Poison Center & Public Health Collaborations Community of Practice (PCPH CoP)

NEWSLETTER

LETTER FROM THE EDITOR September 2022

Greetings!

The featured topic for the September 2022 edition of the PCPHCoP newsletter is Climate Change and Toxic Exposures. Climate change has devastating effects on the global environment. These environmental effects are already impacting human health in many ways; and as climate change progresses, the impact will only rise. Such effects of climate change have increased the potential risk for human exposure to a variety of different hazardous substances.

This newsletter will focus on a few of the environmental effects of climate change and their potential exposure risks. The National Poison Data System (NPDS) has codes for many of the substances referenced in this newsletter. Thus, there is opportunity to increase the use of the nation's 55 poison control centers (poison centers) and their data for monitoring, identifying, and preventing climate change–related exposures, currently and in the future.

If you would like to hear more about a specific topic in future newsletters, please let me know.

Sincerely,
Cailee Hill, M.P.H.
Community of Practice Facilitator
PCPHCoP@cdc.gov

TABLE OF CONTENTS

Letter From the Editor

Impact of Climate Change

Climate Change and Toxic Exposures

- Extreme Weather
- Air Quality
- Changing Habitats

Poison Centers, NPDS, and Climate Change

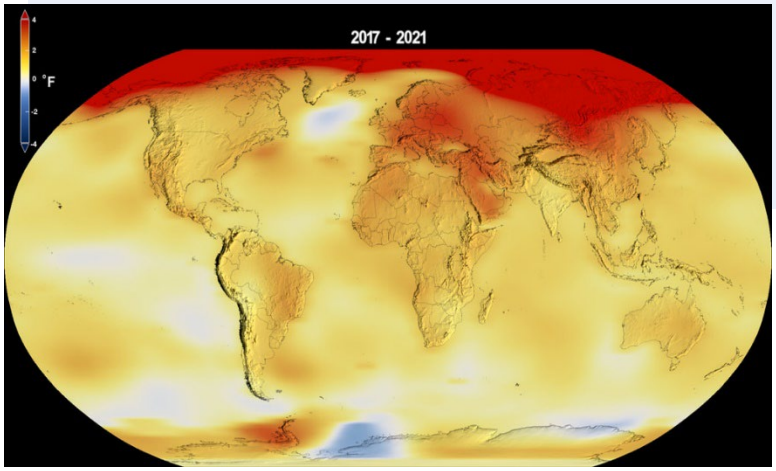
Additional Resources

References

Impact of Climate Change

The National Aeronautics and Space Administration (NASA) defines **climate change** as the "*long-term change in the average weather patterns that have come to define Earth's local, regional, and global climates. These changes have a broad range of observed effects that are synonymous with the term.*[1]"

Climate change encompasses **global warming** but refers to the broader changes happening to the planet, including changes in precipitation, temperature, and wind patterns, as well as plant blooming times.



Global Temperature Anomalies from 1880 to 2021

Global warming is the term used to describe the long-term rise in global temperatures resulting mainly from human activities. Activities such as burning fossil fuels, have resulted in the increase of greenhouse gases in Earth's atmosphere, warming the planet.[1]

Climate change can have a variety of environmental effects, including extreme weather incidents; rising levels of air pollution; changes in land, aquatic, and vector ecosystems and habitats; and changes in water and food quality.

The impact of climate change on human health is vast. The resulting environmental changes not only impact health outcomes such as food shortages, heat-related illness, and mental health, but also have the potential to increase exposure to a variety of toxins. This may lead to an increase in toxic exposure frequency and incidence.[2,3]

Major U.S. Climate Trends[3,4]

Rising temperatures: Average temperature has increased by 1.3°F–1.9°F, with most of this increase occurring since 1970.

Extreme precipitation: Average annual precipitation has increased since 1900, with prominent regional differences.

Floods: Intensity and frequency of heavy downpours are increasing, particularly in the East.

Drought: Intensity and duration of droughts have increased in the West, with groundwater depletion exacerbating the risk.

