

# Health Care in a Changing North Carolina Climate

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North Carolina's health care systems face dramatic risks from climate change that are here now and will last for decades, including disease outcomes and increased health risks that will disproportionately affect disadvantaged populations. At the local level, health care practitioners have to become advocates for climate mitigation; longer-term responses must involve society at all levels.

## Introduction

In 2020, the worldwide medical community has focused on the virus strain SARS-CoV-2 and the disease it causes, COVID-19. However, there is a larger, even more ominous threat facing the medical community: our changing climate. There is no vaccine for this threat, and responding to it will require coordinated local and global action to a degree thus far unseen in human history.

Author David Wallace-Wells opens his 2019 book, *The Uninhabitable Earth*, with the chilling assessment that, "It is worse, much worse, than you think" [1]. This is not an alarmist statement; it is a concise representation of data demonstrating that it is a delusion to think of climate change as a gradual change primarily affecting polar bears and threatening our coasts in some far distant time to come. If we stay on our current path, heat, desertification, and flooding could render significant parts of the globe uninhabitable, and sooner than we think. Even if we were to eliminate emissions tomorrow, climate models project that the carbon in the atmosphere would increase average temperatures across the contiguous United States by at least 2.3°F relative to 1986-2015 by the middle of this century [2].

Climate change is not tomorrow's problem: it is ours, now. Effects we will see over the next 50 years are, to use a bad pun, baked in. Nor are its consequences equally distributed; while climate change will affect everyone, already disadvantaged groups will suffer disproportionately [2, 3]. What matters at this point is how well we anticipate, prepare for, and prevent its effects.

## How Will Climate Change Affect Health?

Health professionals have long been aware of the effects of a changing climate on health. In 2008, Dr. Mark Keim, at that time associate director for science in the Office for Environmental Health Emergencies at the Centers for

Disease Control and Prevention (CDC), summarized a large body of literature by noting that the consequences of climate change would include significant and wide-ranging public health risks [4].

These risks are many and varied. In 2016, the US Global Change Research Program listed seven distinct categories of impacts: extreme heat, outdoor air quality, flooding, vector-borne infections, water-borne infections, food related infections, and mental health and well-being [5]. A specific North Carolina example discussed elsewhere in this issue describes health effects from wildfires such as the 2008 peat bog fire in Pocosin Lakes National Refuge [6, 7]. Impacts in these categories often occur simultaneously and their synergism makes things worse.

Stories about the health impacts of extreme weather events often focus on the heroic work of hospital professionals. One example in North Carolina was the response of the New Hanover Regional Medical Center during Hurricane Florence [8]. Yet, notwithstanding the heroism of health care professionals here, in New Orleans in 2005, in New York in 2011, or in Houston in 2017, what happens when extreme events become more frequent? Moreover, focusing solely on hospitals overlooks the needs faced by populations without access to hospitals or even basic medical care.

## Social Systems and Climate Change

In a changing climate, social disruptions will accompany climate-related health effects. We don't usually think of North Carolina as either generating or receiving climate refugees, and the state does not have the same concentration of populations in low-lying areas as, for example, Florida or Louisiana. Nevertheless, our coastal communities generate tens of thousands of jobs and billions of dollars of revenue in industries such as agriculture, commercial and recreational fishing, and tourism. All of these are vulnerable to sea level rise that will create existential challenges to the communi-

