

Proposal for Improving Climate Health Education in the Required VUSM Curriculum

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Statement of Purpose

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“The Planetary Health Alliance describes planetary health as “a field focused on characterizing the human health impacts of human-caused disruptions of Earth’s natural systems.” This definition is intentionally broad, intended to encompass the multitude of ways that the environment can affect health, including water scarcity, changing food systems, urbanization, biodiversity shifts, natural disasters, climate change, changing land use and land cover, global pollution, and changing biogeochemical flows. The health of humanity is dependent on our environment and our environment is changing rapidly and in disastrous ways. Although the World Health Organization has called climate change “the greatest threat to global health in the 21st century,” many medical school’s institutional priorities do not reflect the urgency of this danger to human health.

As future health professionals, we must be prepared to address the impacts of human-caused environmental changes on our patients’ health. This preparation is in the hands of the institutions providing our medical training. It is imperative that we hold our institutions accountable for educating medical students about the health impacts of climate change and other anthropogenic environmental changes, generating research to better understand health impacts and solutions, supporting related student initiatives, embracing sustainable practices as much as possible, and engaging with surrounding communities that are most affected by environmental threats. Because climate change and environmental threats disproportionately affect vulnerable populations (for example, communities of color, older adults sensitive to health threats, and individuals in low-resource settings), these issues are inherently ones of equity and justice.”

In addition to the proposed sessions highlighted below, we recommend the following systematic changes to improve the education of Vanderbilt medical students in the areas of climate change, planetary health, health equity and environmental justice.

Faculty

We recommend the creation of one tenure-track faculty appointment for a content expert in the health effects of climate change, who will have primary teaching responsibilities in the School of Medicine during the FMK and FCC phases, in addition to mentoring medical student research and advocacy work. We suggest jointly hiring with appropriate offices or departments (e.g. Office of Health Equity; Department of Medicine, Health, and Society; Department of Health Policy; Center for Biomedical Ethics) in order to support these faculty members’ professional development and research goals.

Student Professional Development

We recommend the creation of two annual year-long fellowships for medical students who have completed the FMK and FCC phases. Fellows will both aim to improve the medical school curriculum around climate change and environmental justice, in addition to working with the Office of Health Equity on a health equity project at the Medical School and Medical Center. The fellowship grants should cover the costs of living in

Nashville for a year, including health insurance. Fellow selection should prioritize students who are underrepresented in medicine. The fellows should receive formal mentorship from the Office of Health Equity.

Planetary Health Curriculum

We propose the incorporation of a longitudinal, multimodal curriculum on climate change and its intersection with medicine into the MS1 through MS4 curricula at Vanderbilt University Medical Center. These sessions draw their foundation from the Planetary Health Report Card (<https://phreportcard.org/>), Climate Resources for Health Education (<https://climatehealthed.org/>) and Medical Students for a Sustainable Future Curriculum Guide ([Curriculum Guide_2022 - Danny Walden.pdf](#)).

The chart below is our suggestion for a core curriculum and lists the main topic areas that we feel all medical students should be exposed to. We propose learning objectives, list vetted references, and give examples from other institutions below the chart. Our suggestion is that most be incorporated into the first year curriculum, with supplemental topics added to the second year curriculum.

If all of these topics cannot be incorporated into the M1 or M2 phase, then we recommend “The Impact of Extreme Heat and Rising Temperatures on Renal Health and Chronic Kidney Disease” and “The Changing Patterns of Vector-borne Diseases” be deleted, in that order.

	FOP	Lecture: Social Determinants of Health in a Changing Climate
	M&I	Lecture/SG: The Changing Patterns of Vector-borne Diseases
	Homeostasis	Lecture/SG: Cardiovascular Consequences of Extreme Heat and Respiratory Health, Air Pollution, and Climate Change
	Renal, Digestion	Lecture/SG: Impact of Extreme Heat and Rising Temperatures on Renal Health and Chronic Kidney Disease
	Repro, Endo	Lecture/SG: Climate Change: Disproportionate Effects on Women’s Health and Pregnancy
	BBM	Lecture/SG: Mental Health in the Climate Crisis
	Clerkships	TBD
	FHD	Lecture/SG: Sustainability, Medical Waste and Healthcare’s Carbon Footprint
	FHD: Public Health	Lecture: Climate Change: The Greatest Public Health Threat You Have Not Heard Of
	FHD: Advanced Communication	Lecture/SG: Communicating about Climate Change in Terms of Health

Detailed Outline of Curriculum

The Learning Objectives are adapted from: <https://climatehealthed.org/learning-objectives/>

The Examples from other institutions are found at: <https://phreportcard.org/>

Additional references and presentation materials can be found at: <https://climatehealthed.org/>

First Year

● Social Determinants of Health in a Changing Climate

○ Setting: Foundations of the Profession

○ Objectives:

- Include understanding of local issues
- Underscore that patients from poorer, formerly redlined neighborhoods are significantly more likely to face extreme heat events compared to those from neighborhoods that did not face discriminatory housing policy.
- Overview inequity in cause and consequence of climate change, using examples of “pollution inequity” in the U.S. and case-studies of small island nations
- Describe how patients of color, especially black communities, are disproportionately affected by air pollution and make connections between structural racism and climate change.
- Examine how different social determinants of health predispose certain communities to developing asthma and having poorer asthma-related health outcomes, especially among more vulnerable subpopulations such as children
- List populations of patients who are most vulnerable to adverse mental health impacts from climate change and discuss the disproportionate impact climate change has on the mental health of these populations
- Describe pathways by which extreme climate events and climate-related infrastructure changes can interact with social determinants of health and lead to poor mental health
- Discuss the mechanisms by which extreme weather events disrupt infrastructure essential for human health