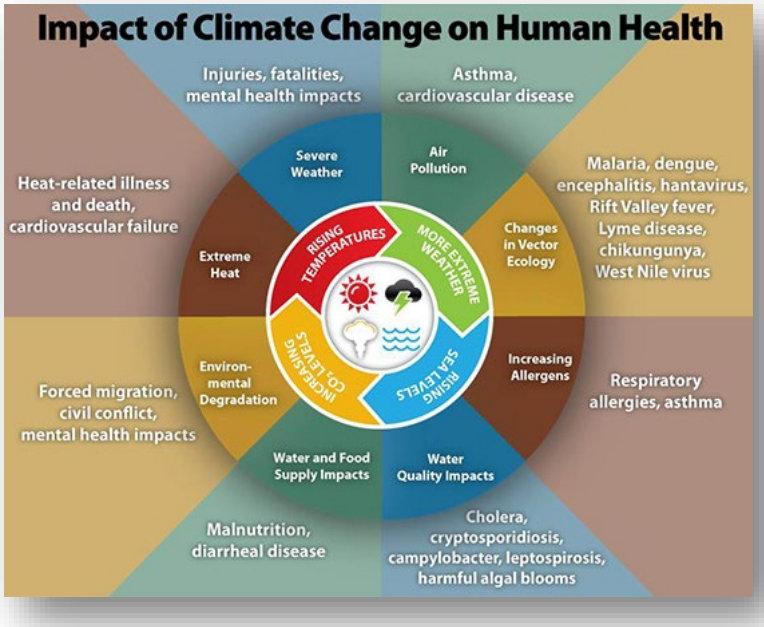
Hurricanes: Intensity, frequency, and duration of hurricanes have all increased since the 1980s.

Heat waves: Heat waves have become more frequent and intense in many regions.

Wildfires: In the West, wildfires are starting earlier, lasting longer, and burning more acreage.

Cold waves and winter storms: Cold waves have decreased in frequency and intensity, while winter storms have increased.

Sea level: Over the last century, sea levels have risen approximately eight inches along the Mid-Atlantic and Gulf coasts.



Climate Effects on Health | CDC

Climate Change and Toxic Exposures

We are already seeing poisonings related to the environmental effects of climate change. As extreme weather incidents increase, land and aquatic habitats change, and air quality worsens. Understanding potential exposures that may affect human health because of climate factors is necessary to prevent, monitor, and respond effectively.

Extreme Weather

Extreme weather incidents such as Hurricane Irma, Hurricane Sandy, and the 2021 Texas winter storm (Winter Storm Uri), have been linked to increased exposures to carbon monoxide (CO) and gasoline.[5,6,8] Hurricanes and winter storms can lead to power outages, leaving those affected to find other sources of indoor energy, such as fuel combustion sources or generators.

Carbon Monoxide and Gasoline Exposures

Hurricane Irma[5]

After Hurricane Irma made landfall in Florida on September 10, 2017, over 90% of Florida counties reported power outages the following day.

An investigation into reported CO poisonings found the following:

- 529 people who met the case definition for CO poisonings
- CO poisoning rates highest among ages 5–14 years
- Most CO exposures caused by generator use

Hurricane Sandy[6,7]

Hurricane Sandy made landfall on October 29, 2012, near Atlantic City, New Jersey. The damage led to widespread power outages and gasoline shortages.

A 4-week study of the regional poison center (PC) data found the following:

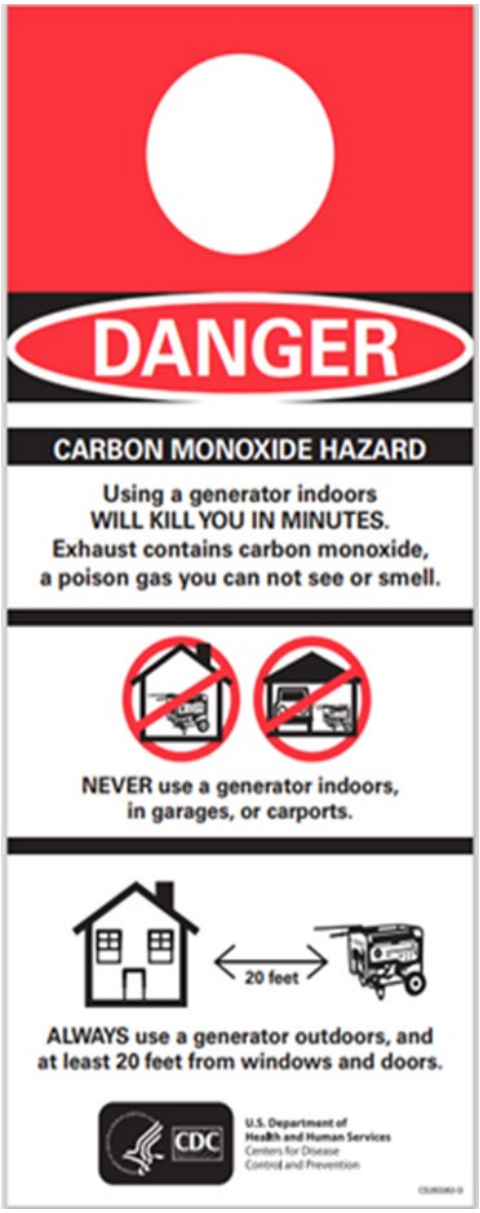
- 290 gasoline exposure cases
- Siphoning was leading cause of exposure

