developed countries bear the largest and most harmful burden, despite the fact that they contribute little to the problem compared to large industrialized nations.



SB535 continued

- \$75 million for energy efficiency and weatherization upgrades to low-income single-family homes, lowering the cost of energy for these families and reducing greenhouse gas emissions.
- \$18 million for urban greening and forestry programs in urban areas, providing healthy green space for physical activity and community-building while reducing urban heat island effects and flood risks, and removing air pollution and carbon dioxide from the atmosphere.

How can physicians contribute to building climate resilience?

Because vulnerability and resilience are so closely related to pre-existing health status and living and working conditions, anything we can do to improve chronic disease prevention & management and promote healthy community environments can also reduce vulnerability to climate change and build climate resilience.

Physicians can play an important role in helping patients and communities reduce vulnerability and build resilience in the face of climate change impacts:

- Advocate for policies and systems changes that promote healthy living and working environments, such as walking and biking infrastructure or zoning for more urban farming.
- Assess patient risks and connect patients to community resources that address them, for example refer heat vulnerable patients to programs that help reduce electricity costs.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems.
- Learn about community climate vulnerability and advocate for changes to reduce risk, for example through programs to plant trees or expand the use of cool roofs.

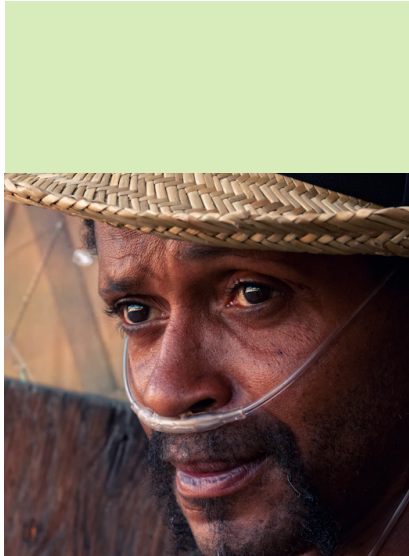
In this Guide, you will find many specific strategies to promote climate change resilience. See also the fact sheets on “Climate Solutions for Healthy People, Healthy places, Healthy Planet.”

- [Transportation, Climate Change and Health](#)
- [Energy, Climate Change and Health](#)
- [Food & Agriculture, Climate Change and Health](#)
- [Urban Greening, Climate Change and Health](#)



For More Information

- Kresge Foundation report on climate change resilience
<http://kresge.org/sites/default/files/Bounce-Forward-Urban-Resilience-in-Era-of-Climate-Change-2015.pdf>
- Center for Climate Change and Health report on climate change and health equity
https://www.phi.org/uploads/application/files/h7fjouo1i38v3tu427p9s9kc_mhs3oxsi7tsg1fov3yesd5hxxu.pdf



FAST FACT:

Adults with a high school education or less are eight times more likely to report their health as “fair or poor” than those with a college education.¹

- EPA climate change fact sheets populations of concern <https://www3.epa.gov/climatechange/impacts/health/factsheets/>
- Bay Area Regional Health Inequities Initiative (BARHII) Climate change and health equity quick guides <http://barhii.org/issues/climate-change/>

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Citations

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Physician Surveys on Climate Change and Health



Researchers at [George Mason University's Center for Climate Change Communication](#) have surveyed physicians on their experiences and understanding of climate change and its health impacts. Below are findings from surveys of the National Medical Association (NMA),¹ the American Thoracic Society (ATS)² and the American Academy of Allergy, Asthma and Immunology (AAAAI).³

Through these surveys, the researchers asked over 2300 physicians across the U.S. whether they think climate change is happening, whether it is human caused, and whether it is impacting the health of their patients *now*. The results are striking - a large proportion of all physicians surveyed see the impacts of climate change on patients' health, through a variety of pathways. NMA respondents report the highest level of impact, perhaps because NMA physicians have patients that are more likely to reside in urban areas and be low-income and non-white and therefore experience existing inequities and greater vulnerability to climate-related events. In addition, 50% of the NMA sample were primary care doctors, who are more likely to observe climate related health impacts.

CLIMATE CHANGE AND HEALTH	NMA Response N=284/30%	ATS Response N=915/17%	AAAAI Response N=1184/22%
Climate change is happening.	97%	89%	80%
Climate change is human caused.	62%	68%	76%
Climate change is affecting my patients.	79%	73%	74%
My patients are affected by climate change through:			
Severe weather-related injuries	88%	57%	49%
Increase in chronic disease related to air pollution	88%	77%	73%
Increase in allergy symptoms	80%	58%	63%
Heat related illness	75%	48%	34%
Vector-borne illness	58%	40%	36%
Food and waterborne illness	56%	26%	23%

- *With the aging of the population, the incidence of heat strokes has risen in my practice area.*

- *I had a high-school patient who suffered heat stroke while playing football in extremely hot weather.*
- *I have a patient who has environmental allergies that are usually treated with antihistamines. They now have to use steroid inhalers and bronchodilators at times.*

A higher percentage of physicians are seeing climate change impacts and think it's important. Physicians from all groups believe that they should play a role in educating patients and the public on the health impacts of climate change.



ROLE OF PHYSICIANS IN CLIMATE CHANGE AND HEALTH	NMA Response N=284/30%	ATS Response N=915/17%	AAAAI Response N=1184/22%
Physicians should:			
Inform patients about the health impacts of climate change	75%	62%	56%
Inform the public about the health impacts of climate change	71%	72%	56%
Have leadership roles in encouraging environmentally sustainable clinics, hospitals and offices	81%	80%	70%
Medical associations should play an advocacy role in climate change and health issues	76%	75%	61%

- *In my practice setting in DC/MD, the climate has been severe and unpredictable and I feel that as a result the viral illnesses have been much more debilitating. Previously relatively benign viruses are now more often causing severe illness in both inpatient and outpatient settings.*

Barriers and resources for physicians on climate change

While most physicians reported that they are at least modestly knowledgeable about the association between climate change and health, many reported significant barriers to taking action, including:

- Lack of time
- Not sure how to talk to patients about this issue
- Lack of resources and recommendations for patients
- Non-billable activities



- *My patient experienced atrocities during Hurricane Katrina. As a result, she had PTSD and severe depression that prevented her from holding a stable job.*
- *My practice works with injury and the area in which I work has been affected by increased flooding and increased snowfall which has increased episodes of back injury from snow and water removal.*
- *I have more patients with asthma and allergies coming in with flares earlier and earlier in the year because pollen is produced earlier and earlier.*

The surveys identified specific resources that would assist physicians in addressing climate change and health, including:

- Educational opportunities, such as webinars, podcasts, or Continuing Medical Education units on climate change
- Patient education materials and resources, as well as training on how to talk to patients about these issues
- Policy Statements from professional medical and health associations
- Advocacy events, such as public and community forums, opportunities for political action, public service announcements

To view the full reports, please visit:

- NMA Report: <http://climatechangecommunication.org/all/a-survey-of-african-american-physicians-on-the-health-effects-of-climate-change/>
- ATS Report: <http://climatechangecommunication.org/reports/final-version-ats-report/>
- AAAAI Report: <http://climatechangecommunication.org/all/views-of-allergy-specialists-on-the-health-effects-of-climate-change-2/>

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- ³ Safaty, M., Kreslake, J., Bloodhart, B., Price, K., Canale, T., Folstein, S. & Maibach, E. (2015). Views of allergy specialists on the health effects of climate change. *George Mason University Center for Climate Change Communication*.

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Extreme Heat, Climate Change and Health

? DID YOU KNOW?

CDC defines extreme heat as “summertime temperatures that are substantially hotter and/or more humid than average for that location at that time of year.”



Extreme heat has direct effects on health, and heat kills more people than any other extreme weather event. In this brief, we focus on the health impacts of climate change and heat in the U.S.

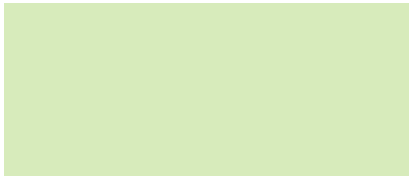
Extreme heat threatens health

- Extreme heat results in excess death and illness through [heat stroke](#), [heat exhaustion](#) and exacerbations of chronic illness.
 - Heat stress and associated dehydration can exacerbate existing renal disease and may be linked to new epidemics of chronic kidney disease among individuals without other traditional risk factors.¹
 - Heat increases ozone levels, exacerbating asthma, other respiratory disease and cardiovascular disease.
 - [Some medications](#) inhibit sweating or reduce the ability to sense overheating, increasing the risk of heat illness.
- Heat causes more deaths than any other type of natural disaster.
 - From 1999-2010, 7,415 people died from heat-related illness in the U.S., an average of 618 per year.²
 - The 2006 California heat wave resulted in 655 excess deaths, over 16,000 additional emergency room visits, and a 10-fold increase in admissions for heat-related illness.^{3,4}
 - Extreme heat events in Europe (2003) and Russia (2010) resulted in over 70,000 and 55,000 deaths, respectively.⁵
- Heat waves and concurrent drought contribute to crop and livestock loss, resulting in rising food prices and increased food insecurity. In 2015 the California drought resulted in \$900 million in crop revenue loss, \$350 million in livestock and dairy loss, tens of thousands of lost jobs, and a total economic impact estimated to be \$2.7 billion.⁶

What is extreme heat?⁷

Because individuals acclimate to their local climate, extreme heat is not defined by an absolute temperature, but rather by a relative change from past local conditions. CDC defines extreme heat as “summertime temperatures that are substantially hotter and/or more humid than average for that location at that time of year.”

- California defines extreme heat days as those days above the 98th percentile of maximum temperatures, based on 1961-1990 data for a given location's warmest months.



FAST FACT:

Heat causes more deaths than any other type of natural disaster.

What is extreme heat? continued

- For example, in San Francisco the extreme heat day threshold is 85°F for daytime temperature, while in Los Angeles it is 91°F.
- The National Weather Service issues Excessive Heat Warnings or Advisories based on a “Heat Index” that combines heat and humidity, because high humidity levels decrease the body’s ability to regulate heat through sweating.

Climate change increases extreme heat exposure

Due to climate change, extreme heat events are increasing in frequency, severity, and duration. In 2011 and 2012, the number of extreme heat waves was nearly triple the long-term average.⁸

- California’s average temperature is projected to increase by 3-5° F by mid-2030s and 2.8-10.8°F by the end of the century.⁹
- Rising average temperatures are projected to result in 2,100-4,300 excess deaths in California in 2025 and 6,700-11,300 excess deaths in 2050.¹⁰

The table below shows projected increases in the number of extreme heat days for various regions of California.¹¹

CITY	2050	2099
Bakersfield	48	93
El Centro	60	101
Fresno	46	90
Los Angeles	78	110
Redding	35	75
Sacramento	44	85
San Diego	76	129
San Francisco	39	126
San Jose	71	111
Truckee	41	83

Climate change, extreme heat and health equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for the effects of extreme heat:

- **Urban heat islands:** Low income and communities of color are more likely to be located in “urban heat islands” — dense urban areas with fewer trees, less green space, more buildings, higher energy use, and more impervious asphalt and concrete. These characteristics create “urban heat islands,” where nighttime temperatures may be as much as 22°F higher than surrounding areas. These vulnerabilities map onto areas of historical residential segregation.¹⁸
- **Poverty:** For people living in poverty, the urban heat island effect is compounded by poor housing conditions, lack of air conditioning, or fear of using AC due to high-energy costs or fear of opening doors and windows for safety concerns.



DID YOU KNOW?

Heat-related deaths are 20 times higher among crop workers.

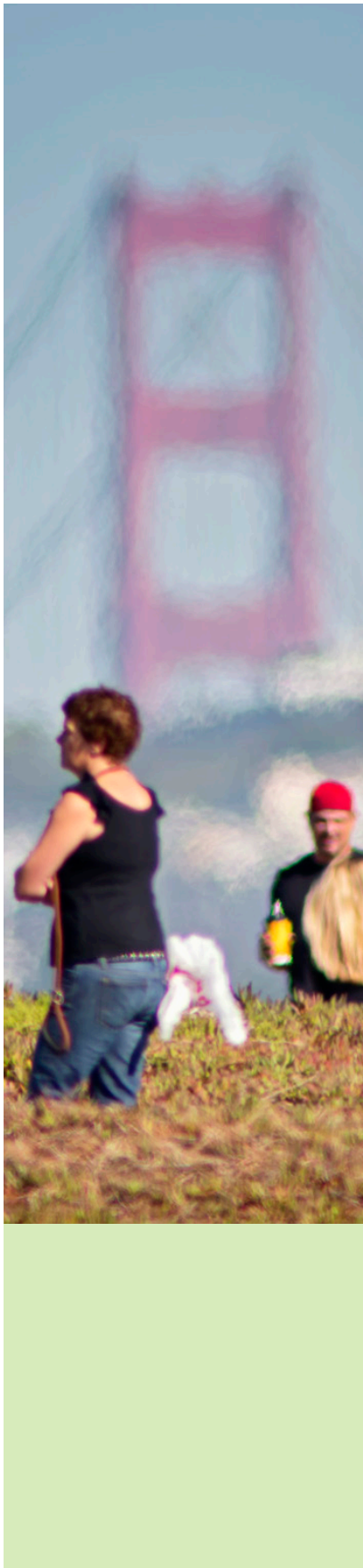
Forty percent of heat-related deaths among crop workers in California from 1999-2002 occurred in Mexican, Central or South American workers.



- **Working conditions:** Farm workers and other outdoor workers are at greater risk of exposure to extreme heat and heat illness. Heat-related deaths are 20 times higher among crop workers.¹⁴ More than ¾ of California's agricultural workers are Latinos¹⁵ and 40% of heat-related deaths among crop workers in California from 1999-2002 occurred in Mexican, Central or South American workers.¹⁶
- **Social isolation:** Social, cultural, and linguistic isolation are all risk factors for heat illness.¹³ In the European heat wave of 2003, elders living alone had the highest mortality rates.
- **Physical or cognitive impairments:** Limited mobility increases the risk of isolation, and the ability to move to a cooler location. Cognitive impairment may limit the ability to recognize risk or seek assistance during an extreme heat event.
- **Age:** The very young and the elderly are less able to sense and adapt to changes in temperature, due to limitations in body temperature regulation.
- **Chronic Illness:** Those with conditions such as obesity, diabetes or renal, cardiovascular and respiratory diseases are at higher risk of heat illness, including changes in medication effects and other complications.¹² See [handout on medications and extreme heat](#).

What can physicians do to address climate change and extreme heat?

- Talk with patients about the risks and dangers of extreme heat and how to prevent heat-related health impacts
 - Make sure patients are aware of their own risks of heat illness and how to prevent it; provide fact sheets to patients and their families (see For More Information section below for links to patient materials). The basics include:
 - Use air conditioning, or get to a cool place like a cooling center or air conditioned shopping center or public building
 - Although there are real concerns that the use of fans in hot weather simply recirculates hot air, [a new study](#) suggests that fans can help prevent heat-related increases in heart rate and body temperature for healthy adults¹⁹.
 - Stay hydrated — drink plenty of cool water. Avoid dehydrating drinks such as alcohol and caffeinated beverages.
 - Use cool water for showers and baths.
 - Never leave children, elderly people, or pets unattended in homes with no air conditioning and particularly in vehicles, even if the windows are 'cracked' or open, as temperatures quickly rise to unsafe levels.
 - Inform patients about the risks of some medications and heat.
 - Some medications increase the risk of heat illness, such as psychotropic medications, diuretics, tranquilizers, and some medications for Parkinson's disease. See [handout on medications and extreme heat](#).
 - Other medications, such as insulin, may lose their effectiveness if subject to very high temperatures.



- Encourage individuals to check in on neighbors, friends and relatives during extreme heat events. Encourage patients to make sure they have a “heat buddy” who will check in on them.
- Advise patients with pre-existing respiratory illness (asthma, COPD) to check [air quality levels](#) during extreme heat events and to limit outdoor air exposure when air quality is poor.
- Connect patients to resources for financial support in coping with heat, such as Low-Income Home Energy Assistance Program ([LIHEAP](#)). Air conditioning is cited as a key coping strategy, but many people are concerned about the high-energy costs of air conditioner use.
- Educate your colleagues and community on the links between climate change, extreme heat and health, and what can be done to prevent negative health impacts.
- Encourage development of a neighborhood response network to check in on vulnerable individuals during extreme heat events.
- Make sure your hospital and local health department have an extreme heat emergency preparedness contingency plan.
- Promote mitigation and adaptation strategies related to climate change and extreme heat.
 - Advocate for “urban greening” – planting trees and building green infrastructure – in neighborhoods that are tree and park poor, to increase shade and cooling. See the [Urban Greening & Green Infrastructure Climate Change and Health](#)
 - Support policies that mandate the use of cool roofs and green roofs and cool pavements, for example [Los Angeles Cool Roof ordinance](#)
 - Support policies that increase energy efficiency and the use of clean, renewable energy. This limits global warming, but also reduces local impacts like the creation of urban heat islands, which often result from increased energy use at the local level. See [Energy, Climate Change and Health](#)
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems. Advocate for investments in disadvantaged and highly impacted communities to reduce social and economic vulnerability risks of heat health, for example, education and job opportunities and social service support.



DID YOU KNOW?

Never leave children, elderly people, or pets unattended in homes with no air conditioning and particularly in vehicles, even if the windows are ‘cracked’ or open, as temperatures quickly rise to unsafe levels.



For More Information

- Preparing California for Extreme Heat: Guidance and Recommendations
http://www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf
- CDC Extreme Heat Preparedness site
<http://emergency.cdc.gov/disasters/extremeheat/faq.asp>
 - English site and materials:
<http://emergency.cdc.gov/disasters/extremeheat/index.asp>
 - Spanish site and materials:
http://www.cdc.gov/extremeheat/espanol/materials_esp.html
- Resources for urban greening in California
 - [Urban Releaf](#)
 - [California ReLeaf](#)
 - [CalFire Urban and Community Forestry Program](#)
- Resources for “cool” infrastructure in California
 - [Climate Resolve](#)
 - [CoolCalifornia.org](#)

Photo page 3: USDA; page 5: Jessica Lucia; page 6: Chameleon/Shutterstock.com.



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Drought, Climate Change and Health



DID YOU KNOW?

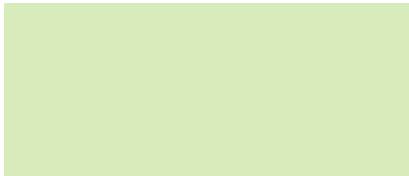
California's [The Human Right to Water Act](#) statutorily recognizes that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.



Drought impacts health through many pathways. Water is life! People need water to drink, grow food, and be clean. But drought affects health in many other ways too. In this brief we focus on the impact of climate change and drought in California and the U.S.

Drought and health

- Access to clean and safe drinking water is something we take for granted in the U.S., but in many poor, rural communities that access is tenuous, and further threatened by drought (see box below on Tulare County).
- Drought results in lower crop yields and increased crop loss or destruction, exposing large populations of people to rising food prices, food insecurity and — especially in developing nations — malnutrition, famine, and forced migration. See [Food Security, Climate Change and Health](#).
 - In 2015 the California drought resulted in \$900 million in crop revenue loss, \$350 million in livestock and dairy loss, and tens of thousands of lost jobs in agriculture. The total economic impact to the state's agriculture is estimated to be \$2.7 billion.¹
- During droughts, communities increasingly turn to groundwater stores for water supply. Groundwater is often contaminated with industrial materials, heavy metals and agriculture runoff, including nitrates from fertilizers in the Central Valley. Drought increases the concentration of these contaminants, further increasing the risk of waterborne disease.
 - As communities draw on groundwater stores, land subsidence — or sinking — puts critical infrastructure like roads, aqueducts and levees at risk of permanent damage.²
- Drought conditions create the need to conserve water, which may limit sanitation and hygiene practices, resulting in greater exposure to disease-causing organisms or chemicals.
- The multiple and interconnected impacts of drought on physical health, food security, economic livelihood and social stability can have serious mental health impacts. Long-term drought and its impacts has been linked to increased rates of suicide among rural Australian farmers.³ See [Mental Health and Climate Change](#).
- Drought is often accompanied by dry, dusty conditions. Valley Fever, which is caused by inhaling the fungus *Coccidioides immitis*, spreads under drought conditions when dried out dirt and dust are dispersed in the air.
- Dry vegetation and increased heat from drought are associated with more frequent and intense wildfires, which pose a risk of smoke inhalation and increased exposure to particulate matter and resultant asthma exacerbation, other respiratory illness, and cardiovascular disease.⁴ See [Wildfires, Climate Change and Health](#).



Drought, Conflict, and Migration

Drought is to blame for the largest mass migration in U.S. history. By 1940 the Dust Bowl had forced 2.5 million people out of the Plains states, with 200,000 of them heading to California.⁵ Today, scientists and political observers believe drought contributed to the Syrian civil war, as widespread crop failure from a 2007–2011 drought drove farming families to urban centers and fueling existing political unrest.⁶

- Warmer temperatures and changes in precipitation have impacts on the habitat and distribution of disease carrying vectors such as mosquitos carrying West Nile Virus or Dengue, and ticks transmitting Lyme Disease. [See Infectious Disease, Climate Change and Health.](#)

Health Impacts of Drought: Focus on Tulare County

Tulare County, California – a rural agricultural community in California’s San Joaquin Valley – may be a harbinger of what increased drought looks like on the ground. As the worst California drought in recorded history lingered on (and on), private wells in Tulare County started to run dry.