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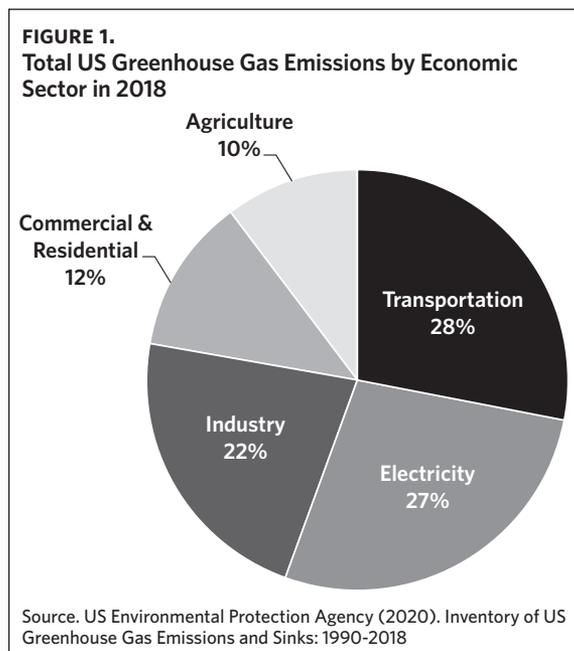
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ties that rely on these industries. Outside the coastal zone, other areas will find themselves more susceptible to flooding due to both extreme rainfall events and increased runoff in an urbanizing state. Low-income communities that already have insufficient resources for clean water will find themselves even more at risk from stormwater pollution, failing septic systems, and saltwater intrusion. More broadly, just as COVID-19 has disproportionately affected communities of color, climate change and accompanying extreme weather impacts will exacerbate these injustices if our society does not improve its ability to provide equitable health care for all.

While health care professionals are routinely on the front lines in fighting diseases, including those that disproportionately affect disadvantaged communities, with climate it can seem as if we are doing battle with the very Earth itself. The battle metaphor, however, may not be the best way to think about our current dilemma. As shown in Figure 1, the sources of the greenhouse gases that are at the heart of climate change are things on which our society depends: electric power generation, transportation, business and industry, buildings and the built environment, and agriculture. Health care systems, especially hospitals, are large sources of greenhouse gas emissions in the United States and worldwide, and North Carolina is likely no exception [9-11]. Pogo, of comic strip fame, was right: “We have met the enemy, and he is us.” The links between these sectors and our daily lives present a daunting challenge, and the concerns of health professionals can reasonably extend to all of these systems. Mitigation of the risks that these emissions create is a matter for both national policy and state/local community action.

### North Carolina’s Response to Climate Change

Governor Cooper’s recent Executive Order 80 recognized the health risks associated with a changing climate, stat-



ing that “to maintain economic growth and development and to provide responsible environmental stewardship, we must build resilient communities and develop strategies to mitigate and prepare for climate-related impacts in North Carolina” [12]. The good news is that actions to mitigate climate change will also benefit our economy, both by avoiding adverse economic effects in sectors such as agriculture and manufacturing and by generating employment opportunities in sectors such as renewable energy [13, 14]. But even as we reduce emissions, realistic public policy requires us to prepare to meet today’s effects of climate change.

North Carolina county health departments, local hospitals, and health professionals across all settings—and especially in already disadvantaged areas—face immediate potential impacts from extreme weather events [15, 16]. But the changing climate also adds to risks from other health care stressors, such as mosquito-borne diseases including West Nile, chikungunya, dengue, and Zika viruses; water or vector-borne diseases including Lyme; and higher levels of ozone air pollution resulting from increased temperatures, urban heat-island effects, and aeroallergens [17]. Mitigation of these disease risks will require communities to coordinate health care services with other essential functions such as housing, food, and other social welfare programs. These responsibilities inevitably fall to local communities in the long run, and are most effective when there is a preexisting network of relationships facilitating mutual understanding and awareness of capabilities, resources, and limitations.

As noted by Mark Keim in Figure 2, there is a difference between crisis response and risk reduction, similar to the public health levels of primary, secondary, and tertiary prevention when facing health threats. Risk-reduction measures are actions to keep a crisis from happening in the first place, or, if the crisis occurs, to limit the consequences as much as possible. Crisis management measures are actions taken in the middle of the event.