Winter Storm Uri[8,9]

Winter Storm Uri struck Texas in February 2021. At the peak of the storm, more than 4.5 million households lost electricity, some for multiple days.

Media reports and the Texas Department of State Health Services (DSHS) found the following:

- More than 1,400 people sought emergency care for CO poisoning during Feb. 13–20.
- At least 11 fatal CO poisonings were attributed to improper use of generators and heaters, vehicles running in enclosed spaces, and other unsafe practices.



Carbon Monoxide/CO Poisoning Infographics | NCEH (cdc.gov)

Air Quality

Most of today's energy is derived from fossil fuels. The burning of fossil fuels emits large amounts of carbon dioxide (CO_2), black carbon, methane, nitrogen oxides, and sulfur dioxide (SO_2). The overabundance of these gases in the atmosphere account for global warming. Air pollutants can affect the health of all exposed, but they particularly affect groups with higher risk factors within a community.[10]

Groups at higher risk from air pollution exposure:

- 65 years of age and older
- People with preexisting cardiac or respiratory conditions
- People living in low-income communities
- Pregnant women
- Children
- Outdoor workers

Climate change induces respiratory and allergic diseases:[11]

- Local air pollution levels are associated with higher temperatures and increased frequency of heatwaves, both of which increase the morbidity and mortality of respiratory diseases.
- Increases in allergenic species' growth patterns, acting synergistically with air pollution, affect the seasonality and severity of allergic rhinitis and asthma.
- Increased rain and flooding induce dampness and indoor mold growth, which can cause allergic reactions, as well as promote inflammation of the airways.

Wildfires: Ignition sources for wildfires become more common with increases in the frequency and intensity of heatwaves, droughts, and lightning strikes from extreme weather. The main pollutants from wildfire smoke are particulate matter (PM), CO, nitrogen oxides, and volatile organic compounds (VOCs), with chemical reactions also creating ozone. $PM_{2.5}$ (PM that is ≤2.5 microns in diameter) accounts for most of the health burden of outdoor air pollution, and wildfires are a major source of $PM_{2.5}$. Wildfire smoke can increase ambient air pollution and the associated health risks as far as 1000 km away.[12]

Climate change has already led to an increased frequency of large wildfires and longer wildfire seasons. By 2050 wildfires in the western United States are projected to increase concentrations of organic carbon by 40% and elemental carbon by 20%.[3]

California Wildfires[13,14]

- The annual burned area in California is five times higher than it was in the early 1970s.
- 1.5 million acres of the Sierra Nevada burned in the 2021 fire season.
- Large fall fires are becoming increasingly more frequent.

Health effects of wildfire exposure:

- Burns
- Injuries
- Death
- Eye irritation
- Corneal abrasions

Wildfire smoke PM exposure and health associations:[12]

- Studies suggest an association between the level of PM during wildfire and the risk of death, from any cause.
- Short-term wildfire PM exposure is associated with an increased risk of respiratory incidents, including hospitalizations, emergency department visits, physician visits, and medication use for asthma, chronic obstructive pulmonary disease, and respiratory infections.

CDC: Air Quality

Firefighters and local residents near fires are most at risk.

Habitat Changes

Changing temperatures and precipitation patterns are affecting aquatic and land ecosystems, altering the natural habitats of plant and animal life. These changes in the habitat and subsequently the geographical distribution of poisonous and venomous organisms may increase the potential for human exposure, depending on an organism's adaptability and/or migration.[15,16,17]

Aquatic Habitats

Warming waters, rising sea levels, and increased CO_2 absorption have caused serious harm to aquatic ecosystems. These changes are causing multiple effects on the quantity and distribution of venomous and toxic aquatic life.