- By November 2015, 1,308 wells had run dry, affecting over 6,000 residents in the county.⁷
- Thousands of agricultural workers lost their jobs as thousands of acres of farmland were fallowed due to lack of water.
- Local food banks and other services were overwhelmed.
- Local emergency rooms reported a 25% increase in respiratory disease visits.⁸
- Illnesses such as West Nile Virus and Valley Fever began to rise.⁹
- The county experienced twice the statewide rate of diarrheal disease in 2013.¹³ and rising levels of stress, anxiety, depression and other mental health concerns.¹¹

The Human Right to Water¹²

California’s The Human Right to Water Act was signed into law in 2012, making California the first state in the nation to legally recognize the human right to water (HRTW). The Act statutorily recognizes that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.” The HRTW extends to all Californians, including vulnerable and marginalized individuals, groups, and communities in rural, tribal and urban areas. It affirms the State’s commitment to guaranteeing affordable, accessible, acceptable and safe water sufficient to protect the health and dignity of all residents; prioritizes water for personal and domestic use; and delineates the responsibilities of public officials at the state level.

Climate change and drought

Climate change is increasing the frequency, severity and duration of droughts due to:

- less total precipitation
- a higher proportion of precipitation as rain instead of snow,
- less snowpack with more and earlier spring runoff and
- higher temperatures that increase evaporation rates.



DID YOU KNOW?

Drought results in lower crop yields and increased crop loss or destruction, exposing large populations of people to rising food prices, food insecurity and — especially in developing nations — malnutrition, famine, and forced migration.



At the same time, water consumption and withdrawal of water from surface and underground water aquifers is increasing, leading to greater clean water shortages.

The U.S. Southwest has already shifted to a much drier climate, with a downward trend in overall precipitation, and scientists are predicting that the American West may experience a “mega-drought” lasting decades in the latter half of this century.¹³ Despite the 2015–16 “El Nino”, California remains in a significant drought and can expect to see more severe droughts in the future.

- By mid-century, 83% of California counties will experience water shortages as a result of climate change. This leads to increased reliance on groundwater, which is often polluted with pesticides, fertilizer and other industrial chemicals.¹⁴
- The Sierra Snowpack — the biggest storage site for California water — is expected to be reduced by 25% by mid-century.¹⁵

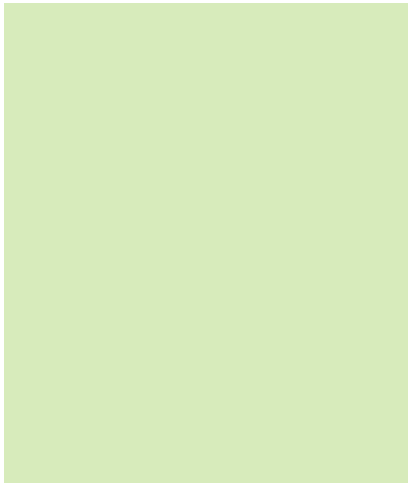
Climate change, drought and health equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for the effects of drought:

- **Poverty:** Those with limited income or financial resources are especially vulnerable to food insecurity from rising food prices associated with drought and crop loss. Food insecurity is associated with higher risks of chronic illness such as diabetes and hypertension. See [Food Security, Climate Change and Health](#). People without home insurance are less able to recover after displacement from wildfires.
- **Agricultural workers and communities** are more vulnerable to the significant adverse economic impacts of drought, and to the mental health impacts of drought. Poor rural communities are also disproportionately reliant on small water systems or private drinking water wells, and thus at increased risk of water shortages or exposure to contaminated well water.
- **Chronic illness:** Lack of safe drinking water can exacerbate pre-existing renal disease and other chronic illness

What can physicians do to address climate change and drought?

- Talk to your patients about the impacts of drought and how best to protect their health:
 - Educate patients about [West Nile Virus](#) and ways to avoid transmission, including insect repellent, clothing and screens to keep mosquitos out of homes.
 - Educate patients about [Valley Fever](#) and ways to avoid becoming ill, including avoiding areas and activities with high dust exposure (construction or dusty fields, gardening, etc), staying indoors with windows closed on windy and dusty days, wearing a respirator, such as an N95 mask if areas and activities with dust can't be avoided, and ensuring good indoor air filtration.



FAST FACT:

By mid-century, 83% of California counties will experience water shortages as a result of climate change.

- Discuss the social and psychological impacts of drought on patients and refer for mental health care.
- Advise patients to create a personal and family emergency plan in case of evacuation from wildfire.
- Educate your colleagues and community on the links between climate change, drought and health, and what can be done to prevent adverse health impacts.
- Promote mitigation and adaptation solutions related to climate change and drought
 - Promote action to protect groundwater and surface water from contamination, for example through reduced use of fossil fuel based agricultural inputs such as pesticides and nitrogen-based fertilizers, and use of green infrastructure.
 - Promote water conservation in agriculture and in cities.
 - Promote upgrades to the [Safe Drinking Water Information System](#), which provides information about violations of public drinking water regulations to ensure safe and reliable public water sources.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems. Address the individual and community factors that lead to health inequities from drought.
 - Ask your patients if they are having difficulty accessing clean and safe drinking water, and connect them to resources for water assistance and disaster insurance
 - Support full implementation of California's Human Right to Water law
 - Promote local and sustainable agriculture practices, such as urban gardens, to reduce food insecurity when food prices increase.
 - Advocate for more investment in communities hardest hit by drought, and for full funding of assistance measures such as water relief, local food security measures, job relief, and displacement prevention.
 - Advocate for measures to protect against risks of vector born disease due to drought. See [Infectious Disease, Climate Change and Health](#).
 - Advocate for policies that provide unemployment assistance and sustainable economic opportunities for disadvantaged workers, such as farm workers.

For More Information

- CDC Drought and Health site:
<http://www.cdc.gov/nceh/drought/>
- Research Article:
[Health effects of drought: A systematic review of the evidence](#)

Page 2 photo: Patrick Emerson; page 3: Cate Turton/Department for International Development; page 5: MPCA.



DID YOU KNOW?

During droughts, communities increasingly turn to groundwater stores for water supply. Groundwater is often contaminated with industrial materials, heavy metals and agriculture runoff, including nitrates from fertilizers in the Central Valley.



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Wildfires, Climate Change and Health

? DID YOU KNOW?

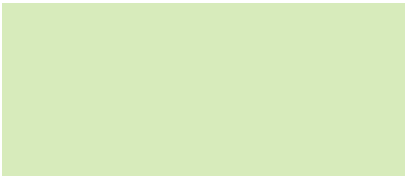
Without bold efforts to reduce greenhouse gas emissions, drought-fueled wildfires are expected to increase by 58–128% by 2085 across California.



As climate change leads to hotter and drier summers, wildfires are already increasing in frequency, duration and severity in many parts of the U.S., especially the West.¹ In this brief, we focus on the health impact of climate change and wildfires in California and the U.S.

Wildfires and health

- Wildfires are a major source of particulate matter (PM), especially during summertime in the West.^{2,3} See [Air Quality, Climate Change and Health](#)
 - Particulate matter increases the risk of lung cancer, COPD, cardiovascular disease and the development and exacerbation of asthma and other respiratory diseases.
 - PM from wildfires is associated with increased risk of premature death, increased emergency department visits due to asthma, bronchitis, and chest pain and negative birth outcomes.⁴
 - 2007 Southern California wildfires led to significant increases in emergency room visits for asthma and breathing difficulty.⁵
- Wildfires also increase other harmful air exposures, including exposure to carbon monoxide, ground level ozone and toxic chemicals released from burning building materials or chemicals used to fight the fire.⁶
 - In 2007, California wildfires caused ground-level ozone spikes to rise to unhealthy levels across much of rural California.
- Indoor air quality is also impacted as smoke penetrates into homes. Because people spend more of their time inside, the majority of exposure to, and health effects from, wildfire particulate matter come from particles inhaled indoors.⁷
- Wildfires cause immediate harm through burns, traumatic injury, smoke inhalation and PTSD.⁸
 - From 2000-2013, more than 300 firefighters died in the line of duty and the average number of annual work-related firefighter deaths has been increasing since the 1970s.^{9,10}
- Wildfire smoke can travel very long distances and affect the health of people far downwind of the fire.
 - Smoke from the 2002 wildfires in Quebec caused a 30-fold increase in PM_{2.5} in Baltimore, MD, which is nearly 1,000 miles downwind.¹¹ Likewise, pollutants from a 2004 Alaska wildfire were found in Europe.¹²



DID YOU KNOW?

Soil erosion and runoff from wildfires can contaminate water supplies far downstream from the fire site, negatively impacting the quality, quantity and availability of safe freshwater supplies.

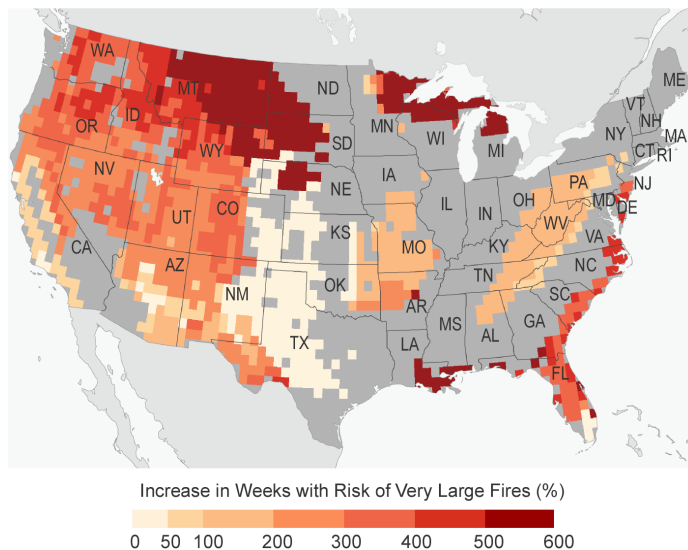
- Soil erosion and runoff from wildfires can contaminate water supplies far downstream from the fire site, negatively impacting the quality, quantity and availability of safe freshwater supplies.¹³
 - The 2013 Yosemite rim fire threatened to contaminate water for San Francisco Bay Area residents 200 miles away, since the city draws its water from Hetch Hetchy reservoir near the wildfire.
- Health care and public health systems — including skilled nursing facilities — are stressed by the need for evacuations, emergency response resources (shelter, food, water) and increased medical visits during and following a wildfire.

Climate change is worsening wildfire risks

Climate change will significantly increase the frequency, intensity and duration of wildfires, as well as increase the length of wildfire seasons across the U.S. and particularly in the West.

- In California, earlier snowmelt, higher temperatures and drier conditions over a longer fire season will directly increase the risk of wildfires across the state.¹⁴
 - Without bold efforts to reduce greenhouse gas emissions, drought-fueled wildfires are expected to increase by 58-128% by 2085 across California. The amount of area burned will increase between 51-169% in different areas across the state.
- Trends in land use and development, with more and more development happening at the [wildland-urban interface](#), will compound the effects of increasing wildfires.
 - By 2050, fire damages in California could range from \$200 million-\$2.5 billion per year.¹⁵
- Warming weather and drought have led to a severe epidemic of bark beetles nationwide. Since 2010, about 66 million trees have been killed by a combination of drought and bark beetle, just in the central and southern Sierras. This large tree die-off releases tons of CO₂ and increases the risk of intense wildfires.

Projected Increase in Risk of Very Large Fires by Mid-Century



Source: US. Global Change Research Project



FAST FACT:

Wildfires also increase other harmful air exposures, including exposure to carbon monoxide, ground level ozone and toxic chemicals released from burning building materials or used to fight the fire.



Wildfires also worsen climate change

Wildfires contribute to global warming by releasing massive amounts of carbon into the atmosphere and reducing the amount of forest available for [carbon sequestration](#).¹⁶

- Up to 3% of annual U.S. greenhouse gas emissions come from wildfires.¹⁷
- The western forests are an important source of carbon sequestration, capturing 20-40% of U.S. carbon emissions.

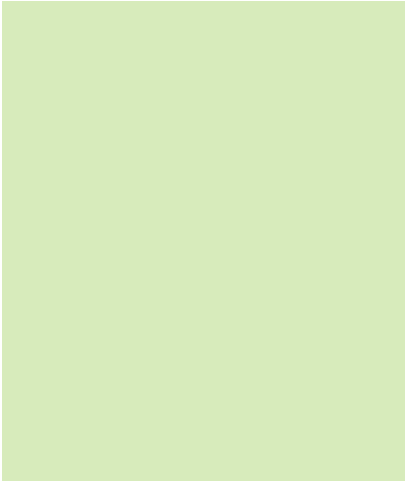
Climate change, wildfires and health equity


Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for the impacts of wildfires from climate change:

- **Poverty:** low-income families and individuals are less likely to have disaster insurance to help rebuild after a catastrophic fire.
- **Occupational risks:** Firefighters, health care personnel and emergency responders are at increased risk for injury, death and respiratory impacts of wildfires, as well as mental health effects due to trauma. Other outdoor workers, such as farmworkers and utility workers, are also at risk for respiratory effects of traveling smoke plumes and pollution.
- **Age:** The very young and the very old are more sensitive to the air quality impacts of wildfires. For children in particular, their still-developing respiratory systems make them especially vulnerable to long-term impacts of wildfire smoke, particulate matter and ground level ozone.
- **Chronic conditions:** Individuals with pre-existing cardiac or respiratory disease are at risk of disease exacerbations due to wildfire smoke. Also, the emergency conditions created by wildfires disrupt individuals' ability to adequately manage their health conditions.
- **Limitations in physical or cognitive ability** place some individuals at greater risk of injury or death during evacuations from wildfires.
- **Pregnant women** are particularly sensitive to wildfire smoke and particulate matter, which is associated with low birth weight.¹⁸

What can physicians do to address climate change and wildfires?

- Talk with patients about the risks and dangers of wildfires and how to prevent related health impacts.
 - Advise patients with pre-existing respiratory illness (asthma, COPD) to check [air quality levels](#) during wildfires and to limit outdoor air exposure when air quality is poor.
 - If patients are sheltering in place due to wildfire, advise them to keep windows and doors closed, set air conditioners to recirculate (close air intake) and use HEPA air filters if available to decrease indoor air pollution.
 - Connect patients to resources for financial support in coping with wildfires.
 - Remind patients living in fire-prone areas to make sure they have a "defensible" space clear of brush and trees that can burn easily.



**FAST FACT:**

Wildfires cause immediate harm through burns, traumatic injury, smoke inhalation and PTSD.

- Encourage patients living near fire-prone areas to create an emergency response plan in case of evacuation due to fire, and warn them to always pay attention to evacuation recommendations.
- Educate providers and the community on the links between climate change, wildfires and health, and what can be done to prevent negative health impacts.
- Promote mitigation and adaptation strategies related to climate change and wildfires.
 - Advocate for land use policies that reduce development at the wildland-urban interface, thus reducing the risk of property damage related to wildfires.
 - Support stronger zoning policies to limit development near fire-prone areas.
 - Advocate for changes in building codes that require the use of flame-resistant building materials in fire-prone areas.
 - Provide adequate funding and support for smart forestry management to conduct controlled burns and thin out overcrowded forests, which are more susceptible to high intensity, fast burning wildfires.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems, including social and economic vulnerabilities to wildfire for individuals and communities.

For More Information

- CDPH Wildfire Smoke Guides:
<https://www.cdph.ca.gov/programs/cclho/Pages/WildfireSmokeGui.aspx>
- Oregon Health Authority Wildfires and Smoke page (includes patient care guides):
<http://public.health.oregon.gov/preparedness/prepare/pages/prepareforwildfire.aspx>
- Washington Department of Health Wildfire Smoke page:
<http://www.doh.wa.gov/CommunityandEnvironment/AirQuality/SmokeFromFires/WildfireSmoke>
- CalFire Fire Prevention page
http://calfire.ca.gov/fire_prevention/fire_prevention
- Centers for Disease Control Wildfire Emergency Response page:
<http://emergency.cdc.gov/disasters/wildfires/>

Page 2 photo: Kari Greer/US Forest Service; page 3 photo: USDA; page 5 photo: Eileen McFall

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! FAST FACT:

Wildfire smoke can travel very long distances and affect the health of people far downwind of the fire.

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Rainfall & Storms, Climate Change and Health



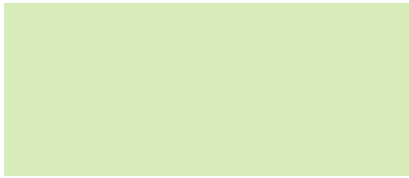
FAST FACT:

Damage from severe storms and flooding has caused California to declare a disaster area six times since 2000.

Climate change is altering precipitation patterns worldwide, and increasing the frequency of severe storms and flooding. Some areas are already experiencing “wetter wets” in the form of increased average rainfall, and more frequent and severe rainstorms and blizzards. From urban flooding to indoor mold to mudslides, this excess precipitation has negative impacts on health. In this brief we focus on the impacts of climate change and precipitation in California and the U.S.

Extreme precipitation impacts health in a variety of ways

- Severe storms result in injury and death due to trauma or drowning.
 - In 2012, SuperStorm Sandy caused the death of at least 177 individuals on the Eastern U.S. seaboard alone,¹ and damaged or destroyed more than 650,000 housing units in New York and New Jersey.
- Extreme weather causes disruption of medical care, particularly for those with chronic illness.
 - An estimated 40%-70% of those affected by Hurricane Katrina had a chronic illness, for which medication management was a key challenge during the days and weeks after the event.²
 - Two major hospitals had to be evacuated during SuperStorm Sandy, and the storm caused loss of significant bed capacity. A year after Sandy, several hospitals were still struggling to return to normal.
- Critical infrastructure is disrupted, including electricity, sanitation & water treatment, food refrigeration, health care, communications systems and transportation.³
 - After Hurricane Katrina, 20% of homes lacked water and 25% lacked electricity.
- Indoor air quality declines, as excess moisture from rainfall and flooding often results in increased mold production in the months after an extreme event.⁴
- **Infectious disease** risks increase, particularly with exposure to water-borne pathogens as sewage or water treatment systems overflow, or due to skin wounds and fungal infections.⁵
 - Diarrheal illness, acute respiratory illness, and skin infections have all been reported post-disasters.⁶
- Exposure to toxic chemicals increases, due to overflowing of toxic waste sites or chemical storage facilities.⁷
- Vector-borne disease: Floods and hurricanes are frequently followed by a proliferation of mosquitos, possibly increasing the risk of vector-borne illnesses particularly in warmer climates.⁸



DID YOU KNOW?

In 2012, Hurricane Sandy caused the death of at least 177 individuals on the Eastern U.S. seaboard alone, and damaged or destroyed more than 650,000 housing units in New York and New Jersey.

- Displacement rises due to property loss.
 - An estimated 1.5 million fled their homes after Hurricane Katrina, and some estimate that hundreds of thousands of them were never able to return to their homes.⁹
- Mental health impacts
 - Flooding has been associated with post-traumatic stress disorder, anxiety, depression and other mental health problems.¹⁰
 - After Katrina, 47.7% of the adult population was classified as having PTSD symptoms and the prevalence of moderate-to-serious mental illness rose from 23.5% to 37.5% before and after the disaster, respectively.¹¹

Climate change increases the risk of extreme storms and flooding in California

Although California is in the midst of an historic four-year drought, climate change is also causing increased rainfall, storms and flooding in some areas. As the atmosphere warms, it holds more water vapor, leading to heavier downpours.

- Scientists estimate that California will experience an almost 30% increase in extreme precipitation (rain or snow) days by the end of the century, as more “atmospheric rivers” reach the state.¹²

Climate change, extreme precipitation and health equity

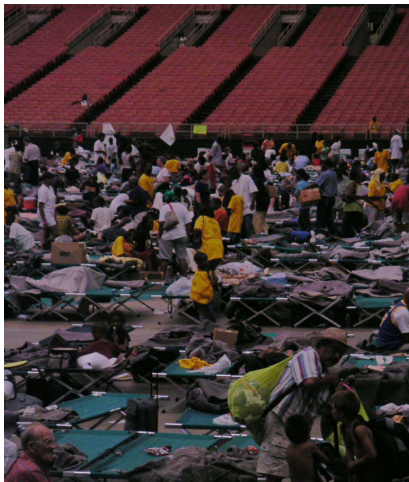
Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for the effects of flooding and storms from climate change:

- **Failing public infrastructure:** Lack of investment in secure transportation or protective barriers, such as the levees in New Orleans during Hurricane Katrina, leaves residents vulnerable to flooding and poses barriers for evacuation. Inadequate or failing water treatment and sewage systems increase the risk of contamination after floods and storms.
- **Substandard housing:** Poor housing quality and ventilation increase the risk of indoor air pollution and mold from excess moisture. Lack of window and door screens exposes families to mosquitoes carrying vector-borne diseases.
- **Poverty:** Low-income or lack of financial resources make it difficult to absorb the impacts of extreme storms and flooding, resulting in displacement.
 - Low-income communities are disproportionately underinsured for extreme weather events and often lack access to emergency credit to recuperate from property loss. As climate change increases the frequency and severity of extreme weather events, insurance prices will rise and continue to move further out of reach for low-income individuals and communities.¹³
- **The Digital Divide:** Inequities in access and quality of information systems (including the Internet) as well as cultural and linguistic services, create a disadvantage for low-income communities non-English language speakers to prepare for extreme weather events.



