# Preparing Physicians for the Climate Crisis: Next Steps for the Graduate Medical Education Community

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Since the time of Hippocrates, physicians have written about the influence of the environment on human health and disease.[1] While delivering routine care in cleansed and sterilized clinical settings, it is easy to forget the interdependence of human health and the environment. Our hospitals consume resources intensively and contribute to environmental harm outside their walls, where we discharge patients to live, learn, work, and play. The repercussions of climate change underscore this reality: the health of people and the planet are intertwined.[2,3]

In compiling the Climate Change and GME Supplement, we aimed to share efforts of the graduate medical education (GME) community at this critical time for climate and health and to encourage those considering new interventions. Collectively, the progress represented in this supplement is inspiring. There is a burgeoning movement of program directors, trainees, and faculty who recognize the importance of integrating climate health into GME. Articles reference the myriad patient-level and systemic health challenges, emerging from or intensified by the climate crisis, and their relevance to GME. By fostering a generation of physicians whose clinical training prepares them to face these challenges, we can contribute to improved patient outcomes and a more sustainable and resilient health care system.

The collection of supplement articles underscores challenges and opportunities for climate and medical education efforts moving forward. Many of the competencies required of learners to address the climate crisis are included already in current training programs. While the Master Adaptive Learner (MAL) framework may not be mentioned explicitly in these articles, many of the represented initiatives seek to cultivate traits in trainees that echo those of the master adaptive learner: Learners who embrace complexity, are creative and flexible in problem-solving, demonstrate comfort with systems thinking, and collaborate across disciplines and health professions.[4] In this supplement, themes emerge around trainees who steward health care resources in clinical decision-making and prioritize preventive care and resilience.

With the climate crisis as a paradigm for the evolving challenges GME trainees will face in their careers, the MAL framework may prove to be a useful mental model for educators, particularly in relation to learner outcomes. The climate and health field may find value in drawing from this and other medical education frameworks. Across the medical education continuum, there is a need for shared language and mental models for climate and health education. There are additional opportunities to leverage best practices from medical education and educational research, particularly around curriculum development, program evaluation, and learner assessment. Enthusiastic efforts spearheaded by climate subject matter experts—faculty and trainees alike—will benefit from engaging medical education experts and social scientists. The technical and contextual expertise of the latter can bring rigor to this field and may speed integration of pertinent knowledge, skills, and attitudes across the medical education continuum.

Even with an increasing emphasis on climate and health in undergraduate medical education (UME), learners may grapple with incorporation of relevant skills in their day-to-day routines as physicians. In many GME programs, trainees face strenuous and variable work schedules and rapidly expanding responsibilities for acutely ill patients. Trainees also experience high rates of burnout and may have less time and enthusiasm for "extracurricular" engagement than UME students. From a feasibility and sustainability lens, climate health initiatives embedded within the scope of trainees' daily practice are needed to support trainee involvement.

Trainees may also acknowledge anxiety that the climate crisis affects their "daily life and functioning."[5] Large populations in the United States are now living through and dealing with hurricanes, flooding, wildfires,

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and other ramifications of climate change. These events affect not only patients and caregivers, but also GME trainees and faculty. Integrating climate health initiatives into routine activities may help alleviate mental health burdens by showing trainees that it is possible to engage in this "wicked challenge" during routine clinical care. Additionally, acknowledging climate anxiety and providing support via trainee wellness activities is recommended.

While UME has begun to lay the groundwork for a workforce that embraces climate and health competencies as essential to evidence-based practice, GME-level applications of climate and health knowledge, skills, behaviors, and attitudes will ensure these principles are retained as part of resident and fellow professional identities and competencies.

**BOX Key Terminology**

**One Health:** An integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems (Food and Agriculture Organization, the World Organisation for Animal Health, the United Nations Environment Programme, and the World Health Organization).[6]

**Planetary Health:** The health of human civilizations and the natural systems on which they depend (The Rockefeller Foundation-*Lancet* Commission on Planetary Health).[7]

**Climate and Health:** Often used to refer to the interaction between the impacts and implications of global climate change and fossil fuel pollution that drives climate change and the health of humans.

**Sustainability:** Meeting the needs of the present without compromising the ability of future generations to meet their own needs.[8]

## Next Steps for GME

The supplement articles underscore challenges to integrating climate and health in GME curricula. As more medical schools integrate climate and health within their curricula, the baseline level of knowledge of incoming GME trainees will increase and evolve. While UME may provide relatively standard and generalizable curricula to support relevant knowledge, skills, and attitudes of students, GME curricula will need to be tailored to specialty and subspecialty competencies and ACGME Milestones, resident- and fellow-specific roles, and entrustable professional activities.

There will be overlap and synergies across the care continuum. Internal medicine, family medicine, pediatrics, psychiatry, and preventive medicine, for example, could share tools and resources on promoting the health and mental health benefits of climate action (eg, plant-forward diets, nature contact, and active transportation). These specialties and others, including occupational medicine and obstetrics and gynecology, could share successful curricula on prevention of harm from environmental exposures like extreme heat. Many specialties will need tailored curricula for patients with complex medical histories (eg, on disaster preparedness or strategies for managing medications that alter heat and water homeostasis). Collaboration with emergency medicine may be geared toward recognizing, assessing, and addressing acute health impacts of climate change as well as advocacy efforts. As operating rooms disproportionately contribute to health care waste and carbon emissions, surgical subspecialties and anesthesiology are primed to collaborate on greening operating rooms such that more sustainable practices become standard practice.

While educational initiatives will be tailored to meet the needs of specific patient populations, synergies in anticipatory guidance, discharge planning considerations, disaster preparedness, and sustainable use of resources and prescribing practices exist across specialties. The GME perspective is essential to ensure that educational interventions align with current opportunities in climate health and remain grounded in GME-level expectations, competencies, and assessment strategies.

## Next Steps for Curriculum Development

When developing new climate and health curricula, the GME community is encouraged to engage key stakeholders and strive for interprofessional collaborations between physicians and other health care professionals, educators, climate scientists, sustainability experts, and community activists. The incorporation of planetary health, climate health, and One Health frameworks (see BOX for key terminology) will necessitate explicitly teaching systems–thinking skills, which are foundational to competencies such as systems-based practice. This approach requires a broadening of systems-based practice competencies to include an awareness of the ecosystems in which patients live and work. Trainees need to fully appreciate the intersections between climate change and patient care and to collaborate across health professions education fields (eg, medicine, nursing, pharmacy, allied health, education) to meet patients' needs.

## Next Steps for Scholarship

Investigators who are interested in examining the effects of climate health curricular innovations that are part of normal educational practices (and typically carried out with one group of learners) will benefit from using quality improvement methodology (eg, use of Plan-Do-Study-Act cycles, impact-effort

matrices, and determination of measurable outcomes). Climate and health curricula in GME will benefit from continuous quality improvement methods as interventions often require adaptation over multiple rotations.

In addition to educational quality improvement projects focused on interventions with one group of learners at one site, carefully designed educational research studies using theory testing (quantitative) and theory generating (qualitative) methods are needed. From a quantitative perspective, studies that move beyond pre-experimental designs (eg, one-group, pretest-posttest designs) and can establish causality are needed.[9-11] When possible, researchers can recruit participants and randomize to groups (usual training vs training in climate and health) to examine constructs such as "climate health specialty knowledge" (eg, in pediatrics, emergency medicine, internal medicine, etc) via written examinations or assessments of trainees' "patient communication skills related to climate and health impacts" via mini clinical evaluation examinations or observed structured clinical encounters with standardized patients. When randomization is not possible, a design such as an interrupted time series can be considered to examine the effects of a climate and health intervention on learners from a longitudinal perspective, which allows researchers to examine issues such as skill decay.

From a qualitative perspective, studies examining the lived experiences of trainees, faculty, patients, and communities affected by climate change will ensure that curricula continue to meet the needs of trainees, but also the needs of patients, caregivers, and society. For instance, focus groups and interviews with community action groups and community members can allow faculty and trainees to examine unmet health care needs related to climate-exacerbated issues (eg, flooding and associated vector-borne diseases in areas prone to increased rainfall) to provide a foundation for curricular innovations and further research.

Funding for these efforts may be necessary, given barriers to project development and participation (eg, stipends and incentives needed for focus group participation and survey studies). Researchers may be able to seek funding from their institution's internal grants programs, in addition to external sources such as the Association of American Medical College's Group on Educational Affairs annual grants programs. For larger research projects, investigators can seek grant funding through foundations (eg, Josiah Macy Jr. Foundation, Spencer Foundation), governmental agencies (eg, National Institute of Environmental Health Sciences, the Health Resources and Services Administration), and universities (eg, the University of Illinois Chicago Ilene B. Harris Legacy Research Fund). Given the implications of climate change for communities, funding from foundations focusing on climate change and environmental justice may also be suited to educational research studies in this area.

## Next Steps for Program Evaluation

Formal evaluations of climate and health curricula using established program evaluation models (eg, Context, Input, Process, and Product, before-during-after, systems, logic models)[12-14] are currently lacking in the field of climate and health. Without well-planned evaluations of curricula, it is difficult to determine whether an intervention worked, why it worked, for whom it worked, and whether these interventions—designed for specific health professions education contexts—can be implemented with success elsewhere.[15] For instance, an internal medicine residency program could conduct a program evaluation that accounts for specific contextual factors when examining the efficacy of program focused on climate change advocacy skills. Contextual factors could include geographic location, regional climate impacts, number of trainees, interests and backgrounds of trainees related to climate change, number of faculty trained in climate and health, existence of a partnership with a local university offering courses on climate change, administrative support, GME culture, and residents' perspectives on their needs. This information is critical for other institutions that may want to implement the innovative program, as outcomes may not be generalizable to all contexts.

## Conclusions

GME has a vital role in climate and health education to meet patient care and societal needs created by the climate crisis. For some trainees, climate and health may become an area of intensive interest and expertise. For all trainees, climate and health will be an essential area of training. GME can ensure that environmental implications for health are uniformly recognized as essential competencies for graduates. GME climate and health curricula can promote climate-informed, resilient, and effective care that will better support our patients, our trainees, and ourselves.

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