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Testimony of:
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Thank you to Chairwoman Maloney, Ranking Member Comer, and members of the Oversight and Reform committee for holding this hearing and inviting me to testify on this critical topic.

I testify before you as a practicing emergency medicine doctor who is here representing my patients. The statistics I present here today have faces and names – and represent stories of the patients that I see in my emergency department. I want to bring these patients stories to you, as the decisions you make in these halls of power shape the health and well-being of everyone in the United States.

For too long, we have been more inclined to see the harms of climate change in melting ice caps and starving polar bears, than in the faces of our children, our aging parents and our neighbors. We now know that climate change matters to the health of all of us and is particularly a threat to the welfare of those least able to cope – the young, the old, the poor and many people of color.[1-4] The harms to our health represent the true – and too often hidden – human cost of climate change.

The Climate Crisis and My Patients

For example, two patients of mine – very different in many respects – were joined together by one common vulnerability, both faced death from heat stroke – the most severe form of heat illness.

The first was a vibrant, young and otherwise healthy construction worker who was working two jobs to support his growing family in record-breaking heat in Boston. By the time he arrived at my emergency department, his organs were already failing as we rapidly tried to cool him.

His story makes clear; climate change spares no one – not even a young man in excellent health.

The second was an elderly man whose wife called 911 because he was acting confused. The emergency medical technicians said that when they opened the door to their apartment, they were hit by a wave of heat that felt like the Sahara Desert. The apartment had no air conditioning and had only one window cracked open. The man's core temperature was 106°F. When I tell this

story, I often wonder about his wife who remained in the apartment that day while her husband was taken to the hospital.

His story highlights the unique vulnerability of the elderly and poor, and her story of those left behind.

Heat waves rarely make the kind of dramatic headlines that other climate-sensitive events like hurricanes can because patients often die silently in their homes, but they are the deadliest extreme weather events we face.[1,5] As global temperatures rise, heat waves are becoming more intense, longer, and more frequent.[2,4] A 2006 heat wave in California caused over 16,000 excess visits to emergency departments and nearly 1,200 excess hospitalizations.[6] Record high temperatures in Wisconsin in 2012 from mid-June to mid-July led to an estimated $251.8 million dollars in health costs.[7]

As my patients' stories illustrated, everyone is susceptible to heat-related illness, and vulnerable populations suffer most.[1-4] Outdoor workers are especially at risk for harms and many lack essential protections to keep them safe, as outlined in the extended case study in the 2019 Lancet Countdown on Health and Climate Change Policy Brief for the United States of America Appendix [see appendix].[2] In 2018, 64.7 million potential labor hours were lost, and Southern U.S. states lost 15-20% of possible daylight work hours in direct sun due to the extreme heat exposure in July 2018, which was the hottest month of the year.[2]

Another patient of mine was a 4-year old girl who presented to my emergency department on an overnight shift after multiple visits that week for asthma attacks. As she was waiting to be transported upstairs, her distraught mother shared her feelings of helplessness at being unable to protect her daughter from the high pollen levels in the Greater Boston area.

Climate change is contributing to longer and more intense pollen seasons, a known trigger for allergic conditions and respiratory diseases like asthma.[3] In 2010, the allergen oak pollen was linked to over 21,000 visits to emergency departments in the Northeast, Southeast, and Midwest with an estimated price tag of $10.4 million.[8] Climate change is expected to increase the number of these visits by 5% by 2050 and 10% by 2090.

Lastly, I treated a patient who came directly to Massachusetts General Hospital from Boston Logan Airport after leaving Puerto Rico following Hurricane Maria. She sat in the exam room with her luggage in tow and thrust a Ziploc bag at me with empty medication bottles. Her home had been destroyed, and she had not had access to her medications in weeks. Now in Boston, she had no plans on where to go and no access to health care other than the emergency department.

Oftentimes we think about climate refugees in far off lands. However, the climate crisis is also already displacing citizens within the United States as a result of the climate change-driven intensification of extreme events like hurricanes, flooding, and wildfires, which are also increasingly likely to co-occur in the same place and at the time.[3,9-11] Overall, hurricanes are getting stronger, wetter, and slower as a result of climate change leading to more destruction. Hurricane Maria was intensified by warmer ocean temperatures.[12-14] Individuals from Puerto Rico were displaced to most, if not all 50 states following Maria.[15] The U.S. Census Bureau also

found that approximately 142,000 Puerto Ricans left in 2018 with the majority moving to the mainland U.S., nearly a third more than in 2017.[16]

The Broad Health Implications of the Climate Crisis

These patient cases provide just a few examples of the broad array of ways the climate crisis harms health (e.g., vector- and waterborne diseases, decreased nutrient content in crops, harmful algal blooms, and degraded air quality through wildfire smoke and ground level ozone), affecting nearly every organ system directly or indirectly through pathways that are well described in the literature [see appendix for the 2019 *New England Journal of Medicine* interactive Perspective by Salas and Solomon].[4,17]

I often describe our understanding of climate change as an iceberg. Though we see the mass of ice above the surface of the water, there is a much larger mass underneath - the health effects that we haven't yet identified. To hint at the mass beneath the surface, we can turn to extreme heat - perhaps our best understood example of how climate change harms health. Recently, emerging evidence suggests that extreme heat may be linked to rising bacterial resistance to antibiotics, cognitive impairment, worsening mental health – and rising rates of congenital heart disease, suicide, and diabetes.[18-24] Mental health challenges from the climate crisis, which are inherently difficult to quantify, range from what has recently been termed "eco-anxiety" to new mental health concerns following exposure to extreme events to exacerbation of existing disease.[4,25]

Even broader health impacts - with significant implications for health and health care systems - stem from other societal impacts of the climate crisis. Globally, the climate crisis is linked with increasing the number of people experiencing poverty, with an additional 100 million predicted by 2030.[26] The poor, already more susceptible to the health threats of the climate crisis, can get trapped in this vicious cycle of poverty.[27] The climate crisis also leads to population movement, which interacts with poverty and creates disruptions to health care delivery. As pathways that connect climate and health grow and shift, we can expect corresponding alterations to domestic human migration patterns as a result of climate change. The U.S. Environmental Protection Agency predicts climate change will lead to population migration away from the Great Plains and Southeast Gulf states with increased gains along the coasts and Midwest.[28]

It is anticipated that health care costs will increase due to more illness and a subsequent increase in health care utilization and treatments. For example, data on ten climate-sensitive events in the United States in 2012 - ranging from hurricanes to harmful algal blooms - were estimated to cause an excess of nearly 21,000 hospitalizations and $1.5 billion in excess health care utilization.[7] Within that study, the researchers report that a West Nile Virus outbreak in Texas led to $91 million in hospital admission costs and $151.9 million in emergency department visit costs. It is estimated that the climate-attributable cases of the West Nile Virus will cost $1.1 billion in total by 2050.[28]

The Climate Crisis, Public Health, and Geographic Variation

Public health systems are critical to preventing health harms, yet as also exposed by the COVID-19 pandemic, they are underfunded and lack the nuanced evidence-based understanding required to adequately prepare for the climate and health challenges of today, let alone tomorrow. We also know that the broad geographic diversity of climate change in the United States means that different parts of the country experience difference exposures that harm health. For example, the Northeast is facing rising Lyme disease cases, Western states are suffering increased health harms of wildfire smoke, and Central states are experiencing more dramatic flooding as they did in 2019.[3,4]

Yet, even universal health threats like extreme heat vary by geographic region. For instance, the peak in hospitalizations for heat-related illnesses occurs at around 80ºF in the West and Northwest, while the peak in the South occurs at about 105ºF.[29] These variations stress the importance of having a data-driven understanding of how the climate crisis harms health locally, in addition to the national common themes. Unfortunately, heat alerts were often found to be going out after the peak of hospitalizations occurred.[29] In the Central region, this was occurring at nearly 20ºF above the peak. Exhibiting both the power of data, and the importance of public health – Northern New England and New York lowered their thresholds for heat alerts with New York City observing a reduction in heat-related illness in the elderly.[2]

The implications for public health are further explored in the 2018 and 2019 Lancet Countdown on Health and Climate Change Policy Brief for the United States of America [see appendix].[1,2]

The Climate Crisis, Clinical Practice, and Health Care Delivery

When public health systems lack the ability to prevent harm, it increases climate-related disease burdens that flow into the health care system. Climate change is making it harder for me to do my job – which is to prevent harm and improve health - and disrupting health care delivery systems [see appendix for the 2020 *New England Journal of Medicine* Perspective by Salas].[30] Nearly all of the climate exposure pathways could lead an individual to the doorsteps of my emergency department.

Often times, we try to look at historical data in medicine to get a sense for the future. For example, I always review any prior urine cultures before prescribing antibiotics for a urinary tract infection. Yet, we can no longer rely on a rear-view mirror to map out the health harms of our patients because the climate crisis is creating an unprecedented future that looks nothing like our past.

The medical community is increasingly engaging on the topic of how the climate crisis is impacting clinical practice, especially given the disruptions to health care delivery and the anticipated continued understanding of new health harms. This led my colleagues and I to launch the Climate Crisis and Clinical Practice Initiative in collaboration with the *New England Journal of Medicine* and Harvard where we held an inaugural symposium in Boston that brought together every major hospital system in the city in February 2020.[30-32] Through this Initiative, working with experts and hospitals around the country, we are seeking to build expert consensus and a

research agenda that outlines what we know and what we need to know in order to better understand how we in health care must adapt our clinical practice across every specialty. This, for example, can range from triage protocols, screening questions, treatments, and patient education – tailored for each climate exposure pathway, unique geographic vulnerabilities, and the local health care context.[30] For example, medications, especially those prescribed for cardiovascular or psychiatric use, may increase an individual's risk of heat-related illness.[33] In addition, certain life-saving medications, such as epinephrine or albuterol, have been found to have decreased efficacy when exposed to extreme heat.[34-36] These examples reinforce the need to add a climate lens to all we do in medicine.

Health care systems themselves are vulnerable to disruption from climate-sensitive events, leaving them at higher risk to being unable to provide high-quality care during a community's greatest need or being forced to close due to catastrophic infrastructure damage. Hospitals have closed from wildfires in the West, floods in the Central region, and hurricanes along the coast. The experience of hospitals in Florida following Hurricane Michael provides a vivid example.[37] These disruptions can result in significant revenue losses; New York University (NYU) Langone, as an example, had an estimated $1.4 billion loss in 2012 from Hurricane Sandy.[38] Damage that extends to other critical extensions of the health care system, such as outpatient pharmacies, can further amplify health care disruptions.

Power outages, more common from both heat and the intensification of extreme weather, leave physical infrastructure intact but create low resource environments in otherwise high resource hospitals.[3] Recently, 250 hospitals lost power in California due to wildfire prevention measures.[30,39,40] Typically, back-up power generation only supplies a subset of the needs, creating potentially dangerous heat exposure impacting, for example, patients, health care workers, equipment, and medications or vaccinations. A hospital near Boston lost power last year during an approximately 90°F day and was forced to evacuate patients from the upper floors and had overheated equipment that was still impaired even after power was restored.[41]

Even if a facility remains open, patients may not be able to access care due to disruptions in transportation through personal travel vehicles (e.g., loss of car) or community infrastructure (e.g., road blockages, public transportation disruption, loss of cell phone access, lack of access to EMS). Following Hurricane Maria, nearly a third of households reported disruptions including an inability to access medications (14%), utilize medical equipment that required power (10%), access health care facilities due to closures (9%) or doctors (6%), access emergency medical services by phone (9%).[42]

If patients can reach care at operable facilities, potential disruptions to care provision still exist. Health care in the United States depends on global supply chains, which have been increasingly shown to be vulnerable.[43] The national shortage of intravenous saline following Hurricane Maria exemplifies how even common medical treatments are vulnerable, let alone the personal protective equipment shortages of the COVID-19 pandemic occurring without significant additional climate stressors.[1,44,45] Following Hurricane Maria, there was an intravenous saline shortage that touched my hospital in Boston and as a result we had certain guidelines for who could receive this treatment. If my patient didn't meet the guidelines, I treated them by providing Gatorade. You can imagine a patient's surprise.

Extreme weather events can also create shortages of health professionals due to injury, displacement, or personal needs following these incidents. This occurred for over 200 Kaiser Permanente employees in the wake of the 2017 California wildfires and at NYU Langone following Hurricane Sandy in 2012.[46]

The downstream impacts to health are anticipated to be significant as health care is disrupted for patients.[47,48] Hurricane Maria led to a 62% increase in mortality compared to one year prior and about a third of these deaths are attributable to disrupted care.[42] In addition, it was recently shown that patients who had their radiation treatments for lung cancer disrupted as a result of hurricanes had decreased survival.[49]

These disruptions are now layered on top of the financial stress hospitals have faced during the COVID-19 pandemic. More than 120 rural hospitals have closed in the past decade and rates of closure are only increasing, with 18 rural hospital closures in 2019 alone.[50] Before the COVID-19 pandemic, 25% of rural hospitals were at risk of closure.[51] The pandemic will only exacerbate these risks. Through April of this year, 10 rural hospitals have already been forced to shut down due to financial challenges.[50] In the 17 days following the signing of the CARES act, two rural hospitals closed and two others announced plans for closure.[52] Not only has the COVID-19 pandemic created financial vulnerabilities for rural hospitals, it has also uniquely threatened safety-net hospitals, which primarily serve low-income communities and people of color, a population that has been disproportionately impacted by the virus itself.[53]

The Climate Crisis is a Metaproblem and Threat Multiplier: Reflections on the COVID-19 Pandemic and Health Inequities

The climate crisis is both a "metaproblem" – meaning it underlies other problems – and a "threat multiplier" – meaning it makes existing problems worse. This means that climate change touches everything and is creating barriers to successfully tackling the nation's most pressing health challenges of today, including the COVID-19 pandemic and health inequities [see appendix for the 2020 *New England Journal of Medicine* Perspective by Salas, Shultz, and Solomon]. In addition, the health harms of climate change are also intertwined with the burning of fossil fuels, which creates both dangerous air and carbon pollution.

The Climate Crisis and the COVID-19 Pandemic

The parallels between the COVID-19 pandemic and the climate crisis are clear, inaction on science that can prevent health harms will lead to illness and death, especially for the most vulnerable [see appendix for the 2020 opinion in the *British Medical Journal* by Salas].[54] But additionally, the climate crisis is making it harder for us to optimally respond to the pandemic through difficulty maintaining physical distancing, forced displacement, exacerbation of coexisting conditions, and disruption of health care services.[11]

In a recent article in the *New England Journal of Medicine* that I was first author on, my colleagues and I outline that those most at risk for sickness and death from heat – and affected by the other harms of climate change – are the very people who have been shown to be more at risk

of getting infections and dying of COVID-19 and suffering health inequities. Meanwhile, carbon and air pollution from fossil fuels are causing more of – or worsening – the very underlying medical problems that increase risk of death from COVID-19.

The climate crisis, which is intensifying extreme weather like heat waves, hurricanes and wildfires, is making power outages more likely and forcing us from our homes and to travel or congregate with others. The pandemic is sending critical ill COVID-19 patients to already overwhelmed hospitals, yet the ability of these hospitals to function and provide care is being increasingly disrupted by the climate crisis, as outlined above. If people stay quarantined in their home – to try to protect themselves from the coronavirus – they may get sick or die from heat if they don't have access to a cool environment. Even people who do have access to cooling like air conditioning may lose it during a power outage or may not be able to afford to use it. If they do leave their homes – they may find that cooling centers are not open and the usual air-conditioned public spaces are closed. Even if they find them open, they run the risk of contracting COVID-19.

These are impossible choices for people.

We outline short- and long-term strategies for local communities and state agencies to help protect people and call on the federal government to provide more coordinated policy and funding. The ones we outline are not exhaustive, but are meant to highlight the types of solutions we need.

For example, we need to ensure that cooling centers are available and open. We also need to modify usual procedures with safe practices like limiting occupancy, while also ensuring enough sites to accommodate everyone, mask wearing, ample hand sanitizer, and physical distancing. We can also provide electricity subsidies and extending moratoriums to prevent electricity and water shutoffs during extreme heat so people can remain safely at home.

In the long-term, investments in making communities cooler and more resilient to climate change, like adding greenspace and white roofs, are critical for keeping people safe within their residences during pandemics. We also need to continue to innovate our health care systems, like using community paramedicine to screen and protect people vulnerable to heat at home.

The Climate Crisis and Health Inequities

I chose emergency medicine because I have the privilege of treating whoever walks into my department – and it is a beautiful palette of humanity every shift – from the homeless to professional sports players – because every life is equally valued and provided equal care. Yet, climate change, just as the COVID-19 pandemic, is not felt equally. Minorities and low-income communities disproportionately bear the brunt of the health harms of climate change even though they contribute less to the very carbon pollution that harm them most.[2,4,55,56]

For example, Black and Latinx communities are exposed to higher levels of particulate matter air pollution, 21% and 12% more respectfully, than white communities.[55] Those who live in counties that have more low-income, less educated, and higher proportions of Black residents

have lower lifespans due to particulate matter exposure.[57] Racial minorities are also more likely to live in areas of the city that are hotter, increasing their risk for heat-related illness. Blacks are 52% more likely to reside in areas that are prone to heat-related risks, as are non-Hispanic Asians (32%), and Latinx populations (21%).[58] Evidence also suggests that historic redlining may be contributing to this disproportionate heat exposure.[59]

Example Suggestions for a Path Forward to Address the Climate Crisis to Protect Health and Advance Health Equity

The COVID-19 pandemic has made health central to decisions across nearly every sector in an unprecedented way during modern times. Similarly, health must be central to our discussions on climate change because the medical diagnosis is clear – air and carbon pollution fueling climate change are harming us. Discussion of climate policy should include the perspective of health benefits and health costs. For example, the National Oceanographic and Atmospheric Administration's calculations for the costs associated with billion-dollar weather and climate disasters should include the health costs. Thus, this hearing, and its important framing on health, is critical.

As an emergency medicine doctor, I can never take just one health problem and place it in isolation in my practice. One insult on the body creates new problems and worsens old ones, just like climate change. We have to address all of these problems together – from the climate crisis to the COVID-19 pandemic - through innovative, cohesive, multi-disciplinary solutions that recognize that they are all interconnected and mandate an integrated agenda.

When a patient is critically ill and crashing in front of me, I give that patient every treatment that may save their life. The same is true for this crisis - we need to boldly and urgently implement solutions together. With critically ill patients, there is also often a narrow window when treatment works. If we don't act quickly, the patient may still die even though the treatment would have saved their life earlier. We are in that narrow window for the climate crisis. Climate scientists have clearly outlined that those of us alive today have the profound responsibility of being the ones that have to swiftly act and reduce our greenhouse gas emissions over the next decade.[60]

Reducing our greenhouse gas emissions by reducing our reliance on fossil fuels – also called mitigation – will improve health immediately. As an example for how quickly air pollution can improve – thus exhibiting the immediate benefits – we experienced a 17% reduction in greenhouse gas emissions worldwide with the slowed activity caused by the pandemic, with marked decreases in air pollution.[61,62] While it will benefit everyone, it will disproportionately benefit vulnerable populations.

Even if I could snap my fingers today and stop all greenhouse gas emissions, the carbon pollution already in the atmosphere locks us into continued warming. Thus, to prepare our public health and health care systems, the federal government must ensure they have the financial resources and the evidence-base to adapt and be resilient for what lies ahead, especially as compounding challenges arise. Our current investment for these types of integrated responses is far from adequate. Only 5% of all climate adaptation investments in the United States went to the

health care sector in 2016.[1,63] Financial investments at all levels – local, state, and federal - are required, but future federal stimulus packages can be an immediate platform.

In addition, there is a paucity of funding to support work in this space without promotion and facilitation of the multidisciplinary approach that is required. Unprecedented challenges require unprecedented solutions. We must recognize the complexity and encourage and facilitate multidisciplinary research and collaboration, especially between federal agencies. For example, the National Science Foundation could put forth funding for trans-disciplinary efforts to comprehensively understand the nexus of climate change and health. Generating further evidence will build upon our existing base to allow us to better understand these issues and optimally guide our preparation.

Please see the 2018 and 2019 Lancet Countdown on Health and Climate Change Policy Briefs for the United States of America for more detailed recommendations [see appendix].

Closing

As members of Congress, you have the power to create real, upstream solutions that can address the root causes of climate change and help build the health systems that could prevent illnesses or death in my patients.

The COVID-19 pandemic has placed health central in our society unlike ever before in modern times, and it has exposed our underfunded public health infrastructure and fragile health care systems.

More importantly, it has shown us that when we ignore the science and delay action, people die.

I am here to urge you to make health the driver of climate action, to set aside your differences and agree that health is common ground that we can all stand on, and to collectively vow to learn from the suffering and loss of our current moment to avoid the same mistake with the climate crisis.

Thank you for your time.

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