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U.S. public health response to climate change, for allergists-immunologists

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Climate change is already affecting public health through pathways like pollen, air quality, wildfires, and precipitation extremes or temperature extremes.[1, 2] This Perspective highlights some climate change-related health impacts and U.S. public health response activities affecting allergy-immunology.

Examples of how climate change can affect people with allergic-immunologic conditions

Climate change can affect anyone's health. Some people and communities are disproportionately affected, including children, pregnant persons, older adults, and those who are socially or economically disadvantaged.[1, 2] Health impacts can vary depending on individuals' medical conditions.[2]

Table 1 introduces some allergic-immunologic conditions that can be affected by climate change, how allergists-immunologists can help patients with these conditions, and relevant resources from the U.S. Centers for Disease Control and Prevention (CDC). For example, for people with allergic rhinoconjunctivitis sensitized to seasonal aeroallergens (e.g., pollens, outdoor molds), the onset and duration of their "allergy season" can be influenced by climate change-associated increases in the number of frost-free days and seasonal air temperatures.[2] Allergists-immunologists can consider using resources i and ii in Table 1 to educate patients, including what patients can do to protect their health. Also,

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climate change-related increases in heavy precipitation events (e.g., floods, hurricanes) can contribute to more mold growth in homes and other buildings, because of excess moisture and standing water after these events[2]; for people with mold allergy, increased exposure to mold in affected buildings can worsen allergy symptoms (resources iii–v in Table 1).

Climate change can worsen asthma symptoms through various pathways. Ground-level ozone is formed in a heat-sensitive reaction; high ambient temperatures and stagnant air conditions are associated with higher levels of ground-level ozone.[2] In some locations, climate change is projected to increase levels of ground-level ozone or possibly particulate matter, which can both worsen asthma symptoms (resources vi and vii in Table 1).[2] Heat waves have become more frequent since the mid-1960s and are projected to become longer and more intense.[2] For some people with asthma, exposure to extreme summer heat can worsen asthma symptoms (resource viii in Table 1); extreme heat can disproportionately affect people without secure housing or air conditioners.[1–3] People with asthma and mold allergy can experience more respiratory symptoms after heavy precipitation events if they are exposed to mold in affected buildings. Concomitantly, climate change has contributed to changes in the frequency, duration, and geographic distribution of droughts, which can increase the risk of wildfires.[2] While wildfire smoke can affect anyone's health, people with asthma are especially at risk of experiencing increased respiratory symptoms (resource xii in Table 1).[2]

Climate change-related disasters (e.g., floods, wildfires) can complicate management of any medical condition, including allergic-immunologic conditions not mentioned above. For example, disasters can affect usual access to medications (e.g., for atopic dermatitis or hereditary angioedema), medical services (e.g., allergen immunotherapy or supplemental gamma globulin, or electricity (e.g., to refrigerate perishable, allergen-free foods).[3] Emergency action plans can help people stay healthy in an emergency; collecting and protecting asthma action plans and/or food allergy and anaphylaxis care plans (when medically indicated) is part of an emergency action plan (resource xiii in Table 1).

Examples of the U.S. public health response to climate change relevant to allergists-immunologists

CDC's Climate and Health Program (CHP), established in 2009, is a national leader in empowering communities to protect human health from climate change.[1] CHP activities include conducting epidemiologic studies and supporting state, tribal, local, and territorial public health agencies (through technical assistance and funding) to implement the Building Resilience Against Climate Effects (BRACE) framework.[1] Below are examples of CHP-supported work, through the Climate-Ready States and Cities Initiative, relevant to medical conditions often managed by allergists-immunologists.

