

Q&A with Paul Epstein, MD, and Dan Ferber, coauthors of *Changing Planet, Changing Health*

Climate change is sometimes portrayed as a victimless crime, but it's not. In 2005, the World Health Organization found that climate change was already causing 150,000 deaths and 5 million illnesses a year. That was an underestimate, and the threat is growing. Major medical or public health groups have recently issued urgent warnings about the harm climate change could pose to human health, including the American Medical Association, American Nurses Association, American Lung Association, American Thoracic Society, American Academy of Pediatrics, and the American Public Health Association. The Lancet, the leading international medical journal, stated flatly that "climate change is the biggest global health threat of the 21st century."

The earth's atmosphere is warming because of the huge amounts of carbon dioxide and other greenhouse gases emitted by human activities since the start of the industrial revolution. These extra greenhouse gases act like a blanket, warming air, land, and oceans. Warmer oceans evaporate more water, and warmer air holds 7% more water vapor for each 1°C of warming. This extra water vapor in the atmosphere returns to earth as heavier rains and snows. In the United States, torrential rains of more than six inches occur 27 percent more often than they did in 1970. Climate change means more heat, but also more wild and potentially dangerous weather.

Question: In what ways do these changes threaten our health?

In five main ways—for now.

(1) **Dangerous heat waves.** Heat waves kill 1500 people a year in the United States—more than hurricanes, tornadoes, earthquakes and floods combined. But that's an underestimate because heat waves trigger heart attacks and other causes of deaths that aren't logged as heat-related. The brutal 2003 European heat wave killed 52,000 people, and was so far off the historical norm that the chance of it not being caused by climate change was just one in ten million. At least one rigorous climate model has projected that if we don't radically cut back on greenhouse gas emissions, heat waves like that will occur every other year in the United States by the 2040s.

(2) **Infectious diseases.** A warming climate allows mosquitoes and other disease-transmitting animals to move to new locations. For example, mosquitoes that carry malaria have moved into the East African highlands, which were once too cold for the mosquito to survive. For example, in the book we relate how a seven-year-old girl named Elena barely survived a life-threatening case of malaria in the Mt. Kenya foothills. There are hundreds of thousands of children like her in the East African highlands who are newly vulnerable to malaria.

North Americans are also susceptible to climate-linked disease. Dengue fever, known as break-bone fever for the intense pain it causes, is epidemic in Central America. It has moved north to northern Mexico as the climate has warmed, and now it's poised to spread to Texas and throughout the South. Ticks that transmit Lyme disease have spread north through New England as the climate has warmed, increasing 8-fold in New Hampshire and 10-fold in Maine in the past decade alone. Studies using rigorous computer models concluded that the disease will spread through Eastern Canada in the coming decades.

(3) **Asthma and allergies.** Burning gasoline, diesel, oil and coal helps cause both respiratory diseases and climate change. Vehicles and heavy industry emit several air pollutants that worsen asthma, allergies, and other respiratory diseases. Nitrogen oxides (NO_x) from tailpipe emissions react in the air with air pollutants called volatile organic compounds to form ground-level ozone—a principal ingredient of smog, which corrodes the lining of the lungs and worsen allergies. Tiny particles of soot from the tailpipes of diesel-burning trucks and buses penetrate tiny airways deep in the lung. Both of these processes can trigger asthma attacks and worsen respiratory disease.

Carbon dioxide emissions themselves can also worsen allergies. One of us (Paul Epstein) and Lewis Ziska of the U.S. Department of Agriculture have shown that elevated carbon dioxide levels and warming cause ragweed to produce more pollen, and make the pollen more potent, worsening allergies. Others have shown that pollen gloms on to soot particles, which carry the pollen deep into the lung, further aggravating allergic asthma in polluted cities.

(4) **Extreme weather** Extremely heavy rains (over 6 inches in a day) have become 27 percent more common in the United States since 1970. They can cause devastating floods, as in Cedar Rapids in 2008 and Nashville in 2010. These floods can kill or injure hundreds, even thousands, as in Pakistan in 2010. Lingering floodwaters can trigger epidemics of diarrheal, respiratory, mosquito-borne disease and rodent-borne disease. Ice storms, blizzards can injure or kill people from falls, car crashes, and heart attacks with shoveling snow.

(5) **Diseases of trees and crops.** The warming climate in the U.S. and Canadian West has unleashed bark beetle infestations that have destroyed vast areas of forests, turning them into tinder. A warmer, drier climate has caused larger and longer-burning forest fires. Smoke from these fires aggravates bronchitis, asthma attacks, releases carcinogens and raises the risk of heart attacks. Plus, the fires themselves destroy thousands of homes, cost a lot to fight, and kill people.

Crop diseases and infestations can cause shortages of healthy food, which can spell malnutrition – or even famine. We describe research at the University of Illinois that shows how soybeans fall prey to more insect damage at carbon dioxide levels expected by 2050. Other crops may be at risk as well. Scientists estimate that each 1°C warming will cut grain crop production by 10 percent.