FAST FACT:

An estimated 1.5 million people fled their homes after Hurricane Katrina, and some estimate that hundreds of thousands of them were never able to return to their homes.



- **Chronic illness:** Individuals with asthma or other respiratory conditions are more vulnerable to indoor air pollution and mold that results from excess moisture or flooding.
- **Cognitive or physical impairments** impede safe evacuation during extreme storms or flooding.

What can physicians do to address the health impacts of extreme rainfall and storms due to climate change?

- Talk with patients about the health risks of extreme precipitation, floods and storms and how to stay safe and healthy.
 - Encourage individuals and families to create emergency response plans to be prepared in the event of flooding or extreme storms.
 - Advise families on food and water safety during and after floods and storms.
 - Educate individuals on the risks and symptoms of indoor mold exposure. Before a flooding event, provide information — especially to patients with asthma or other respiratory conditions — about where to get help with home clean-up and rehabilitation to prevent mold exposure.
 - Educate individuals on the increased risk of vector-borne disease following extreme rainfall advise them to make sure they do not leave standing water in their yards, and on protective measures. See [Climate Change, Infectious Disease and Health](#).
 - Encourage patients and families to follow emergency communications in the event of anticipated extreme storms or flooding.
- Educate your colleagues and community on the links between climate change, extreme precipitation, and health, and what can be done to prevent negative health impacts.
- Work with your colleagues and hospital and clinic administrators to assess health care facility vulnerability to extreme weather events, and to develop and implement a plan to make sure that your facilities can remain operational during an extreme event.
- Promote mitigation and adaptation strategies related to climate change and extreme rainfall and storms.
 - Advocate for [green infrastructure](#) to reduce the risks of flooding.
 - Strengthen vulnerable public infrastructure in flood or storm-prone areas, including levees, water treatment and sewage facilities, transportation routes and power grids.
 - Advocate for stronger emergency response systems and resources for the most vulnerable communities, including closing the digital and communications divide.

- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems including the social and economic inequities that influence health and social outcomes after extreme storms and floods.
 - Promote access to disaster insurance for low-income communities, and allocation of disaster relief and assistance targeted to those communities.
 - Support funding for programs that assist low-income renters and homeowners in rehabilitation to prevent mold, and other protective measures such as screening on houses.
 - Advocate for targeted investments in low-income communities with aging infrastructure.

For More Information

- CDC Flood information: <http://emergency.cdc.gov/disasters/floods/index.asp>
 - Preparedness: <http://emergency.cdc.gov/disasters/floods/readiness.asp>
 - Returning home: <http://emergency.cdc.gov/disasters/floods/after.asp>
 - Cleanup: <http://emergency.cdc.gov/disasters/floods/cleanupwater.asp>
- FDA Food and Water Safety during floods
 - English: <http://www.fda.gov/Food/ResourcesForYou/Consumers/ucm076881.htm>
 - Spanish: <http://www.fda.gov/Food/ResourcesForYou/Consumers/ucm076935.htm>

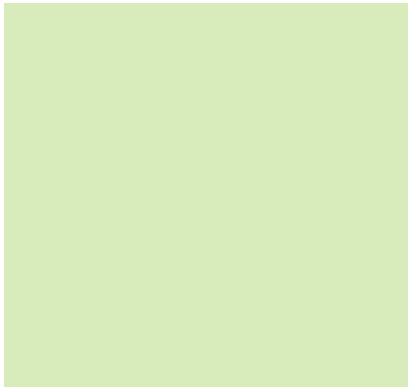
Page 1 photo: Lowe Llaguno / Shutterstock.com; page 2 photo: Wavian/flickr.com; page 3 photo: Kit Lange/flickr.com; page 5 photo: Rodenberg Photography/Shutterstock.com.

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DID YOU KNOW?

Although California is in the midst of an historic four-year drought, climate change is also causing increased rainfall, storms and flooding in some areas.



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Sea Level Rise, Climate Change and Health



Climate change is causing sea level rise around the world, as a result of melting glaciers and thermal expansion due to rising ocean temperatures. In this brief we discuss the ways in which sea level rise from climate change impacts human health, with a focus on California and the U.S.

Rising seas, rising health risks

- [Flooding and storm](#) surges associated with sea level rise increase risks for drowning, injury and displacement.
 - In California, 260,000 people and \$50 billion in property are now at risk for a 100-year flood. If population, development and climate change stay on track, by 2100 those numbers will nearly double, with 480,000 people and \$100 billion in property at risk.¹
 - Increased coastal flooding and storms also raises the risk of indoor mold growth from excess dampness, with impacts on respiratory disease.
- As sea levels rise, saltwater intrusion into fresh water increases salinity of groundwater basins and well water. This reduces crop yields and the availability of safe drinking water. It also increases the risk of hypertension, as well as vector-borne and diarrheal disease.²
- Sea level rise threatens coastal tourism, through erosion and flood/storm damage to beachfront property and beaches.³ Losses in coastal tourism could cost California beach communities many thousands of jobs and hundreds of millions of dollars.⁴

Disappearing cities, disappearing homes^{9 10 11 12}

If we do nothing to curb climate change, global sea levels will rise 14-32 feet by 2100. This would mean that 20 million U.S. residents in more than 1,000 communities will be at risk of permanent flooding. The four most impacted states are Florida, California, Louisiana and New York. Already, Native populations in Alaska and Louisiana have made plans to relocate their communities due to rising seas and flooding, becoming the first U.S. climate change refugees. Miami Beach is now waging an aggressive and expensive (hundreds of millions of dollars) battle against sea level rise. It already routinely experiences neighborhood flooding during high tides, and residents say palm trees are dying due to saltwater intrusion. But the efforts of Miami Beach are probably futile. For some cities — notably Miami and New Orleans — enough global warming is already locked in that they have passed a “point of no return,” and no measures will save them. Only strong action to curb carbon emissions quickly will delay the point of no return for other cities, such as New York City or Norfolk, Virginia.



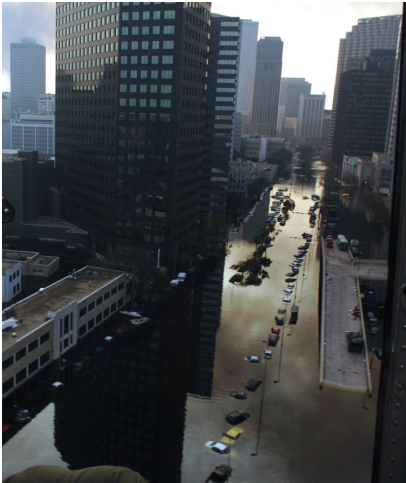
FAST FACT:

In California, 260,000 people and \$50 billion in property are now at risk for a 100-year flood.

Climate change and sea level rise

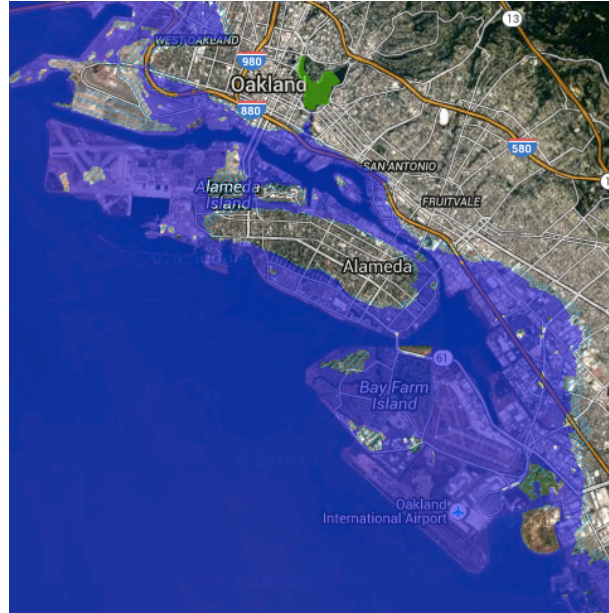
Climate change is accelerating sea level rise as a result of oceans warming and expanding, and glacial melting. By 2100, parts of California's coastline will see up to 66 inches of sea level rise.⁶

- By 2050, 100-year floods could happen annually in California as a result of sea level rise and changes to winds and waves that are also linked to climate change.⁷



! FAST FACT:

Scientists say that for some cities — notably Miami and New Orleans — enough global warming is already locked in — due to the long life of GHG in the atmosphere — that they have passed a “point of no return,” and no measures will save them.



CalAdapt map showing Oakland International Airport and Oakland neighborhoods, freeways, and industrial parks under water with 200 cm of sea level rise.⁸

Climate change, sea level rise and health equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for the effects of sea level rise from climate change:

- **Indigenous communities** that practice subsistence farming and fishing are particularly vulnerable to the impacts of sea level rise on freshwater ecosystems, including saline intrusion, and of fisheries collapse.
- **Low-income communities** face greater challenges from food security as saline intrusion disrupts agriculture and availability of safe, reliable drinking water.
- **Low-income individuals** disproportionately lack disaster insurance and often lack access to resources to recuperate from property loss, placing them at greater risk for destabilization and displacement from floods or submergence related to sea level rise.⁵



? DID YOU KNOW?

By 2100, parts of California's coastline will see up to 66 inches of sea level rise.

What can physicians do to address climate change and sea level rise?

- Talk with patients about the health risks of sea level rise, related floods and how to stay safe and healthy.
 - Assist individuals and families to create emergency response plans in the event of flooding.
 - Advise families on food and water safety during and after floods and storms and the risks of waterborne diseases.
 - Encourage patients and families to follow emergency communications in the event of anticipated extreme storms or flooding.
- Educate your colleagues and community on the links between climate change, sea level rise and health, and what can be done to prevent negative health impacts.
- Advocate for mitigation and adaptation strategies related to climate change and sea level rise.
 - Support funding for “green infrastructure,” such as reefs, sand, coastal wetlands and mangroves, and other natural barriers that reduce erosion and protect coastal areas from storm surges. Green infrastructure provides multiple co-benefits, including improved water quality, habitat for marine life, and carbon sequestration. See [Urban Greening & Green Infrastructure and Health](#)
 - Advocate for comprehensive assessment of vulnerable public infrastructure along coastlines (e.g. transit systems and roads, water and sewage systems, energy infrastructure, hospitals), and development of plans and funding to protect it.
 - Strengthen emergency preparedness and response systems to protect vulnerable coastal communities.
 - Protect freshwater sources from all contamination, including saline intrusion.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems, including the social and economic inequities, for individuals and communities, related to climate change and sea level rise.
 - Connect families to financial resources for disaster insurance and emergency communications resources.

For More Information

- California Coastal Commission page on sea level rise
<http://www.coastal.ca.gov/climate/slr/>
- California sea level rise vulnerability assessments and adaptation plans
 - [SF Bay Area](#)
 - [San Diego](#)
 - [Santa Cruz](#)

Page 1 photo: NPS; page 4 photo: Lieut. Commander Mark Moran, NOAA Corps, NMAO/AOC

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Allergens, Climate Change and Health



FAST FACT:

Allergies are the 6th most costly chronic disease in the U.S., with associated healthcare expenditures of about \$21 billion annually⁵ and a significant contributor to work and school absence.



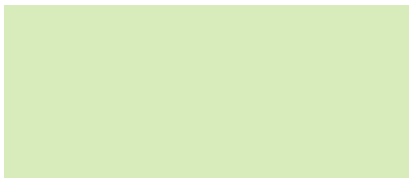
Climate change is increasing the length of the pollen season and its intensity, with big impacts on the millions of U.S. residents who already suffer from allergies. In this brief we focus on the impacts of climate change on allergies in California and the U.S.

Allergies already affect a huge number of people

- Hay fever, asthma, and eczema are the three major allergic diseases associated with exposure to aeroallergens — pollens from trees, weeds, and grasses, molds, and other indoor allergens.¹ For those with allergies, pollen triggers sneezing, wheezing, asthma attacks, and inflammation of the nose and eye membranes.
- An estimated 10-30% of people globally are affected by allergic rhinitis (hay fever).² The prevalence of hay fever in the U.S. rose from 10% in 1970 to 30% in 2000.³
- Over 50 million people in the U.S. each year are affected by contact dermatitis from plants in the poison ivy family (poison ivy, oak and sumac).⁴
- Allergies are the 6th most costly chronic disease in the U.S., with associated healthcare expenditures of about \$21 billion annually,⁵ and a significant contributor to work and school absence.

Climate change increases potential exposure to allergens

- Increasing temperatures lead to earlier and longer pollen and allergy seasons, due to more frost-free days and earlier and longer flowering seasons.
 - Higher temperatures also increase ozone production, which sensitizes the respiratory tract to allergens.⁶
- Higher carbon dioxide levels cause greater plant growth, resulting in increased pollen production and increased pollen potency. More winter precipitation further contributes to increased pollen production.⁷
 - Annual birch pollen production and peak values are expected to be 1.3–2.3 times higher from 2020–2100, relative to 2000 averages.⁸
 - Exposure to allergy-inducing molds may increase as more frequent and severe extreme weather events lead to more flooding. See [Rainfall & Storms, Climate Change and Health](#)
 - The allergenicity of some molds may also increase with higher CO₂ levels.
- Carbon dioxide enhances production of the chemical (urushiol) in poison ivy and poison oak that causes contact dermatitis, as well as the spread in growth of these allergenic plants.



DID YOU KNOW?

Higher carbon dioxide levels cause greater plant growth, resulting in increased pollen production and increased pollen potency. More winter precipitation further contributes to increased pollen production.

Between 1995 and 2011 ragweed season has increased as much as 11 to 27 days in the central US and Canada as a result of rising temperatures. These increases are correlated with the number of frost-free days in the region.^{10 11}

- California's frost-free season has already increased by three weeks (compared to pre-1960), and is likely to increase by an additional 8 weeks by the end of the century if greenhouse gas emissions are not curtailed.⁹

Ragweed Pollen Season Lengthens

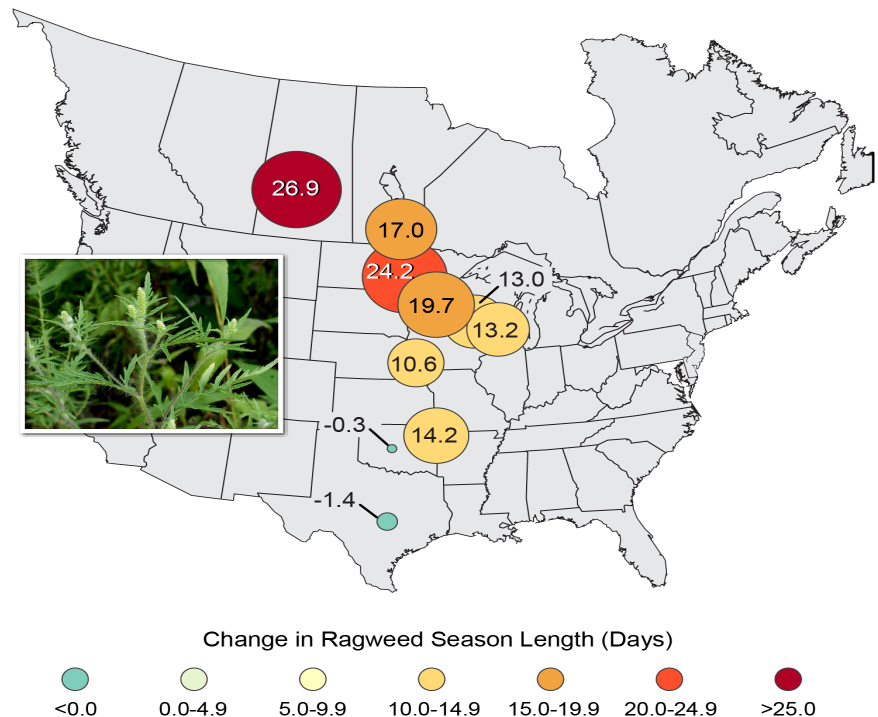


Photo Credit: Lewis Ziska, USDA

Climate change, allergies and health equity:

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for allergies from climate change:

- **Poverty:** People living in poverty may experience substandard housing and lack health insurance coverage for allergy management. Low-income communities are often under-insured for property loss due to flooding, resulting in fewer resources for home rehabilitation to prevent mold growth.
- **Housing:** Poor housing construction or ventilation can increase exposure to pollen or mold, exacerbating asthma and allergy symptoms.
- **Working conditions:** Outdoor workers face increased exposure to pollen and to allergenic plants. Low-wage workers without paid sick leave face job and economic loss if required to miss work due to allergies or asthma.¹²
- **Asthma or other chronic respiratory illness:** Exposure to aeroallergens can trigger asthma symptoms.



! FAST FACT:

An estimated 10–30% of people globally are affected by allergic rhinitis (hay fever).

What can physicians do to address climate change and allergies?

- Talk to patients about how climate change is increasing exposure to allergens, and what they can do to minimize their exposures to reduce allergy and asthma symptoms:
 - Check pollen levels frequently — patients can sign up for free alerts at [National Allergy Bureau™ \(NAB\)](http://www.nationalallergybureau.org)
 - For patients with allergies, the best times to be outdoors are when pollen levels are lower, typically on rainy, cloudy, and windless days.
 - Keep windows closed during allergy season, to prevent pollen from drifting inside; drive with car windows closed.
 - Consider showering after spending time outdoors, where pollen can collect on your skin, clothes, and hair.
 - For patients with asthma, check ozone levels at <http://www.airnow.gov/>
- Educate your colleagues and community on the links between climate change, allergens and health, and how to prevent adverse health impacts.
- Promote mitigation and adaptation strategies related to climate change and allergies
 - Encourage local planning departments to plant low-allergenicity trees, shrubs and plants in neighborhoods.
 - Support strengthened monitoring and reporting of pollen and ragweed levels.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems. Address social and economic inequities and vulnerabilities to allergen-related illness, for individuals and communities.
 - Connect individuals to social services for health care coverage to enable better management of allergies and asthma.
 - Advocate that emissions credits and other revenues be invested in the hardest-hit communities for resilience measures such as improved ventilation in housing, mold remediation, planting of less-allergenic trees, and measures to reduce air pollution from stationary and vehicular sources.

i For More Information

- American Academy of Allergy, Asthma and Immunology: <http://www.aaaai.org/>
- EPA report on climate change and allergens: <https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?jsessionid=13974F5D67FADE552079AEABE3B2742F.cfpub?deid=190306&CFID=72904308&CFTOKEN=64421912>
- US Climate and Health Assessment, Chapter 3: Air Quality Impacts: <https://health2016.globalchange.gov/air-quality-impacts>
- Sneezing and Wheezing-NRDC report on climate change, allergies, asthma and air quality: <https://www.nrdc.org/sites/default/files/sneezing-report-2015.pdf>



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Photo page 1: Susan Sermoneta; page 2: Alastair Vance; page 3: Stephanie Bryant; page 4: Henri Sivonen.



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Air Quality, Climate Change and Health



Climate change is reducing air quality in many ways. In this brief we focus on the impact of climate change on air quality and health in California and the U.S.

Air quality and health in California

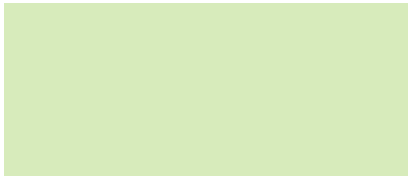
- California has a serious air pollution problem, despite great progress over the last few decades.¹
 - California has 7 of the top 10 most polluted cities for year-round particle pollution.
 - Los Angeles has been ranked the No. 1 most ozone-polluted city for at least the past 16 years.
- In 2010, about 13% of California adults and children had been diagnosed with asthma at some point in their lifetime. Each year there are nearly 200,000 new cases of asthma in California, and the incidence is increasing.²
- 40% of Californians, nearly twice the national average, live within about 1/3 of a mile of a busy roadway, where air pollution levels are higher.³
- Poor air quality limits physical activity, which is important for cardiovascular health, obesity prevention and mental health or stress reduction.

