How Will Global Health Survive Climate Change?

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Introduction

Without a dramatic change of course in multilateral strategy, climate change will be the greatest transboundary threat to health in the coming decades. This change is as much an inevitability of the climate crisis, which scientists have identified unequivocally as "the greatest threat to humanity and global ecosystems," as it is an entirely preventable consequence of neglect. The health sector has been called the "forgotten child of climate discussions," with substantially less scientific research, policy coordination, and multilateral financing than other areas such as agriculture and infrastructure.

The shortest path to saving lives is still *mitigation*: curbing the climate crisis at its point of origin by reducing greenhouse gas emissions. But progress on mitigation has been slow, and as health risks materialize, it becomes increasingly apparent that most populations will be left unprotected. Global health institutions face a crisis of *adaptation*: creating and redistributing the resources, investments, and knowledge to make a warmer world survivable. Achieving this goal will require both national progress towards universal health coverage and international progress on health governance reform—both issues where once-in-a-generation political willpower and public support have created a narrow post-pandemic window for action.

The State of the Science

At the time of writing, the planet is roughly 1.2°C (2.2° F) warmer than before the industrial revolution, an increase that makes climate change a present-day problem for health. So far, the most obvious early impacts have been from direct loss of life related to extreme weather (e.g., storms, floods, and wildfires), extreme temperatures (i.e., heat-related illness), food and water insecurity, and several arthropod-borne infections such as dengue fever and Lyme disease.

In the past two decades, these impacts have been insufficient to motivate strong action on climate change and health, and efforts to address climate change have sometimes met resistance from other competing priorities in the health sector. For the infectious diseases with the highest global burden, such as malaria, climate has likely played a smaller role in long-term trends than disease control and prevention efforts, and so has sometimes been dismissed as a distraction. For emerging diseases—including pandemic threats—climate change has similarly been framed as unimportant compared to biodiversity loss, deforestation, wildlife trade and hunting, or agricultural intensification. Next to these planetary issues, the mortality costs of climate change can seem trivial on paper, particularly given that most messaging relies on a small number of outdated statistics. For example, sources including the World Health Organization (WHO) and even the Intergovernmental Panel on Climate Change (IPCC) still frequently reference a decade-old estimate that by mid-century climate change (or more precisely, four of its best-studied health hazards) will kill roughly 250,000 people per year, a global burden barely greater than drowning-related deaths.

However, as the volume of climate-health research has increased sharply in recent years, and methods for detecting climate signal have become more sophisticated, scientists increasingly understand that the earliest-known health risks of global warming were only a small subset of current risks. Newer evidence suggests that rising temperatures are an order of magnitude deadlier than once thought; by the end of the century, the millions of heat-related deaths could be comparable in scope to the total burden of all infectious diseases. Scientists also now believe that climate increases the burden of most human infectious diseases, speeds up the evolution of antimicrobial resistance, increases the spillover of zoonotic viruses from key reservoirs like bats, and restructures ecosystems in ways that are creating thousands of new evolutionary pathways for viral emergence in humans, increasing the risk of future pandemics such as COVID-19. Beyond infectious diseases, rising temperatures are already increasing violence, conflict, mental illness, and suicide. The ripple effects of climate hazards through other social and economic impacts are even broader, and more unpredictable; for example, when drought creates economic shocks in African agricultural communities, HIV transmission increases by 11 percent. Even for health burdens without sensitivity to environmental drivers, climate hazards can disrupt essential services or outbreak response—a major problem faced during COVID-19 response around the world.

While many effects remain poorly documented or quantified, scientific consensus is increasingly clear: there are no aspects of human health that are truly unaffected by (or safe from) climate change. To fill evidentiary gaps, a globally coordinated research program along the lines of the Global Burden of Disease Study could establish an equitable platform for data sharing and scientific collaboration, allowing health impacts to be detected and attributed to climate change in near real time (and incidentally creating scientific advances that could also power better early warning systems). With this evidence base in hand, countries might even be better empowered to advocate for "loss and damage" financing or to pursue climate-related litigation. But in the absence of this data, countries will still need to develop health systems that are able to make decisions under uncertainty and meet growing healthcare needs.

No "Safe" Future for Human Health

Given global failure to end fossil fuel use, the health burdens of climate change are expected to become significantly worse as warming continues in the coming decades. Within the next five years, current projections indicate a roughly 50 percent chance of passing +1.5°C (2.7°F), a limit most commonly associated with the 2015 Paris Agreement, which also includes the goal of keeping warming levels "well below" 2°C (3.6°F) by the end of the century. While there are no "safe" levels of global warming, these targets reflect unequivocal scientific evidence that adverse impacts increase sharply with higher warming levels, and that past these thresholds, extreme impacts become much more likely, especially given possible "tipping points" for sudden and potentially irreversible change to weather systems and ecosystems.