Harmful algae blooms (HABs): Though increased surveillance may be partially responsible, increased HABs have been attributed to the effects of climate change combined with increased phosphorous and nitrogen levels in waters due to fertilizer runoff. This is not only affecting increases in bloom frequency and growth, but also changes in the dominance of several toxin-producing algae and cyanobacteria species.[15]

Ciguatera fish poisoning (CFP): Algal toxins and ciguatoxins (CTXs) are produced by dinoflagellates. These dinoflagellates are ingested by other organisms, specifically surface feeding fish. Human consumption of the contaminated fish lead to CFP. One study found that some of the common dinoflagellate CTX species in the Gulf of Mexico are projected to increase because of higher growth rates, as well as expand northward as oceans warm.[16]

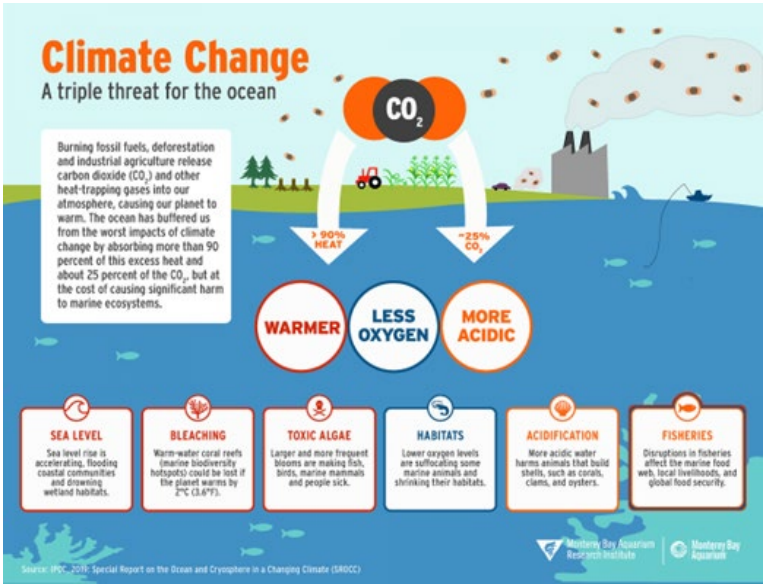
CFP symptoms

- ***Short-term***: nausea, vomiting, diarrhea, and stomach pain
- ***Long-term***: hot and cold sensations, pain, weakness, and low blood pressure

Land Habitats

Venomous snakes: Snakes are cold-blooded animals whose activities, life cycle, and geographic distribution are tied to ambient temperature. The effect of climate change on snakes varies between species. Most current evidence suggests that warming temperatures and their diminishing food supply will negatively impact snake populations.[17] While snakes relocate to more suitable regions and search for food, there may be increased human encounters.

A 20-year study on California snakes found that snakebite incidence decreased following drought, while it increased after precipitation.[18]



Monterey Bay Aquarium: Centering the ocean in the climate conservation

Vector-borne diseases[3]: Like other organisms, the geographical distribution of disease carrying vectors, such as mosquitos and ticks, will be affected by climate change.

- Ticks capable of carrying Lyme disease bacteria and other pathogens will show earlier seasonal activity and expand into new habitats.
- Extreme weather, changing precipitation, and higher temperatures will affect the prevalence, abundance, and distribution of mosquitos that transmit West Nile virus and other pathogens.
- Vector-borne pathogens are expected to emerge or re-emerge because of climate change and changing land use patterns.

Changing vector distribution may impact the amount and type of pesticides being applied. This could lead to increased pesticide exposures and poisonings.

Aedes aegypti mosquitos (photo above) can carry pathogens that cause diseases including dengue fever, chikungunya, and Zika fever.