The Minnesota Climate and Health Program (MCHP), in the Minnesota Department of Health, has engaged in multiple activities addressing climate change and health.[4] For instance, MCHP helped initiate the collection and display of Minneapolis-area pollen data in the Minnesota Public Health Data Access Portal (available at https://data.web.health.state.mn.us/pollen_charts), including pollen season length, annual number

of elevated pollen days, and pollen data by type (tree, grass, or weed) or species. Moreover, MCHP worked with the Minnesota Pollution Control Agency to develop health-based Air Quality Alert templates (e.g., about particulate matter and ozone) and improve an air quality alert program to help inform and protect Minnesota residents, including those with asthma or other respiratory diseases.[4]

The San Francisco Climate and Health Program (SFCHP), in the San Francisco Department of Public Health, has conducted various activities to protect human health from climate change.[5] For example, SFCHP helped develop and disseminate resource sheets for clinicians on aspects of climate change pertinent to patients with allergic-immunologic conditions and others; topics include air quality preparedness and extreme heat preparedness.[5] Each resource sheet has local, state, and national resources that clinicians can use to help or inform their patients.[5] Also, SFCHP has developed educational resources for the general public, such as information on how individuals (including property owners and renters) can prepare for flood events, report mold in buildings, reduce their exposure to mold, and remediate mold in buildings with or without a contractor.[5]

To expand on existing efforts, CDC plans to implement and evaluate a strategy focusing on climate and health data, science, and action.[1] Goals of this three-pronged strategy include: increasing understanding of the impacts of climate change and the effectiveness of adaptation strategies; supporting locally led response actions; and using data to inform, track, and evaluate these actions.[1] Health equity and environmental justice will be prioritized in these activities.[1] This strategy is designed to be widely applicable, including to allergists-immunologists.

Conclusion

Climate change can affect the health of anyone, including people with allergic-immunologic conditions.[2] Everyone can do their part to prepare for and prevent health effects associated with climate change.[2] For example, allergists-immunologists can consider using the example action steps and available CDC resources in Table 1 when interacting with patients. Healthcare providers, public health officials, and others can work together to help communities and individuals become more prepared for the health impacts of climate change.[1–3]

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Abbreviations/Acronyms:

CDC	Centers for Disease Control and Prevention
CHP	CDC’s Climate and Health Program
MCHP	Minnesota Climate and Health Program

SFCHP San Francisco Climate and Health Program

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Table 1.

Examples of allergic-immunologic conditions that can be affected by climate change, how allergists-immunologists can help patients with these conditions, and relevant CDC resources

Health condition	Examples of how allergists-immunologists can help patients with conditions that may be affected by climate change*
Allergy to pollen	• Allergists/immunologists can encourage patients with pollen allergy, their families, and their caregivers to: – Learn more about pollen and health (e.g., by using resources i–ii below). – Check pollen forecasts on local news or online sources (e.g., https://pollen.aaaai.org). – Try to spend less time outdoors (if possible) when pollen levels will be high.
Allergy to mold	• Allergists/immunologists can encourage patients with mold allergy, their families, and their caregivers to: – Learn more about mold and health (e.g., using resource iii). – Check mold forecasts on local news or online sources. – Plan to spend less time outdoors (if possible) when outdoor mold levels will be high. • Allergists/immunologists caring for patients in areas with increased risk of severe flooding (e.g., areas often affected by hurricanes) can: – Learn more about information that can be provided to patients about mold after hurricanes or tropical storms (e.g., using resource iv). – Encourage patients, their families, and their caregivers to use the Homeowner's and Renter's Guide to Mold Cleanup After Disasters (resource v), to learn how to clean up mold safely.
Asthma	• Allergists/immunologists can teach patients with asthma, their families, and their caregivers to: – Learn more about **outdoor (ambient) air pollution** and health (e.g., using resources vi–vii). – Use air quality measurements or air quality alerts to know when outdoor air pollution levels might be harmful in their area and adjust outdoor activities when air pollution levels are high. Many local TV stations, radio programs, and newspapers report the Air Quality Index; also, individuals can access this information using https://www.AirNow.gov, the AirNow app, or an email subscription from http://www.enviroflash.info. – Consider taking the following steps when outdoor air pollution levels may be harmful in their area: - Try spending more time indoors, where outdoor air pollution levels are usually lower. - Choose easier outdoor activities (like walking instead of running), that do not involve breathing as hard. • Allergists/immunologists caring for patients in areas or communities with increased risk of **extreme heat** can encourage patients, their families, and their caregivers to: – Use CDC's Heat & Health Tracker (resource viii) to explore how extreme heat affects their county and other information. – Learn more about how to prevent heat-related illness by staying cool, staying hydrated, and staying informed (e.g., using resources ix–x). – Review and follow manufacturer's instructions regarding recommended temperatures for storage of asthma inhalers (because temperatures above 120° F might cause pressurized canisters [e.g., an albuterol inhaler] to burst†). • Allergists/immunologists caring for patients in areas with increased risk of **severe flooding** (e.g., areas often affected by hurricanes) can: – Learn more about information that can be provided to patients about mold after hurricanes or tropical storms (e.g., using resource iv). – Encourage patients, their families, and their caregivers to learn more about taking care of asthma before, during, and after a hurricane or tropical storm (e.g., using resource xi). • Allergists/immunologists caring for patients in areas with increased risk of **wildfires** can encourage patients, their families, and their caregivers to: – Learn more about taking care of themselves before, during, and after a wildfire (e.g., using resource xii).