Climate change worsens air quality

- Climate change makes it ever more difficult to attain national air quality standards for ground-level ozone, a major component of smog.
 - Climate change is causing higher temperatures, which increase ozone formation, and increasing the frequency of stagnation events that create the worst ozone episodes.⁴ Recent studies suggest that increased ozone levels due to climate change could result in thousands of additional illnesses and deaths per year in coming decades.⁵
- Climate change is increasing the frequency and intensity of wildfires. Smoke from wildfires — laden with fine particulate matter (PM_{2.5}) — spreads over very long distances, and is associated with increased risks of premature deaths, ED visits, and hospitalizations — especially for respiratory and cardiovascular disease.⁶ See [Wildfires, Climate Change and Health](#).
- The five smoggiest cities in California are also projected to have the greatest climate change-related ozone increases. They also have the highest densities of low-income communities and communities of color.⁷
- As climate change brings increased storms and excess rainfall, excess moisture in homes leads to mold production that can exacerbate asthma and other respiratory illness. See [Rainfall & Storms, Climate Change and Health](#).
- Drought — also increasing in frequency and severity due to climate change — dries out the soil and increases dust levels, causing respiratory irritation. See [Drought, Climate Change and Health](#).

? DID YOU KNOW?

Los Angeles has been ranked the No. 1 most ozone-polluted city for at least the past 16 years.



FAST FACT:

Air pollution can cause permanent damage to the developing respiratory systems of children.

- With higher temperatures and more extreme heat days, air conditioner use increases. The associated greater energy demand increases air pollution from fossil-fuel based electricity production. See [Extreme Heat, Climate Change and Health](#).

Climate change, air quality and health equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for the air quality “penalty” due to climate change:

- **Race and Place:** Low-income communities and communities of color are more likely to have neighborhood characteristics that increase exposure to climate change-related air pollution, such as proximity to polluting industries, lack of green space, and urban heat islands.
 - African-Americans are disproportionately affected by asthma in California: compared to Whites, they experience 40% higher prevalence rates, four times higher emergency room and hospitalization rates, and twice the asthma death rates.⁸
- **Poverty** increases the risks of asthma. Those living in areas with a median household income of \$20,000 or less experience rates of emergency room visits and hospitalizations for asthma that are four times higher than those in areas with a median income greater than \$100,000.⁹
 - Low-income households, people of color, and non-English speaking and foreign-born persons are more likely to live near busy roadways, and therefore face worse air quality.
- **Age:** Air pollution can cause permanent damage to the developing respiratory systems of children.
- **Chronic illness:** Individuals with pre-existing chronic conditions, such as asthma, other respiratory disease, and cardiovascular disease, are at greater risk of disease exacerbations and complications due to air pollution.
- **Health insurance:** lack of adequate coverage and health care can result in poorly managed disease for those with respiratory or cardiovascular illness.

What can physicians do to address climate change and air quality?

- Talk to patients about how climate change worsens air quality, and what they can do to minimize the impact on health.
 - Advise patients with asthma or other respiratory illness to check the Air Quality Index <http://airnow.gov/index.cfm?action=aqibasics.aqi> for unsafe ozone and particulate levels.
 - Talk to patients about how to adjust their activities and recreation when air quality is bad.
 - For patients who smoke (or whose family members smoke), encourage them to quit and provide resource support.
- Educate your colleagues and communities on the links between climate change, air quality and health, and what strategies can reduce the risks of both.

Reduce Carbon Pollution, Expand Clean Energy¹⁰

In August 2015, President Obama and the EPA established [The Clean Power Plan \(CPP\)](#), which lays out regulatory standards on existing power plants to cut emissions by 32% of 2005 levels by the year 2030. Under the plan, solar and wind energy capacity is expected to double by 2030, compared to 2013 levels. The Clean Power Plan will lead to climate and health benefits, including avoiding 2,700 to 6,600 premature deaths and 140,000 to 150,000 asthma attacks in children.



- Advocate for strategies that simultaneously reduce greenhouse gas emissions and air pollution:
 - Clean transportation policies. For more, see [Transportation, Climate Change and Health](#)
 - Investment in public transit and pedestrian and bicycle infrastructure to reduce vehicle miles traveled
 - Improved vehicle fuel efficiency standards
 - Requirements to increase the use of renewable fuels
 - Electric vehicle infrastructure and programs to allow lower-income residents to purchase EVs
 - Strategies to reduce diesel emissions, including clean freight strategies
 - Policies to hasten transition to clean and renewable energy and increase energy efficiency. For more, see [Energy, Climate Change and Health](#)
 - Targets and subsidies for renewable energy and energy efficiency. See the box below for California's renewable energy and energy efficiency targets.
 - Elimination of subsidies for fossil fuels
 - Programs to allow lower-income homeowners and renters to benefit from rooftop solar and energy efficiency
 - Tighter regulations on emissions of carbon and toxic air pollutants from power plants and other industrial emitters
 - Urban heat island reduction strategies such as tree planting and other urban greening, cool roofs, and cool pavements. Trees reduce air pollution levels and cooling strategies reduce temperatures and related ozone production. See [Urban Greening & Green Infrastructure, Climate Change, and Health](#)
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems. Address social and economic inequities and vulnerabilities for air pollution, for individuals and communities.
 - Advocate that emissions credits and other revenues be strategically invested in disadvantaged and low-income communities.
 - Connect patients to social services and resources to ensure adequate health care coverage for better maintenance of respiratory health.

California's Clean Energy Plan¹¹

In 2015, California enacted ambitious new targets for clean energy. SB 350 commits the state to:

- Increase the amount of electricity derived from [renewable energy](#) from 1/3 to 50% by 2030
- Double [energy efficiency](#) in existing buildings by 2030

The proposal to reduce petroleum use by 50% by 2030 was thwarted by the oil industry. However, new legislation passed in August 2016 sets targets for reduced emissions of short-lived climate pollutants (SLCPs) — black carbon, methane, and fluorinated gases. See [Climate Change 101](#) for more information on SLCPs.



? DID YOU KNOW?

Smoke from wildfires — laden with fine particulate matter— spreads over very long distances, and is associated with increased risks of premature deaths, ER visits, and hospitalizations.

For More Information

- California Air Resources Board Short Lived Climate Pollutants Reduction Strategy <http://www.arb.ca.gov/cc/shortlived/shortlived.htm>
- American Lung Association State of the Air Report: <http://www.lung.org/our-initiatives/healthy-air/sota/>
- EPA Clean Power Plan site and Factsheet: <https://www.epa.gov/cleanpowerplan/clean-power-plan-protects-our-environment-health-economy>
- CA Governor's Climate Change Pillars: 2030 Greenhouse Gas Reduction Goals Factsheets: <http://www.arb.ca.gov/cc/pillars/pillars.htm#factsheets>
- Sneezing and Wheezing-NRDC report on climate change, allergies, asthma and air quality: <https://www.nrdc.org/sites/default/files/sneezing-report-2015.pdf>

Page 2 photo: Brandon Matthews/TransFormCA.org; page 3 photo: turtix/Shutterstock.com; page 4 photo: National Park Service, Alaska Region.

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Infectious Disease, Climate Change and Health



Climate change is increasing the risk of infectious diseases, including vector, food, and water-borne diseases, through multiple pathways. In this brief, we focus on the impacts of climate change on infectious diseases in California and the U.S.

Vector-borne disease and climate change

- Climate change is causing warmer temperatures and changes in precipitation that impact the habitat distribution and mating cycles of disease-carrying mosquitos and ticks, increasing the risks of exposure to disease in some areas.
- In the U.S., mosquito-borne West Nile Virus and tick-borne Lyme Disease are the two most commonly occurring vector-borne diseases.
 - Since it first appeared in the U.S. in 1999 and in the state in 2002, California has reported more than 4800 cases of West Nile Virus, the highest of any state in the union. The annual number of reported cases has been rising steadily in the state since 2010,¹ and cases more than doubled between 2013 and 2014.^{2,3}
- The *Aedes aegyptii* mosquito that transmits dengue, yellow fever, and Zika virus is now found in 28 U.S. states⁴. This “yellow fever mosquito” was not found in California until 2013 but is now present in 56 counties.⁵
 - Currently, more than 125 countries are considered endemic for Dengue, with global incidences ranging from 50 to 200 million cases.⁶
- Although 90% of Lyme Disease cases occur in the Eastern and Midwestern United States, the western black-legged tick, which transmits the virus, is present throughout California.

Water-borne disease and climate change

- There are an estimated 12 to 19 million endemic cases of water-borne illness in the U.S. each year.⁷
- The frequency and intensity of extreme precipitation and flooding is increasing with climate change.
 - In the U.S., more than 50% of water-borne disease outbreaks are associated with extreme rainfall.⁸
 - Flooding of water and sewage treatment facilities increases the risk of waterborne disease.
 - In areas with “combined” sewer systems that collect sewage and storm water runoff, heavy rainfalls can overwhelm the systems. Sometimes municipalities release untreated waste into water bodies to prevent back-up of untreated wastewater into homes. This “combined sewer overflow” can increase risk of water-borne gastrointestinal disease if people come into contact with contaminated water bodies.⁹

! FAST FACT:

In the U.S., more than 50% of waterborne disease outbreaks are associated with extreme rainfall.



? DID YOU KNOW?

Since it first appeared in the U.S. in 1999 and in the state in 2002, California has reported more than 4800 cases of West Nile Virus, the highest of any state in the union.

- Warmer water temperatures, in both ocean and freshwater sources, allow for greater proliferation of microorganisms such as *Vibrio* that cause gastrointestinal and more serious illness, including cholera.
- Warmer water also fosters the growth of harmful algal blooms (HAB), associated with increased risk of exposure to dangerous, potentially fatal, toxins.
 - In summer of 2015, an unprecedented HAB stretched from Alaska to the central California coast, leading to the shutdown of shellfish, salmon, tuna, and anchovy fishing to prevent exposure to domoic acid produced by the algae. Domoic acid can accumulate in shellfish and, if consumed, results in life-threatening Amnesic Shellfish Poisoning.¹⁰

Food-borne disease and climate change

- There are currently an estimated 48 million cases of food-borne illness in the U.S. each year,¹¹ with over 120,000 hospitalizations and nearly 3,000 deaths.¹²
- Higher ambient temperatures increase the replication cycle of food-borne pathogens such as salmonella, campylobacter, or *E.coli*, increasing disease risk.
- As temperatures increase, people may engage in behaviors — such as outdoor picnics — that further amplify the risk of food-borne illness.

Drought and infectious disease

- Increasing drought, as a result of climate change, will also increase the risk for food and waterborne illness, as water becomes more scarce for basic sanitation purposes. See [Drought, Climate Change and Health](#)

Drought and West Nile Virus¹³

Because mosquitoes are known to thrive in tropical conditions, it seems counterintuitive that drought would exacerbate spread of West Nile Virus (WNV). In reality, this is exactly what it does.

- As water sources dry up, mosquitos move toward domestic water sources, such as pools and fountains, thus increasing the likelihood of contact with and transmission of the disease to humans.
- Fewer water sources also increase the likelihood of contact between mosquitos and birds, which serve as amplification hosts for the virus and then spread WNV to other mosquitos when bitten.
- Ample rainfall can help “wash out” underground mosquito populations, for example in sewer pipes; during drought, these wash outs decrease, leaving stagnant pools of water in which mosquito populations thrive.
- Hotter temperatures also have a dramatic effect on increasing WNV by increasing viral replication rate, increasing the frequency of feeds per mosquito, and speeding mosquito development rate, which in turn increases the population size.



DID YOU KNOW?

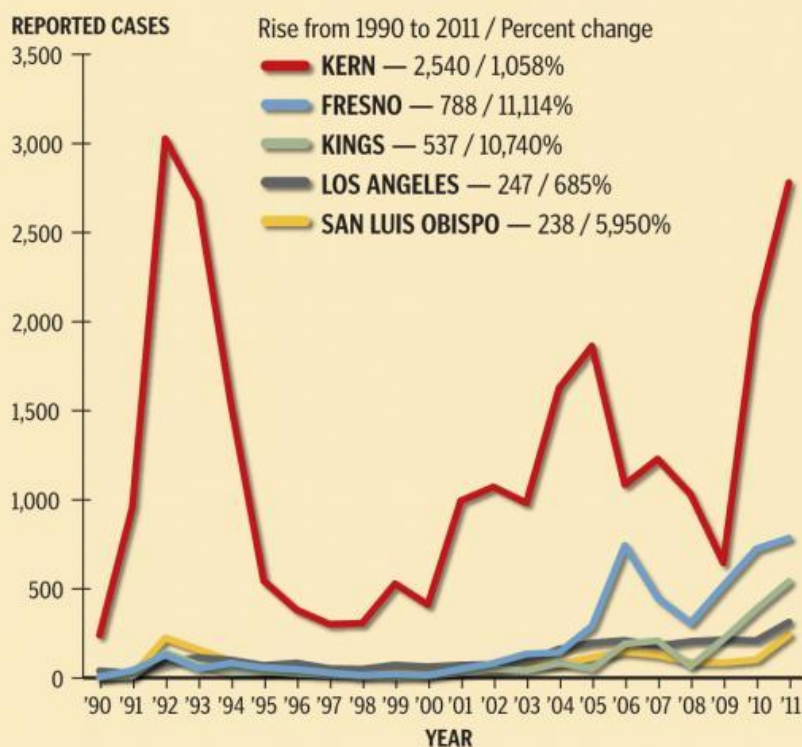
Sometimes municipalities release untreated waste into water bodies to prevent back-up of untreated wastewater into homes. This “combined sewer overflow” can increase risk of water-borne gastrointestinal disease if people come into contact with contaminated water bodies.⁹



Valley Fever in California's Changing Climate

- As temperatures and drought increase, soils dry out and dust levels increase. In some arid regions including the U.S. Southwest, the spores of the *Coccidioides immitis* fungus are carried on dust. Inhaling these spores causes Coccidioidomycosis, also known as cocci or “Valley fever.”
- Cases of Valley fever in the U.S. have risen about 15% each year from 1998 to 2011.¹⁴ Valley fever is characterized by coughing, chest pain and fever, as well as headaches, joint pain and rash. If untreated, it may cause pneumonia or complications from the spread of the disease outside the lungs and into other organs.
- California experienced a fivefold increase in Valley fever cases between 2000–2011, with 75% of cases occurring among residents of the San Joaquin Valley. Since 1990, the rates in some counties have increased by thousands of percentage points.¹⁵
- East Porterville, in Tulare County,¹⁶ is experiencing an epidemic of Valley fever with a rate of 39.2 per 100,000 residents. The impacts are especially devastating for this economically disadvantaged town, where nearly one-third of residents are uninsured, 40% do not have an educational level beyond 9th grade, 75% are Latino and over 30% are below the Federal Poverty Level.
- Dozens of workers constructing two solar power-generating facilities in central California contracted Valley fever between 2011–2014.¹⁷

California counties with largest rise in valley fever cases



Source: California Department of Public Health

KENT KUEHL / THE CALIFORNIAN

Climate change, infectious disease and health equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for climate change-related infectious diseases:

- **Occupation:** Farm workers and other outdoor laborers are at greater risk for exposure to disease vectors and fungus.
- **Housing conditions:** insufficient vector barriers, such as screens on windows and doors, can facilitate disease transmission.
- **Poor infrastructure:** People living in neighborhoods with aging water and sewer infrastructure may be at greater risk of sewer overflows and water-borne disease after flooding.
- **African-Americans and Filipinos** are at higher risk of illness following exposure to *Coccidioidomycosis*.¹⁸
- **Chronic illness:** those with pre-existing chronic medical conditions are more susceptible to complications from infectious disease as a result of climate change.



! FAST FACT:

There are currently an estimated 48 million cases of foodborne illness in the U.S. each year,¹¹ with over 120,000 hospitalizations and nearly 3,000 deaths.¹²

What can physicians do to address climate change and infectious disease?

- Talk with patients about the health risks of infectious diseases and how to stay safe and healthy.
 - Educate patients about mosquito-borne illnesses such as West Nile Virus, Dengue and Zika and ways to avoid transmission, including using insect repellent, clothing and installing door or window screens to keep mosquitos out of homes.
 - West Nile Virus Factsheet: [English](#), [Spanish](#)
 - Dengue Factsheet: [English](#), [Spanish](#)
 - Zika Virus:
 - Avoid travel to areas where there have been outbreaks of Zika virus: <http://wwwnc.cdc.gov/travel/page/zika-travel-information>
 - CDC Zika and pregnancy site for patients: <http://www.cdc.gov/zika/pregnancy/question-answers.html>
 - For physicians: Doctor's Visit Checklist for Pregnant Women who Traveled to an Area with Zika: <http://www.cdc.gov/zika/pdfs/docvisit-checklist-travelpreg.pdf>
 - Educate at-risk patients about Valley Fever and ways to avoid exposure, including avoiding areas and activities with high dust exposure (construction or dusty fields, gardening, etc), staying indoors with windows closed on windy and dusty days, wearing a respirator such as an N95 mask if areas and activities with dust can't be avoided, and ensuring good indoor air filtration.
 - Valley Fever Factsheet: [English](#), [Spanish](#), [For workers](#)



FAST FACT:

Cases of Valley Fever in the U.S. have risen about 15% each year from 1998 to 2011.¹⁴

- Educate patients on the importance of good sanitation practices to avoid food and water-borne illness, especially following heavy rainfalls.
 - Information about WASH-related (water, sanitation & hygiene) practices: <http://www.cdc.gov/healthywater/emergency/audience/public.html>
- Educate your colleagues and community on the links between climate change, infectious disease, and what can be done to prevent adverse health impacts
- Promote mitigation and adaptation strategies related to climate change and infectious disease.
 - Work with local water management boards to ensure clean, safe drinking water for all communities, including protection of water systems during extreme storms and contamination prevention during drought, when groundwater sources are more likely to be tapped.
 - Advocate for improved surveillance of insect vectors impacted by climate change.
 - Work with planning departments to strengthen infrastructure related to flooding, including sewer system up-grades and run-off prevention through the use of green infrastructure.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems, including the social and economic inequities, for individuals and communities, related to climate change and infectious disease.
 - Advocate that emissions credits and other revenues be invested the hardest-hit communities to improve food and water system infrastructure, vector surveillance and mitigation efforts.



For More Information

- CDC Infectious Disease sites-includes information and resources for patients
 - **Valley Fever**
CDC: <http://www.cdc.gov/fungal/diseases/coccidioidomycosis/>
 - **West Nile Virus**
CDC: <http://www.cdc.gov/westnile/index.html>
 - **Dengue**
CDC: <http://www.cdc.gov/dengue/>
 - **Lyme Disease**
CDC: <http://www.cdc.gov/lyme/>
 - **Zika**
CDC: <https://www.cdc.gov/zika/>

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Food Security, Climate Change and Health



DID YOU KNOW?

Ozone pollution not only contributes to respiratory and cardiovascular disease, it is also harmful to plants — especially soybeans, wheat, oats, green beans, and peppers — and already causes millions of tons of crop losses each year.

Climate change impacts food security and nutrition in many ways. Food security is “access by all people at all times to enough food for an active, healthy life.”¹ It requires that food is available and accessible, that it can be utilized to nourish the body, and that a nutritious food supply is stable. In this brief, we focus on the impacts of climate change on food security in California and the U.S.

Food security is a fundamental human need²

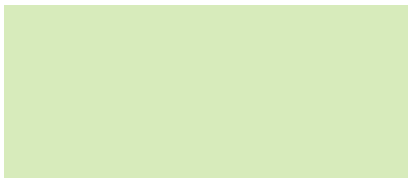
- In the U.S., about 14% of households are food insecure and 48.1 million people live in food insecure homes, including 7.9 million children. Nearly 6 million Californians are food insecure.
- Food insecurity is more common in people of color and those living in poverty. Twenty-six percent of U.S. Black households and 22% of Hispanic households report food insecurity. Thirty-four percent of low-income households in the U.S. are food insecure.
- Food insecurity includes under-consumption (more common in developing nations) and over-consumption (more common in developed countries).
 - Under-consumption contributes to poor physical and mental development and diminished physical capacity. Globally, about 2 billion people — over 10% of the global population — are undernourished.
 - Over-consumption is a major contributor to development of chronic diseases such as obesity, cardiovascular disease, and diabetes.

Climate change threatens food security in many ways:^{3 4}

Climate change can adversely affect not only agricultural and food production, but also its processing and distribution.

- Food production is adversely impacted by declines in crop yield, animal health, and the health of fisheries:
 - Crop yields are reduced by [extreme heat](#), [drought](#), and extreme weather events, all of which are increasing in frequency and severity due to climate change.
 - Warmer temperatures are leading to fewer “chill hours”, required for production of nuts, tree fruits, and avocados.
 - Warmer temperatures cause higher ground-level ozone concentrations. Ozone pollution not only causes respiratory and cardiovascular disease, it is also harmful to plants — especially soybeans, wheat, oats, green beans, and peppers — and already causes millions of tons of crop losses each year.
 - Heat stress causes illness in livestock, and reduces milk and egg production.





FAST FACT:

The typical American meal includes ingredients from at least five foreign countries, contributing to transportation GHGE, especially if food is shipped by air.