Poison Control Centers, NPDS, and Climate Change

Poison center and NPDS Utilization for Climate Change–related Exposures: Past, Present, and Future

Past extreme weather incidents

Hurricane Irma: The Florida Department of Health (FDOH) used healthcare and laboratory reports, the Electronic Surveillance System for Early Notification of Community-based Epidemics, and the Florida Poison Information Center Network (FPICN) statewide database to investigate carbon monoxide (CO) exposures and poisonings during Hurricane Irma. Without emergency department and FPICN data, FDOH would have missed 60% of the hurricane-related CO poisoning cases.[5]
Hurricane Sandy: German et. al analyzed the New Jersey Poison Information and Education System's (NJPIES) call patterns in the days preceding, during, and after Hurricane Sandy. The report found the most frequent exposures to be gasoline and CO, followed by food poisoning and water contamination.[6] Kim et al used NJPIES data to compare gasoline exposures from the four weeks after Hurricane Sandy made landfall, to the previous years. Analyzing the NJPIES call data identified the leading exposure routes, the substantial increase in exposures compared to the previous four years, and the need for more education and intervention to improve the proper use and handling of gasoline-powered generators.[7]
Winter Storm Uri*:* A spokesperson for the Texas Department of State Health Services, shared with news outlets that the Texas Poison Center Network received 450 CO-related calls during February 11–18.[19]

Air quality

NPDS has existing codes for smoke, ozone, and respirable particulates. Increased training and use of the codes could help monitor these climate change–related exposures.

Other possible PCs and NPDS data applications[20]

- Create a wildfire code
- Syndromic surveillance for respiratory and cardiac related symptoms in locations impacted by poor air quality
- Analysis of changes to allergy medication exposure with historical comparisons

Aquatic and land habitat changes

HABS	***Snakes***	***Vectors***
NPDS has existing codes for blue-green algae and a case-based definition for ciguatera. ***PCs and NPDS data applications*** • Monitor HAB exposures during an active bloom • Surveillance of geographical and distributional changes in HABs and ciguatera exposures • Analysis of historical HABs and ciguatera case data correlated with historical climate data	NPDS has existing codes for snake envenomation. ***PCs and NPDS data applications*** • Surveillance of geographical and distributional changes in snakebite exposures • Surveillance of snakebite exposures during and after extreme weather incidents • Analysis of historical snakebite case data correlated with historical climate data[20]	NPDS has recently been beneficial for monitoring emerging infectious diseases of public health concern. NPDS has also been monitoring pesticide exposures for years. ***PCs and NPDS data applications*** • States projected to have increases in tick populations can start monitoring for tick exposures • Monitor for emerging and re-emerging vector-borne diseases • Monitor increases in pesticide exposures

Conclusions

This is a small snapshot of the potential poisonings and toxic exposures associated with climate change. With NPDS collecting near real-time national exposure data from the nation's 55 poison centers, there is an opportunity to monitor and assess climate change–related exposures. Though some exposures related to climate change are already being monitored, as climate health hazards continue to increase and change, it will be prudent to determine how NPDS can be utilized best, both currently and in the future.

Looking into the future, it may be beneficial for PC jurisdictions to start brainstorming dashboards specific to climate change–related exposures that may affect their region (e.g., near real-time waterborne dashboard). Such dashboards could be an additional tool for exposure trends and analysis.[20]

PCs also provide a direct line of communication with the public, creating opportunities to capture data beyond what is available in the NPDS database. Through regional collaboration, these data could help public health departments better understand and respond to the impacts of climate change.[20]

As climate change progresses, interagency collaboration will be important to accurately monitor the climate change–related health impacts and effectively educate the public on preventative measures.

How will climate change affect the environment and ecology of your agency's jurisdiction? How can your agency prepare for the environmental exposures that may affect your community members most?

Additional Resources

Climate Effects on Health | CDC

American Association of Poison Control Centers - Annual Reports (aapcc.org)

Announcements

The next quarterly PCPHCoP webinar will be held October 19, 2022, 3 p.m. to –4 p.m. ET.

If anyone wants to be added to the CoP email distribution list, they can email their request to PCPHCoP@cdc.gov.