○ Reading:

- Frank T. Rise in extreme heat will hit minority communities hardest
<https://www.eenews.net/articles/rise-in-extreme-heat-will-hit-minority-communities-hardest/>
August 2022
- Vaidyanathan et al. Heat-Related Deaths — United States, 2004–2018 *MMWR Weekly* / Vol. 69 / No. 24 June 19, 2020
- Minor et al. Rising temperatures erode human sleep globally 22, *One Earth* 5, 534–549.
<https://doi.org/10.1016/j.oneear.2022.04.008>
- Gronlund et al. Racial and socioeconomic disparities in heat-related health effects and their mechanisms: a review *Curr Epidemiol Rep.* 2014 September 1; 1(3): 165–173.
[doi:10.1007/s40471-014-0014-4](https://doi.org/10.1007/s40471-014-0014-4)
- Hoffman et al. The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas *Climate* 2020, 8(1), 12;
<https://doi.org/10.3390/cli801001> <https://www.mdpi.com/2225-1154/8/1/12/htm>
- Watts 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: 1836–78 November 13, 2019 [https://doi.org/10.1016/S0140-6736\(19\)32596-6](https://doi.org/10.1016/S0140-6736(19)32596-6)
- Mahendran et al. Interpersonal violence associated with hot weather *Lancet Planetary Health* 2022; 5: e571-572
- Van Daalen et al. Extreme events and gender-based violence: a mixed-methods systematic review *Lancet Planetary Health* 2022; 6: e504-523
- Burrows K and Fussell E. A lifecourse epidemiology approach to climate extremes and

human health Lancet Planetary Health 2022; 6: e549-550.

- Crimmins A et al. 2016: Executive Summary The Impacts of Climate Change on Human Health in the United States: A scientific assessment. U.S. Global Change Research Program, Washington, DC : pg 1-24.
<https://health2016.globalchange.gov/downloads#executive-summary>
- Perera F and Nadeau K. Climate change, fossil-fuel pollution, and children's health. NEJM 2022; 386:2503-2514 DOI: 10.1056/NEJMra2117706
- Related Lectures:
 - “Health Equity: Seeds of Change” by Dr. Consuelo Wilkins
 - Objective: Articulate their (medical students) thoughts in considering the role of the medical profession in addressing issues of equity and disparity
 - Discussed differences across Nashville neighborhoods, including redlining and racially motivated public construction projects
 - Students in this course were expected to research different neighborhoods surrounding the school in terms of their “built environment”
 - Part of this discussion included discussing the differences in accessibility of green spaces
 - Possible Faculty: Consuelo Wilkins, Bonnie Miller, Eva Parker
 - Other institutions: *At Queen's university Belfast the C19 curriculum 'People and Populations' lecture by Prof. Frank Kee, “Climate Change and Sustainability”, notes reduced water and food security, leading to malnutrition and diarrheal disease as some of the international effects of climate change. It states the climate change effects on ecosystems and particular species as impacting microbial proliferation; and impaired crop, livestock and fisheries yields, leading to impaired nutrition, health and survival.*
 - *At the Royal College of Surgeons in Ireland the GEM1 curriculum covered the impact of climate change on marginalized populations in the “Environmental Health” lecture in the Public Health & Epidemiology module. The topic was also covered in the GEM2 curriculum Gastrointestinal medicine module clinical lectures “Global Environmental Health” (L16) and “Sanitation” (L17).*
 - *At University of Arkansas (U.S.) in the M1 POM course, Drs. Sara Tariq and Riley Lipschitz discuss the intersectionality of climate change and social health determinants. They describe how health, social equity, and environment synergistically contribute to global issues, such as climate change. Drs. Tariq and Lipschitz also explain how climate change will continue to impact health outcomes through access to food, water, and clean air. They highlight specific examples of environmental factors disproportionately impacting lower SES communities and communities of color, such as the 1995 heat wave in Chicago. Additionally, Dr. Manisha Singh's lecture on chronic kidney disease states that climate change will force more people into extreme poverty by 2030 through diminishing crop yields and water supplies.*
 - *At Imperial College London in the Year 2 Lifestyle and Prevention Medicine course there is a Global Health Module that explores the UN Sustainable Developments Goals and how climate change unequally impacts health across the globe. In addition there is a learning outcome for Year 3 which states: "Explain the impact of climate change, conflict and other natural and anthropogenic events on the health of vulnerable populations around the world."*

● The Changing Patterns of Vector-borne Diseases

- Setting: Lecture/small groups during the Microbes portion of M&I
- Objectives:
 - Discuss how environmental changes caused by climate change contribute to changing geographic distribution and prevalence of vector borne infectious illnesses (Hantaviruses, Arboviruses, Malaria)
 - Describe types of vectors and vector-borne illnesses impacted by climate change in North America (Tick Borne diseases)
 - Explain how a warming climate creates seawater changes that increases the risk of human

vibrio infections (*Vibrio vulnificus*)