- In California's recent drought, thousands of head of livestock were culled due to lack of forage grass.
- Fish yields - already declining due to overfishing and ocean dead zones - are further impacted by ocean acidification associated with rising carbon dioxide levels, and by drought as streams where fish spawn are dried up.
- Climate-related increases in crop damage due to higher weed growth and more pests may result in higher use of toxic herbicides and pesticides, with increased risks of pesticide-related illness for agricultural workers, farm communities, and consumers.
- Warmer temperatures increase the growth of *Salmonella*, *Camphylobacter*, *Rotavirus*, and various *Vibrio*, as well as the incidence of harmful algal blooms, thus increasing the risk of bacterial and biotoxin contamination of food.
- Increased atmospheric carbon dioxide results in a reduction in the levels of protein and micronutrients (e.g. calcium, zinc, iron) in important crops like barley, sorghum and soy.
- Extreme weather events can prevent transportation of food products, disrupting food supply chains and increasing loss due to spoilage.
- Population growth will drive global food demand, at the same time that global food production will decrease due to climate change. The Intergovernmental Panel on Climate Change (IPCC) estimates that global food production will decrease by 2% per decade, while global food demand increases by 14% per decade.⁵

Agricultural practices drive climate change

Unfortunately, the link between climate change and our modern industrial agriculture practices creates a vicious cycle that harms health through food insecurity and worsening global warming. For more, see [Food & Agriculture, Climate Change and Health](#)

- Agriculture contributes about 9% of total U.S. GHGE, 52% of methane emissions, and 84% of nitrous oxide release.⁶ Methane and nitrous oxide are both potent short-lived climate pollutants with global warming potentials far higher than that of CO₂.^{7,8}
 - When fertilizer use, refrigeration, transportation, and land use changes (such as deforestation and soil depletion) are taken into account, our food and agriculture systems account for about 1/3 of all U.S. GHGE.⁹
 - The application of nitrogen fertilizer accounts for nearly 80% of domestic nitrous oxide emissions.¹⁰
 - Livestock — especially cattle — accounts for nearly ½ of methane emissions from agriculture, and about 18% of global GHGE.
- Conventional agricultural practices are extremely water intensive. Agriculture uses about 70% of the world's freshwater supply.¹¹ In California, 80% of water is currently used for agriculture, though water management practices can significantly improve water efficiency.^{12,13}
- Food production and processing are energy intensive, accounting for 17% of U.S. fossil fuel use.¹⁴ The typical American meal includes ingredients from at least five foreign countries, contributing to transportation GHGE, especially if food is shipped by air.¹⁵



FAST FACT:

Nearly 40% of food — worth about \$165 billion — goes to waste each year. Every year 30 million tons of food waste ends up in landfills, where it produces methane.



- Nearly 40% of food — worth about \$165 billion — goes to waste each year. Every year 30 million tons of food waste ends up in landfills, where it produces methane, a potent climate pollutant.¹⁶

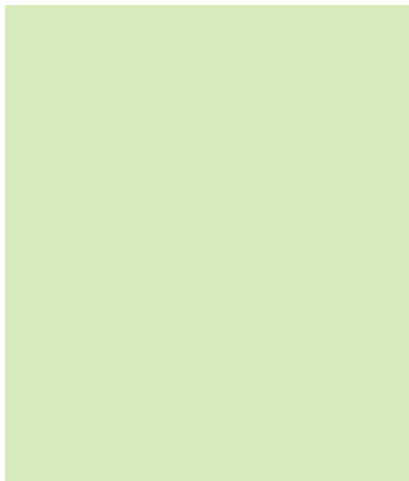
Climate change, food security, and health equity:

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk for the effects of climate change on food security:

- **Poverty:** Low-income people have less ability to absorb rising food prices. As food prices rise, they face greater food insecurity, and may be forced to choose between food and other necessities such as shelter and transportation. Because people turn to cheaper, low-nutrient, processed foods with more fat, sugar, and salt, food insecurity is associated with higher risks for diabetes and hypertension.¹⁷
- **Occupation:** Declines in food production result in significant job and economic losses in farming communities. In California, 92% of farmworkers are Latino and 73% of all farmworkers earn less than 200% of the Federal Poverty Level.¹⁸
- **Cultural Practices:** Many indigenous communities practice traditional hunting, subsistence farming and fishing, and are thus vulnerable to climate change impacts on local game, farming and aquatic habitats. For example, rising sea levels will threaten freshwater and saltwater fishing habitats for many indigenous communities along the Gulf Coast. Rising temperatures are affecting the availability and nutrient content of wild berries for Alaskan Natives.¹⁹

What can physicians do to address climate change, nutrition, and food security?

- Talk to patients about the risks of climate change, food insecurity, and health and environmental impacts. Encourage patients to:
 - Reduce meat consumption and increase consumption of fruits and vegetables.
 - Buy or produce food locally through community gardens, backyard gardens, and farmers markets.
 - Reduce food waste at home and when eating out. Forty percent of food waste occurs at the consumer level.
- Educate your colleagues and community on the links between climate change and food security, and climate solutions with health co-benefits.
 - Encourage planning departments to create and zone for more urban and community gardens and farmers' markets.
 - Encourage schools, businesses, hospitals and clinics to procure food locally and sustainably.
 - Encourage local public environmental health departments to work with schools, restaurants, and hospitals to reduce food waste and divert edible food to local food banks.
 - Advocate for local composting programs for residents and businesses.



? DID YOU KNOW?

The Intergovernmental Panel on Climate Change (IPCC) estimates that global food production will decrease by 2% per decade, while global food demand increases by 14% per decade.

- Promote mitigation and adaptation strategies related to climate change and food security.
 - Implement policies that focus on local food production and procurement, to decrease emissions related to production and distribution of food and increase availability of affordable healthy foods in all communities. See Food and Agriculture Co-benefits sheet for more information.
 - Implement policies to divert edible food from food waste streams to programs that reduce food insecurity, and prevent large-scale food waste.
 - Advocate for reduced federal subsidies for commodity crops, such as corn, which is a staple to cheap, high sugar, low nutrient foods.
 - Advocate for policies that make local, healthy food available to all, such as allowance for SNAP EBT at farmers markets.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems, including the social and economic vulnerabilities to food insecurity for individuals and communities.
 - Close the wage and employment gaps that exist among communities of color and low-income communities. In particular, advocate for just wages for farmworkers, including migrant workers, who usually earn below poverty wages and cannot afford to purchase the very food they grow.



For More Information

- CalCAN: California Climate and Agriculture Network: <http://calclimateag.org>
- California Food Policy Council: <http://www.rootsofchange.org/who-we-are/networks/california-food-policy-council/>
- Re-Fed: Reducing Food Waste: <http://www.refed.com/?sort=economic-value-per-ton>
- Equitable Development Toolkit: Local Food Procurement http://www.policylink.org/sites/default/files/edtk_local-food-procurement.pdf
- Sample Policy: Los Angeles Good Food Purchasing Policy <http://goodfoodla.org/policymaking/good-food-procurement/>
- Los Angeles Food Policy Tracker: <http://goodfoodla.org/2016/03/07/los-angeles-food-policy-tracker/>
- American Community Gardens Association: <https://communitygarden.org>
- San Francisco Urban Agriculture Program: <http://sfrecpark.org/park-improvements/urban-agriculture-program-citywide/>

Photo page 1: Marc van Vuren/Shutterstock; page 3: Stephen Rees; page 4: James Hooley/FCO.



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Mental Health and Climate Change

? DID YOU KNOW?

Increased rates of substance abuse and interpersonal violence, especially intimate partner violence against women, have been observed following weather-related disasters.



Along with destruction to the physical environment, climate related impacts, including extreme storms, drought, wildfires and others, can damage the social fabric of communities. Even people who are not experiencing direct impacts from climate change may experience stress, anxiety, and fear about climate change from news reports or through the experiences of family and friends. Here we highlight some of the mental health impacts of climate change.

Extreme weather events¹

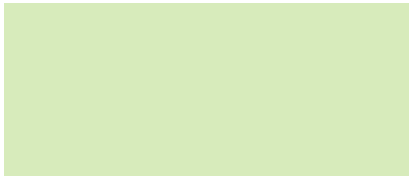
- Exposure to extreme weather events, such as floods, hurricanes and wildfires, is associated with a range of mental health impacts, including post-traumatic stress disorder (PTSD), depression, anxiety and suicide.
- Increased rates of substance abuse and interpersonal violence, especially intimate partner violence against women, have been observed following weather-related disasters.

Hurricane Katrina: The Storm After the Storm

The mental health impacts of Hurricane Katrina persisted long after the storm ended. Residents of storm-ravaged areas experienced worse mental health, including an increase in both suicidal thoughts and suicidal plans.

- In areas of Alabama, Louisiana and Mississippi, prevalence of PTSD rose from 15% a few months after the hurricane to 21% a year later. During the same timeframe, the proportion of people with suicidal thoughts more than doubled: from 2.8% to 6.4%.²
- For some, the hurricane's impact was cumulative: veterans with preexisting mental illness were 6.8 times more likely to develop additional mental illness after the disaster, as compared to those without a preexisting mental condition.³

Hope abounds: One study that followed Katrina survivors over the long term found that two-thirds of those who experienced increased rates of PTSD and psychosis one year after the storm no longer displayed symptoms of psychological distress three years afterwards. Some also report “post-traumatic growth,” or the feeling that surviving the hurricane made them stronger, despite also experiencing mental illness. These findings suggest the importance of long-term support for survivors of climate change-related disasters.⁴



Individuals taking certain medications such as antipsychotics, tranquilizers or medication for Parkinson's disease may experience complications during a heat wave. This places individuals with those conditions at greater risk for destabilization of their mental illness.

Extreme heat⁵

- Exposure to extreme heat impacts mental health through increased incidence of disease, death, violence, aggression, suicide and higher rates of admission for those with a psychiatric condition.
- Persons with mental illness may have triple the risk of death during a heat wave. In addition, for individuals admitted to emergency departments for heat-related illness, those with mental illness have a higher risk of death.

Drought⁶

- Drought is a slow-moving natural disaster, appearing over months and potentially lasting for years. Lack of water, however, is a life threatening emergency, leaving people without safe water to drink, grow food, or for sanitation purposes.
- Drought interacts with multiple other social and environmental stressors to negatively impact mental health by disrupting livelihoods and lifestyles — sometimes permanently — of individuals, families and communities.
- Especially for rural and agricultural communities, drought can have devastating impacts on economic and community stability, creating much stress and uncertainty for the future.

Mental Health Impacts of California's Historic Drought^{7 8}

In the fall of 2015, during the fifth year of the worst drought of California's history, the California Department of Health Surveyed two of the counties most impacted by the drought, Mariposa County and Tulare County. Among findings related to physical and economic health, the assessment noted that:

- In Mariposa, 18.9% of households surveyed reported having with a member with pre-existing depression or other mental illness. Among them 26.9% reported the drought was worsening their condition. In Tulare, 6.8% of the households reported this pre-existing mental health status, but most (59.1%) reported a worsening of their condition from the drought.
- Overall, 61% of the Mariposa households surveyed said the drought was negatively affecting their "peace of mind." In Tulare, 49.4% reported the same.





FAST FACT:

Social resources and connections such as social cohesion, network connectedness and community trust are critical to response and recovery efforts after disasters.

Climate change, mental health, and equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk for the effects of climate change on mental health:

- **Poverty:** Economic burden may increase the likelihood of stress-related mental health problems, and people with mental illness may encounter barriers to employment that impair economic stability. Low-income households are also less likely to have insurance or other financial resources to help recover from dislocation or other impacts prolonging stress after an extreme weather event.
 - The constant anxiety and stress of living in poverty and/or in neighborhoods with high levels of crime may impede the ability to prepare for and respond to adverse events.
- **Health access:** Community level inequities also exist, particularly in regards to health provider capacity and access. In California, the three counties with the highest percentage of individuals with Severe Psychological Distress (Kern, Kings and Madera) also have the lowest number of practicing physicians.⁹

Climate Change, Social Support and Resiliency: Lessons from Superstorm Sandy¹⁰

Social resources and connections such as social cohesion, network connectedness and community trust are critical to response and recovery efforts after disasters, which are increasing in frequency and severity due to climate change. In a study of 12 neighborhoods affected by Superstorm Sandy, those with high social resources viewed their community as more resilient and prepared for future disasters. Importantly, the role of social resources transcends neighborhood socioeconomic status: poorer neighborhoods with abundant social resources are more resilient, while wealthy neighborhoods with low social resources are less resilient in the face of disasters.



The physician role in climate change and mental health

- Talk to your patients about climate change risks and associated mental health impacts, and refer them for mental health services, as well as social support services to mitigate stress related to the economic and social impacts of climate change, including:
 - [LIHEAP](#): Low income home energy assistance program
 - Resources and support for disaster insurance, where possible.
- Advocate for policies and programs that build community cohesion and resilience, and that help empower individuals and communities to respond constructively to the threats of climate change, for example:
 - Neighborhood-based preparedness programs that help people to meet their neighbors and educate about specific strategies to reduce risks from natural disasters.¹¹
 - Psychological first aid training for local emergency response providers.¹²
 - Resident leadership academies and other community leadership programs that strengthen connections among community members and provide avenues for their participation in the decisions that impact their lives.
 - Engagement of community members in development of policies to address climate change and other community issues.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems. Advocate for greater mental health resources, particularly for disadvantaged and vulnerable communities.



! FAST FACT:

Lack of water is a life threatening emergency, leaving people without safe water to drink, grow food, or for sanitation purposes.

i For More Information

- American Psychological Association Report on Psychology and Climate Change
 - Executive Summary <http://www.apa.org/science/about/publications/executive-summary.pdf>
 - Full Report <http://www.apa.org/science/about/publications/climate-change-booklet.pdf>
- Los Angeles County Community Disaster Resilience Program <http://www.laresilience.org>

Photo page 1: Ed Edahl/FEMA; page 2 sidebar: Heather Buckley/flickr.com; page 2 box: Giorgio Montersino; page 3 sidebar: W. M. Shelley; page 3 box: Kevin Jarrett; page 4: Elizabeth Haslam; page 5: Lance Cheung/USDA.

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DID YOU KNOW?

The constant anxiety and stress of living in poverty and/or in neighborhoods with high levels of crime may impede the ability to prepare for adverse events.

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Special Focus: Climate Change and Children

? DID YOU KNOW?

Diarrheal disease causes approximately 1.6 million deaths per year in children under the age of 5, making it the leading cause of child mortality globally.



Children are especially vulnerable to the health impacts of climate change, due to their developing brains and bodies, and their dependence on adult caregivers. Nearly 90% of global disease burden related to climate change is borne by children under 5 years of age, in both developed and developing countries.¹ Special consideration should be given to helping children and their families adapt to climate change impacts.

Why are children more vulnerable to climate change?²

- **Biological sensitivity:** The immature and developing nature of children's physiologic systems makes them more vulnerable to injury and illness from various exposures related to climate change. They have a proportionately higher intake of air, water and food relative to their size, which increases risks of some exposures through those pathways and makes them disproportionately exposed to elements and toxins in the environment.
- **Social behaviors and environments:** Children often spend more time outdoors and engaged in hand-to-mouth activities as part of their education, recreation and development, which can increase their risk of exposure to [air pollution](#), [allergens](#), [extreme heat](#) or waterborne pathogens from climate change.
- **Limited adaptive capacity:** On their own, children have fewer resources at their disposal to cope with climate change hazards. For example, means of evacuation in event of extreme weather or ability to access fresh, locally grown produce on their own. Biologic adaptive capacity is also more limited. For example, infants and young children are not able to regulate their body temperature as well as older children and adults, thus placing them at greater risk for heat-related illness.
- **Socioeconomic situation:** Similar to adaptive capacity, children are dependent on the socioeconomic position and resources of their family and community. Low-income children and children of color are more likely to experience existing health inequities that place them at greater risk for adverse impacts of climate change.

Heat-related illness³

- Due to their immature thermoregulatory systems, children are more vulnerable to heat stress, especially children under 1 year of age.
- Older children are also at risk: Among, high school athletes, heat illness is the leading cause of death and disability, with football players being the most at-risk subgroup.



FAST FACT:

In the U.S., boys age 5-9 are the most high-risk group for contracting Lyme disease .



- There are approximately 120,000 children farm laborers across the country, making them an often-hidden subpopulation at risk for heat illness.

Air quality⁴

- Because of their higher respiratory rate and amount of time spent doing outdoor activities, children are more vulnerable to ozone and [air quality](#) exposures than other groups. Ozone is a strong lung irritant and major component of smog that has been associated with increased risk of developing bronchitis, bronchiolitis, asthma, asthma exacerbations and ED admissions and pediatric ICU stays for asthma.
- [Wildfires](#), which are increasing due to climate change, produce toxic smoke that can travel for thousands of miles and cause respiratory illness. In 2003, Southern California wildfires increased asthma admissions rates for 5-19 year olds by during and after the fire by 25% and 56%, respectively.
- Pollen [allergies](#) can also be affected: higher springtime temperatures increase the length of the allergy season, particularly in Northern regions. Increased carbon dioxide concentrations in the atmosphere may independently increase pollen production by ragweed, a common cause of seasonal allergies.

Infectious disease⁵

- Diarrheal disease causes approximately 1.6 million deaths per year in children under the age of 5, making it the leading cause of child mortality globally. Many factors, including climate, influence patterns of [infectious diseases](#) like Lyme disease, mosquito-borne illnesses like West Nile virus, and childhood diarrhea. Rising temperature has been linked to the northward spread of Lyme disease in the United States, putting more children at risk of this disease.
- Climate change is increasing the risk of several vector-borne diseases that influence children, including malaria, dengue fever, West Nile Virus, Lyme disease, Rocky Mountain spotted fever, Chagas disease and Chikungunya.
 - Malaria is a leading cause of global child mortality.
 - Dengue fever is the most rapidly spreading mosquito borne virus in the world and a majority of annual mortality is among children.
 - In the U.S., boys age 5-9 are the most high-risk group for contracting Lyme disease.

Extreme weather events⁶

- Children's unique needs place them at risk of injury or death, separation from or loss of caregivers, and mental health consequences following [weather disasters](#).
 - Following Hurricanes Katrina and Rita, more than 5000 children were separated from their families and the last missing child was reunited with her family after 6 months.
 - Following storm and flood disasters, children are especially at risk for respiratory and diarrheal disease, related to things like indoor mold exposures and waterborne pathogens.
- Disasters can also harm children through devastation of the community resources on which they rely for their healthy mental and physical development, like schools and hospitals.



DID YOU KNOW?

Heat illness is the leading cause of death and disability among high school athletes, with football players being the most at-risk group.



- It is estimated that children need 4-6 months to recover academically when a severe weather event causes school displacement. Children displaced from Hurricane Katrina experienced an average of 3 moves per child. In the year following the disaster, students demonstrated worse academic performance, school attendance, behavioral issues and mental health.

Food security⁷

- Agricultural productivity and food prices can be affected by extreme heat, drought, flood and rising sea levels. [Food](#) safety and processing is also impacted, leading to increased foodborne pathogens and associated illness.
- Rising atmospheric carbon dioxide concentration may alter the nutrient content of major crops like wheat and rice.
 - Studies have projected that climate change has caused a 7-20% increase in the number of malnourished children worldwide.

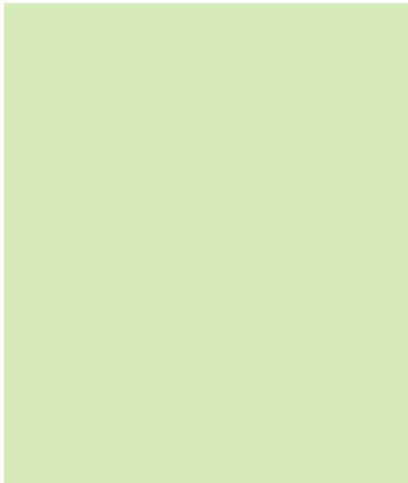
Mental health⁸

- Climate change significantly affects children's [mental health](#) and wellbeing.
 - To date, most research has focused on the impacts of severe weather events on children's mental health.
 - Children experience high rates of PTSD symptoms after natural disasters such as hurricanes and floods.
 - Children displaced by extreme events experience disruption in school, and have demonstrated school performance and behavior problems.
 - Providing safety, security and family reunification after a disaster is critical to preventing severe stress reactions.
 - Practitioners have also expressed concern about the levels of anxiety they are seeing in children and youth who understand that climate change will impact their future wellbeing.

What can physicians do to protect children's health in the era of climate change?

The following recommendations come directly from the [American Academy of Pediatrics](#):⁹

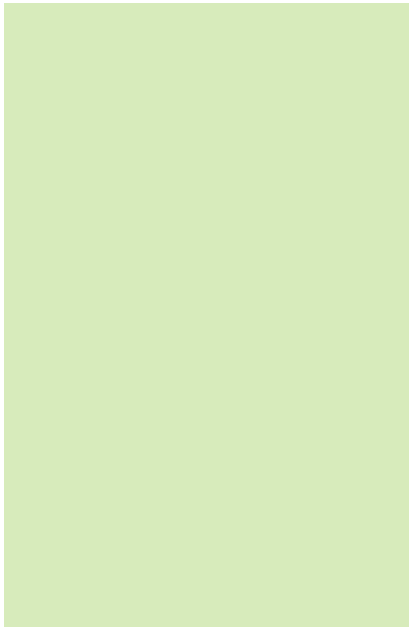
- Work to promote medical educational opportunities regarding the effects of climate change on the environment and child health.
- Seek ways to reduce the carbon and environmental footprint of health facilities, including hospitals, medical offices, and transport services.
 - Increase energy efficiency
 - Incorporate renewable energy sources
 - Reduce waste
 - Promote public and active modes of transport (eg, walking, bicycling) during new construction or remodeling.