Health condition	Examples of how allergists-immunologists can help patients with conditions that may be affected by climate change*
	– Keep track of nearby wildfires, by using https://fire.airnow.gov or listening to the Emergency Alert System (EAS) and National Oceanic and Atmospheric Administration (NOAA) Weather Radio for emergency alerts.
Any allergic-immunologic condition	• Allergists/immunologists can encourage patients with any allergic/immunologic condition, their families, and their caregivers to: – Develop emergency action plans (as described in resource xiii) to use during climate change-related disasters that might disrupt usual access to medications, medical services, or electricity. – Learn more about climate-related health considerations that might affect where they live (e.g., regional health impacts of climate for ten U.S. regions are accessible through resource xiv).

Examples of relevant CDC resources for allergists-immunologists and their patients

i.	Climate Change and Public Health – Health Effects – Pollen and Your Health: https://www.cdc.gov/climateandhealth/effects/pollen-health.htm
ii.	Allergens and Pollen: https://www.cdc.gov/climateandhealth/effects/allergen.htm
iii.	Basic Facts about Mold and Dampness: https://www.cdc.gov/mold/faqs.htm (available in English, Arabic, Chinese, Creole, French, Portuguese, Spanish, and Vietnamese)
iv.	Information for Clinicians Helping Patients with Asthma, Other Respiratory Conditions, and/or Allergies to Mold After a Hurricane or Other Tropical Storm: https://www.cdc.gov/disasters/clinicians_asthma.html
v.	Homeowner's and Renter's Guide to Mold Cleanup After Disasters: https://www.cdc.gov/mold/cleanup-guide.html (available in English, Spanish, and Vietnamese; CDC developed this document in collaboration with the U.S. Environmental Protection Agency, the Federal Emergency Management Agency, the U.S. Department of Housing and Urban Development, and the National Institutes of Health)
vi.	Particle Pollution: https://www.cdc.gov/air/particulate_matter.html
vii.	Ozone and Your Health: https://www.cdc.gov/air/ozone.html
viii.	Heat & Health Tracker: https://ephtracking.cdc.gov/Applications/heatTracker
ix.	Climate and Health – Temperature Extremes: https://www.cdc.gov/climateandhealth/effects/temperature_extremes.htm
x.	Tips for Preventing Heat-Related Illness: https://www.cdc.gov/disasters/extremeheat/heattips.html
xi.	Asthma Care Before, During, and After a Hurricane or Other Tropical Storm: https://www.cdc.gov/disasters/asthma_control.html
xii.	Protect Yourself from Wildfire Smoke: https://www.cdc.gov/air/wildfire-smoke/default.htm
xiii.	Plan Ahead – Prepare Your Health: https://www.cdc.gov/prepyourhealth/planahead/index.htm
xiv.	Climate Effects on Health: https://www.cdc.gov/climateandhealth/effects/default.htm

CDC, Centers for Disease Control and Prevention.

* In addition to the examples of action steps and resources provided in the table, allergists-immunologists can contact their local, state, tribal, or territorial public health agency to inquire about other relevant resources that could be useful in their work. Contact information for selected programs on climate and health in public health agencies is available at https://www.cdc.gov/climateandhealth/crsci_grantees.htm and https://www.nihb.org/public_health/climate_ready_tribes.php.

† https://dailymed.nlm.nih.gov/dailymed/fda/fdaDrugXsl.cfm?setid=ad299502-8779-d280-e053-2995a90a7371