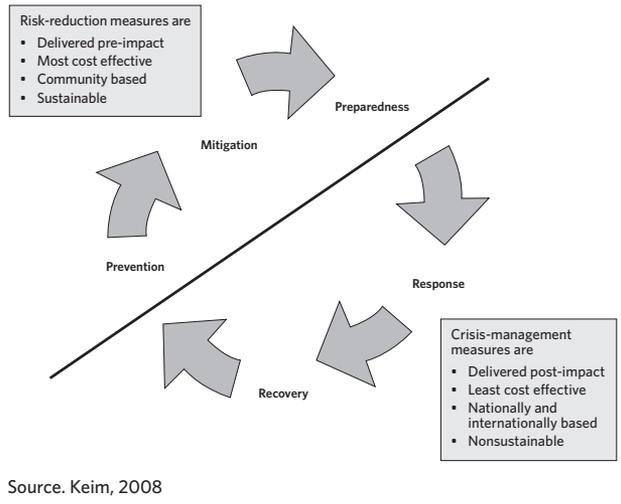
### What Must Happen First?

We will be managing climate change health threats for a long time. A coordinated strategy will recognize both the need to reduce emissions to keep things from getting even worse, and the need to anticipate that even with emissions reductions, things will get worse before they get better. There are no simple answers, and all of society will have to be involved. For health care systems, some of the hardest decisions will be about what to do first. Here are three principles that may apply not just to hospitals, but to health care providers at all levels.

### Prepare for a Climate Emergency

Whether the challenge is a drought, a flood, a severe storm, or wildfires, health care systems and providers should have an emergency response plan in place. Any plan is better than no plan, as long as it is understood that the plan aids in preparation but may not match the crisis in real time. The

**FIGURE 2.**  
**The Disaster Risk Management Cycle**



Federal Emergency Management Agency (FEMA) and the North Carolina Division of Emergency Management have useful guides to assist health care providers in anticipating and planning for extreme weather events, and health care professionals should know and understand their county's emergency preparedness and response structure and personnel [18].

### Test Implicit Assumptions

Do the plans really anticipate what might happen? Ask tough questions, such as: What else might go wrong? What happens if the power goes out? If drinking water systems fail? If the community is surrounded by water, as Wilmington was during Hurricane Florence? If areas are cut off by wildfire? Is there a plan for a surge of refugees from other affected areas? What if personal protective equipment (PPE) stores are exhausted? Do disease patterns in communities reflect past patterns, or is something new going on? How do we get accurate data on community members that can be available anywhere in the health care system?

### Learn from Prior Mistakes and Successes

In 2017, Houston was hit by unprecedented flooding due to Hurricane Harvey, a storm which, like Florence, may have been a harbinger of the kind of slow-moving, high-rainfall events that will become more likely in a changing climate. However, Houston's Texas Medical Center was a Hurricane Harvey success story, escaping much more serious damage thanks to well-designed flood protection doors installed after Tropical Storm Allison caused severe destruction in 2001 [19].

Truly addressing the health consequences of a changing climate will require us to link public health, primary care, emergency, and critical care facilities in a functioning health care system. The ongoing pandemic has illustrated

the importance of these links and the fragility of the care networks available in underserved communities, both in rural and economically depressed urban areas. A changing climate will similarly stress these networks, not only in tropical storms but also as a result of extreme heat or infectious disease outbreaks.

The climate is already changing from its historic norms. We owe it to ourselves to build resilience into our current systems. But, as urgent as these actions are, we will need to change many of our social systems to avoid even worse consequences down the road. Health care practitioners have to become advocates for climate mitigation so that things do not get even worse, especially for our most disadvantaged fellow citizens. COVID-19 has shown us that some parts of our society can change quickly when we feel the urgency to do so, but others struggle and produce needless suffering. Lessons from the weaknesses exposed in our response to the pandemic should inform our preparations for the daunting health threats of our changing climate. **NCMJ**