DID YOU KNOW?

It is estimated that children need 4–6 months to recover academically when a severe weather event causes school displacement.

- Use existing anticipatory guidance as a framework for discussing climate change with families. For example, encouraging active modes of transport, reducing food waste and meat consumption, and improving home energy efficiency. Serve as a personal role model for practices that promote environmental sustainability.
- Educate children, families, and communities on emergency and disaster readiness. For guidance, see:
 - American Academy of Pediatrics [Children and Disasters Web page](#).
 - www.ready.gov and <https://www.ready.gov/es> (Spanish)
- Advocate for local, national, and international policies that reduce greenhouse gas emissions and for adaptation strategies that improve preparedness for anticipated climate-associated effects.
 - Educate elected officials on the risks climate change poses to child health; speak at public hearings; and provide expert testimony.
 - Help educate the public through letters to the editor and community engagement.
- Help to build a broader coalition across disciplines to address climate change at the local and national levels.
- Advocate for strategies on the part of government to improve climate change and health:
 - Promote energy efficiency and renewable energy production at the federal, state, and local levels while decreasing incentives for continued production and consumption of carbon-intensive fuels such as coal, oil, and gas.
 - Fund research, surveillance, reporting, and tracking of climate-associated health effects. Invest in prudent and vital preparations for public health care systems, anticipating climate change effects.
 - Support education and public awareness of the threats from climate change for public and children's health now and in the future.
 - Develop essential adaptation strategies and assist state and local governments, public health agencies, and health professionals in implementation of these strategies. The specific needs of children should be addressed in disaster preparedness and response.
 - Include the health sector in national and international policy-making meetings that address the threats of climate change.
 - Fund public transportation systems and support urban planning designs that incorporate walkability, open space, green building design, reduced dependence on automobile transit, and climate change resilience.



For More Information

- See the guide's sheets on [specific climate impacts](#) for more guidance on adaptation and mitigation strategies.
- American Academy of Pediatrics resources
 - Technical report on climate change and children's health
<http://pediatrics.aappublications.org/content/pediatrics/early/2015/10/21/peds.2015-3233.full.pdf>
 - Policy statement on climate change and children's health
<http://pediatrics.aappublications.org/content/136/5/992>
- CDC: Caring for Children in a Disaster
<http://www.cdc.gov/childrenindisasters/index.html>

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Photo page 1: Doune Porter/GAVI ; page 2: Ken Bosma; page 4: Robert Terrell.



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Special Focus: Climate Change and Worker Health



Workers in some occupations are especially vulnerable and at risk due to the impacts of climate change on health. In this brief, we focus on climate change and worker health in California and the U.S.

Heat and work¹

- Outdoor workers (e.g. agriculture, landscaping, construction) are more vulnerable to heat-related illness, especially where jobs involve heavy exertion.
 - In addition to the direct impacts of heat and risks for heat illness, [extreme heat](#) may decrease vigilance and mental performance, increasing the risk for those who work on elevated structures or operate heavy machinery.
 - Lack of heat-illness-prevention programs in the workplace is strongly associated with extreme temperature-related death.
 - Recent studies suggest that labor productivity will decline significantly as rising temperatures reduce the capacity to work outside.
- Workers in hot indoor environments (e.g. steel mills, dry cleaners, restaurant kitchens, manufacturing facilities, warehouses, and other areas that lack air conditioning) are also at increased risk for extreme heat exposure and heat illness.
- Risk on top of risk: For migrant workers and day laborers working outdoors, these climate change impacts are compounded by other social and economic inequities, including poor housing and food access, stress and lack of preventive healthcare.

Air quality and allergens

- Outdoor workers experience degraded [air quality](#) as a result of heat waves that combine with ozone to create smog. [Drought](#) creates dry, dusty conditions that can exacerbate chronic respiratory conditions or expose workers to *Coccidioides immitis*, the fungal spore that causes Valley fever.²
- Agricultural and landscape workers in particular face increased risk for [allergies](#) from longer and more intense pollen seasons as a result of climate change.³
- Firefighters are on the front lines of climate change, as the increasing intensity and severity of [wildfires](#) increases exposure to particulate matter and other toxic chemicals in wildfire smoke. Other outdoor workers are also at risk of wildfire smoke exposure.⁴
- Efforts to increase energy efficiency can inadvertently lead to “tight building syndrome,” where indoor workers are exposed to poor indoor air quality and increased concentrations of indoor chemicals, pollutants and microorganisms as a result of inadequate ventilation. Symptoms include respiratory problems, skin irritation and headaches. “Tight” buildings can also lead to higher concentrations of radon, an odorless, tasteless, colorless gas linked to lung cancer.⁵



FAST FACT:

Agricultural and landscape workers face increased risk for allergies from longer and more intense pollen seasons.



From the latest Global Change Research Program Report:

From 2000 to 2013, almost 300 U.S. wildfire firefighters were killed while on duty. With the frequency and severity of wildfires projected to increase, more firefighters will be exposed. Common workplace hazards faced on the fire line include being overrun by fire (as happened during the Yarnell Hill Fire in Arizona in 2013 that killed 19 firefighters); heat-related illnesses and injuries; smoke inhalation; vehicle-related injuries (including aircraft); slips, trips, and falls; and exposure to particulate matter and other air pollutants in wildfire smoke. In addition, wild land firefighters are at risk of rhabdomyolysis (a breakdown of muscle tissue) that is associated with prolonged and intense physical exertion.

- As climate change increases the prevalence of some insects and weeds, pesticide and herbicide use is expected to rise, increasing agricultural workers' exposure to harmful chemicals in outdoor air or through direct skin contact.⁶

Vector-borne disease⁸

- Landscape designers or agriculture workers may come into close contact with mosquito and tick habitats as part of their work, exposing them to vector-borne diseases such as Lyme disease, West Nile Virus, Zika virus or Dengue.
- Anyone working outdoors in drought conditions is also susceptible to vector-borne disease as a result of drought impacts on insect habitats and reproduction cycles.

Extreme weather and natural disasters⁹

- Utility workers, emergency workers and first responders, including healthcare and public safety workers, are exposed to deaths, injuries, diseases and mental stress caused by climate and weather-related disasters.
 - Recovery and clean-up from disasters may include perilous physical conditions from infrastructure failure (roads, buildings, power grids and transportation systems) and social unrest or violence if food, water and shelter are compromised.
 - Workers may be out during a [severe weather event](#), which increases risk for death or injury from lightning strikes, flooding, high winds or other conditions.
 - These workers are also more susceptible to experiencing negative mental health consequences, as the very nature of the work involves spending long hours in stressful and traumatic settings, often away from loved ones.

Job insecurity and job loss¹⁰

- Climate change impacts jobs, local economies and employment patterns. For example, thousands of agricultural workers lost their jobs as fields were fallowed as a result of [California's drought](#). Extreme weather events may force places of employment to close for months, or permanently. While employment in renewable energy is growing rapidly, those who have lost their jobs in coal mining regions may not be able to obtain jobs in the new "green" economy.
- Low-wage workers and those without benefits often lack resources and capacity to respond to climate change impacts. Low wages make it difficult to absorb rising food prices; lack of paid sick leave limits the ability to properly recuperate from climate change-related illnesses; lack of disaster insurance prevents many from recouping property losses after extreme storms, wildfires or other climate change-related disasters.



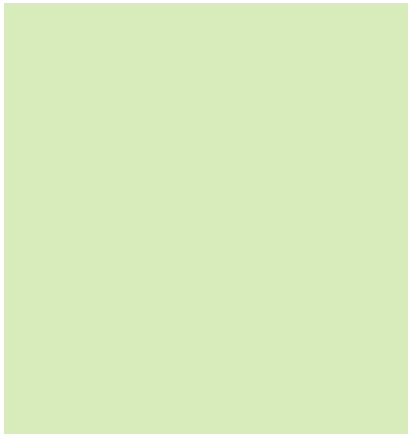
DID YOU KNOW?

Agricultural workers should take steps to avoid bringing pesticide exposures home, including washing any exposed skin at the worksite and keeping work clothing and boots separate from other laundry.



The physician role in climate change and worker health

- Ask your patients about their work and provide appropriate referrals or information on workers' health and safety rights and on-the-job hazards.
 - Advise outdoor workers about their rights for heat illness prevention, including their right to adequate shade, rest periods and water. <https://www.dir.ca.gov/Title8/3395.html>.
 - Provide them with information such as the worker pocket guide on heat illness (English and Spanish): https://www.dir.ca.gov/dosh/dosh_publications/HeatIllnessEmployeeEngSpan.pdf
 - Advise outdoor workers to check the Air Quality Index <http://airnow.gov/index.cfm?action=aqibasics.aqi> for unsafe ozone and particulate levels.
 - Landscape and agriculture workers who spend time near heavy shrubs or woods should wear protective clothing such as long sleeves, pants, hats and gloves.
 - Lyme Disease factsheet for outdoor workers (English): http://www.cdc.gov/lyme/resources/toolkit/factsheets/10_508_lyme-disease_outdoorworkers_factsheet.pdf
 - Lyme Disease factsheet for outdoor workers (Spanish): http://www.cdc.gov/lyme/resources/toolkit/factsheets/10_508_lyme-disease_outdoorworkers_factsheet_spanish.pdf
 - Agricultural workers should take steps to avoid bringing pesticide exposures home, including washing any exposed skin at the worksite and keeping work clothing and boots separate from other laundry. <https://www.epa.gov/pesticide-worker-safety/training-and-safety-materials-implementing-worker-protection-standard>
 - Pesticide protection guidelines are difficult for low-literacy or low-income workers, such as migrant workers. Ask these patients about their social needs and consider a referral to social services.
- Advocate for policies and standards to protect workers in the face of a changing climate:
 - Encourage employers and occupational health agencies to assess emerging worker health and safety risks associated with climate change.
 - Support strengthening of existing standards and new standards to protect worker health and safety.
- Support policies for a just transition from fossil fuel-related jobs to jobs in the green economy, including efforts to retrain and hire displaced, low-income workers and people of color.



For More Information

- See the guide's sheets on [specific climate impacts](#) for more guidance on adaptation and mitigation strategies.
- National Institute for Occupational Health and Safety (NIOSH): Climate Change and Worker Health page: <http://www.cdc.gov/niosh/topics/climate/how.html>
- CDC Lyme Disease page: <http://www.cdc.gov/lyme/index.html>
- CDC Dengue page: <http://www.cdc.gov/dengue/>
- CDC West Nile Virus page: <http://www.cdc.gov/westnile/index.html>

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Special Focus: Climate Change and Pregnant Women

? DID YOU KNOW?

Floods place pregnant women at increased risk of exposure to environmental toxins and mold, reduced access to safe food and water, psychological stress, and disrupted health care.



Pregnant and postpartum women and their infants are uniquely vulnerable to the health impacts of climate change, due to the many physiologic and social changes that occur as a result of pregnancy. Climate-related exposures may lead to adverse pregnancy and newborn health outcomes, including spontaneous abortion, low birth weight, preterm birth, increased neonatal death, dehydration and associated renal failure, malnutrition, diarrhea, and respiratory disease.

Heat-related impacts¹

- Pregnant women are vulnerable to temperature extremes and are especially susceptible to dehydration, which releases labor-inducing hormones. Newborns are especially sensitive to ambient temperature extremes because their capacity for regulating body temperature is limited.
- [Extreme heat](#) events are also associated with adverse birth outcomes, such as preterm birth, low birth weight and infant mortality.

Drought and flood risks²

- [Drought](#) endangers pregnant women's access to safe and reliable water sources for drinking and sanitation, increasing their vulnerability to dehydration (leading to pre-term labor) and infectious agents.
- Pregnant women and newborns are uniquely vulnerable to [flood](#) health hazards. Flood exposure was associated with adverse birth outcomes (preterm birth, low birth weight) after Hurricane Katrina and the 1997 floods in North Dakota.
 - Floods also place pregnant women at increased risk of exposure to environmental toxins and mold, reduced access to safe food and water, psychological stress and disrupted health care. Other flood-related health outcomes for mothers and babies include maternal risk of anemia, eclampsia, and spontaneous abortion.

Infectious disease³

- Pregnancy-related changes to immune function could also place pregnant women at increased risk for waterborne disease, especially gastrointestinal illness, as a result of flooding. Pregnant women who develop severe gastrointestinal illness are at high risk for adverse pregnancy outcomes.
- Women are especially vulnerable to vector-borne disease, including Lyme Disease, Dengue and Zika virus, which causes microcephaly in fetuses.



! FAST FACT:

Zika causes microcephaly, along with other infant health problems like hearing loss, delayed growth and eye defects.

Zika virus and pregnancy⁴

Beginning in May 2015, Brazil experienced a significant outbreak of Zika virus and rising cases of microcephaly in infants born to mothers with the virus. Subsequent research concludes that Zika causes microcephaly, along with other infant health problems like hearing loss, delayed growth and eye defects. Pregnant women can be infected with Zika virus if exposed and can pass the virus to their fetus. However, at the time of this writing (August 2016), researchers do not know what the level of risk for contracting the virus once a pregnant woman is exposed, nor do they know the level of risk an infected woman has of passing the virus to her fetus. They also do not yet know what the relative risks are for complications and defects if a fetus is infected. Therefore, every precaution should be taken to prevent exposure of pregnant women to Zika. For more information, see the [CDC healthcare provider recommendations for Zika virus](#).

Extreme weather events⁵

- Extreme heat exposure can lead to dehydration and renal failure in pregnant women. Dehydration in early pregnancy can affect the fetal growth, while dehydration in late pregnancy can cause pre-term birth.

Air Quality⁶

- Pregnant women are more sensitive to the harmful health effects of [wildfire](#) smoke and exposure of pregnant women to inhaled particulate matter is associated with negative birth outcomes.
- Exposure to [air pollutants](#) and ground-level ozone can cause respiratory illness in pregnant women and lead to low birth-weight or pre-term babies.

Food security⁷

- Nutrition is essential to healthy pregnancy, nursing and newborn outcomes. Pregnant women are therefore particularly vulnerable to climate-related impacts to [food](#) safety, access and nutritional value. Poor nutrition is related to delivery problems, low birth weight, and even newborn death.

The physician role in climate change and pregnancy health

- Talk to your patients about climate-related health risks, and advise them on how to minimize risks:
 - Closely monitor pregnant patients during periods of extreme heat: assess their access to clean drinking water, shade or cooling centers, air conditioning, and social supports.
 - Advise patients to check the Air Quality Index (AQI) <http://airnow.gov/index.cfm?action=aqibasics.aqi> for unsafe ozone and particulate levels during hot days and in event of wildfires. Even if pregnant women live far from wildfire sites, smoke plumes can travel thousands of miles so they should monitor air quality closely.



FAST FACT:

Extreme heat exposure can lead to dehydration and renal failure in pregnant women. Dehydration in early pregnancy can affect the fetal growth, while dehydration in late pregnancy can cause pre-term birth.



- Advise and assist patients to create an emergency response plan in case of need to evacuate, for example in event of flood, wildfire, extreme weather or other emergent climate threat. For more information and guidance, visit the CDC site for emergency preparedness for pregnant women and infants.
- Advise patients on the risks of illness from food, water and vector-borne pathogens and to take appropriate precautions against illness:
 - Prepare all food with safe, clean water
 - Wear protective garments and insect repellent when outdoors near mosquito and tick habitats. Use screens on windows and door at home to keep insects out.
 - Recognize the symptoms of Lyme disease and Dengue
 - CDC Lyme Disease and pregnancy fact sheet: http://www.cdc.gov/lyme/resources/toolkit/factsheets/10_508_lyme-disease_pregnantwoman_factsheet.pdf
 - CDC Dengue and pregnancy factsheet: http://www.cdc.gov/dengue/resources/educationMaterials_pdfs/15_261427-A_Seda_508_Update_Prevent_dengue_during_pregnancy508.pdf
 - Zika virus:
 - Avoid travel to areas where there have been outbreaks of Zika virus: <http://wwwnc.cdc.gov/travel/page/zika-travel-information>
 - CDC Zika and pregnancy site for patients: <http://www.cdc.gov/zika/pregnancy/question-answers.html>
 - For physicians: Doctor's Visit Checklist for Pregnant Women who Traveled to an Area with Zika: <http://www.cdc.gov/zika/pdfs/docvisit-checklist-travelpreg.pdf>
- Educate your colleagues and community about the impacts of climate change on the health of pregnant women and their babies.
- Advocate and work to ensure reliable access to and provision of quality reproductive services for all women.
- Advocate for policies to reduce greenhouse gas emissions and the health impacts of climate change.



For More Information

- See the guide's sheets on [specific climate impacts](#) for more guidance on adaptation and mitigation strategies.
- Environmental Protection Agency Air Pollution and Pregnancy Health https://www.epa.gov/sites/production/files/2014-05/documents/ochp_prenatal_fs_7_10.pdf
- American Congress of Obstetricians and Gynecologists position statement on climate change and women's health: <http://www.acog.org/Resources-And-Publications/Position-Statements/Climate-Change-and-Womens-Health>
- Climate change and the potential effects on maternal and pregnancy outcomes: an assessment of the most vulnerable—the mother, fetus and newborn child <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3595418/>



? DID YOU KNOW?

Pregnant women are vulnerable to temperature extremes and are especially susceptible to dehydration, which releases labor-inducing hormones.

- EPA Climate Change and Pregnancy factsheet
<https://www3.epa.gov/climatechange/impacts/health/factsheets/pregnant-health-climate-change.pdf>
- CDC Zika Virus page: <http://www.cdc.gov/zika/pregnancy/>
- CDC Lyme Disease page: <http://www.cdc.gov/lyme/index.html>
- CDC Dengue Fever page: <http://www.cdc.gov/dengue/>

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Climate Action for Healthy People, Healthy Places, Healthy Planet: **Transportation, Climate Change and Health**



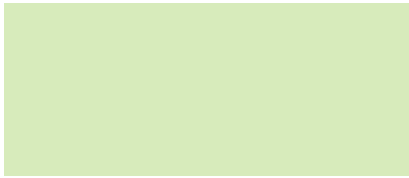
Climate change is the greatest health challenge of the 21st century. It threatens our air, food, water, shelter and security — the basics on which human life depends. Climate change exacerbates health inequities by disproportionately impacting people living in poverty and communities of color.

At the same time, action on climate change provides one of our greatest health opportunities because many climate change solutions improve community environments and health and reduce health inequities. Everybody benefits.

In this brief we explain the health and health equity benefits of reducing climate pollution from the transportation sector. For more on **“Climate Action: Healthy People, Healthy Places, Healthy Planet”** please visit: <http://www.usclimateandhealthalliance.org>.

Key Messages

- Key strategies to reduce transportation greenhouse gas emissions (GHGE) all offer significant health, equity and environmental benefits.
- Transportation is the now the largest source of greenhouse gas emissions in the U.S., contributing 30% of all emissions in 2016.¹
- Our car-dependent land use, housing and transportation patterns have taken physical activity out of our daily routines. Sedentary lifestyle increases the risk of heart disease, stroke, diabetes, depression, osteoporosis, obesity and some cancers.
 - Replacing car travel with walking, biking, and using public transit increases physical activity and significantly reduces chronic disease risks.
 - Safe walking and biking infrastructure prevents pedestrian and bicycle injuries and deaths.
- Low-income families often have more limited transportation options, and thus struggle to access necessary resources and economic opportunities.
 - Affordable and accessible public transit allows low-income people, youth, seniors and the disabled better access to resources.
- Low-income individuals and people of color are more likely to live in high-traffic areas and are disproportionately affected by motor vehicle emissions and car crashes.
- Motor vehicles are a major source of air pollution, and a leading cause of injury and death due to automobile collisions.
- Low carbon fuels and low or zero emission (electric) vehicles substantially reduce air pollution.
- Everybody benefits from a healthy transportation system that is good for our health, good for our communities, and good for the climate.



In the San Francisco Bay Area, an increase in the average time spent in active transportation from the current 4 minutes to 22 minutes would reduce cardiovascular disease and diabetes by 14%, along with significant reductions in dementia, breast cancer, colon cancer and depression.

Health and transportation

Our current transportation system causes injury and illness from air pollution, motor vehicle collisions, sedentary behavior, noise and stress.