○ Reading:

- Rocklöv et al. Climate change: an enduring challenge for vector-borne disease prevention and control *Nature Immunology* volume 21, pages 479–483 (2020)
<https://www.nature.com/articles/s41590-020-0648-y>
- Thomson et al. Climate Change and Vectorborne Diseases *N Engl J Med* 2022; 387:1969-1978 DOI: 10.1056/NEJMra2200092
<https://www.nejm.org/doi/full/10.1056/NEJMra2200092>
- Hauser et al. Climate Change and Infections on the Move in North America *Lancet* 2019; 394: 1836–78 [https://doi.org/10.1016/S0140-6736\(19\)32596-6](https://doi.org/10.1016/S0140-6736(19)32596-6)
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8722568/>

○ Related Lectures:

- “Introduction to Microbes” Objective: Understand the factors involved in the emergence of infectious diseases
- “Enteric Bacteria II” Objective: Epidemiology of *Vibrio cholerae* and *Vibrio vulnificus* • Changes in water temperature, salinity, currents, and seasonality patterns has affected prevalence of these species in the US
- “Atypical Bacteria I Spirochetes” Objective: Epidemiology of Lyme Disease
 - Changing geographic distribution of *Ixodes* tick species is linked to climate change
- “Atypical Bacteria II Intracellular Microbes - Chlamydia, Rickettsiae, Ehrlichia” Objective: Epidemiology of Rickettsiae
 - Wildfires change the proportion of *Dermacentor* ticks present compared to other tick species
- “Protozoa” Plasmodia
 - Malaria is starting to re-emerge in temperate regions in response to rising temperatures
- “Arboviruses, Flaviviruses, and Togaviruses”
 - West Nile Virus
 - Dengue Virus
 - Zika Virus
 - Chikungunya
 - Extreme rain conditions create ideal sites for vectors of arboviral diseases. Geographic distribution of vectors is expanding due to the warming atmosphere.

○ Possible Faculty: Eva Parker

- Other institutions: *In George Washington University's PPS3 lecture “Climate Change”, Dr. Akselrod mentions climate change's impact on the worsening spread of vector borne, water borne, zoonotic, and person-to-person diseases. There are several slides on each topic, which make clear the connection between worsening natural disasters and the spread of water borne infections, warming climate and vector-borne disease, disruption of wildlife habitat and spreading of zoonotic and emerging diseases.*

● Cardiovascular Consequences of Extreme Heat

- Setting: Lecture/small groups during the Cardiology portion of Homeostasis

○ Objectives:

- Explain why the elderly are more susceptible to heat-related exacerbations of cardiovascular and pulmonary illness (primary prevention of cardiac disease)
- Recognize heat stress and fine particulate matter as increasingly common triggers for MI and arrhythmias and to provide appropriate anticipatory guidance to high-risk patients.
- Understand the risks associated with taking blood pressure medications during heat waves and counsel patients how to use them safely.

- Understand the risks associated with taking diuretics during heat waves and counsel patients how to use them safely.
- Understand the time interval during which patients may be at high risk of increasing morbidity and mortality in the setting of a heat wave.
- Understand how sedative and narcotic medications alter temperature regulation ○

Reading:

- Khraishah et al. Climate change and cardiovascular disease: implications for global health <https://www.nature.com/articles/s41569-022-00720-x>
- Liu C et al. Cardiovascular response to thermoregulatory challenges Am J Physiol Heart Circ Physiol 2015; 309: H 1793-812 doi: 10.1152/ajpheart.00199.2015.
- Alahmad et al. Associations Between Extreme Temperatures and Cardiovascular Cause-Specific Mortality: Results From 27 Countries Circulation. 2022;146:00–00. DOI: 10.1161/CIRCULATIONAHA.122.061832
- Rai et al. Future temperature-related mortality considering physiological and socioeconomic adaptation: a modeling framework Lancet Planet Health 2022;6:e784–92
- Liu C et al. Heat exposure and cardiovascular health outcomes: a systematic review and meta-analysis Lancet Planet Health 2022;6: e484–95
- Sherwood et al. An adaptability limit to climate change due to heat stress 9552–9555 | PNAS | May 25, 2010 | vol. 107 | no. 21 www.pnas.org/cgi/doi/10.1073/pnas.0913352107
- Vecellio et al. Evaluating the 35°C wet-bulb temperature adaptability threshold for young healthy subjects (PSU HEAT Project) Journal of Applied Physiology January 28, 2021 10.1152/jappphysiol.00738.2021
- Westaway et al. Medicines can affect thermoregulation and accentuate the risk of dehydration and heat-related illness during hot weather J Clin Pharm Thera 13 June 2015 <https://doi.org/10.1111/jcpt.12294>
- Yousef et al. Physiology, thermal regulation NIH National Center for Biotechnology Information May, 8, 2022 <https://www.ncbi.nlm.nih.gov/books/NBK499843/>

○ Related Lectures:

- “Atherosclerosis”
 - Objective: Describe how arteriosclerosis develops and the major risk factors that contribute to arteriosclerosis.
 - Discuss that particulate matter increases and rising temperatures contribute to increased mortality related to CAD/ischemic heart disease and atherosclerosis, including the proposed pathophysiology of increased thrombotic events in the context of increased temperature fluctuations
 - The lecture already has a bullet point on air pollution (PM2.5) as a risk factor, which could be expanded upon
- “Ischemic Heart Disease”
 - Objective: Review the pathogenesis of ischemic heart disease and the common causes of acute and chronic myocardial ischemia.
 - Same potential discussion points as above
- “Hypertension: Introduction”
 - Objective: Discuss how the body regulates blood pressure in response to acute and chronic alterations.
 - Increases in systolic blood pressure and diastolic blood pressure, especially at night, has been tied to increasing mean temperatures, diurnal temperature changes, and air particulate matter (PM2.5)

- “Tachyarrhythmias”
 - Objective: Recognize atrial flutter and atrial fibrillation and describe the 3 components of management.
 - Increased risk for atrial fibrillation and ventricular arrhythmias are linked to increasing air pollution
- Possible Faculty: Jay Montgomery
- Other institutions:
 - *UC Berkeley offers courses, available for JMP students, that discuss heat-related illnesses along with several other health implications of climate change. These courses cover cardiovascular health effects. Examples include GEOG 149B: Climate Impacts and Risk Analysis and PB HLTH C271G: Health Implications of Climate Change. Components of the Problem-Based Learning (PBL) Curriculum (Core Medical Curriculum) do discuss this topic, and students develop testable learning objects around these themes. For example, the PBL curriculum includes a 3 day patient case on health complications due to extreme heat.*

● Respiratory Health, Air Pollution, and Climate Change

- Setting: Lecture/small groups during the Pulmonology portion of Homeostasis
- Objectives:
 - Describe the association between heat and COPD and asthma exacerbations
 - List the air pollutants associated with climate change that increase the frequency of asthma exacerbations
 - Understand the mechanism by which air pollutants, particularly PM_{2.5}, PM₁₀, and ground-level ozone, contribute to development of obstructive lung disease, hypersensitivity pneumonitis, restrictive lung disease, and to exacerbations of asthma and chronic obstructive lung disease.
 - Understand how climate change is driving an increase in pollens and other aeroallergens that predispose patients to asthma and COPD flares
 - List the asthma health outcomes that are worsened by climate related air pollutants and allergens
 - Develop recommendations to help patients with COPD and asthma reduce their risk of exacerbations during wildfires/periods of poor air quality
 - Understand the synergistic effects of ozone and pollen on asthma and how to utilize existing tools to identify high risk geographic populations
- Reading:
 - Kar Kart et al. Pulmonary health effects of air pollution *Curr Opin Pulm Med* 2016; 22: 138-143 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4776742/>
 - Sing N, Singh S. Interstitial lung diseases and air pollution: narrative review of the literature. *Pulm Ther* 2021; 7: 89-100 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7943709/>
 - D’Amato et al. Climate change and respiratory diseases *Euro Resp Rev* 2014; 23: 161-168 <https://err.ersjournals.com/content/23/132/161>
 - Southerland et al. Global urban temporal trends in fine particulate matter (PM_{2.5}) and attributable health burdens: estimates from global datasets *Lancet Planet Health* 2022; 6: e139–46 [https://doi.org/10.1016/S2542-5196\(21\)00350-8](https://doi.org/10.1016/S2542-5196(21)00350-8)
 - Bressler RD The mortality cost of carbon. *Nature Communications* | (2021) 12:4467 | <https://doi.org/10.1038/s41467-021-24487-w> | www.nature.com/naturecommunications
- Related Lectures:
 - “Interstitial Lung Disease”
 - Objective: Describe the pathophysiology of restrictive lung disease
 - Air pollution is linked to increased reactive oxygen species production, resulting in exacerbations in idiopathic pulmonary fibrosis, increased prevalence of

hypersensitivity pneumonitis, and increased pulmonary fibrosis presence

- “Allergic Diseases”
 - Objective: Describe relevant physical exam findings, common diagnostic tests and therapies for common allergic diseases covered in this lecture.
 - Increase in CO₂, ozone, and NO₂ is linked to increased pollen counts and increased amounts of allergenic proteins within pollen, which serve as triggers for allergic rhinitis and allergic asthma
 - Some air pollutants have adjuvant immunological effect on IgE synthesis in atopic patients
 - Climate change brings increased floods, cyclones which increases fungal spore production, which also serves as a trigger for allergic rhinitis and allergic asthma
- CBL Case 26: “Joshua Waters, a 64-year-old male with shortness of breath and wheezing” ●
 - Objective: Discuss the epidemiology of COPD including the most common risk factors for developing this disease. Discuss the relationship between smoking and development of COPD.
 - Worsening air quality (indoor, occupational, and outdoor) worsens incidence and mortality of COPD
- TBL Asthma
 - Increasing exposure to air pollutants (e.g. ozone, SO₂) aggravates inflammatory response in lungs, resulting in increased wheezing, cough, and phlegm
 - PM_{2.5}, ozone, and NO₂ exposure associated with lower FEV₁ and FVC values. In children PM₁₀ and NO₂ exposure is associated with lower FEV₁ growth.
 - Air pollution not only causes asthma exacerbations, it also increases the incidence of development of asthma
- Possible Faculty: Robert Miller, Melinda Aldrich
- Other institutions: *Georgetown has a required, interactive climate change half-day didactic discussion during the Family Medicine clerkship. The session focuses exclusively on air pollution and its effects on respiratory and cardiovascular diseases. The discussion includes approaching air quality and mechanisms of injury while thinking about the patient.*