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### References

1. Wallace-Wells, David, *The Uninhabitable Earth: Life After Warming*, Tim Duggan Books, New York, 2019
2. USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 186 pp. Accessible at <https://nca2018.globalchange.gov/>
3. Watts N, Amann M, Arnell N, et al. The 2019 Report of The Lancet Countdown on Health and Climate Change: Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate. *Lancet*. 2019;394(10211):1836-1878. doi: 10.1016/S0140-6736(19)32596-6
4. Keim ME. Building human resilience: the role of public health preparedness and response as an adaptation to climate change. *Am J Prev Med*. 2008;35(5):508-516. doi: 10.1016/j.amepre.2008.08.022
5. Crimmins AJ, Balbus JL, Gamble CB, et al. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Washington, DC: U.S. Global Change Research Program; 2016. [https://health2016.globalchange.gov/low/ClimateHealth2016\\_FullReport\\_small.pdf](https://health2016.globalchange.gov/low/ClimateHealth2016_FullReport_small.pdf). Accessed June 14, 2020.
6. Rappold AG, Stone SL, Cascio WE, et al. Peat bog wildfire smoke exposure in rural North Carolina is associated with cardiopulmonary emergency department visits assessed through syndromic surveillance. *Environ Health Perspect*. 2011;119(10):1415-1420. doi: 10.1289/ehp.1003206
7. Robarge G, Katz S, Cascio W. Wildfire smoke: opportunities for co-operation among health care, public health, and land management. *N C Med J*. 2020;81(5):320-323.
8. Gizdic J. In the Center of the Storm. New Hanover Regional Medical Center website. <https://www.nhrmc.org/blog/2018/10/in-the-center-of-the-storm>. Published October 16, 2018. Accessed June 14, 2020

9. Sherman JD, MacNeill A, Thiel C. Reducing pollution from the health care industry. *JAMA*. 2019;322(11):1043-1044. doi: 10.1001/jama.2019.10823
10. Tomson C. Reducing the carbon footprint of hospital-based care. *Future Hosp J*. 2015;2(1):57-62. doi: 10.7861/futurehosp.2-1-57
11. U.S. Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2018. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>. Accessed May 31, 2020.
12. State of North Carolina. Executive Order NO. 80: North Carolina's Commitment to Address Climate Change and Transition to a Clean Energy Economy. Raleigh, NC: State of North Carolina; 2018. <https://governor.nc.gov/documents/executive-order-no-80-north-carolinas-commitment-address-climate-change-and-transition>. Accessed May 31, 2020.
13. Horton M. Climate mitigation could yield trillions in economic benefits. Stanford Earth website. <https://earth.stanford.edu/news/climate-mitigation-could-yield-trillions-economic-benefits#gs.8m0ke7>. Published May 23, 2018. Accessed June 15, 2020.
14. Kahn M, Mohaddes K, Ng R, Pesaran MH, Raissi M, Yang J-C. Long-Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis. NBER Working Paper No. 26167. National Bureau of Economic Research website. <http://www.nber.org/papers/w26167>. Published August 2019. Accessed June 15, 2020.
15. Wuebbles DJ, Fahey DW, Hibbart KA, Dokken DJ, Stewart BC, Maycock TK. Climate Science Special Report: Fourth National Climate Assessment (NCA4), Volume I. U.S. Global Change Research Program website. <https://science2017.globalchange.gov/>. Accessed June 14, 2020.
16. Deaton J. Hurricane Harvey hit low-income communities hardest. ThinkProgress.org. <https://archive.thinkprogress.org/hurricane-harvey-hit-low-income-communities-hardest-6d13506b7e60/>. Published August 27, 2017. Accessed June 14, 2020.
17. Patz J. Climate Change. In: Frumkin H, ed. *Environmental Health: From Global to Local*, 2nd Ed. San Francisco, CA: Wiley; 2010:279-328.
18. North Carolina Division of Emergency Management. 2017 North Carolina Emergency Operations Plan. Raleigh, NC: NC DEM; 2017. <https://files.nc.gov/ncdps/documents/files/Divisions/EM/EOP/Plan%20-%202017%20NCEOP%20FINAL.pdf>. Accessed June 25, 2020.
19. Mason J. Past weather emergencies have strengthened the storm-tested cancer center. University of Texas M.D. Anderson Cancer Center web site. <https://www.mdanderson.org/publications/conquest/past-weather-emergencies-strengthened-storm-tested.h36-1591413.html>. Published Fall 2017. Accessed May 31, 2020.