

Climate Change and Skin Disease

Ashley D. Lundgren, MD



Despite commanding essentially universal scientific consensus, climate change remains a divisive and poorly understood topic in the United States. Familiarity with this subject is not just for climate scientists. The impact of climate change on human morbidity and mortality may be considerable; thus, physicians also should be knowledgeable in this realm. Climate change science can seem opaque and inferential, creating fertile ground for political polemics and undoubtedly contributing to confusion among the general public. This puts physicians in a pivotal position to facilitate a practical understanding of climate change in the public sphere by discussing changes in disease patterns and their possible relationship to a changing climate. This article provides a background on climate change for dermatologists and highlights how climate change may impact the management of skin disease across the United States.

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The term *climate* refers to the average weather conditions of a specific geographic location measured over several decades.¹ While a certain degree of variation in the Earth's climate is expected, a persistent warming or cooling trend is not. The factors driving the Earth's warming remain difficult to prove.² We know the Earth previously has undergone dramatic climate changes and that natural factors driving these changes are varied (eg, the relationship between the Earth and the Sun, volcanic eruptions, solar irradiance).^{1,3} These factors ideally change over protracted periods of time in a way that allows organisms to adapt to new environments.

Anthropogenic climate change refers to human-caused climate change. This is thought to be a major driving factor in the Earth's recent warming trend, partly due to the rapidity of warming in recent years.³ According to climate scientists, the Earth's temperature has risen 4°C to 7°C over the past 5000 years, but it has risen 0.7°C

in just the past 100 years alone.⁴ Greenhouse gases such as carbon dioxide are emitted by various natural processes and human activities and play a central role in current warming because they trap solar heat and increase ambient temperature.³

In a recent edition of the commonly cited textbook *Dermatology*, Bologna et al⁵ referenced climate change only once in a figure legend regarding the expansion of dengue fever in the Americas. However, climate change may have the potential to cause outright skin disease epidemics worldwide, and the Climate Change Committee of the International Society of Dermatology has called upon dermatologists across the globe to help raise awareness of this issue.⁶

Much of the literature regarding the effects of climate change on human health focuses on insect-borne diseases, but over the past decade other areas of impact also have been investigated, such as increases in airborne diseases, zoonoses, newly endemic saprophytic and dimorphic fungal infections, fecal-oral diseases, and severe allergic disease.^{7,8} It is postulated that climate change leads to region-specific increases in human disease because it creates newly favorable habitats for infectious agents, their vectors, and their reservoirs, allowing expansion of their ranges and access to immunologically naïve populations.⁹ Furthermore, extreme weather events such as heat waves, hurricanes, and flooding, which are expected to increase in frequency as a result of climate change, have all been linked to infectious disease outbreaks.¹⁰

Lyme Disease

In the past 20 years, Lyme disease incidence has tripled in the United States.¹¹ It has been hypothesized that the increase may be occurring as a result of the expanding

From the Division of Dermatology, University of Texas Dell Medical School, Austin.

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Correspondence: Ashley D. Lundgren, MD, 313 E 12th St, Ste 103, Austin, TX 78701 (ashley.diana@gmail.com).

geographic distribution of the *Ixodes* tick and its mammalian hosts (eg, white-tailed deer) under the influence of climate change.¹² Lyme disease is a multisystem disease affecting the skin, joints, heart, and nervous system. Its most characteristic manifestation is cutaneous in the form of erythema migrans. Dermatologists may be called upon to play an increasingly important role in early detection and treatment of this potentially chronic and debilitating condition.

Arboviruses

Arboviruses are transmitted by arthropods and are an important category of climate change–related diseases due to the expansion of the mosquito habitat worldwide. The vectorial capacity for the transmission of dengue fever has increased worldwide by 9.4% via *Aedes aegypti* and 11.1% via *Aedes albopictus* since 1950.¹³ Dengue fever, also known as breakbone fever, presents with intense joint pain, fevers, headaches, and a transient morbilliform rash that desquamates with defervescence and in some cases will incite hemorrhagic skin lesions.¹⁴ Dengue fever previously was considered to be a tropical disease but locally acquired cases have been reported in the United States, including Texas, Hawaii, and Florida.^{15,16}

Reports of local transmission of chikungunya, another arbovirus transmitted by *A albopictus* and *A aegypti* mosquitoes in Florida, the US Virgin Islands, and Puerto Rico, began in 2014.¹⁷ A higher prevalence of these diseases within the United States also may be related to increased globalization, with US travelers returning from endemic regions with infections. Prior to 2014, transmission occurred in traditional endemic regions, primarily in Asia, Africa, or island nations in the Indian Ocean. Like dengue fever, chikungunya causes high fevers, cutaneous manifestations (eg, urticarial papules, morbilliform eruption, hypermelanosis, intertriginous lesions, lymphedema),¹⁷ and intense joint pain. Unlike dengue fever, however, joint involvement can be chronic, erosive, and debilitating.

Lastly, New World leishmaniasis, an arboviral disease characterized by mucocutaneous ulcers and transmitted by phlebotomine sand flies, has been acquired locally in Oklahoma and Texas when it was previously considered to be endemic to Mexico and Central and South America.^{14,18} The habitats of New World *Leishmania* species are expected to expand northward, with an ecological niche model predicting that they reach southern Canada by the year 2080 due to the expanding habitats of sand fly and rodent vectors.¹⁹

Fungal Infections

In the Pacific Northwest, there have been reports of newly endemic *Cryptococcus gattii* and *Coccidioides immitis*, both of which previously had been confined to the southwestern United States.⁸ Endemic ranges of these mycotic pathogens may be expanding for a variety of reasons, with climate change creating new regions conducive to the

colonization of these species.^{8,20,21} *Coccidioides immitis* is a soil-dwelling fungus that usually presents with primary pulmonary disease that can disseminate acutely or even months later. Prompt recognition of disseminated disease may allow life-saving therapy to be initiated. *Cryptococcus gattii* is a fungus with multiple niches, including oil, trees, and birds.²⁰ This fungus also is acquired via inhalation, with dissemination occurring most commonly in immunosuppressed patients to the central nervous system, bone, and skin. Primary or secondary infection with both of these fungi may present with cutaneous manifestations presenting as polymorphous lesions, including umbilicated or ulcerated papules, indurated nodules, and acneiform pustules.

Final Thoughts

Awareness of the shifting habitats of microorganisms and vectors locally is important in order for clinicians to make correct diagnoses in a timely fashion. Regional or endemic diseases are presenting outside their traditional boundaries due to changing habitats of microbes and vectors and may be easily overlooked, resulting in a delayed diagnosis. Being prepared to diagnose diseases with increasing incidence secondary to climate change and discussing this with patients is an important physician obligation, but it is not the only one. We cannot effectively advocate for the health of patients and the community while ignoring the destruction of the environment. Our additional responsibility is straightforward—being advocates for good stewardship of the Earth's resources now on both a personal and a policy level.²²

REFERENCES

1. Climate Central. *Global Weirdness: Severe Storms, Deadly Heat Waves, Relentless Drought, Rising Seas, and the Weather of the Future*. New York, NY: Pantheon Books; 2012.
2. Cook J, Nuccitelli D, Green SA, et al. Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environ Res Lett*. 2013;8:024024.
3. A blanket around the Earth. NASA Climate website. <https://climate.nasa.gov/causes/>. Accessed February 5, 2018.
4. How is today's warming different from the past? NASA Earth Observatory website. <https://earthobservatory.nasa.gov/Features/GlobalWarming/page3.php>. Accessed February 5, 2018.
5. Mancini AJ, Shani-Adir A, Sidbury R. Other viral diseases. In: Bologna JL, Schaffer JV, Cerroni L, eds. *Dermatology*. 4th ed. Philadelphia, PA: Elsevier; 2017:1425-1446.
6. Andersen LK, Davis MDP. A wake-up call to dermatologists—climate change affects the skin. *Int J Dermatol*. 2017;56:E198-E199.
7. Liang L, Gong P. Climate change and human infectious diseases: a synthesis of research findings from global and spatio-temporal perspectives [published online March 23, 2017]. *Environ Int*. 2017;103:99-108.
8. Lockhart SR, McCotter OZ, Chiller TM. Emerging fungal infections in the Pacific Northwest: the unrecognized burden and geographic range of *Cryptococcus gattii* and *Coccidioides immitis*. *Microbiol Spectr*. 2016;4. doi:10.1128/microbiolspec.EI10-0016-2016.
9. Kilpatrick AM, Randolph SE. Drivers, dynamics, and control of emerging vector-borne zoonotic diseases. *Lancet*. 2012; 380:1946-1955.
10. McMichael AJ. Extreme weather events and infectious disease outbreaks. *Virulence*. 2015;6:543-547.

11. Lyme disease graphs. CDC website. <https://www.cdc.gov/lyme/stats/graphs.html>. Updated November 1, 2017. Accessed April 12, 2018.
12. Stone BL, Tourand Y, Brissette CA. Brave new worlds: the expanding universe of Lyme disease. *Vector Borne Zoonotic Dis*. 2017;17:619-629.
13. Watts N, Amann M, Ayeb-Karlsson S, et al. The Lancet Countdown on health and climate change: from 25 years of inaction to a global transformation for public health [published online October 30, 2017]. *Lancet*. doi:10.1016/S0140-6736(17)32464-9.
14. Nawas ZY, Tong Y, Kollipara R, et al. Emerging infectious diseases with cutaneous manifestations: viral and bacterial infections. *J Am Acad Dermatol*. 2016;75:1-16.
15. Kaffenberger BH, Shetlar D, Norton SA, et al. The effect of climate change on skin disease in North America. *J Am Acad Dermatol*. 2017;76:140-147.
16. Dengue. CDC website. <https://www.cdc.gov/dengue/epidemiology/index.html>. Updated June 9, 2014. Accessed April 3, 2018.
17. Chikungunya virus in the United States. CDC website. <https://www.cdc.gov/chikungunya/geo/united-states.html>. Updated October 30, 2017. Accessed April 4, 2018.
18. Clarke CF, Bradley KK, Wright JH, et al. Emergence of autochthonous cutaneous leishmaniasis in northeastern Texas and southeastern Oklahoma. *Am J Trop Med Hyg*. 2013;88:157-61.
19. González C, Wang O, Strutz SE, et al. Climate change and risk of leishmaniasis in North America: predictions from ecological niche models of vector and reservoir species. *PLoS Negl Trop Dis*. 2010;4:E585.
20. Chang CC, Chen SC. Colliding epidemics and the rise of cryptococcosis. *J Fungi (Basel)*. 2015;2. doi: 10.3390/jof2010001.
21. Marsden-Haug N, Goldoft M, Ralston C, et al. Coccidioidomycosis acquired in Washington state. *Clin Infect Dis*. 2013;56:847-850.
22. Rosenbach M. Climate change & dermatology: what can *you* do? Paper presented at: American Academy of Dermatology Annual Meeting; March 3-7, 2017; Orlando, FL.