Zika, Climate Change & January 25

On December 30, as 2018 drew to an end, NBC's Meet the Press aired an entire program on the climate change crisis, well worth watching (https://www.nbc.com/meet-the-press/video/meet-the-press-1230/3850857). Host Chuck Todd gave no air time to climate change denialism. Instead, the episode plunged into analyzing the crisis at hand, what might be done, what impediments slow our time-critical response, and how to overcome those impediments. Florida Republican Representative Carlos Curbelo, among other program guests, called for constructive action. "We need to stop covering the debate and start covering the story, so that people see that this is real, and so that politicians take a more-pragmatic approach and find solutions that are actually achievable," Curbelo said. The day after Thanksgiving, despite Mr. Trump's personal dismissal of climate change, the Trump administration released Volume II of the Fourth National Climate Assessment (https://www.globalchange.gov/nca4), and we've been digesting its deeply concerning contents in the week since.

The impacts of climate change are myriad, affecting our world, our communities, our health, our food supply, and our investments. We will be taking a look at a number of climate-change-related issues impacting Florida and beyond, from sea level rise to red tide to hurricanes to fruitful adaptive strategies and the economic opportunities they present, when we convene on Friday, January 25, at the University of South Florida Sarasota-Manatee for our one-day event, "Adapting to a Changing Climate: Challenges & Opportunities." See the full roster of speakers, including our own Patricia Healy, here: http://sar.usfsm.edu/event/adapting-to-a-changing-climate/. We hope to see you there.

In today's commentary, however, I would like to zero in on the impact of climate change on vector-borne diseases, including Zika. Chapter 14 of the Fourth National Climate Assessment (https://www.globalchange.gov/nca4) addresses the adverse effects of climate change on human health, noting that "Climate change affects human health by altering exposures to heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, and water; and stresses to mental health and well-being" (p. 545 in the full report PDF). We have no trouble grasping the threats posed by heat waves, fires, floods, and storms that claim lives as well as property, along with droughts that parch crops and threaten water supplies, but we should not miss the implications of climate change for increased vector-borne disease risks. As the report points out, "Climate change is expected to alter the geographic range, seasonal distribution, and abundance of disease vectors, exposing more people in North America to ticks that carry Lyme disease or other bacterial and viral agents, and to mosquitoes that transmit West Nile, chikungunya, dengue, and Zika viruses" (p. 545).

The range of the Aedes aegypti mosquito, for example, a primary vector for dengue, chikungunya, Zika, and yellow fever, is expected to expand considerably worldwide, exposing far larger populations, particularly in Australia, Europe, and North America, to those viruses. According to one recent study, well before the end of the 21st century, 68%–80% of human populations may share their environments with Aedes aegypti and thus be vulnerable to the diseases that mosquito can carry, with the percentages depending on the climate change scenario that actually unfolds, (https://link.springer.com/article/10.1007%2Fs10584-016-1679-0). In general, lower greenhouse gas emissions translate to less risk for human health.

Risk of mosquito-borne diseases in general is to be understood

not just in terms of the range of a particular mosquito species but also in terms of mosquito "disease danger days." As an August 2018 report published at Climate Central points out, "there's an elevated risk of disease transmission [assuming disease is present] when temperatures are between 61 degrees and 93 degrees Fahrenheit." The report notes the circumstances required for disease transmission: "In addition to needing the proper climatological factors for the mosquito to survive and transmit disease, there needs to be the establishment of the disease in the first place – having the proper climatic conditions, a critical density of mosquitoes, and the conditions for the sustained cycle of disease transmission itself. And, in order to transmit disease, a mosquito must bite twice – once to acquire the disease [itself], and a second time to pass it on. The largest number of these twice-biting mosquitoes were produced at 75 degrees Fahrenheit." (http://www.climatecentral.org/news/us-faces-a-rise-in-mosquito-disease-danger-days-21903)

Climate Central analyzed weather data for 244 US cities to determine the number of disease danger days each city faces now as the climate warms. They found that 94%, or 229, of the cities they studied are already seeing an increase in the number of days when average temperatures fall within the optimal range for mosquito-borne disease transmission. Some areas, however, may become too hot for the mosquitoes themselves. Phoenix, for example, actually has fewer disease transmission danger days than it did previously because of the number of extremely hot days the city must contend with. All in all, only 12 cities are experiencing a decrease in disease danger days. As the climate warms, the report concludes, Americans face heightened risks for dengue, Zika, chikungunya, and West Nile (http://www.climatecentral.org/news/us-faces-a-rise-in-mosquito-disease-danger-days-21903).

The 2015–2016 Zika outbreak drove home the hazards of mosquito-borne diseases, as Zika took a terrible toll on the development of one in seven unborn children whose mothers were exposed to the otherwise generally mild virus (https://www.contagionlive.com/publications/contagion/2018/october/zika-where-are-we-now). Babies were born with microcephaly and/or other birth defects such as vision problems, deafness, and epilepsy. Their lives and their family's lives were forever changed from what might have been.

In 2018, Zika has not made many headlines in the US, and the case count is down. As of December 4, 2018, the provisional case count for US States is 58 for the year, all travelers returning from affected areas. US territories have reported 116 Zika cases, with the virus presumably transmitted through local populations of infected mosquitoes (https://www.cdc.gov/zika/reporting/2018-case-counts.html). Case counts aside, the virus remains a threat – nothing has changed about its intrinsic potential to wreak havoc. It is still active throughout the South and Southeast Asia region, and some districts in India saw worrisome outbreaks in 2018 (https://www.hindustantimes.com/health/healthwise-new-outbreaks-need-better-disease-surveillance/story-2bSekn9rGCIbWADtk9p2TK.html).

While some experts hypothesize that "herd immunity" has been achieved in areas hardest hit in 2016, Carmen Zorilla, professor of obstetrics and gynecology at the University of Puerto Rico School of Medicine in San Juan, disagrees. She estimates that about 10.5% of pregnant women in Puerto Rico tested positive for Zika during the outbreak – an infection rate not nearly high enough to confer herd immunity. She observes that such viral outbreaks tend to happen in 3–5-year cycles.
(https://www.contagionlive.com/publications/contagion/2018/october/zika-where-are-we-now).

Problematically, some 60–80% of Zika cases are asymptomatic,

so Zika can readily go undetected and gain a foothold before it is identified in a particular area. Fewer than half of those infected actually seek medical care (https://www.contagionlive.com/publications/contagion/2018/october/zika-where-are-we-now). Most of the time, symptoms, when people do have them, are relatively mild and somewhat flu-like: fever, rash, headache, achy joints and muscles, and conjunctivitis, though in rare instances a Zika infection can lead to Guillain-Barré syndrome. Currently, the CDC recommends Zika testing for pregnant women with possible Zika exposure and for those who experience Zika symptoms after traveling to areas where they might have been exposed to the virus (https://www.cdc.gov/zika/hc-providers/testing-guidance.html).

Is there room in that surveillance net for a Zika outbreak to fire up before it is detected? Definitely so. In 2016, a research team led by Northeastern University professor Alessandro Vespignani and overseen by the Center for Inference and Dynamics of Infectious Diseases, projected the discrepancy between the number of reported Zika cases and the likely number of actual cases. The team's models projected that the actual number of infections in July 2016 was likely 25 times the number of confirmed cases (https://www.sciencedaily.com/releases/2016/08/160802133703.htm).

Dr. Vespignani notes that major outbreaks are associated not only with the right air temperature but also with areas of standing water. In many instances, people educated to understand the risks can manage those, emptying the birdbath or flower pot saucers and the like at least once a week; but after major precipitation events magnified by climate change, when there is standing water everywhere, mosquito populations can spike. The sopping US Southeast, where rainfall records were handily broken in 2018, can testify that there is sometimes "water, water everywhere," to borrow a phrase from Samuel Taylor Coleridge

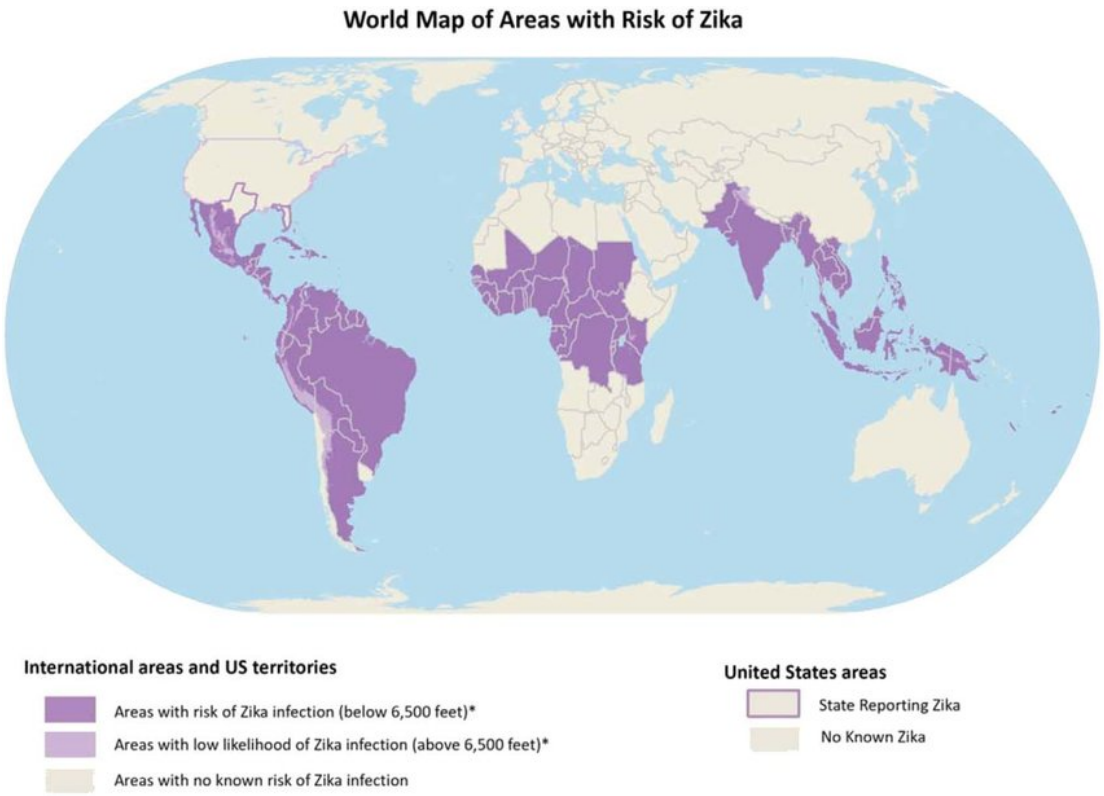
(https://www.accuweather.com/en/weather-news/2018-leaves-its-mark-in-the-rainfall-record-books-across-eastern-southern-us/70007024).

Furthermore, densely populated areas face elevated risk. Juanita Constible, a climate expert at the Natural Resources Defense Council, explains that, for mosquitoes, "extension of habitat is a combination of climate change and human behavior. Urbanization can expand habitats for some species of mosquito that prefer cities [Aedes egypti among them], so as people expand into natural areas, those species will go with them. Not only do urban settings have plenty of habitat and food, but in cities, mosquitoes lack natural predators." (https://www.citylab.com/environment/2018/10/hurricane-florence-mosquitoes-north-carolina/571912/)

Kate Fowlie, spokesperson for the US CDC, warns, "Mosquito-borne disease outbreaks are difficult to predict. There will be future outbreaks, including large ones, as well as years with reduced transmission, but it is impossible to know when or where these transmission patterns will occur" (https://www.contagionlive.com/publications/contagion/2018/october/zika-where-are-we-now).

It seems obvious that surveillance is key to preventing outbreaks both in the present and in a warming future, but the CDC's funding for expanded infectious disease surveillance is due to run out in 2019. The CDC is already planning to scale back its participation in the Global Health Security Agenda (GHSA), an early-warning system for infectious disease outbreaks, in 39 of 49 countries (http://www.ghtcoalition.org/blog/global-health-and-medical-research-saved-from-the-chopping-block-in-2018-spending-bill).

While the US will be assisting with infectious disease surveillance in 10 countries, the map of Zika-affected areas around the globe, courtesy of the CDC, is expansive (https://wwwnc.cdc.gov/travel/files/zika-areas-of-risk.pdf).



There is a lot of purple on this map, but these are not all the places Zika can go; they are merely places where infection is already a risk. Infected travelers can fly all over the world, and disease-bearing mosquitoes know no borders other than inhospitable habitats. Climate change, as we have seen, will widen the range of vector-borne diseases, sharply increasing the percentage of the global population at risk. Viruses themselves, of course, are moving targets, as they mutate regularly – Zika posed no known risk to the unborn until this century, when a mutation changed what had been a mild pathogen (https://www.washingtonpost.com/news/speaking-of-science/wp/2017/09/28/zika-was-a-mild-bug-a-new-discovery-shows-how-it-turned-monstrous/?utm_term=.af60fd526a41). Scientists also warn us that we may soon be contending with disease-causing bacteria and viruses that have lain dormant for centuries or even millennia, frozen in permafrost that is now melting as the Arctic warms (www.bbc.com/earth/story/20170504-there-are-diseases-hidden-in-ice-and-they-are-waking-up).

As we look ahead, addressing climate change will clearly entail grappling with expanded threats to human health, and one of those threats will be elevated vector-borne disease risks, perhaps coupled with diseases modern medicine has yet to encounter. Climate change mitigation and adaptation, combined with vigilant surveillance, vaccine development, and mosquito population control strategies will all be keys to managing vector-borne disease risks posed by certain species of mosquitoes and ticks.

This commentary has been a deepish dive into just one of the secondary challenges climate change will pose to nations, states, cities, municipalities, and the well-being of Americans. In the instance of Zika, we know that the lifetime cost of caring for one child whose life is profoundly impacted by prenatal exposure to the Zika virus, beyond heartbreak, is likely to reach one to ten million dollars (https://wwwnc.cdc.gov/eid/article/23/1/16-1322_article). Human health is just one area in which proactively addressing climate change and adaptation makes both imminent sense and dollars and cents. Again, if you are in the Sarasota area on January 25, we hope you will join us at the University of South Florida Sarasota-Manatee for "Adapting to a Changing Climate: Challenges & Opportunities." Find more information about this one-day event and register here: http://sar.usfsm.edu/event/adapting-to-a-changing-climate/.