References

1. NASA. Climate Change: Vital Signs of the Planet. Climate Change: Vital Signs of the Planet. Published 2019. https://climate.nasa.gov
2. CDC. *PREPARING for the REGIONAL HEALTH IMPACTS of CLIMATE CHANGE in the UNITED STATES*.; 2020. https://www.cdc.gov/climateandhealth/docs/Health_Impacts_Climate_Change-508_final.pdf
3. Crimmins A, Balbus J, Gamble JL, et al. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Published online 2016. doi:10.7930/j0r49nqx
4. Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2
5. Mulay PR, Mulay PR, Atrubin D, Rubino H, Blackmore C. Utilizing Syndromic Surveillance for Hurricane Irma-Related CO Poisonings in Florida. *Online Journal of Public Health Informatics*. 2019;11(1). doi:10.5210/ojphi.v11i1.9940
6. German SB, Thomas PA, Ruck B, Marshall EG, Davidow AL. Poisonings After a Hurricane: Lessons From the New Jersey Poison Information and Education System (NJPIES) During and Following Hurricane Sandy. *Disaster Medicine and Public Health Preparedness*. Published online September 1, 2020:1–3. doi:10.1017/dmp.2020.201
7. Kim HK, Takematsu M, Biary R, Williams N, Hoffman RS, Smith SW. Epidemic Gasoline Exposures Following Hurricane Sandy. *Prehospital and Disaster Medicine*. 2013;28(06):586–591. doi:10.1017/s1049023x13009023

8. News LC and PT The Texas Tribune and ProPublica, and Suzy Khimm, NBC. Texas must do more to effectively prevent carbon monoxide disasters, experts say. The Texas Tribune. Published September 3, 2021. https://www.texastribune.org/2021/09/03/texas-winter-storm-carbon-monoxide-disasters/
9. Busby JW, Baker K, Bazilian M, et al. Cascading risks: Understanding the 2021 winter blackout in Texas. *Energy Research & Social Science*. 2021;77:102106. doi:10.1016/j.erss.2021.102106
10. US EPA O. Power Plants and Neighboring Communities. www.epa.gov. Published January 24, 2021. https://www.epa.gov/airmarkets/power-plants-and-neighboring-communities
11. Eguiluz-Gracia I, Mathioudakis AG, Bartel S, et al. The need for clean air: The way air pollution and climate change affect allergic rhinitis and asthma. *Allergy*. 2020;75(9). doi:10.1111/all.14177
12. Xu R, Yu P, Abramson MJ, et al. Wildfires, Global Climate Change, and Human Health. *New England Journal of Medicine*. 2020;383. doi:10.1056/nejmsr2028985
13. 2021: Another historic Sierra Nevada fire season. Sierra Nevada Conservancy. Published January 24, 2022. https://sierranevada.ca.gov/2021-another-historic-sierra-nevada-fire-season
14. Williams AP, Abatzoglou JT, Gershunov A, et al. Observed Impacts of Anthropogenic Climate Change on Wildfire in California. *Earth's Future*. 2019;7(8):892–910. doi:10.1029/2019ef001210
15. Summary Report – One Health Harmful Algal Bloom System (OHHABS), United States, 2019. Centers for Disease Control and Prevention (CDC). Published 2021. https://www.cdc.gov/habs/ data/2019-ohhabs-data-summary.html
16. Kibler SR, Tester PA, Kunkel KE, Moore SK, Litaker RW. Effects of ocean warming on growth and distribution of dinoflagellates associated with ciguatera fish poisoning in the Caribbean. *Ecological Modelling*. 2015;316:194–210. doi:10.1016/j.ecolmodel.2015.08.020
17. Crowell HL, King KC, Whelan JM, et al. Thermal ecology and baseline energetic requirements of a large-bodied ectotherm suggest resilience to climate change. *Ecology and Evolution*. 2021;11(12):8170–8182. doi:10.1002/ece3.7649
18. Phillips C, Lipman GS, Gugelmann H, Doering K, Lung D. Snakebites and climate change in California, 1997–2017. *Clinical Toxicology*. 2018;57(3):168–174. doi:10.1080/15563650.2018.1508690
19. Treisman R. "A Disaster Within a Disaster": Carbon Monoxide Poisoning Cases Are Surging in Texas. *NPR*. https://www.npr.org/sections/live-updates-winter-storms-2021/2021/02/18/969050038/a-disaster-within-a-disaster-carbon-monoxide-poisoning-cases-are-surging-in-texa. Published February 18, 2021.
20. Brown K. Use of the national poison data system (NPDS) and poison center data for monitoring human health outcomes related to climate change [White paper]. American Association of Poison Control Centers. 2022.
21. Climate and Health Program. Centers for Disease Control and Prevention. Published 2019. https://www.cdc.gov/climateandhealth/default.htm