Limited progress on emissions reduction has closed off some of the more extreme possible futures, but substantial loss of life is still in the cards. At present, the world is on track for roughly 3°C (5.4°F) of warming by 2100—a barely survivable future that would submerge the National Mall and drive up to a third of terrestrial species to extinction. Recent legislative wins in the United States offer hope for further decarbonization, as do ongoing UN Framework Convention on Climate Change (UNFCCC) negotiations. Even still, roughly 90 percent of projections suggest that the world will pass the Paris Agreement limit at least temporarily, even if warming is reduced back to below the 1.5°C limit by 2100. This overshoot would have substantial downsides for human health; the margin of difference between a +1.5°C and +2°C world includes annual health impacts such as 28,000 more heat-related deaths in China or hundreds of thousands more cases of dengue fever in Latin America.

The shortest path to preventing this loss of life remains transformative social and economic change to achieve net-zero emissions as soon as possible. Doing so would save both lives and resources: one estimate suggests that the United States alone could both prevent 7.4 million deaths and save $3.7 trillion on adaptation by achieving its net-zero target. The steps required to achieve this moonshot would also bring substantial health co-benefits. For example, a strategy based on reducing automobile use, non-renewable energy production, and meat consumption would also significantly reduce mortality from air pollution, diet-related morbidity, and potentially even the risk of flu pandemics. While social progress on these issues has been promising, they seem unlikely to be matched by the aggressive climate policy needed to achieve net-zero; whereas staying under +1.5°C would require total greenhouse gas emissions to be reduced by nearly half in the next decade, fossil fuel-related emissions hit record highs in 2022. Without transformative steps like a Fossil Fuel Non-Proliferation Treaty—a civil society proposal so far endorsed by the WHO, the Vatican, 2 national governments, and 101 Nobel laureates—both warming levels and health risks will probably continue to steadily increase over the next few decades.

Given the risks of the current trajectory, climate policy has started to weigh a handful of more experimental "techno-fix" solutions. Most scenarios that stay under Paris Agreement targets assume at least some use of negative emissions technologies, which include various strategies such as directly pulling CO_2 out of the atmosphere, mass-converting land to biofuel production, and some nature-based solutions for carbon sequestration. Global use of negative emissions technologies could save lives at a scale comparable to the global burden of Parkinson's disease, a health benefit worth around $38 to $148 for every metric ton of CO_2 removed from the atmosphere. These approaches are promising, but strategies that rely on land conversion might severely increase food insecurity, and technological solutions have yet to be scalable for global markets.

Increasingly, an emergency climate intervention called solar radiation management (SRM, also sometimes called solar geoengineering) is also being considered as a possible stopgap to reduce the near-term impacts of climate change. Most SRM proposals focus on injecting sulfur aerosols into the stratosphere to reflect light back into space, offsetting the greenhouse gas effect and decoupling warming levels from emissions—a temporary way to "buy extra time" for emissions reduction and carbon capture. While this intervention could avert millions of heat-related deaths, and presumably offset other climate-related mortality as well, the technology itself would also cause thousands of deaths by adding particulate matter to the air, altering ozone levels and ultraviolet-B exposure, and even increasing suicide rates by reducing daylight. Geoengineering could also introduce regional trade-offs into health outcomes: for example, SRM deployment might shift malaria burdens back into lowland tropical areas where a billion people would otherwise face lower transmission risks (potentially even in the present-day climate). This kind of tactic would introduce an unwanted "trolley problem" into global health governance, and—like any emerging technology—could also introduce other unforeseeable health outcomes.

Every aspect of uncertainty around climate change trajectories creates downstream uncertainty about the nature and scope of the resulting health crisis. However, across plausible futures, the health burden of climate change is likely to substantially increase in the next two decades, with a disproportionate impact on poorer populations globally. Even in the best-case scenario for policy, social, and technological change, the climate crisis will continue to drive significant excess mortality through the rest of the century, requiring additional response from the health sector. There are no "safe" futures available for human health; the best-case scenario—and the only policy strategy that public health practitioners and decision-makers have any immediate power to effect—is a massive investment in universal health coverage and health system strengthening as a climate adaptation strategy.

The Adaptation Gap

Health is often the last priority in climate change adaptation efforts, for a number of possible reasons. Mitigation has often taken a higher priority across sectors, in large part because it permanently reduces both cumulative impacts and adaptation needs. National commitments to mitigation that set future targets and specify long-term commitments may also be more politically palatable (and those promises ultimately easier to break) than actually investing, today, in adaptation *or* mitigation. Moreover, adaptation to the biggest health risks is sometimes considered outright impossible. For example, extreme weather is increasingly cited by popular media as evidence that the planet is approaching "hard limits" to adaptation. But the reality is that adaptation will make or break those burdens: without the built-in benefits of infrastructure, experience with extreme heat, and income—and downstream, healthcare availability and quality—the future mortality costs of rising temperatures could be 40 percent higher.