- Current land use, transportation and housing patterns (often low-density neighborhoods and poor mix of land use) have increased our dependence on automobiles and reduced physical activity in daily life.
- Too little physical activity is associated with heart disease, stroke, diabetes, obesity, osteoporosis, depression and all-cause mortality.
 - More than 60% of U.S. adults do not achieve the recommended amount of regular physical activity.
- Motor vehicle crashes are the leading cause of injury, disability and death in the U.S. for those between 5–24 years old.²
 - In 2013 alone, more than 2.3 million U.S. residents were injured and over 32,000 people were killed from auto collisions.³
 - Low-income people, people of color and children face a greater risk of injury and death due to motor vehicle collisions, and pedestrians are killed at disproportionately higher rates in the nation's poorer neighborhoods.⁴
- Motor vehicles are a major source of air pollution.
 - Exposure to traffic-related air pollutants (i.e. particulate matter, nitrogen oxides, sulfur oxides, ozone and toxic air contaminants like benzene) increases the risk for heart disease, asthma and other respiratory disease, cancer, premature death, and affects lung and brain development of children.⁵
 - People of color and low-income people are more likely to reside near busy roadways and are disproportionately affected by pollutants from motor vehicles.⁶
- Road traffic is a major source of noise pollution.
 - Excess noise is associated with sleep disruptions, increased risk for heart disease, stroke, stress and disturbances at school and work.
- Transportation is the second largest expense for American households, costing more than food, clothing, and health care.⁷
 - Low-income families often have few low-cost transportation options. As a result, almost 30% of their income goes to transportation alone.

Climate and transportation

The transportation sector is now the largest contributor to U.S. greenhouse gas emissions.

- The transportation sector contributed 30% of all U.S. emissions in 2016.¹ Transportation is one of the fastest-growing sources of domestic GHGE and accounts for nearly half of the increase in total emissions since 1990.⁸
- On-road vehicles were responsible for the vast majority (83%) of transportation-related GHGE; passenger cars and light-duty trucks contribute 60% of these emissions.⁹
- Reducing personal vehicle use will substantially reduce emissions of transportation-related greenhouse gases and associated pollutants.



FAST FACT:

Low-income families often have few low-cost transportation options and spend almost 30% of their income on transportation alone.

Low-income people are already greater users of active transportation but need better service, safety and affordability.



Major Health Benefits with Active Transportation

In the San Francisco Bay Area, an increase in the average time spent in active transportation from the current 4 minutes to 22 minutes would reduce cardiovascular disease and diabetes by 14%, along with significant reductions in dementia, breast cancer, colon cancer and depression. Additionally, it would reduce greenhouse gas emissions (14%) and air pollution, too. However, without attention to safer active transportation infrastructure, it could significantly increase the burden of cycling and pedestrian fatalities.¹⁰

Healthy Transportation: Good for our health and good for the climate

There are many ways to improve our transportation system so that it's better for our health, for our communities, and for the climate.

- One of the best ways to improve our health and reduce climate pollution is to spend less time driving cars and more time walking, biking, and using public transit - together called “active transportation.”
 - Studies show that shifting from car travel to active transportation provides big reductions in chronic disease.
 - Nearly 50% of all trips in urban areas are three miles or less and 28% are one mile or less, both easy bicycling distances.¹¹
 - Walking, biking and public transit must also be safe to ensure that expanding active transportation doesn't lead to more injuries. In 2013, approximately 17% of automobile crash fatalities included pedestrians and bicyclists.³
 - Studies have shown that the health benefits of physical activity, such as biking and walking, are greater than any harm due to increased pollution exposure from being active outdoors.¹²
 - “[Complete Streets](#)”, better road and sidewalk design, segregated bike lanes, lighting, shade, and bike parking make biking and walking safer and more pleasant.
 - Programs such as “[Safe Routes to School](#)” or walking school buses can increase the safety and security of children and promote active transportation.
- Better active transportation infrastructure and public transit is especially important to reduce inequities. Due to the high cost of driving, low income people are already greater users of active transportation but need better service, safety and affordability.
 - Affordable and accessible public transit allows low-income people, youth, seniors and the disabled better access to resources and opportunities.
 - Active transportation reduces transportation costs, allowing people to spend more on healthy food and housing.

- Free or discounted public transit fees for students and low-income people could increase school attendance, decrease contact with juvenile justice system, increase available funding for schools and provide more disposable income for families.¹³

- Zero-emission vehicles and hybrid low carbon vehicles reduce air pollution and climate pollution.
 - Zero-emission vehicles (battery electric and hydrogen fuel cell) produce zero tailpipe smog-forming or greenhouse gas emissions.
 - Using today's average U.S. electricity mix of renewable and non-renewable resources, an electric car will cut harmful carbon pollution by about half compared to the average new vehicle.¹⁴
- Low carbon fuel standards and automobile fuel efficiency standards reduce air pollution and climate pollution.
 - For example, in California, new vehicle emission standards are aimed at reducing greenhouse gas emissions by 34% in 2025,¹⁵ and nationally, the U.S. EPA's Low Carbon Fuel Standards Program 2017-2025 model year light-duty vehicles are projected to save approximately 2 billion metric tons of GHGs over the lifetimes of those vehicles.¹⁶

What can we do?

The health sector can play an important role in creating healthy, equitable, climate resilient communities. We can talk to our patients, colleagues, communities and policy-makers about how a healthy transportation system is good for our health, good for our communities, and good for the climate. We can support strategies that will move us toward a healthy transportation system:

- Design healthy communities that allow more people to live closer to jobs, schools, services and destinations such as parks and stores, including infill and transit-oriented development.
 - Anti-displacement measures and affordable housing are critical to ensure that low-income residents are not displaced through gentrification, as “smart growth” may increase property values.
- Increase funding and planning for safe bicycle and pedestrian infrastructure, [Complete Streets](#), and programs such as [Safe Routes to School](#) to encourage active transportation and reduce the risk of injuries.
- Increase funding for transit infrastructure and transit operations that increase capacity and convenience and lower costs for riders. Provide low-cost transit discounts for students and low-income people.
- Implement and strengthen low carbon fuel standards and vehicle efficiency standards.
- Develop strategies to increase the use of electric vehicles, including electrification infrastructure and financial incentives.
 - Ensure mechanisms that allow low-income populations to benefit from EV ownership, such as enhanced rebates and charging stations in multi-unit housing.¹⁷



! FAST FACT:

An electric car will cut harmful carbon pollution by about half compared to the average new vehicle.



DID YOU KNOW?

Nearly 50% of all trips in urban areas are three miles or less and 28% are one mile or less, both easy bicycling distances.

Summary

We can reduce climate pollution and improve the health of our communities at the same time by supporting a healthy transportation system. The biggest gains in health will come from increases in walking, biking and public transit use. Reducing petroleum use in vehicles through fuel efficiency, low carbon fuels and zero emission vehicles will reduce air pollution and greenhouse gas emissions. We know what we need to do to create a healthier, more equitable and more climate-friendly transportation system. We need your support to get there.



For More Information

- Healthy, Equitable Transportation Policy: Recommendations and Research
<http://www.policylink.org/find-resources/library/healthy-equitable-transportation-policy-recommendations-and-research>
- Getting Involved in Transportation Planning
<http://www.changelabsolutions.org/publications/getting-involved-transportation-planning>

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FAST FACT:

Studies show that shifting from car travel to active transportation provides big reductions in chronic disease.

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Climate Action for Healthy People, Healthy Places, Healthy Planet: **Energy, Climate Change and Health**



Climate change is the greatest health challenge of the 21st century. It threatens our air, food, water, shelter, and security — the basics on which human life depends. Climate change exacerbates health inequities by disproportionately impacting people living in poverty and communities of color.

At the same time, action on climate change provides one of our greatest health opportunities because many climate change solutions improve community environments and the public's health and reduce health inequities. Everybody benefits.

In this brief we explain the health and health equity benefits of reducing climate pollution from the energy sector. For other **"Climate Action for Healthy People, Healthy Places, Healthy Planet"** briefs see <http://www.usclimateandhealthalliance.org>

Key Messages

- Switching from coal combustion and other fossil fuels to clean, safe, renewable energy - like wind, solar and hydroelectric - is one of the most important things we can do for our health and for the climate.
- Energy efficiency and clean renewable energy have substantial benefits for health, including reductions in asthma and other respiratory disease, cardiovascular disease and premature deaths.
- Energy production is the largest source of climate pollution in the U.S., responsible for nearly 1/3 of greenhouse gas emissions.
 - Coal-fired power plants release 3.5 million tons of CO₂ per year, the most significant climate pollutant.
- Energy production is also a major source of air, water, and soil pollution, and harms our health in many ways.
 - Air pollution from burning coal causes over 13,000 deaths and 20,000 heart attacks in the U.S. each year.
 - Coal power plants are disproportionately located in low-income communities and communities of color.
- Increased energy efficiency (in homes, offices, and industry) allows us to meet our energy needs at lower cost and with less climate and air pollution.

Health, environment and energy

Energy and electricity production has greatly improved our quality of life, providing for lighting, heating, cooling and the manufacture of many helpful products. But the way in which electricity is currently produced — mainly through burning of fossil fuels — comes at a high cost to our health and to the environment.



? DID YOU KNOW?

Coal power plants are the largest single source of mercury that contaminates waterways and makes its way into our bodies from the fish we eat.

- Coal still provides about 33% of U.S. energy, although its use is declining due to the cheap cost of natural gas.⁵ Coal combustion is a major source of toxic air pollutants.
 - Burning coal to produce electricity releases tons of toxic chemicals into the air, including nitrogen oxides, sulfur oxides and particulate matter (PM).¹
 - Coal power plants are the largest single source of mercury that contaminates waterways and makes its way into our bodies from fish we eat. Mercury is a potent neurotoxin that can cause developmental problems and learning disabilities, particularly in the fetus and young children.⁶
 - Coal air pollution is also associated with heart disease, asthma and chronic lung disease, with the greatest impacts affecting children, the elderly, low-income communities, people of color and communities downwind of power plants.^{3,7}
 - In the U.S., nearly six million African Americans live within three miles of a coal-fired power plant.³
 - The cumulative health costs of coal-based electricity in the U.S. have been estimated to fall between \$62 billion and \$523 billion annually.⁸
 - Coal miners suffer from occupational hazards, such as black lung disease, injuries and fatalities.⁹
 - Coal mining can cause significant water contamination and mudslides.
- Recent studies estimate significant reductions in illness and deaths if we switch from dirty fossil fuels to renewable energy.¹⁰
- Other energy sources are also associated with health risks:
 - Natural gas — extraction, storage, and transport are associated with methane emissions. Large concentrations of methane may displace oxygen, causing dizziness, weakness, nausea, and vomiting.¹¹ Gas extraction, storage, and combustion may also release benzene, which has been associated with leukemia¹², and other volatile organic compounds, which contribute to the formation ground-level ozone (smog).¹³
 - Hydroelectric — Construction of large dams for hydroelectric power has often caused displacement of large numbers of families.¹⁴
 - Nuclear power — The use of nuclear power poses a very small risk of accidental releases of radiation, though accidental releases could be catastrophic. Nuclear workers face risks from chronic low-level radiation exposure, with attendant cancer risks, and uranium miners have a high risk of lung cancer. Even the remote possibility that nuclear waste could be obtained to produce a “dirty bomb” raises significant security concerns.¹⁵
- For many low-income families, “fuel poverty” due to high energy costs means choosing between paying for energy to cook, heat, or cool homes, versus other essential necessities such as food.¹⁶ Fuel poverty is associated with increased risk for cold-related illness, and use of unsafe heat sources that can cause carbon monoxide poisoning or fires.¹⁷ Concerns about high-energy costs may reduce the use of air conditioning during heat waves, increasing the risk of heat illness and deaths among low-income families (as 18% of households below the poverty line do not have air conditioning).¹⁸



FAST FACT:

The World Bank has stopped funding construction of coal-powered fire plants, rejecting the notion that coal energy is the answer to fuel poverty.



Energy and the Developing World

Over one billion people around the world still lack electricity or gas for lighting, cooking, or heating, with the overwhelming majority living in sub-Saharan Africa or developing countries in Asia. Many of these families rely on the use of indoor household cook stoves that burn biomass such as dung or charcoal, which can release large amounts of black carbon particulate matter into their houses and the environment. These indoor air exposures can result in childhood pneumonia, asthma, chronic respiratory disease, and lung cancer. The World Health Organization attributes about 4.3 million deaths each year to indoor air pollution. For the many people living in extreme poverty without access to secure energy, it is critically important that wealthier nations support development assistance that will allow them to meet basic needs using safe and clean renewable energy.¹⁷

The World Bank has stopped funding construction of coal-powered fire plants, rejecting the notion that coal energy is the answer to fuel poverty. Says Rachel Kyte, the Bank's climate envoy, "Do I think coal is the solution to poverty? There are more than 1 billion people today who have no access to energy... If they all had access to coal-fired power tomorrow their respiratory illness rates would go up, etc... We need to extend access to energy to the poor and we need to do it the cleanest way possible because the social costs of coal are uncanceled and damaging, just as the global emissions count is damaging as well."¹⁹

Climate change and energy

- The energy sector is responsible for 30% of U.S. greenhouse gas emissions (GHGE), almost all of which is associated with the burning of dirty fossil fuels.²⁰ Fossil fuels — coal, oil, and gas — are fuels that were formed when prehistoric plants and animals died and were gradually buried by layers of rock.²¹
 - Coal produces more carbon dioxide per unit of energy than any other energy source, producing nearly 71% of CO₂ from U.S. electricity production,²² but only 33% of electricity.²³
- Natural gas has been proposed as a "bridge fuel," as its end-use results in significantly lower CO₂ emissions than that of coal.²¹ But recent findings suggest that the methane released during the lifecycle of natural gas use may have a climate impact even greater than that of coal. Methane is a potent short-lived climate pollutant with a global warming potential far higher than that of CO₂.^{24 25}
- Electricity generated from renewables releases about 1/20th the GHGE of coal over the full life-cycle.²⁶ Switching from fossil fuels to clean, renewable energy is a critical path to the reduction of greenhouse gas emissions.
- Advances in renewable energy technology have helped reduce implementation costs — making renewable energy ever more cost-competitive — and increased market shares.²⁷
 - Since 2011, electricity from solar power has increased tenfold, and wind generation of electricity has increased by 50%.²⁸

Clean Power Plan

The [Clean Power Plan \(CPP\)](#) aims to reduce carbon pollution from power plants. These are the first national standards that address carbon pollution from power plants. The CPP requires states to develop a plan that will significantly cut carbon and air pollution, advance clean energy development, and provide the foundation for long-term strategies to tackle climate change. In a study conducted by Harvard University using a scenario that resembled the CPP, they found that health benefits would outweigh the estimated costs of the Plan, with an estimated net benefit of \$38 billion per year. Unfortunately, the CPP has been challenged by some states and the Supreme Court issued a hold on its implementation (Summer, 2016) until the lawsuit is heard in U.S. District Court. (Summer, 2016).^{29 30}



FAST FACT:

Recent findings suggest that the methane released during the lifestyle of natural gas may have a climate impact even greater than that of coal.

The Benefits of Energy Efficiency: Good for our Health and Good for the Planet

- Energy efficiency and energy conservation are extremely important tools for tackling climate change. They reduce the need for energy production, can decrease indoor air pollution, and help to significantly reduce the health and climate impacts mentioned above.³¹ In San Francisco, a health impact assessment found that standard energy efficiency upgrades would likely reduce deaths attributed to ambient particulate matter 2.5 by 4%.³²
- Energy efficiency also reduces energy costs, saving families and businesses money, which can be invested back into the local economy.^{26 33}
- Improved energy efficiency and savings benefit populations sensitive to volatile energy prices, such as those with fixed or low incomes.
- A number of programs are available to ensure that energy efficiency upgrades are available to those who need them the most, such as the Low Income Home Energy Efficiency Plan (LIHEAP)³⁴ and the Weatherization Assistance Program (WAP).^{26 27 35}
- Key strategies for energy efficiency include:
 - Zero net energy homes and commercial buildings
 - Industry adoption of energy efficiency
 - Deployment of energy-efficient appliances and light bulbs
 - Strengthened energy efficiency standards for buildings and appliances

What can we do?

Public health professionals play a critical role in building healthy, equitable, sustainable, and climate resilient communities. You can help to promote an increase in energy efficiency and clean renewable energy:

- Share information about the health harms of dirty fossil fuel energy from coal, oil, and natural gas and the health benefits of clean energy with your colleagues, patients, policy-makers, and community.



DID YOU KNOW?

Since 2011, electricity from solar power has increased tenfold, and wind generation of electricity has increased by 50%.



- Support local, state, and federal policies and standards that:
 - Encourage increased energy efficiency, such as California's Building Energy Efficiency Standards³⁶ or the U.S. Department of Energy's Appliance and Equipment Standards Program.³⁷
 - Regulate GHGE and pollutants from electricity production, such as through the Clean Power Plan.
 - Expand the installation of clean renewable energy, such as through California's Renewable Energy Standards Portfolio.
- Support funding to allow low-income households and those in multi-unit housing to enjoy the benefits of solar energy.
- Advocate for the expansion of low-income energy retrofitting and weatherization programs, and for the inclusion of healthy home components in those programs.
- Support discounted electricity rates for low-income households to help low-income household maintain service. Support rules that ban electricity shutoffs during heat waves.
- Supporting community choice energy (CCE) initiatives, which enable local governments to consolidate electricity demand within their jurisdiction in order to procure clean energy supplies while maintaining existing providers for transmission and distribution services. CCE allows cities and counties the ability to aggregate regional energy demand, negotiate with competitive suppliers and developers, purchase more green power, reduce the cost of electricity, and provide power from more local sources.³⁸
- Encourage your local hospitals and other institutions to purchase renewable energy. Many large health care systems have already joined the Health Care Without Harm 2020 Health Care Climate Challenge³⁹ and made significant gains in procuring clean renewable energy, achieving cost savings and contributing to cleaner air in their communities.^{40,41}

Summary

We can reduce climate pollution and improve health at the same time by supporting improvements in energy efficiency and a switch to safe and clean renewable energy. The biggest gains in health will come from reducing generation of electricity using coal. We know what we need to do to create a healthier, more equitable, and more climate-friendly and climate resilient energy system. We need your help to get there.



For More Information

- Learning more about health and energy:
<https://www.princeton.edu/~mauzeral/papers/Energy%20ARPH%2013.pdf>
- Learning to be more energy efficient:
<http://energy.gov/energysaver/energy-saver-guide-tips-saving-money-and-energy-home>
- Learning how solar energy can benefit you:
<http://www.gosolarcalifornia.ca.gov/csi/index.php>

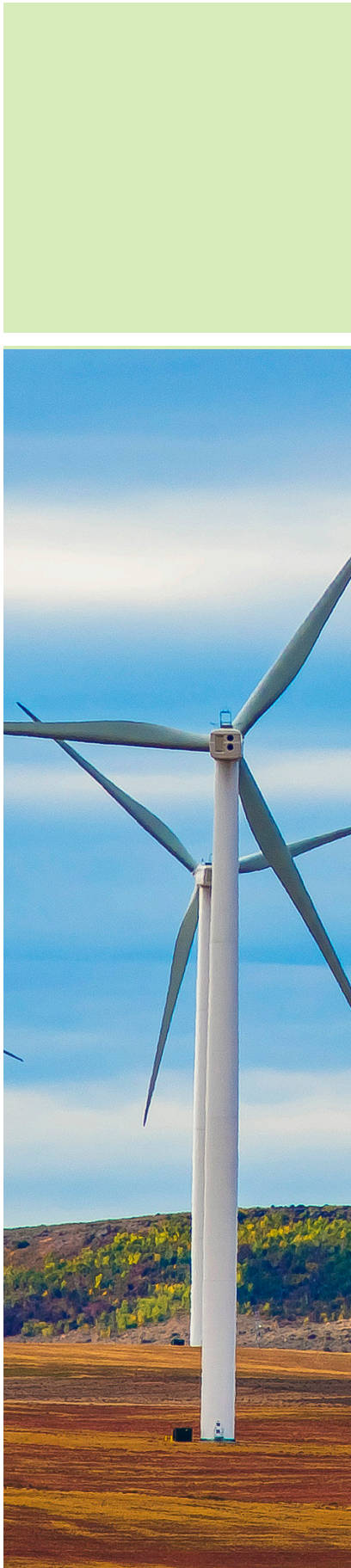
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Coal produces more carbon dioxide per unit of energy than any other energy source.



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Climate Action for Healthy People, Healthy Places, Healthy Planet: Food & Agriculture, Climate Change, and Health



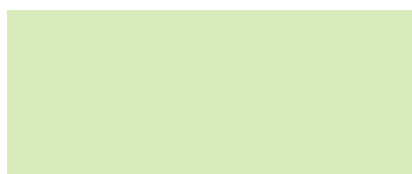
Climate change is the greatest health challenge of the 21st century. It threatens our air, food, water, shelter, and security — the basics on which human life depends. Climate change exacerbates health inequities by disproportionately impacting people living in poverty and communities of color.

At the same time, action on climate change provides one of our greatest health opportunities because many climate change solutions improve community environments and the public's health and reduce health inequities. Everybody benefits.