Question: You also write about some slower moving, but potentially even more serious threats. What are the biggest worries?

Drought is a big one. Climate change is making dry areas dryer. Drought can cause famine that kills hundreds of thousands, as it did in sub-Saharan Africa in the early 1980s. Droughts make it harder to provide safe drinking water, which is already scarce for almost a billion people. The U.N. Environmental Programme projects that two out of three people will live under water-stressed conditions by 2025—and that's without accounting for climate change. Mountain glaciers that help supply downstream areas with water for drinking and irrigation are melting worldwide, including in the North America West. A warming Indian Ocean has already fostered

drought in Ethiopia that is causing crop yields to fall. Groups that monitor famine are watching the area closely.

Another worry is abrupt climate change. Climate has crossed many tipping points in the past few million years, changing radically within a decade or two, or even a few years. Scientists know this from analyzing annual layers of ice sheets, ocean sediments, and tree rings. A little-known Pentagon planning scenario a few years ago concluded that if climate crossed a tipping point today, it would lead to global economic depression, widespread crop failures throughout the Eastern United States, worsened drought in the U.S. West, famine in China, mass migration, increased tension and possibly war over resources.

Question: Even if our changing climate causes a little more disease, can't we take it in stride?

Up to a point. But our changing climate could throw so much at us at once that it would overwhelm our ability to adapt. Weather extremes pose the greatest threat to life and health. In a two-year study sponsored by the Center for Health and the Global Environment at Harvard Medical School, the United Nations Development Programme, and the reinsurance giant Swiss Re, we had teams of experts create scenarios of how climate change would affect human health and the world economy. The mildest scenario of continued warming and more severe weather extremes projects and increased health impacts. In the second, more severe, scenario, a rapidly changing climate and other environmental damage caused ecosystems to buckle, causing, with health impacts, famine and population displacements via loss of food crops, fisheries and forests. Already food prices have spiked to historic highs, posing nutritional risks for people in many nations. Climate change is partly to blame.

Question: Which climate change solutions give us the biggest bang for the buck?

We need a smart electrical grid that will increase efficiency, reduce demand and incorporate renewable sources. We also must carefully choose energy sources that best preserve human health and the natural systems we depend on. The winners here are wind, concentrated solar, geothermal, tidal, solar photovoltaics, wave, hydroelectric. The losers are nuclear, coal, even with carbon capture and storage, and corn-based ethanol.

These choices are based on extensive studies called life cycle analyses that take every step of a technology and its effects into account—not only what consumers pay, but also effects on human health, wildlife, and the environment. In January Paul Epstein and a dozen other researchers published their own life cycle analysis of coal in the *Annals of the New York Academy of Sciences*. The take-home: coal and its waste stream cost the U.S. public more than one third of a trillion dollars per year. That's \$4000 per year for a typical family of four. The numbers are based on coal's cost, plus its contribution to climate change, air pollution, black lung disease in miners, the destruction of Appalachian landscapes. Air pollution from burning coal, which leads to 30,000 premature deaths each year--almost twice the death toll from homicides.

Ethanol-based biofuel is another loser. Forty percent of U.S. corn harvest now goes to ethanol, enough to feed 350 million people. And widespread use of E85 fuel—85% ethanol and 15%

gasoline—would cause more air pollution deaths than any other energy source, save for a nuclear plant accident like Chernobyl.

Question: You argue that money and geopolitical forces drive climate change and harm health? How? And, how should we take these global forces into account when coming up with climate solutions?

We describe how international financial institutions—the International Monetary Fund, the World Bank, and the World Trade Organization—enforce policies that drive the destruction of climate-preserving forests, create poverty and harm human health. We propose changes to global rules, institutions, and funds to reverse this destructive course. Currency speculation destabilizes national economies and discourages them from long-term investments to protect public health, forests. A new global fund of \$500 billion a year, drawn from a small levy on currency transactions, should offer grants to preserve forests and move the world toward renewable energy. And an institution like the UN’s Global Environment Facility, rather than a bank like the World Bank should be put in charge of the money. The Global Environment Facility is a candidate. It already offers grants for climate stabilization projects worldwide, but it’s vastly underfunded,

Question: This all sounds hugely ambitious. Is it realistic?

Transforming our energy system is daunting, no doubt. We need bold public works programs: the equivalent of a Manhattan Project to research renewable energy technologies; a Marshall Plan to finance them; an Apollo Plan to launch the transformation, and a Green New Deal to sustain it. But all of these projects have succeeded in the past, and so can this one. We still have a fighting chance of preventing runaway climate change, and we have the moral obligation to do everything we can. Think of it as the equivalent of a global health insurance policy. We need to pay the premiums and do the work, and we need to do it now.

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