Any possible health burden of climate change is therefore just as reflective of multilateral refusal to curb climate change as it is reflective of a refusal to make adaptation a multilateral priority. So far, only 0.5 percent of adaptation financing has been directed toward health programs. At the frontlines of the climate-health crisis, the problem is even more stark: Africa only receives 14 percent of the adaptation aid it needs, and—even though 30 African nations have identified health as a vulnerable sector that could jeopardize their ability to meet their UNFCCC Nationally Determined Contributions—nearly no adaptation funds are spent on health beyond overlapping areas such as disaster risk reduction. After a landmark agreement at the 2022 UN Climate Change Conference (COP27), funding for Loss and Damage could provide a new source of capital that countries could invest back into adaptation or even broader goals like universal health coverage. Reform proposals such as reallocation of International Monetary Fund (IMF) Special Drawing Rights would put also more decision-making power in the hands of countries at the frontlines of climate change, and might help correct the flow of climate adaptation financing to be more efficient and equitable (and allow governments to prioritize health more explicitly).

In the long run, though, a reliance on climate financing may be insufficient to support the scope of adaptation activities necessary in the health sector. Some priorities—such as the development of early warning systems for climate-sensitive infectious disease outbreaks—would benefit from more dedicated climate funding, and would otherwise be difficult for national health systems to sustain. But many of the activities required to adapt to climate change have already been identified as minimum core capacities of a strong health system. For example, the infectious disease burdens of climate change are most directly managed with existing strategies including One Health disease surveillance; pathogen genomic epidemiology; outbreak response plans; mosquito control; livestock and human vaccination; and water, sanitation, and hygiene. None of these activities are specific to climate change, and all have broader benefits (and financial incentives) for population health.

At the same time, the COVID-19 pandemic also provides an important template for understanding how and why these core functions can break down. Just as well-rehearsed pandemic response plans gave way to political breakdowns and public mistrust, the same forces are likely to disrupt the health components of UNFCCC National Adaptation Plans and similar strategies. Post-pandemic governance reforms, including amendments to the International Health Regulations and the negotiation of a new Pandemic Accord, could help solve (or at least anticipate) some of the thorniest issues waiting in the wings—in particular, equitable access to countermeasures. In 2018, a Morgan Stanley report estimated that climate change would expand the market for a safe dengue vaccine by $125 billion, with the majority of those profits concentrated in North America and Europe. Just as inequitable COVID-19 vaccine sharing cost an estimated 1.3 million lives in 2021, inequitable access to countermeasures will severely handicap climate adaptation, concentrating resources in countries that already have better access to healthcare, better population health, and—in the case of dengue especially—the lowest death rates. Solving this policy problem will be vital to face the rising burden of several other vaccine-preventable epidemic threats such as cholera, yellow fever, influenza, and even novel pathogens that may emerge due to climate change.

Tensions like these also point to more fundamental conversations about the feedbacks between climate adaptation and universal health coverage. Given that the countries at the frontlines of warming bear the least responsibility for the crisis, the ultimate mission of health-related adaptation strategies should be to provide the healthcare required to make climate change survivable at zero cost, especially for the victims of climate injustice. Universal health coverage embodies this goal and has been identified by experts as a top predictor of national adaptation capacity. But just as climate change disrupted COVID-19 responses, it will also disrupt health systems by creating physical barriers to healthcare access, disrupting clinics and health workforce functionality, straining public financing for healthcare, increasing financial hardships for patients, and creating displaced populations outside of the reach of medical services. These outcomes cannot be prevented without substantially greater global investment in universal health coverage. Conversely, healthcare investments may support mitigation efforts in unexpected ways. A groundbreaking study in Indonesia recently found that building a healthcare clinic helped rural communities nearly eliminate illegal logging, averting a loss of natural carbon sinks worth $65 million.

These innovations may even have lessons for the United States—a country that ranked first in pandemic preparedness until COVID-19 revealed the gross inefficiencies of for-profit healthcare, private health insurance, racial discrimination in healthcare quality and access, rural clinic closures, and limited governmental ability to sustain financing and political willpower for both countermeasures and non-pharmaceutical interventions. Health economists have estimated that a single-payer universal system could have saved an estimated 212,000 lives and $106 billion in the first year of the pandemic alone. As climate change continues to strain the post-pandemic American healthcare system, policy proposals such as "Medicare for All" or state-level Medicaid expansions could gain wider popular support and resurface as a central feature of "building back better."

Conclusion

Today, populations at the frontlines of climate change are already experiencing new health burdens. From this point, no future exists where the rest of the world avoids exposure to more serious hazards, including some that could fundamentally restructure the global burden of disease. Neither public health ministers nor clinicians have a say in the climate reality they are handed; though hospitals and clinics can contribute to decarbonization efforts, these reductions will need to be matched by commensurate changes across the other 95 percent of emissions that come from energy, transportation, agriculture, and industry. Adaptation, then, is the imperative. Investment in healthcare can ensure that vulnerable populations are afforded effective and equitable protection from the health impacts of dangerous warming. Despite this, health has barely been addressed by most adaptation programs. Multilateral instruments and national reforms can help provide the funding, workforce, and political willpower necessary to close this gap, and minimize loss of life from climate change not just in the future, but in the immediate term.