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.


The term climate refers to the average weather conditions of a specific geographic location measured over several decades. 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. 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). 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. 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. 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.

In a recent edition of the commonly cited textbook Dermatology, Bolognia et al 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.

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. 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 naive populations. 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.

Lyme Disease

In the past 20 years, Lyme disease incidence has tripled in the United States. It has been hypothesized that the increase may be occurring as a result of the expanding
geographic distribution of the *Ixodes* tick and its mammalian hosts (eg, white-tailed deer) under the influence of climate change.\(^1\) 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.\(^5\)\(^,\)\(^6\) 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.\(^7\) 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.\(^8\)\(^,\)\(^9\)

Reports of local transmission of chikungunya, another arbovirus transmitted by *A albopictus* and *A aegypti* mosquitoes in Florida, the U.S. Virgin Islands, and Puerto Rico, began in 2014.\(^1\)\(^7\) 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),\(^1\)\(^7\) 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.\(^1\)\(^4\)\(^,\)\(^8\) 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.\(^9\)

**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.\(^8\)\(^,\)\(^1\)\(^0\) 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.\(^8\)\(^,\)\(^2\)\(^,\)\(^2\)\(^1\) *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.\(^2\)\(^0\) 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.\(^2\)\(^2\)