In this brief we explain the health and health equity benefits of reducing climate pollution from food and agriculture systems. For other **"Climate Action for Healthy People, Healthy Places, Healthy Planet"** briefs see <http://www.usclimateandhealthalliance.org>

Key Messages

- Shifting to healthy diets and local, sustainable food and agriculture systems offers significant health, climate and environmental benefits.¹
 - Local food systems increase access to healthy fruits and vegetables.²
 - Eating less red and processed meat reduces the risk of heart disease and cancer³ and reduces methane emissions from livestock production.
 - Sustainable agricultural practices conserve water, reduce pesticide and fertilizer use, protect topsoil and sequester (store) carbon.⁴
- Reducing food waste and food waste diversion can reduce food insecurity and climate pollution at the same time.⁵
- Poor nutrition — especially overconsumption of calorie-dense foods and meat — is a leading cause of illness in the U.S., associated with diabetes, obesity, and cardiovascular disease.^{6,7}
- Agriculture is a significant source of methane and nitrous oxide, extremely potent climate-warming gases. It is responsible for 9% of U.S. greenhouse gas emissions (GHGE) and about a third of global GHGE.⁸
- Industrial agricultural practices are also associated with antibiotic resistance, water contamination, pesticide illness, and topsoil loss.^{9,10,11}
- Climate change will reduce worldwide food production through adverse impacts on crop yields and fisheries.¹² This will increase food insecurity, and increase the risk of chronic illness and under-nutrition.



Food and agriculture systems affect our health in many ways

Poor diet and nutrition are some of the leading causes of illness and death, contributing significantly to the risk of chronic diseases such as diabetes, cardiovascular disease and cancer.¹³

- Between 2007–2010, over 60% of U.S. children and adults did not meet fruit intake recommendations, and almost 90% did not meet vegetable intake recommendations.^{14 15}
- U.S. consumption of meat, calorie-dense high-fat, high salt foods, and sugar has increased remarkably over the past several decades, driven by big government subsidies for corn and soy crops that have led to cheap meat and processed foods.^{16 17}
- Concentrated animal feeding operations (CAFOs) account for 70% of all antibiotics used in the U.S, providing opportunity for development of antibiotic resistant organisms that can result in antibiotic resistant infections.^{18 19 20}
- Overuse of nitrogen fertilizers results in groundwater contamination with nitrates, which are associated with “blue baby” syndrome.^{21 22}
- Pesticides may cause acute pesticide illness in farmworkers and are associated with cancer, reproductive defects, and impaired mental functioning.²³



? DID YOU KNOW?

Growing soy crops for cattle feed is adding to the destruction of rainforests in Brazil, where deforestation leads to a loss of stored carbon, destroys watersheds, changes weather and adds to climate change.

Food and agriculture systems affect climate change and the environment in many ways

What we eat and the way our food is grown, stored, processed, packaged and transported have important impacts on climate change and on the environment.

- Agriculture was responsible for 9% of total U.S. GHGE in 2013, 52% of methane emissions, and 84% of nitrous oxide release.²⁴ Methane and nitrous oxide are both potent short-lived climate pollutants with global warming potentials far higher than that of CO₂.^{17 25}
- When fertilizer use, refrigeration, transportation, and land use changes, such as deforestation and soil depletion, are taken into account, our food and agriculture systems account for about a third of all U.S. GHGE.²⁶
- Livestock — especially cattle — accounts for nearly half of GHGE from agriculture, emitting 37% of methane, 65% of nitrous oxide, and 64% of ammonia.²⁷
- Total meat consumption reached 271 pounds per person (in 2010), but has slightly decreased in recent years.²⁸ Red meat and dairy production typically cause far greater greenhouse gas emissions than fruit and vegetable production.²⁹
- Growing soy crops for cattle feed is adding to the destruction of rainforests in Brazil, where deforestation leads to a loss of stored carbon, destroys watersheds, changes weather and adds to climate change.
- Livestock production also contributes to the depletion of water resources, topsoil loss, and ecosystem damage.^{27 30}



FAST FACT:

An astounding 40% of food — worth about \$165 billion — goes to waste each year. 23% of methane emissions in the U.S. is due to food waste decay in landfills.



- The application of nitrogen fertilizer accounts for nearly 80% of domestic nitrous oxide emissions.³¹
- Conventional agricultural practices are extremely water intensive. Agriculture uses about 70% of the world's freshwater supply.³² In California, 80% of water is currently used for agriculture, though water management practices can significantly improve water efficiency.^{32 33}
- Food production and processing are energy intensive, accounting for 17% of U.S. fossil fuel use.³⁴ Within the food industry, food production accounts for 83% of carbon emissions, while transportation of food accounts for 11%.³⁵
- An astounding 40% of food — worth about \$165 billion — goes to waste each year.³⁶ 23% of methane emissions in the U.S. is due to food waste decay in landfills.

Climate Change Threatens Global Food Security

Climate change poses a huge threat to global food security, through numerous pathways.

- Drought, extreme temperatures, and precipitation can reduce crop yields.
 - Climate change is expected to lower grain yields and raise crop prices across the developing world, leading to a 20% increase in child malnutrition.
- Prolonged heat stress can affect livestock, making them more vulnerable to disease, reduced fertility, and decreased milk production.
- More frequent and severe droughts are forecast for areas where summer temperatures are increasing and precipitation is decreasing. As water supplies are reduced, it may be more difficult to meet water demands for crops used for human consumption and for feeding livestock.
- Woman and girls' nutrition tends to suffer more during periods of climate-related food scarcity than that of their male counterparts because they are often last in household food hierarchies.
- In a recent Harvard study, researchers found that wheat grains grown at elevated CO₂ levels had 9.3% lower zinc and 5.3% lower iron than those grown at ambient CO₂ levels. These elements are important micronutrients delivered by food.
- Many weeds, pests and fungi thrive under warmer temperatures, wetter climates, and increased CO₂ levels. The ranges of weeds and pests are likely to expand northward, presenting new challenges for farmers, and may drive an increased use of pesticides.

These complex interactions can result in rising food prices, increasing food insecurity — itself associated with increased risks of chronic diseases such as diabetes and hypertension — and political instability.^{37 38 39 40}

We can reduce food-related climate pollution and improve health

If we improve the way we produce and distribute food, eat less meat, and reduce food waste, we can reduce food-related climate and environmental pollution and improve our health.

- The use of available best sustainable agricultural practices could reduce agricultural GHGE by 5-14%, while increasing soil productivity and reducing soil erosion and water contamination^{41 42 43 44} These include better crop management, reduced fertilizer use, soil and degraded land restoration, improved manure management, and increased water efficiency. Healthy soils can also increase the amount of carbon that is stored and kept out of the atmosphere.
- Eating less meat and more fruits and vegetables would decrease greenhouse gas emissions and yield substantial health benefits such as maintaining a healthy body weight, support nutrient adequacy, and reduce the risk of chronic diseases.^{45 46 47 48}
 - One kilogram of beef is roughly equal to 160 highway miles in an average mid-size car. Eating a plant-based diet versus a meat-based diet is comparable to driving a Toyota Camry versus an SUV.^{49 50}
- Reductions in the use of pesticides and antibiotics would reduce pesticide-related illness and water contamination, improve worker safety, and decrease antibiotic resistance.⁵¹
- Building sustainable local food systems can:
 - reduce the use of fossil fuels in food transport, processing, packaging, and storage.
 - increase access to healthy fruits and vegetables.
 - build social capital, neighborhood support systems, and improve mental health.⁵²



? DID YOU KNOW?

One kilogram of beef is roughly equal to 160 highway miles in an average mid-size car. Eating a plant-based diet versus a meat-based diet is comparable to driving a Toyota Camry versus an SUV.

What can we do?

Health professionals have a critical role in building healthy, equitable, sustainable, and climate resilient communities. We can help to achieve substantial climate and health benefits by supporting healthy diets and sustainable food and agriculture systems.

- Support efforts to build more localized, climate resilient food systems, through establishment of community gardens, urban farms, farmer's markets, peri-urban agriculture (agriculture in and near cities), and food hubs.
 - Reduce legal and zoning barriers to the growing and selling of food in urban areas.⁵³
 - Encourage large institutions, such as hospitals, to sponsor farmers' markets and community gardens.
- Increase access to affordable healthy foods.
 - Expand the use of SNAP EBT and financial incentives at farmer's market coupons or mobile fruit and vegetable vendors.⁵⁴
 - Support institutional food procurement policies that preferentially source local and regionally grown foods.⁵⁵



FAST FACT:

We can reduce climate pollution and improve health at the same time by supporting improvements in our diets and in our food and agriculture systems.



- Promote programs that link low-income families to healthy foods, such as nutrition prescription programs.⁵⁶
- Encourage less meat consumption through consumer education and campaigns such as “Meatless Mondays.”⁵⁷
- Reduce food waste.
 - Promote local gleaning and edible food waste diversion programs that increase donations of healthy and usable food from hospitals, restaurants, and groceries to food banks and pantries, and increase composting of food scraps.⁵⁸
 - Educate consumers on reducing food waste by shopping wisely, knowing when food goes bad, and using leftovers.⁵⁹
 - The US Food Recovery Act, currently proposed by Rep. Chelli Pingree, recommends standardizing date labeling practices, which may help reduce the approximately \$29 billion of wasted consumer spending each year by 5-10%.⁶⁰
- Advocate for sustainable farming and land use practices to create climate resilient food systems:
 - Support initiatives that promote farming practices that use environmentally-friendly and energy-efficient growing, processing, and distribution practices, such as drip irrigation strategies for water conservation,^{61 62} and conservation tillage practices that reduce soil degradation.^{63 64}
 - Support the preservation of agricultural lands and natural habitats through tax credits, such as the Natural Heritage Preservation Tax Credit.⁶⁵

Summary

We can reduce climate pollution and improve health at the same time by supporting improvements in our diets and in our food and agriculture systems. The biggest gains in health will come from reducing meat consumption and increasing consumption of sustainably grown fruits and vegetables. We know what we need to do to create a healthier, more equitable, and more climate-friendly and climate resilient food and agriculture system. We need your help to get there.



For More Information

- Equitable Development Toolkit: Local Food Procurement:
http://www.policylink.org/sites/default/files/edtk_local-food-procurement.pdf
- Sustainable Food Systems:
<https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/29/12/34/toward-a-healthy-sustainable-food-system>
- Climate impacts on food systems:
<https://www3.epa.gov/climatechange/impacts/agriculture.html>

Photo page 1: Oregon Department of Agriculture; 3: hadkhanong/Shutterstock.com; page 4: littleny /Shutterstock.com;



DID YOU KNOW?

Local food systems increase access to healthy fruits and vegetables.



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Support initiatives that promote farming practices that use environmentally-friendly and energy-efficient growing, processing, and distribution practices, such as drip irrigation strategies for water conservation.



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FAST FACT:

Climate change is expected to lower grain yields and raise crop prices across the developing world, leading to a 20% increase in child malnutrition.



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Climate Action for Healthy People, Healthy Places, Healthy Planet: Urban Greening & Green Infrastructure, Climate Change and Health



Climate change is the greatest health challenge of the 21st century. It threatens our air, food, water, shelter and security — the basics on which human life depends. Climate change exacerbates health inequities by disproportionately impacting people living in poverty and communities of color.

At the same time, action on climate change provides one of our greatest health opportunities because many climate change solutions improve community environments and the public's health and reduce health inequities. Everybody benefits.

In this brief we explain the health and health equity benefits of urban greening and green infrastructure in the context of climate change. For other “**Climate Action for Healthy People, Healthy Places, Healthy Planet**” briefs see <http://www.usclimateandhealthalliance.org>.

Key Messages

- The health risks of heat, air pollution and flooding are increasing as climate change brings warmer temperatures, more extreme weather events and sea level rise.
- These risks are greatest in “urban heat islands” and in places with aging infrastructure or where natural protections have been weakened.
- Urban greening reduces the risk of heat illness and flooding, lowers energy costs and improves health.
- Green spaces provide places to be physically active and improve our overall well-being.
- Trees sequester carbon dioxide, improve air quality, capture rainwater and replenish groundwater.



FAST FACT:

Higher temperatures lead to higher levels of ozone, which increases risks for asthma and heart attacks.

Climate Change, Urban Heat Islands and Health

- Urban heat islands are areas in cities with many buildings, lots of dark surfaces such as pavement and asphalt, and fewer trees, parks, and green space.¹
 - In these “urban heat islands,” daytime temperatures are on average 1-6° F higher than in surrounding more suburban and rural areas. Nighttime temperatures can be as much as 22° F higher as the heat is gradually released from buildings and pavement. A recent California study found some inland urban areas experienced average temperature increases of up to 19° F.²
 - People living in urban heat islands are at greater risk of heat-related illness.¹³



DID YOU KNOW?

In urban heat islands, nighttime temperatures can be as much as 22° F higher as the heat is gradually released from buildings and pavement.

- Urban areas experience greater air pollution and more negative health impacts during hot summer months.³
- People of color and low-income families are more likely to live in areas with fewer trees and green spaces and are thus more likely to be exposed to the heat risks of urban heat islands.⁴
- People living in poverty are less able to afford the costs of air conditioning, placing them at a higher risk for heat-related illnesses.
- Climate change is projected to increase average summer temperatures and cause more frequent, more severe, and longer heat waves, worsening the effects of urban heat islands and increasing the risks of heat illness and deaths.⁵
 - Heat already causes more deaths than any other type of extreme weather event.⁶ Over the last 15 years heat waves have caused over 70,000 deaths in Europe (2003), 650 in California (2006), 55,000 excess deaths in Russia (2010), and 3,300 in India and Pakistan (2015).
 - Higher temperatures lead to higher levels of ozone, which increases risks for asthma and heart attacks.⁷
 - Warmer weather can also lead to increases in energy demands, particularly summertime air conditioning, increasing the chance of electricity brown-outs.⁸

Urban Greening and Green Infrastructure

- Urban greening refers to strategies that increase trees, parks, gardens, agriculture, forests, and other green and natural space in urban areas.
 - Green infrastructure uses vegetation, soils, and natural processes to manage and create healthier urban environments. Examples include tree planting, rain barrels and rain gardens, green street design with permeable pavements and bioswales, ecosystem restoration and green roofs.^{9 10 11}
 - Green infrastructure can increase resilience to natural disasters and help to reduce the impacts of climate change, such as flooding, storm surges and sea level rise.¹⁴
- Gray infrastructure, sometimes referred to as traditional or hard infrastructure, are man-made structures designed to move water or protect developed areas from flooding. Examples of gray infrastructure include storm sewers, levees, seawalls and detention ponds.
 - Gray infrastructure — often made of concrete — may increase runoff as surface water is unable to be filtered through soil. This contributes to flooding during extreme rain events, and can increase the concentration of pollutants in runoff.
 - Gray infrastructure also retains heat from the air, contributing to the urban heat island effect and increasing nighttime air temperatures.



FAST FACT:

Vegetation has been associated with reduction in traffic noise.

Health benefits of urban greening and green infrastructure

Urban greening and green infrastructure have multiple health, climate, environmental and economic benefits, and contribute to climate resilience.

- Urban greening is an important climate adaptation strategy: it reduces urban heat islands by lowering surface and air temperatures, decreasing the risk of heat illness.^{16 12 13 14}
 - Shaded surfaces, from trees and other plants, may be 20 - 45° F cooler than unshaded surfaces;¹⁵ the surface of a vegetated rooftop can be cooler than the surrounding air, whereas conventional rooftop surfaces can exceed ambient air temperatures by up to 90° F.¹⁶
 - A 0.5° C reduction in the maximum and minimum temperatures has been shown to result in a 50% reduction in heat-related mortality. Green infrastructure could reduce temperatures by 0.5 – 0.7° C.¹⁷
- Trees clean the air by removing harmful pollutants — such as ozone, nitrogen dioxide, and particulate matter.^{18 17} These pollutants cause multiple health effects such as eye irritation, airway constriction, asthma and other respiratory diseases.
- Accessible parks have been associated with greater physical activity, relaxation, social interactions, and improved the quality of life in communities, especially in low-income communities and communities of color.^{19 20 21}
 - Vegetation has been associated with reduction in traffic noise.²²
- Access to green space lowers stress, and even speeds up recovery times in hospitalized patients.^{23 24 25}
- Trees and greenery have been associated with reduction in crime and increases in property value.^{30 26} As with other community design elements, without attention to equity these positive improvements may lead to gentrification and displacement of lower-income residents.²⁷

Environmental Benefits

- Replacing gray infrastructure with green infrastructure can reduce temperatures and heat illness risk in urban heat islands.¹⁵
- Green infrastructure provides more green and cool space, and reduces the risk of flooding.
- Urban greening reduces energy costs.²⁸ For example, using deciduous trees and cultivating green spaces around buildings can provide shade on buildings and decrease air conditionings costs by 20%, especially during extreme heat events.²⁹
³⁰ Green roofs, a vegetative layer grown on rooftops, have been shown to decrease summer cooling costs.³¹
- Trees sequester carbon dioxide (sequestering an estimated 95.5 million metric tons of carbon dioxide in 2006).^{32 33 34}

- Green infrastructure can reduce sewer overflows during storms and recharge groundwater aquifers water by allowing rainwater to soak into the ground. It can also significantly reduce the energy needed to treat and move wastewater.^{12 35 36}
 - Rainwater harvesting and reuse also helps to conserve water.^{37 38}
- Plants and vegetative growth can protect fragile coastal areas and mitigate sea level rise. Vegetation along shorelines can also improve water quality and aquatic habitat.¹²

What can we do?

Health professionals and health agencies have a critical role in building healthy, equitable, sustainable, and climate resilient communities. Greening our communities with trees and green infrastructure is one of the most important things we can do to reduce the risks of heat illness and flooding. There are multiple strategies to improve health and climate resilience through greening:

- Identify tree-poor and park-poor neighborhoods in your community and support targeted greening in these areas.
 - Encourage the use of low-allergenicity trees and vegetation.
- Support the development of an urban greening plan in your community.
- Support retrofitting with green infrastructure — such as bioswales and permeable pavements — during street construction and repair.
- Incorporate green space into street design, particularly in tandem with development of “[Complete Streets](#)” that promote walking and biking.
- Support efforts to fund and build community and school gardens, parks, and initiate community gardens and school gardens.
- Promote the use of green infrastructure for flood protection, including the use of permeable pavements.



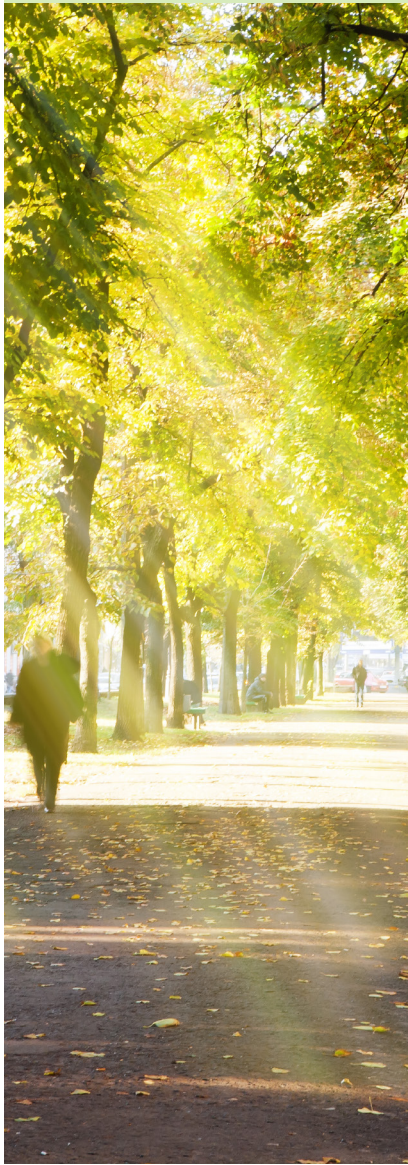
! FAST FACT:

Urban greening and green infrastructure offer health, climate change, and economic benefits for communities.

Summary

Climate change is the greatest challenge of this century, but climate solutions offer tremendous opportunities to improve the health of our communities. Urban greening and green infrastructure offer health, climate change, and economic benefits for communities.

Collective action is needed to confront climate change. Health professionals and health organizations working locally play a critical role in addressing climate change in collaboration with other sectors, and it is necessary to take decisive, aggressive, and immediate action to combat it. Fortunately, a number of opportunities exist to promote urban greening while also enhancing health.



DID YOU KNOW?

Trees and greenery have been associated with reduction in crime and increases in property value.



For More Information

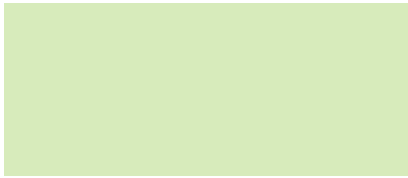
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Citations

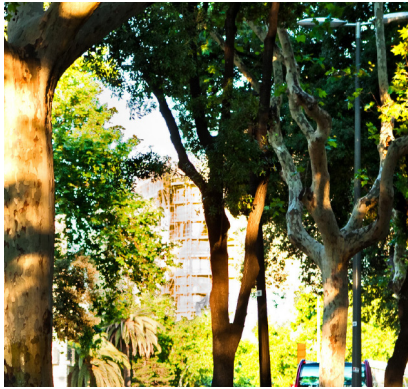
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FAST FACT:

Accessible parks have been associated with greater physical activity, relaxation, social interactions, and improve the quality of life in communities, especially in low-income communities and communities of color.

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