● Impact of Extreme Heat and Rising Temperatures on Renal Health and Chronic Kidney Disease

- Setting: Lecture/small groups during the Renal portion of Renal/Digestion
- Objectives:
 - Appreciate the impact of climate change on blood pressure and cholesterol levels, and how this could contribute to the development of cardiovascular/renal disease
 - Understand the risks associated with taking blood pressure medications during heat waves and counsel patients how to use them safely.
- Reading:
 - Torres C. Climate change and renal health. Awareness and education toolkit for healthcare providers
https://nursing.yale.edu/sites/default/files/files/Climate%20Change%20and%20Renal%20Health%20Toolkit_FINAL.pdf
 - Johnson RJ, Wesseling C, Newman LS. Chronic Kidney Disease of Unknown Cause in Agricultural Communities. *N Engl J Med.* 2019;380(19):1843-1852.
doi:10.1056/NEJMra1813869
 - Hess H et al. Kidney injury risk during prolonged exposures to current and projected wet bulb temperatures occurring during extreme heat events in health young men *J Appl Physiol*; 2022 133: 27-40.
<https://pubmed-ncbi-nlm-nih-gov.proxy.library.vanderbilt.edu/35616302/>
 - Johnson RJ et al. Climate change and the kidney *Ann Nutr Metab* 2019; 74 (suppl 3) :

- 38-44 <https://doi-org.proxy.library.vanderbilt.edu/10.1159/000500344>
- Clark WF et al. Hydration and chronic kidney disease progression: a critical review of the evidence *Am J Nephrol* 2016; 43: 281-92
<https://pubmed-ncbi-nlm-nih-gov.proxy.library.vanderbilt.edu/27161565/>
 - Qu Y et al. Associations between ambient extreme heat exposure and emergency department visits related to kidney disease *Am J Kidney Dis* 2022; 11: S0272-6386(22)00918
<https://pubmed-ncbi-nlm-nih-gov.proxy.library.vanderbilt.edu/36241010/>
 - Sasai F et al. Climate change and nephrology *Nephrol Dial Transplant* 2021; Septa;gfab258.
<https://pubmed-ncbi-nlm-nih-gov.proxy.library.vanderbilt.edu/34473287/>
 - Correa-Rotter R et al. Mesoamerican nephropathy *Sem Nephrol* 2019; 30:263-272
<https://pubmed-ncbi-nlm-nih-gov.proxy.library.vanderbilt.edu/31054625/>
- Related Lectures:
- “Acute Kidney Injury” by Dr. Ed Gould
 - “Chronic Kidney Disease” by Dr. Ed Gould
 - Objective: Recognize that chronic kidney disease is widely prevalent and a public health problem
 - Objective: Enumerate and discuss basic strategies to slow progression
 - Opportunity to discuss the role of extreme heat on worsening progression of CKD
- Possible Faculty: Ed Gould, Jay Bhawe

● Climate Change: Disproportionate Effects on Women’s Health and Pregnancy

- Setting: Lecture/small groups during the Reproduction portion of Repro/Endo
- Objectives:
- Understand how exposure to toxic gasses, volatile organic compounds, and particulate matter can increase risk of gestational HTN disorders in pregnancy and gestational diabetes.
 - Discuss how air pollution has been shown to increase risk of preterm birth and low birth weight.
 - Discuss how heat extremes negatively affect pregnancy
- Reading:
- Wesselink AK and Wellenius GA. Impacts of climate change on reproductive, perinatal and pediatric health *Paediatr Perinat Epidemiol* 2022; 36:1-3
<https://onlinelibrary-wiley-com.proxy.library.vanderbilt.edu/doi/pdf/10.1111/ppe.12839>
 - Xiao et al. The impact of hurricane Sandy on pregnancy complications in eight affected counties of New York State.(abstract) *International Society for Environmental Epidemiology (ISEE) Annual Meeting 26-30 August 2018 Ottawa Canada*
<https://ehp.niehs.nih.gov/doi/abs/10.1289/isesisee.2018.S03.01.33>
 - Bonell A et al. Environmental heat stress on maternal physiology and fetal blood flow in pregnant subsistence farmers in The Gambia, West Africa: an observational cohort study *Lancet Planetary Health* 2022; 6: e968-976
 - Ha S et al. Acute associations between outdoor temperature and premature rupture of membranes *Epidemiology* 2018; 29: 175-182.
 - Basu et al. High ambient temperature and the risk of preterm delivery *Am J Epidemiol* 2010; 15: 1108-1117. PMID: 20889619 DOI: 10.1093/aje/kwq170
 - Cil G and Cameron TA. Potential climate change health risks from increases in heat waves: Abnormal birth outcomes and adverse maternal health conditions *Risk Analysis* 2017; 37: 2066-2079. DOI: 10.1111/risa.12767
 - Rasmussen S and Jamieson D. Protecting pregnant people and babies from the health effects of climate change *NEJM* 2022;387: 957-959
<https://www.nejm.org/doi/full/10.1056/NEJMp2210221>
 - Robbins T et al. Household air pollution and incidence of eclampsia in eight low and

middle-income countries Int J Obstet Gynecol Obstet 2022: DOI:

<https://doi.org/10.1002/ijgo.14484>

- Bekkar et al. Association of air pollution and heat exposure with preterm birth, low birth weight and stillbirth in the US JAMA Netw Open 2020; 3: e208243.
https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2767260?utm_campaign=articlePDF&utm_medium=articlePDFlink&utm_source=articlePDF&utm_content=jamanetworkopen.2020.8243
- Heft-Neal et al. Associations between wildfire smoke exposure during pregnancy and risk of preterm birth in California Environ Res 2022; 203: 1111872
<https://doi.org/10.1016/j.envres.2021.111872>

○ Related Lectures:

- “Pregnancy and Its Complications” by Dr. Soha Patel

- Objective: Appreciate the major fetal complications of pregnancy

- Preterm Labor

- Preterm Prelabor Rupture of Membranes

Opportunity to discuss impact of rising temperatures on preterm birth, low birth weight, and infant mortality (dehydration, heat exhaustion, heat stroke, food quality, food production, spread of food-borne illnesses such as Listeria)

- “Maternal Physiology” by Dr. Elise Boos

- Objective: Review changes to the physiology of the cardiac, pulmonary, hematologic, renal, endocrinologic, gastrointestinal, and immunologic systems in pregnancy

- Objective: Review common disorders associated with these changes

- Opportunity to discuss negative impact of rising temperatures on kidney function in pregnant women that are exacerbated by underlying changes in physiology during pregnancy

○ Possible Faculty: Curtis Baysinger, M.D Member from OB Department.

- Other institutions: *At University of California San Francisco (US) in the Life Stages block, there was a lecture on “Effects of Environmental Toxins and Reproductive Toxins” by Dr. Tracey Woodruff. Associated with the lecture were several course objectives related to environmental exposures, including “Explain how the health impacts of environmental exposure are distributed unequally within and between populations.” an important objective grounded in environmental justice. This lecture was followed by two research-driven small groups on the effect of various environmental toxins on fertility and pregnancy.*

● Mental Health in the Climate Crisis

- Setting: Lecture/small groups during the behavior section of BBM

○ Objectives:

- Describe how extreme weather events impact mental health outcomes
- Understand the concepts of solastalgia and eco-anxiety and how they may contribute negatively to well-being
- Describe how subacute climate events impact mental health
- Discuss how long-term emotional distress and anxiety caused by climate change impacts individuals who have not directly experienced extreme weather events
- Describe reasons why people experiencing substance use disorders are more susceptible to temperature extremes
- Describe the long-term adverse mental health impacts of extreme weather events on children
- Identify and provide resources for patients struggling with climate-related mental health issues

○ Reading:

- Younan D et al. Racial /ethnic disparities in the Alzheimer’s disease risk: Role of exposure to

ambient fine particles *Journals of Gerontology* 2022; 77: 977-985.

<https://academic.oup.com/biomedgerontology/article/77/5/977/6348898>

- Padhy SK et al. Mental health effects of climate change *Indian J Occup Environ Med* 2015; 19: 3-7. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4446935/?report=classic>
- Palinkas LA and Wong M. Global climate change and mental health *Curr Opin Psychol* 2020; 32: 121-15
<https://www-sciencedirect-com.proxy.library.vanderbilt.edu/science/article/pii/S2352250X19300661?via%3Dihub>
- Clayton S. Climate change and mental health *Curr Environ Health Rep* 2021; 8: 1-6.
<https://pubmed-ncbi-nlm-nih-gov.proxy.library.vanderbilt.edu/33389625/>
- Vergunst F and Berry HL. Climate change and children's mental health : a developmental perspective *Clin Psychol Sci* 2022; 10: 767-785.
<https://pubmed-ncbi-nlm-nih-gov.proxy.library.vanderbilt.edu/35846172/>
- Crandon T et al. The clinical implications of climate change for mental health *Nature Human Behavior* 2022; 6: 1474-1481. <https://doi.org/10.1038/s41562-022-01477-6>

○ Related Lectures:

- “Post Traumatic Stress Disorder” by Dr. Terako Amison
 - Objective: Discuss the risk factors, etiology, and pathogenesis of PTSD
 - Discussed examples of extreme weather (hurricanes, tornadoes) as traumatic experiences associated with development of PTSD
 - Opportunity to elaborate on overarching impact of climate crisis on mental health

○ Possible Faculty: Keith Meador

- Other institutions: *Emory University as a dedicated learning outcome stating students must be able to “Appreciate the consequences of population displacement, food insecurity and trauma on mental health and psychosocial wellbeing”. At Cambridge University, UK, the Improving Health lecture on Environmental Change and Health discusses this topic across several slides including that dementia may be linked to air pollution exposure, and the effects of extreme weather impact on depression, anxiety and PTSD and student cognitive performance. There is also mention of mental health with regards to delayed impacts of extreme weather events.*

Second Year: TBD

The Core Clinical Rotations listed below could be used for topics that are not able to be incorporated into the M1 phase. Additionally, <https://climatehealthed.org/> has case based learning cases and slide decks on topics within each medical specialty below.

- **OBGYN**
- **Psychiatry**
- **Neurology**
- **Surgery**
- **Pediatrics**
- **Internal Medicine**

The additional topic below is one we consider essential, but is better incorporated into the second year during clinical instruction, as it deals with the environmental effects associated with clinical care.

- **Sustainability, Medical Waste, and Healthcare’s Carbon Footprint**
 - Setting: FHD

○ Objectives/topics:

- Waste production within the healthcare system and strategies for reducing waste in clinical activities, such as in the operating room
- The impact of inhalers on the healthcare carbon footprint and the environmental benefit of dry powdered inhalers over metered dose inhalers.
- The impact of anaesthetic gases on the healthcare carbon footprint and ways to reduce anaesthesia environmental impacts, such as total intravenous anaesthesia or choosing less environmentally anaesthetic gas options with reduced greenhouse gas emissions
- The environmental impact of pharmaceuticals and over-prescribing as a cause of climate health harm. Alternatively teaching on de-prescribing where possible and its environmental and health co-benefits would fulfill this metric.
- The health and environmental co-benefits of non-pharmaceutical management of conditions where appropriate such as exercise or yoga classes for type 2 diabetes; social group activities such as gardening for mental health conditions; active transport such as bicycle schemes for obesity. This is commonly known as social prescribing in the UK.
- The health and environmental co-benefits of avoiding over-medicalisation, over-investigation and/or over-treatment.

○ Reading:

- Drew J et al. HealthcareLCA: an open-access living database of health-care environmental impact assessments *Lancet Planet Health* 2022; 6: e1000-12.
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- Hampshire K et al. The planetary health report card: a student-led initiative to inspire planetary health in medical schools. *J Planet health* 21022; 6: e449-54
<https://doi.org/10.1016/>
- Eckelman MJ et al. health care pollution and public health damage in the United States: An update *Health Affairs* 2020; 39: 2071-79. doi:10.1377/hlthaff.2020.01247
- Romanello M Calculating the carbon footprint of the NHS in England *Carbon Brief* 18 February 2021
<https://www.carbonbrief.org/guest-post-calculating-the-carbon-footprint-of-the-nhs-in-england>
- Pencheon D and Wight J. Making healthcare and health systems net zero. *BMJ* 2020; 368: m970 <https://www.bmj.com/content/368/bmj.m970>
- Academy of Medical Royal Colleges Protecting resources, promoting value: a doctor's guide to cutting waste in clinical care.
https://www.aomrc.org.uk/wpcontent/uploads/2016/05/Protecting_Resources_Promoting_Value_1114.pdf
- McAlistair S et al. Incorporating carbon into health care: adding carbon emissions to health technology assessments *Lancet Plant Health* 2022; 6: e993-99.
- McGain F et al. Environmental sustainability in anaesthesia and critical care *Br J Anaesth* 2020; 125: 680-692. <https://pubmed.ncbi.nlm.nih.gov/32798068/>
- MacNeil AJ et al. Transforming the medical device industry: Road map to a circular economy *Health Aff* 2020; 39: 2088 - 2097. <https://pubmed.ncbi.nlm.nih.gov/33284689/>
- Sherman J et al. Life cycle greenhouse emissions of anesthetic drugs. *Anesth Analg* 2012; 114: 1086-90. <https://pubmed.ncbi.nlm.nih.gov/22492186/>
- Singh H et al. Mandatory reporting of emissions to achieve net-zero health care. *NEJM* 2022; 29: 2469-2476 <https://pubmed.ncbi.nlm.nih.gov/36516087/>
- Sittig DF et al. i-CLIMATE: a “clinical climate informatics” action framework to reduce environmental pollution from healthcare. *J AM Med Inform Assoc* 2022; 14: 2153-2160. <https://pubmed.ncbi.nlm.nih.gov/35997550/>
- Sherman JD and Ryan S Ecological responsibility in anesthesia practice *Int Anesthesiol Clin*

- 2010; 48: 139-151 <https://pubmed.ncbi.nlm.nih.gov/20616643/>
- Eckelman MJ and Sherman J Estimated global disease burden from US health care sector greenhouse gas emissions *Am J Public Health* 2018; S210-S122. <https://pubmed.ncbi.nlm.nih.gov/29072942/>
 - Tennison I et al. Health care's response to climate change: a carbon footprint assessment of the NHS in England *Lancet Planet Health* 2021; 5: e84-e92. <https://pubmed.ncbi.nlm.nih.gov/33581070/>
- Possible Faculty: Curtis Baysinger, MD
 - Other institutions: *At Brighton and Sussex Medical School, the 'Impact of healthcare on the environment' lecture by Dr Chantelle Rizan covers greenhouse gas emissions of healthcare, NHS, Surgical Carbon footprint, medical plastics and ideas for changing practice.*
 - *At Perelman School of Medicine, US, during the orientation for clerkships, students engage in discussions on the extent of waste generated by the hospital system.*
 - *At Brighton and Sussex University in the 'Global & Social responsibility in healthcare' lecture by Dr Anna Jones she covers unused prescriptions wasted and over-prescribing as a contributor to environmental harm*
 - *At Perelman School of Medicine, US, during the orientation for clerkships, students engage in discussions on how excess medical tests exhaust resources but don't contribute to high value care.*

Third/Fourth Year

We consider these topics important, but not essential, and should be incorporated into the FHD immersion courses or into a stand alone immersion course on climate change and health care.

● Climate Change: The Greatest Public Health Threat You Have Not Heard Of

- Setting: FHD immersion course on Public Health
- Objectives:
 - Describe the effects of rising carbon dioxide levels and climate change on nutrient content and yield of staple crops.
 - Discuss how heat and extreme weather compromise access to safe and nutritious foods ■ Identify the effect that climate change has on food insecurity and to apply this understanding to vulnerable populations who may face increased food shortages.
 - Describe how increased heat and extreme weather increase human exposure to man-made and natural environmental toxins.
 - Describe why certain populations are disproportionately affected by climate-related food insecurity.
 - Understand how blunt trauma from natural disasters may result in MSK complaints.
 - Understand the scale and associated public health harms of health care-associated greenhouse gas emissions, and briefly review climate-smart health care.
 - Outline system co-benefits of improving healthcare value and health system sustainability in various practice settings.
 - Discuss the mechanisms by which extreme weather events disrupt infrastructure essential for human health.
- Reading:
 - Shultz JM, Sands DE, Kossin JP, Galea S. Double Environmental Injustice — Climate Change, Hurricane Dorian, and the Bahamas. *N Engl J Med.* 2020;382(1):1-3. doi:[10.1056/NEJMp1912965](https://doi.org/10.1056/NEJMp1912965)
 - Salas RN, Shultz JM, Solomon CG. The Climate Crisis and Covid-19 — A Major Threat to the Pandemic Response. *N Engl J Med.* 2020;383(11):e70. doi:[10.1056/NEJMp2022011](https://doi.org/10.1056/NEJMp2022011)
 - Salas RN, Malina D, Solomon CG. Prioritizing Health in a Changing Climate. *N Engl J*

Med. 2019;381(8):773-774. doi:10.1056/NEJMe1909957

- Redlener I, Reilly MJ. Lessons from Sandy — Preparing Health Systems for Future Disasters. *N Engl J Med.* 2012;367(24):2269-2271. doi:10.1056/NEJMp1213486
- McMichael AJ. Globalization, Climate Change, and Human Health. *N Engl J Med.* 2013;368(14):1335-1343. doi:10.1056/NEJMra1109341
- Hunter DJ, Frumkin H, Jha A. Preventive Medicine for the Planet and Its Peoples. *N Engl J Med.* 2017;376(17):1605-1607. doi:10.1056/NEJMp1702378
- Haines A, Ebi K. The Imperative for Climate Action to Protect Health. *N Engl J Med.* 2019;380(3):263-273. doi:10.1056/NEJMra1807873
- Greenough PG, Kirsch TD. Public Health Response — Assessing Needs. *N Engl J Med.* 2005;353(15):1544-1546. doi:10.1056/NEJMp058238
- Possible faculty: Carol Ziegler
- Other institutions: *Harvard med school's curriculum included a lecture titled: 'Climate Change; the world's biggest health problem you have not heard about' which goes into the health implications of recent hurricanes.*

● Communicating about Climate Change in Terms of Health

- Setting: FHD immersion course on Advanced Communication
- Objectives:
 - Describe the principles for effective patient communication
 - Understand how personal biases and potential patient bias affects effective communication ■ Describe which words work best for effective communication to specific patient groups and discuss how they are chosen
 - Outline a strategy for communicating climate change into patient counseling session ■ Describe how you can personally advocate for patient health to policy makers
 - Describe the most important steps patients can take to mitigate the effects of their personal environment on their health.
- Readings
 - Center for Research on Environmental Decisions. *The Psychology of Climate Change Communications: A Guide for scientists, journalists, educators, political aides, and the interested public.* New York 2009
<http://cred.columbia.edu/publications-resources/cred-communications-guide/>
 - Paterson and Clarke. Climate change risk communication: vaccine hesitancy perspective. *Lancet Planet Health* 2021; 5: e179-80
<https://www-sciencedirect-com.proxy.library.vanderbilt.edu/science/article/pii/S2542519621000279>
 - Hassol. Changing the language of climate change. *Scientific American* 2023; 328: 64-67. <https://www.scientificamerican.com/article/the-right-words-are-crucial-to-solving-climate-change/>
 - Kotcher et al. Views of health professionals on climate change and health: a multinational survey study. *Lancet Planet Health* 2021; 5: e316-23
[https://doi.org/10.1016/S2542-5196\(21\)00053-X](https://doi.org/10.1016/S2542-5196(21)00053-X)
 - Yale Program on Climate Change Communication. *Global Warming's Six Americas.*
<https://climatecommunication.yale.edu/about/projects/global-warmings-six-americas/>
 - Leiserowitz et al. Global warmings six Americas: a review and recommendations for climate change communication *Curr Opin Behav Sci* 2021; 42: 97-103
<https://www-sciencedirect-com.proxy.library.vanderbilt.edu/science/article/pii/S2352154621000929>
 - Goldberg et al. Leveraging social science to generate lasting engagement with climate change solutions. *One Earth* 2020; 3:314-322.

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- American College of Physicians. Let's Talk Health and Climate Change Guidance for Health Professionals. Washington DC 2016.
https://climateforhealth.org/wp-content/uploads/2020/05/3_letstalk_health_and_climate.pdf
 - Health Care Without Harm. Climate Change and Patient Education
<https://noharm-uscanada.org/content/us-canada/climate-and-health-patient-education>
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- Possible faculty: Beth Mallow, Mike Vandenberg
 - Other institutions: