Published in final edited form as:

J Occup Environ Med. 2021 November 01; 63(11): e813–e818. doi:10.1097/JOM.0000000000002345.

Improving Patient Outcomes in the Dual Crises of Climate Change and COVID-19, Proceedings of the Third Annual Clinical Climate Change Meeting, January 8, 2021

Emily Senay, MD[1,*], **Aaron Bernstein, MD**[2,3], **Peggy Shephard**[4], **Renee Salas, MD**[2,5], **Albert Rizzo, MD**[6], **Jodi Sherman, MD**[7,8], **Lynne Richardson, MD**[9,10], **Gary Butts, MD**[11], **Harleen Marwah, MS**[12], **Caren Solomon, MD**[13], **Maida Galvez, MD**[1], **Erin Thanik, MD**[1], **Grant Pezeshki**[14], **Lauren Zajac, MD**[1], **Alison Lee, MD**[15], **Perry Sheffield, MD**[1], **Robert Wright, MD**[1,16]

[1.]Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, New York, NY

[2.]Center for Climate, Health, and the Global Environment, Harvard T.H. Chan School of Public Health, Boston, MA

[3.]Boston Children's Hospital, Boston, MA

[4.]WE ACT for Environmental Justice, New York, NY

[5.]Department of Emergency Medicine, Harvard Medical School, Boston, MA

[6.]American Lung Association, Chicago, IL

[7.]Department of Anesthesiology, Yale School of Medicine, New Haven, CT

[8.]Department of Epidemiology in Environmental Health Sciences, Yale School of Public Health, New Haven, CT

[9.]Department of Emergency Medicine, Icahn School of Medicine at Mount Sinai, New York, NY

[10.]Population Health Science & Policy, Institute for Health Equity Research, Icahn School of Medicine at Mount Sinai, New York, NY

[11.]Diversity Programs, Policy, and Community Affairs, Icahn School of Medicine at Mount Sinai, New York, NY

[12.]Medical Students for a Sustainable Future

[13.]New England Journal of Medicine, Waltham, MA

[14.]New York City Department of Health and Mental Hygiene, Long Island City, NY.

[*]Corresponding Author: Emily Senay, MD, Department of Environmental Medicine & Public Health, Selikoff Centers for Occupational Health, Division of Preventive Medicine, Icahn School of Medicine at Mount Sinai, 17 East 102nd Street, Box 1043 New York, NY 10029-6574, emily.senay@mssm.edu.

Ethical Considerations & Disclosure: Dr. Jodi Sherman discloses payment from Abbot India for a single lecture on the topic of sustainable anesthesia. Abbot India had no say in content or this paper.

Conflict of Interest: None declared

[15.]Departments of Medicine, Division of Pulmonary, Critical Care and Sleep Medicine, and Pediatrics, Icahn School of Medicine at Mount Sinai, New York, NY.

[16.]Mount Sinai Institute for Exposomic Research, Icahn School of Medicine at Mount Sinai, New York, NY

Abstract

The tremendous global toll of the COVID-19 pandemic does not fall equally on all populations. Indeed, this crisis has exerted more severe impacts on the most vulnerable communities, spotlighting the continued consequences of longstanding structural, social, and healthcare inequities. This disparity in COVID-19 parallels the unequal health consequences of climate change, whereby underlying inequities perpetuate adverse health outcomes disproportionately among vulnerable populations. As these two crises continue to unfold, there is an urgent need for healthcare practitioners to identify and implement solutions to mitigate adverse health outcomes, especially in the face of global crises. To support this need, the 2021 Clinical Climate Change Conference held a virtual meeting to discuss the implications of the convergence of the climate crisis and COVID-19, particularly for vulnerable patient populations and the clinicians who care for them. Presenters and panelists provided evidence-based solutions to help health professionals improve and adapt their practice to these evolving scenarios. Together, participants explored community health system and national solutions to reduce the impacts of COVID-19 and the climate crisis, to promote community advocacy, and to foster new partnerships between community and healthcare leaders to combat systemic racism and achieve a more just and equitable society.

Keywords

climate change; COVID-19; health disparities; patient outcomes; exposures; environmental justice

---

The COVID-19 pandemic has killed millions of people worldwide. It has devastated families and businesses, laid bare vulnerabilities in industries and communities, and stressed the global supply chain and healthcare system. Critically, the pandemic has crystallized existing inequities in healthcare, exacerbating the detrimental effects of deeply entrenched disparities. Similarly, the scope and impact of the pandemic are mirrored, on a much broader scale, by the effects of the ongoing climate crisis. Climate change is decreasing the quality of the air we breathe, the food we eat, and the water we depend upon—directly and indirectly impacting human health across all angles.[1] Like the COVID-19 pandemic, underlying disparities further exacerbate the health risks of climate change, disproportionately laying the burden on disadvantaged communities.[2]

To help healthcare practitioners develop real solutions to better care for their patients now and in the future, especially in the face of global crises, the Third Annual Clinical Climate Change Conference convened virtually on January 8, 2021. This year's meeting focused on the convergence of the climate crisis and COVID-19, including the implications for vulnerable patient populations and the clinicians who care for them. By offering evidence-based solutions and tools, the meeting aimed to help health professionals improve

their practice now and adapt it to better serve patients moving forward. More than 150 participants explored solutions at the community health system and national levels to mitigate the threats posed by COVID-19 and the climate crisis, as well as the role of community advocacy and ways to build new partnerships between community and healthcare leaders to combat systemic racism and achieve a more just and equitable society. See Table 1 for a summary of presentations; for full meeting details and video recordings, see https://www.clinicalclimatechange.com/agenda. Below we summarize contributions from the 2021 meeting.

Exposomics for Unravelling the Health Effects of Climate Change and COVID-19

Exposomics—the study of the totality of health-relevant environmental exposures throughout a lifetime—is relevant to both climate change and the COVID-19 pandemic, as both are components of the environment. Exposome-driven approaches provide the ability to measure thousands of chemical exposures, even without defining those chemicals in advance. This capability is important in the context of climate and health: these factors not only have direct effects on human health, but also have butterfly effects, or localized changes in complex systems that then indirectly affect human health.

"Butterfly effects" of climate change include increased incidence of vector-borne diseases due to expanded survival of vectors like mosquitos and ticks as a result of altered temperature patterns.[3] Such indirect effects are difficult to tease out, especially via targeted approaches—exposomics offers a powerful alternative. With technologies such as satellite remote-sensing and wearable devices, we can collect rich exposure data on diverse parameters of our environment, such as air pollution, weather, and temperature in geospatial time. Further development of targeted assays will help unravel the myriad direct, indirect, and yet-unappreciated contributions of environmental exposures to human health. COVID-19 also has butterfly effects, particularly in the area of mental health, as the lockdown, economic impact and social isolation of the pandemic affects everyone, even those who never got infected. An exposomic framework allows researchers to capture all the impacts of the pandemic and how they interact with climate change, which will no doubt reverberate for years to come.

Additionally, environmental factors make some people more susceptible to exposures than others, and this certainly is true for both COVID-19 and climate change. Thus, environmental susceptibility is a key consideration of how exposures impact human health. Most health disparities are driven by environmental susceptibility and not by genes. Efforts to examine exposure trends over time and focus on the most vulnerable populations—those most environmentally susceptible and affected by health disparities—will help health professionals better plan for the future.

Highlights:

Exposomic technologies can help us understand the complex direct and indirect effects of environmental exposures, which include climate change and the COVID-19 pandemic, for

example through rich satellite remote-sensing data that capture weather, temperature, and air pollution changes both temporally and geographically.

In addition to helping unravel the complex health effects of environmental exposures, exposomics can illuminate the pathways by which these exposures contribute to health disparities—a critical step to mitigating such disparities.

Three Strands of the Same Rope: The Climate Crisis, COVID-19 Crisis, and Equity Crisis

Climate change and COVID-19 are not equal-opportunity killers. Black Americans are nearly twice as likely to die from COVID-19 as whites,[4] and Black Americans are much more likely to breathe polluted air. Even as air pollution nationally has improved dramatically in recent years, disparities between people of color and whites and between impoverished Americans and wealthier Americans have persisted[5]—those who are most at-risk are getting left behind.

The climate crisis, the COVID-19 crisis, the equity crisis—these are three strands of the same rope. While this rope currently represents harm, it also could provide a lifeline, by underscoring that actions to mitigate one crisis can simultaneously improve outcomes from other crises. For example, addressing the root causes of climate change and pandemics also help improve health equity, as their consequences disproportionately affect the people who are most vulnerable. Actions to address climate change are some of the same actions to address the major health problems clinicians face in practice.

Health professionals must address these crises head-on, as they experience firsthand how racial injustice and poverty create the fault lines that crises like climate change and COVID-19 exploit. Clinicians know the value of science and have trusted relationships with patients. Healthcare providers speaking up about how the crises impact health can transcend the political morass and instead make these crises personal, actionable, and hopeful.

Highlights:

The climate crisis, COVID-19, and equity crisis are interwoven. Pulling one strand can help unravel the others, providing a societal path forward to overcome these challenges.

Healthcare professionals can take a leading part in moving towards a healthier, more just, and sustainable world, as their voices can make these issues more personal and actionable to patients.

Community Partnerships, Advocacy, and Building Healthier Communities

Hippocrates observed that to learn about the health of a population, you must look at the air they breathe, the water they drink, and the places where they live. Thousands of years later, this observation from the “Father of Medicine” still rings true. Neighborhood factors such as environmental conditions, housing, transportation, economic development, land use and zoning, open spaces, and access to quality food and water directly impact community

health and sustainability. Yet these resources are not equally distributed across communities—diverse social, racial, economic, and environmental determinants shape each community's access to resources. Lack of access to adequate resources and to healthcare together create a landscape of disparities across communities.[6]

In addition to directly impacting a population's health, existing disparities also make communities more vulnerable to the effects of climate change, such as extreme weather events, and health crises like the COVID-19 pandemic. These compounding negative effects require strategic and directed solutions to mitigate the effects of community disparities. Yet because disparities are rooted in complex histories that include housing segregation, appropriation of tribal lands, and land use and zoning discrimination, there are no simple and singular solutions. The legacy of environmental injustice has woven tight knots that must be unraveled one by one to ensure more equitable healthcare to all communities.

Although we have data on these public health issues, more progress is needed to improve health outcomes by adopting new strategies and approaches to enact change. For example, frameworks that integrate community, academic, and other stakeholders can provide the structure and technical assistance to develop and sustain partnerships that benefit all parties. Community-based organizations have a critical role to play by providing a means for community members to participate in the creation of sound and impactful policies, enact bottom-up solutions, and improve community awareness. Researchers and clinicians also have a powerful voice in public health—engaging in advocacy efforts to articulate research, opening communication channels with impacted communities and relevant stakeholders, and working to advance policies can all help ensure that research data are translated into policy and practice to help build healthier communities.

Highlights:

A complex history of environmental injustice has created a landscape of disparities across communities, requiring tailored and community-based solutions to improve equitable access to high-quality healthcare.

Community-based organizations and health professionals have important roles to play in ensuring equitable access to care by driving bottom-up solutions, enhancing community awareness, and catalyzing policy-based efforts that directly benefit vulnerable communities.

The Climate Crisis and Clinical Practice

Unequal distributions of health burdens across populations necessitates a multipronged approach to address the direct and indirect health harms of the climate crisis within clinical practice. The COVID-19 pandemic has demonstrated, on an accelerated timeline, that a failure to act on science, as well as delayed and inequitable action, results in preventable death and suffering for population health.[7] It is clear that prevention is key and that responses to such crises must be globally coordinated to enable effective mitigation; this applies to the climate crisis as well.

In addition to addressing the root causes of climate change via mitigation strategies, geographically relevant climate exposure pathways and their health-relevant impacts must be identified to adapt and improve clinical practice, especially for the most vulnerable patients. This includes the identification of healthcare system disruptions and vulnerabilities to bolster healthcare system resilience. These efforts further the fundamental mission of the healthcare sector: prevent harm, improve health, save lives, and advance health equity.

As we increasingly face an unprecedented future,[8] now is the critical time to add a climate lens to our clinical practices and healthcare systems. For example, how can we identify and intervene for those individuals who are especially at risk? The impacts of climate change are mediated through diverse factors that contribute to health-related vulnerabilities—meaning that together, they build a framework that informs patient health.

These climate change-related factors include heat stress, leading to heat stroke or broadly worsened health outcomes including cardiovascular or renal disease and obstetric harms; poorer air quality, via pathways like climate-intensified wildfire smoke or higher pollen; food supply and safety, as climate change is lowering the nutritional content of crops, disrupting delivery systems, and influencing climate-sensitive foodborne diseases; and water quality and quantity, as climate change impacts disease-causing waterborne pathogens, toxic algal blooms, and water contamination; extreme weather events, leading to cascading harms and adverse mental health outcomes; and climate-sensitive vector-borne diseases, as mosquitoes and ticks have increased geographic distributions to spread Lyme disease or the West Nile virus.[9] These impacts are further compounded by the implications of climate change on social factors, such as extreme conditions and events continuing to displace individuals both within country borders and across them. On a systems level, healthcare systems are also being disrupted through mechanisms like infrastructure damage, power outages, and supply chain interruptions.

Putting this clinically-relevant framework into the local context can help healthcare professionals address how climate change is affecting their patients. This can be done systematically through the unique considerations of each climate exposure pathway, geography, specialty characteristics, and the local healthcare context. Subsequently, a climate lens can be applied to each aspect of clinical practice (e.g., pre-hospital, triage, screening, diagnosis, patient education) and healthcare delivery (e.g., supply chains, electricity-dependent procedures).

Lastly, we must remember that the research gaps are numerous and that the climate crisis is continuing to evolve. In addition to these better understood and more visible impacts of climate change, the largest burden likely still remains hidden from view. Thus, it is imperative that we gain additional understanding of the effects that have not yet been recognized, characterized, or even manifested. Health professionals must remain vigilant to protect the health of their patients in the face of the climate crisis.

Highlights:

The healthcare community must add a climate change lens to clinical practice and healthcare delivery because the challenges of the future are unprecedented; this includes recognizing

how climate change is having diverse and evolving impacts on human health and healthcare delivery.

Climate change is harming health through geographically diverse pathways—including heat stress, air quality, food supply and safety, water quality and quantity, extreme weather events, climate-sensitive vector-borne diseases, and social implications—and disrupting healthcare delivery—including infrastructure, power outages, and supply chains; a framework that includes these geographic exposures, medical specialty characteristics, and the local healthcare context can be systematically applied to improve clinical efficacy, especially for vulnerable patients, and bolster the resilience of healthcare systems.

2021: State of the Air

In addition to influencing extreme weather and climate-related events, transmission of infectious diseases, and disruption of food and water supplies, climate change has profound effects on air quality. Recent years have recorded the warmest temperatures globally, which further exacerbate the negative effects of air pollution as warmer temperatures increase formation of ozone and prolong its dissipation. Climate change is leading to more conditions for spikes in air pollution to occur—droughts contribute to occurrence of deadly wildfires, and weather inversions trap pollutants closer to the ground, where they are more easily breathed into the lungs.

The American Lung Association's annual State of the Air report documents local air pollution data to inform the public about the quality of air it breathes. The 21st State of the Air report released in spring 2020 reveals disturbing trends—46% of Americans now live in areas with measures of poor air quality, including increasing frequency of elevated ozone and particulate matter levels.[10] Although the risk from airborne pollution affects all of us, particular groups experience disproportionate risk, including those at age extremes (i.e., very old and very young), pregnant women, and individuals with chronic lung conditions or cardiovascular diseases. Socioeconomic status and ethnic background also contribute to risk, as practices like redlining have long-lasting impacts on communities. Efforts to clean up the air must prioritize areas that historically have been overlooked.

Assessing whether long-term exposure to air pollution increases the severity of COVID-19 health outcomes, including death, is another important public health objective. Limitations in COVID-19 data availability and quality remain obstacles to conducting conclusive studies. Yet studies have already revealed important insights, such as that exposure to particulate matter increases the risk of mortality from COVID-19.[5]

Highlights:

Air pollution is now the biggest environmental risk for early death, responsible for as many as five million premature deaths each year from heart attacks, strokes, diabetes, respiratory diseases—more deaths than from AIDS, tuberculosis, and malaria combined.

We increasingly face complex challenging scenarios given the confluence of our two most pressing global health threats currently—the rapid emergence of the COVID-19 pandemic,

and the insidiously evolving climate crisis—both of which disproportionately harm the health of vulnerable and economically disadvantaged people, including those affected by structural racism.

Climate Change, COVID-19, and the Healthcare Supply Chain

Pollution is a leading cause of morbidity and mortality worldwide.[11] Paradoxically, the healthcare industry itself is a leading emitter of environmental pollutants. Globally, the healthcare sector was responsible for 4.6% of total emissions in 2016.[12] Medical devices are trending toward single-use disposable supplies to reduce perceived risks of microbial cross-contamination and keep patients safe; yet, this fails to consider the public health impact of mounting waste and pollution from increasing consumption of energy and resources.[13] Pollution prevention represents a new patient safety movement.[14]

Roughly 70–80% of the healthcare sector emissions come from the medical supply chain.[14,15] Modern supply chains are increasingly complex and global, yet there is a lack of transparency in the supplier tiers that leaves the healthcare industry at risk of interruption. Recently, the COVID-19 pandemic exposed vulnerabilities of medical supply chains, most notably for personal protective equipment (PPE); similar risks are shared with climate change such as from weather-related disasters disrupting manufacturing and transportation.

Sustainable solutions also improve supply chain resilience. The resource inputs and emissions at all phases along a product's life must be understood to better inform sustainable healthcare choices. This can be achieved via lifecycle assessment, a modeling tool for quantifying the total resource inputs and environmental burdens across a product's lifecycle, including natural resource extraction, manufacturing, packaging, transportation and eventual waste disposal. Reusable items tend to require less energy, raw materials, and produce fewer environmental emissions than comparable single-use disposable devices.[16]

Most supply chains within healthcare are currently linear, or "take-make-waste," whereby a product is manufactured, used for a short time, and then thrown away. A shift toward a circular economy is needed, whereby materials are kept in use, and waste and harmful byproducts are designed out of the system. The circular economy aims to keep materials within an ecosystem, for instance by replacing disposable single-use products with products that are designed to make sterilization and reuse easier; and when no longer functional materials can then be repurposed for other uses. A circular economy thereby creates supply chains that are more local, sustainable, and more resilient to global market fluctuations.[17]

Highlights:

Because of the detrimental effects of pollution on public health, pollution prevention represents a new patient safety movement; reducing healthcare pollution can improve the triple bottom line—providing the best care for the most patients at the least cost.

Lifecycle assessments and a shift toward more circular economies can help the healthcare industry reduce its pollution and simultaneously improve the resilience of the healthcare supply chain, especially in the face of ongoing crises such as climate change.

COVID-19, Climate, Racial Injustice: The Path Forward

Infrastructure disruptions due to extreme climate-related events can impact vulnerable populations and communities due to longstanding disparities in health. These populations live in physical and social environments that often lack the resources needed to generate and sustain health, and they also receive less access to healthcare and poorer quality care compared to advantaged populations. It is upon this unequal basis that climate-related emergencies overlay their own disruption.

Such effects have been clearly demonstrated in response to the COVID-19 pandemic. Longstanding structural inequities, pre-existing healthcare disparities, and community disadvantage that leaves communities less able to respond have resulted in unequal risks of contracting and dying from COVID-19.[18] For example, racial and ethnic minorities are more likely to work in low-wage, high-contact jobs; live in multifamily multigenerational households in densely populated areas; have pre-existing medical conditions that make them more susceptible to poor outcomes; and be food insecure and financially insecure. To provide uniformly high-quality care in terms of COVID-19, equitable access to testing, vaccines, and healthcare is needed immediately. Long-term strategies will be required to address the financial devastation of COVID-19, which also negatively impacts health.

Growing recognition acknowledges that racism not only unfairly disadvantages some individuals and communities, but it also unfairly advantages other individuals and communities. Strategies that consider the role of advantage and disadvantage of individual communities are needed to ensure equitable access to healthcare to mitigate the diverse effects of climate change. Efforts to work with community organizations and institutions are needed to build community capacity, by investing in community infrastructure, in housing and roads, and access to broadband and other infrastructure that will help communities survive and recover from climate-related emergencies. In addition, engagement in financial and logistical disaster preparation is necessary to ensure that communities are not left as vulnerable when future emergencies arise.

Highlights:

The COVID-19 pandemic has exposed the vulnerability of disadvantaged communities due to disparities, particularly in terms of healthcare; the same disparities also put these communities at increased risk of the devasting effects of climate change.

Investments in infrastructure are a key component of building the capacity of communities to weather and recover from the global effects of the climate crisis.

COVID-19, Climate, Racial Injustice Panel Discussion

The links between these three ongoing crises—COVID-19, climate change, and racial injustice—reflect a key underlying issue: equity. Panelists involved in both allied health professions and advocacy noted the importance of equity not only as a component of each approach to resolve the multidimensional, complex nature of these interconnected crises, but also as a core value. The transformational change needed to tackle these problems requires

centering marginalized voices, promoting fundamentally different ways of thinking, and fostering community collaborations, as well as being deliberate, intentional, and accountable in enacting solutions. Allied health professionals in particular must work to understand the conditions faced by the communities in their care, to recognize the supports available to those communities, and to promote equity and justice for all people.

Workshops

Two concurrent workshops focused on providing actionable clinical skills. The first, "Climate Change, Environmental Justice, and Public Health Tracking", centered on using public health data tools for surveillance and tracking. The workshop showed clinicians how to access, use, and apply surveillance and tracking data to their work. Case examples demonstrated use of the Centers for Disease Control and Prevention's National Environmental Public Health Tracking Network and the New York City Department of Health and Mental Hygiene's Environment and Health Data Portal, and discussions focused on how clinicians can integrate such data into their work.

The second workshop, "Addressing Climate-Mediated Disease in the Clinical Setting", aimed to help clinicians and others interacting with patients to understand how climate change may be affecting their patients' health and how to practically address these factors in patient interactions. Presentations of clinical scenarios followed by discussion of the cases focused on how to help patients understand how they can improve their health by modifying exposures and use the clinical encounter as a 'teachable moment' for both the clinician and patient to strengthen their mutual understanding of the structural links between the triple threat of climate change, COVID-19, and racial inequities and health.

Conclusions

The COVID-19 pandemic highlighted critical disparities in communities and key vulnerabilities in the healthcare system, providing an acute preview of the mounting effects of climate change on human health. Adapting lessons gleaned from the pandemic will better position healthcare professionals to respond to the climate crisis via strategies that aim to provide equitable access to high-quality healthcare across all populations.

Acknowledgments, including all sources of support:

Alison Lee was supported by K23HL135349 and R01MD013310.

Maida Galvez is supported in part by the cooperative agreement award number 1 NU61TS000296-01-00 from the Agency for Toxic Substances and Disease Registry (ATSDR). Its contents are the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry (ATSDR). Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-95877701. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications Dr. Galvez is also supported by grant P30ES023515 from the National Institute of Environmental Health Sciences, grant UL1TR001433 from the National Center for Advancing Translational Sciences, National Institutes of Health and by the New York State Department of Health (New York State Children's Environmental Health Centers).

Perry Sheffield and Lauren Zajac were supported in part by the cooperative agreement award number 5 NU61TS000296-02-00 from the Agency for Toxic Substances and Disease Registry (ATSDR). Its contents are the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances

and Disease Registry (ATSDR). Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-95877701. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications.

Dr. Sheffield, Dr. Zajac and Dr. Thanik are also supported by the New York State Department of Health (New York State Children's Environmental Health Centers).

Dr. Sheffield, Dr. Zajac and Dr Thanik are also supported by grant P30ES023515 from the National Institute of Environmental Health Sciences

Dr. Robert Wright is supported in part by grant P30ES023515 from the National Institute of Environmental Health Sciences, R01ES013744 and R24ES028522.

Dr. Jodi Sherman receives salary support through the Yale School of Medicine, Department of Anesthesiology.

References

1. U.S. Centers for Disease Control and Prevention. Climate and Health: Climate Change Effects on Health. Type. 2020 Date. https://www.cdc.gov/climateandhealth/effects/default.htm.
2. Climate change preparations must focus on health disparities. Lancet. 2006. 368(9548): p. 1624.Epub 2006/11/14. 17098060.
3. Rocklov J, Dubrow R. Climate change: an enduring challenge for vector-borne disease prevention and control. Nat Immunol. 2020. 21(5): p. 479–83.Epub 2020/04/22. 32313242. [PubMed: 32313242]
4. U.S. Centers for Disease Control and Prevention. Risk for COVID-19 infection, hospitalization, and death by race/ethnicity 2021 [accessed 2021 June 26, 2021]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html.
5. Wu X, Nethery RC, Sabath MB, Braun D, Dominici F. Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis. Sci Adv. 2020. 6(45).Epub 2020/11/06. 33148655.
6. New York City Government. Building healthy communities 2021 [accessed 2021 June 25, 2021]. Available from: https://www1.nyc.gov/nyc-resources/building-healthy-communities.page.
7. Salas RN. Lessons from the covid-19 pandemic provide a blueprint for the climate emergency. BMJ. 2020. 370: p. m3067.Epub 2020/08/09. 32763893. [PubMed: 32763893]
8. Salas RN. The Climate Crisis and Clinical Practice. N Engl J Med. 2020. 382(7): p. 589–91.Epub 2020/02/14. 32053295. [PubMed: 32053295]
9. Salas RN, Solomon CG. The Climate Crisis - Health and Care Delivery. N Engl J Med. 2019. 381(8): p. e13.Epub 2019/08/23. 31433915. [PubMed: 31433915]
10. US Environmental Protection Agency. Our nation's air. 2020 https://gispub.epa.gov/air/trendsreport/2020.
11. Landrigan PJ, Fuller R, Acosta NJR, Adeyi O, Arnold R, Basu NN, et al. The Lancet Commission on pollution and health. Lancet. 2018. 391(10119): p. 462–512.Epub 2017/10/24. 29056410. [PubMed: 29056410]
12. Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Boykoff M, et al. The 2019 report of The Lancet 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): p. 1836–78.Epub 2019/11/18. 31733928. [PubMed: 31733928]
13. Sherman JD, Hopf HW. Balancing Infection Control and Environmental Protection as a Matter of Patient Safety: The Case of Laryngoscope Handles. Anesth Analg. 2018. 127(2): p. 576–9.Epub 2018/01/13. 29324490. [PubMed: 29324490]
14. Eckelman MJ, Sherman J. Environmental Impacts of the U.S. Health Care System and Effects on Public Health. PLoS One. 2016. 11(6): p. e0157014.Epub 2016/06/10. 27280706. [PubMed: 27280706]

15. Eckelman MJ, Huang K, Lagasse R, Senay E, Dubrow R, Sherman JD. Health Care Pollution And Public Health Damage In The United States: An Update. Health Aff (Millwood). 2020. 39(12): p. 2071–9.Epub 2020/12/08. 33284703. [PubMed: 33284703]

16. Sherman JD, Raibley LAt, Eckelman MJ. Life Cycle Assessment and Costing Methods for Device Procurement: Comparing Reusable and Single-Use Disposable Laryngoscopes. Anesth Analg. 2018. 127(2): p. 434–43.Epub 2018/01/13. 29324492. [PubMed: 29324492]

17. MacNeill AJ, Hopf H, Khanuja A, Alizamir S, Bilec M, Eckelman MJ, et al. Transforming The Medical Device Industry: Road Map To A Circular Economy. Health Aff (Millwood). 2020. 39(12): p. 2088–97.Epub 2020/12/08. 33284689. [PubMed: 33284689]

18. The COVID Tracking Project. The COVID Racial Data Tracker. 2021 March 2021. https://covidtracking.com/race.

Table 1.

Clinical Climate Change 2021, Conference Presentations

Exposomics for Unraveling the Health Effects of Climate Change and COVID-19	Robert Wright, MD, MPH, Co-Director, Institute for Exposomic Research and Ethel H. Wise Chair, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai
Three Strands of the Same Rope: The Climate Crisis, COVID-19 Crisis, and Equity Crisis	Aaron Bernstein, MD, MPH, Interim Director, Center for Climate, Health, and the Global Environment (Harvard Chan C-CHANGE), Harvard T.H. Chan School of Public Health; Pediatric Hospitalist, Boston Children's Hospital
Community Partnerships, Advocacy, and Building Healthier Communities	Peggy Shepard, Co-Founder and Executive Director, WE ACT for Environmental Justice
The Climate Crisis and Clinical Practice	Renee N. Salas, MD, MPH, MS, Yerby Fellow, Center for Climate, Health, and the Global Environment (Harvard Chan C-CHANGE), Harvard T.H. Chan School of Public Health; Department of Emergency Medicine, Harvard Medical School; Affiliated Faculty, Harvard Global Health Institute
2021: State of the Air	Albert A. Rizzo, MD, FAACP, FCCP, FAASM, Chief Medical Officer, American Lung Association
Climate Change, COVID-19, and the Healthcare Supply Chain	Jodi Sherman, MD, Associate Professor of Anesthesiology, Yale School of Medicine, Associate Professor of Epidemiology in Environmental Health Sciences; Director, Program on Healthcare Environmental Sustainability (PHES) in the Center for Climate Change and Health, Yale School of Public Health; and Medical Director, Yale New Haven Health Center for Sustainable Healthcare
COVID-19, Climate, Racial Injustice: The Path Forward	Lynne D. Richardson, MD, FACEP, Professor and Vice Chair of Emergency Medicine, Professor of Population Health Science & Policy, and Co-Director, Institute for Health Equity Research, Icahn School of Medicine at Mount Sinai
Panel Discussion–COVID-19, Climate, Racial Injustice: The Path Forward	Lynne D. Richardson, MD, FACEP, Professor and Vice Chair of Emergency Medicine, Professor of Population Health Science & Policy, and Co-Director, Institute for Health Equity Research, Icahn School of Medicine at Mount Sinai Gary C. Butts, MD, Executive Vice President for Diversity, Equity, and Inclusion, Chief Diversity and Inclusion Officer, Mount Sinai Health System; Dean, Diversity Programs, Policy, and Community Affairs, Icahn School of Medicine at Mount Sinai Peggy Shepard, Co-Founder and Executive Director, WE ACT for Environmental Justice Aaron Bernstein, MD, MPH, Interim Director, Center for Climate, Health, and the Global Environment (Harvard Chan C-CHANGE), Harvard T.H. Chan School of Public Health and Pediatric Hospitalist, Boston Children's Hospital Harleen Marwah, MS, Founder & Chair, Medical Students for a Sustainable Future Caren Solomon, MD, MPH, Deputy Editor, New England Journal of Medicine Maida Galvez, MD, MPH, Professor, Departments of Environmental Medicine and Public Health and Pediatrics, Icahn School of Medicine at Mount Sinai
Workshop A: Climate Change, Environmental Justice, And Public Health Tracking	Erin Thanik, MD, MPH, Assistant Professor, Departments of Environmental Medicine and Public Health and Pediatrics, Allergy and Immunology, Icahn School of Medicine at Mount Sinai Grant Pezeshki, Director of Environmental Data Engagement, NYC Department of Health and Mental Hygiene Lauren Zajac, MD, MPH, Assistant Professor, Departments of Environmental Medicine and Public Health and Pediatrics, Icahn School of Medicine at Mount Sinai
Workshop B: Addressing Climate-Mediated Disease in the Clinical Setting	Alison Lee, MD, MS, Assistant Professor, Departments of Medicine, Division of Pulmonary, Critical Care and Sleep Medicine, and Pediatrics, Icahn School of Medicine at Mount Sinai Perry Sheffield, MD, MPH, Associate Professor, Departments of Environmental Medicine and Public Health and Pediatrics, Icahn School of Medicine at Mount Sinai
COURSE DIRECTOR	Emily Senay, MD, Assistant Professor, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai