DISCUSSION PAPER

Opportunities for Strengthening Climate Education for Clinical Health Professionals

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ABSTRACT | *As we bear witness to increasing disease, injury, disruption, and displacement from a changing climate, health professional education is finally coalescing around the imperative to upgrade training programs to address this health threat. There remains a conspicuous knowledge gap within health care on basic environmental health linkages, health vulnerabilities susceptible to climate change, health care system sustainability and resiliency, and climate health communication and leadership. The authors will review successful examples and demonstrable impacts of current efforts to scale-up a climate-savvy health care workforce and will close with a review of opportunities ahead for this urgent educational movement.*

Introduction

Climate change is a major threat to humanity, and health professionals have a critical role in addressing this challenge (Romanello et al., 2023). However many individuals currently lack the knowledge, skills, and abilities to effectively synthesize, address, and influence the public health impacts of climate change (Kircher et al., 2022). Increases in morbidity and mortality attributed to climate change are driving a need for informed practice among all health professionals (Lemery et al., 2020). Accordingly, health professional educators are now scaling up integration of climate and health risks into foundational, core curricula.

Health professional education for the clinician, in aggregate, has conspicuous knowledge gaps on basic health linkages, such as the environment as a determinant of health, health vulnerabilities susceptible to climate change, health care system sustainability and resiliency, and climate health communication. Building on accumulating climate science data, existing public health scholarship and foundations in analogous fields of planetary health, One Health and ecological health, nascent groups in academia, and in the non-profit space have established educational initiatives focused on climate change and health. As these groups have introduced core learning competencies and incubated differing curricula for varied clinical health professional constituencies, the contemporary assessment is that professionals now have a genuine, cumulative scale-up of climate and health curricula across the spectrum of health professional education.

This discussion paper will synthesize the needs assessment for scalable education in climate and health, clarifying the rationale and imperative for core curricular augmentations for clinical practitioners. Specifically, the authors will articulate how such training will empower health care systems' capacity for climate resilience, support goals to decarbonize the health care sector (currently 8.5 percent of the United States' annual carbon footprint; Eckelman et al., 2020), create opportunities for leadership in health-centric public policy, and most importantly, improve patient care.

The authors will undertake a brief inventory of leadership and best-practice examples of early adopters in climate and health education, as well as summarize first generation core competencies. This will serve as a prelude for presenting core competencies in a more comprehensive framework, aligning with existing constructs in health professional training.

Finally, the authors will identify areas for further growth and academic innovation, including health system–led skills training, health care system resilience and decarbonization, and opportunities for collaborations—all are critical,

strategic endpoints of scaling up our health care workforce to meet this growing health risk.

First Movers and Early Adopters

Health professional climate education is currently a mosaic of activity. Curricula share common pedagogical threads, but vastly differ in content emphasis on climate and health science, adaptation, mitigation, resiliency, and health care system engagement. Likewise, an inventory of educational opportunities shows tremendous variations in the learners themselves—from community health workers to health professions students and veteran clinicians. The Global Consortium on Climate and Health Education (GCCHE) was one of the first member collaborations to seek consensus on core competencies from numerous climate and health professional educators. The initial list has now evolved into 23 climate and health core concepts organized within five learning domains: knowledge and analytic skills, communication and collaboration, policy, public health practice, and clinical practice (Sorensen et al., 2023a). In a similar effort, Climate Resources for Health Education provides an open-access knowledge bank with numerous pedagogic resources and links to educational opportunities for health care professionals in medicine, nursing, and public health with hubs for dentistry and social work in development (Climate Resources for Health Education, n.d.). The Association of Schools and Programs of Public Health's Climate Change and Health Public Health Education Toolkit likewise identifies areas of overlap in a crosswalk of associated resources specific to climate and health and foundational public health competencies (Association of Schools and Programs of Public Health, 2022).

Since there is no one-size-fits-all curriculum or educational approach that can be applied to all clinicians (Lemery et al., 2020), these open-access actionable climate and health competencies should be adapted to the requirements of individual health professions. Indeed, these early efforts have sparked further curricular development germane to respective professionals' degree (e.g., nurse, physician) and experience level.

Undergraduate Health Professional Education

An increasing number of medical schools are integrating climate change into their curricula. According to the 2021–2022 Liaison Committee on Medical Education (LCME) Annual Medical School Questionnaire, 55 percent of surveyed medical schools included climate change topics at the pre-clerkship or clerkship level—more than double the 38 percent reported in 2020–2021 (Mallon and Cox, 2022). One early adopter is Emory University's School of Medicine, where students and faculty led the creation of a climate change and health curriculum disseminated across the first 16 months of medical school—emphasizing the relevance of climate change to pathophysiology and health promotion (Liu et al., 2022; Rabin et al., 2020). A further exemplary feature of this program is the investment in medical education leadership: the program employs a faculty director for the climate change and environmental health thread and curriculum. A recent report from the Icahn School of Medicine at Mount Sinai reviewed the strategies and challenges in integration of climate themes and serves as a useful case study for other institutions undergoing educational redesign (Greenwald et al., 2022).

Schools of nursing are also integrating climate and health topics into their curriculum. The Nurses Climate Challenge, a collaboration between Health Care Without Harm and the Alliance of Nurses for Healthy Environments, has led to education of over 37,000 health professional students from 61 nursing schools across 30 states since 2020 (Demorest et al., 2024).

The University of California San Francisco School of Pharmacy (UCSF) and the University of Montana Skaggs School of Pharmacy (UM) have been identified as leaders in pharmacy education based on recent results of their pharmacy planetary health report card initiative, each having unique strategies for curricular integration in their doctor of pharmacy programs. At UCSF, for example, all pharmacy students participate in a three-hour seminar focusing on the relationship between climate change, sustainability, and pharmaceuticals (Gruenberg et al., 2017). At UM, pharmacy students encounter climate-related topics in multiple courses across the didactic curriculum and are given the opportunity to participate in an interprofessional elective course and an elective experiential rotation focused on planetary health in their final year of training.

Graduate Health Professional Education

The University of Minnesota School of Nursing has served as a leader in nursing education, adopting principles of climate and health into core curricula, and has supported climate and health-themed electives at the graduate level. Planetary health is a core pillar of a health innovation and leadership doctorate in nursing practice program.

A range of graduate medical education and early career training opportunities currently exist in the United States. The University of Colorado School of Medicine (CU) pioneered a graduate medical education physician fellowship in climate and health science policy in 2017, which features hands-on policy training at numerous federal agencies and non-profits working on climate-centric health issues (Wheat

et al., 2022; Lemery et al., 2019). Harvard's Climate and Human Health Fellowship followed suit, with a focus on climate-related foundational public health research (Climate & Human Health Fellowship n.d.). The Medical Society Consortium on Climate and Health partnered with the National Medical Association to create the project-based Climate & Health Equity Fellowship, which aims to empower under-represented health professionals to lead on equitable climate solutions in education, advocacy, and policy (The Medical Society Consortium on Climate and Health, n.d.).

A few models exist for education within primary medical residency training. CU leverages its fellowship to offer individual electives and a lecture series for GME learners (University of Colorado Anschutz School of Medicine, n.d.). A report from Harvard reviews their approach to integrating climate and health training into an internal medicine residency curriculum (Kuczmarski et al., 2021). Emerging regional programs are leveraging residency learning networks, such as one multi-institutional symposium that used an illness script framework to better equip family medicine residents with clinical skills needed to care for patients facing climate-related environmental hazards (Kaur et al., 2023).

Continuing Education for Health Professionals

For established health professionals, there are numerous opportunities to gain foundational climate and health knowledge through accredited continuing education (CE). Albeit on a small scale, medical societies and professional organizations are increasingly featuring experts in this field to give plenary or keynote talks at annual meetings. Others have offered workshops or dedicated CE courses to introduce fundamental concepts of climate change and health care system decarbonization to practicing providers. Notable offerings include those from the Medical Society Consortium on Climate & Health, the Climate Change and Human Health ECHO program (University of New Mexico Health Sciences, n.d.), the Clinical Climate Change conference at the Icahn School of Medicine at Mount Sinai (Icahn School of Medicine at Mount Sinai, n.d.), and the Accelerating Healthcare Action on Climate Change and Health Equity webinar series through the U.S. Department of Health and Human Services (Assistant Secretary for Health, 2022). Maintenance of certification activities for medical specialty boards are also emerging. The American Board of Pediatrics now includes options for climate and health educational activities to fulfill both Part II (self-assessment) and Part IV (quality improvement) requirements (Patel et al., 2022). Such modalities can be produced quickly, archived, and accessed conveniently for the busy working health professional.

The Yale School of Public Health offers a climate change and health certificate, which educates professionals in public health and related fields on health impacts, adaptation strategies, and best practices in communication (Yale School of Public Health, n.d.). Practicing clinicians can develop similar skills by enrolling in the GCCHE's regionally based CE certificate courses (Sorensen et al., 2023b; Columbia University, 2022). Launched in 2022, the diploma in climate medicine (DCM), is open to health care providers of all specialties and practice backgrounds (Climate and Health Program 2022). Modeled after similar non-matriculating diplomas in medicine (e.g., tropical medicine), the DCM was conceived to be a definitive credential for knowledge and expertise in this evolving field. At 300 hours, the curriculum features broad competencies in climate and health foundations, health care sustainability, disaster response, energy policy and healthy communities, and global climate change with a myriad of hands-on pedagogical experiences (e.g., hospital disaster training, renewable energy sites, national laboratories).

Advancing Pedagogy

With growing demand for integrating social and environmental determinants of health, health care sustainability, and climate adaptation and resiliency into health professional education, there is a commensurate need for further pedagogical evolution and curricular implementation. There are models in the realms of nursing and medical education for how educators can align climate change and health education with existing accreditation body competencies, such as the Accreditation Council for Graduate Medical Education and American Association of Colleges of Nursing (Philipsborn et al., 2021; Kuczmarski et al., 2021). Similarly, leaders from the American Association of Colleges of Pharmacy have highlighted general policy statements and recommendations for integration of climate change into pharmacy curricula (DiPiro et al., 2023). However, the preponderance of these models remains immature by medical education best-practice standards in that they lack robust guides and resources—stratified by learning stage—tailored to professional roles. Such augmentations would allow health professional students and educators to define both a basic and a gold standard for climate change and health education and facilitate continuous assessment of learners via clear competencies and milestones. Addressing this latter need, a blueprint for how to improve climate and health literacy across K–12 and professional learning stages has been developed,

stressing the importance of basic and functional literacy, student-centered learning approaches, and professional adaptability. (Limaye et al., 2020). Notably, in 2020, the Council of Social Work Education published an exemplary curricular guide on integrating environmental justice into existing social work practice, with the goal of equitably addressing future climate and health impacts (Council on Social Work Education, 2020).

Building on these pedagogical needs and the core concepts within the GCCHE consensus, the authors present a framework for climate change and health education tailored for clinicians that allows for progressive learning across the health professional education continuum (Institute of Medicine, 2015). First, the authors identify six learning domains in which most clinical practitioners, including pharmacists, psychologists, social workers, nurses, and physicians can integrate climate change and health themes and topics across didactic and experiential training pathways (*Table 1*).

Using these learning domains, the authors envision a framework (*Figure 1*) for continuous education that allows learners to add to existing knowledge while gaining proficiencies related to the intersecting systems within and between human, environmental, and planetary health. Notably, the model was designed so that curriculum integration stresses early and continued focus on communication and collaboration skills related to climate change and health (Institute of Medicine, 2015). Subsequent learning builds on foundational knowledge about biopsychosocial and environmental health, aligning with topics, such as health systems science, public health, and population health. Environmental and climate justice issues, as well as scientific inquiry skills are woven in as longitudinal threads. This model also allows educators to map climate change and health learning domains, not only to competencies required by their respective accrediting bodies, but also by learning stage and level of proficiency. This graded, progressive learning model builds on well-established education theory about cognitive load by highlighting areas of overlap between climate and health learning topics and the immediate learning needs of clinicians across their training (Young et al., 2014). Most importantly, given the complex and dynamic relationships between environmental health, anthropogenic climate change and human health outcomes, this framework is shown as a circular continuum, acknowledging the need for a non-linear and iterative approach to education at this nexus. In other words, by leveraging cognitive load theory, the proposed education framework lends itself to fostering the application of systems thinking when managing human vulnerability to climate change, which is dynamic and depends on a place-based socio-biophysical system, affected by the continuous interaction of multiple stressors (Talukder et al., 2024).

In developing this framework, the authors invoke examples from other public health areas with complex relationships between social and environmental determinants leading to poor health outcomes (e.g., lead toxicity, obesity, tobacco use, and heat-related illness) that require systems thinking and modeling approaches (Leischow and Milstein, 2006). While the order of exposure to content in these learning domains may be variable and interchangeable, a trajectory toward competency emerges. At the preclinical stage, learners can acquire foundational communication skills, tools for interdisciplinary collaboration, and foundational knowledge about climate and health science. Subsequently, at the clinical level, learners can gain critical skills and knowledge in assessing climate-related health risks, identifying opportunities for disease prevention and mitigation of these risks, and managing their acute and chronic health impacts at the point of care, building upon interdisciplinary collaborations where appropriate. As learners become competent in these skills, they may move on to mastering interdisciplinary care while managing these health impacts, not only at the point of care, but also within their community. Simultaneously, learners may begin to consider practice management and quality improvement issues. As they advance in their training, and their foundational cognitive load, the curriculum can broaden to population health management and public health practices. In this way, clinicians can draw from systems-based practice—a core competency in health professions like medicine, nursing, and pharmacy—to critique and engage with policy issues driving environmental health outcomes. This enhances their effectiveness as advocates addressing these concerns.

This framework outlines areas of overlap between learning priorities across the formal, health professional education continuum and climate and health learning domains. Stressing the importance of interprofessional practice, the model stresses early and sustained focus on communication and collaboration skills related to climate and health (Institute of Medicine, 2015). The model also highlights the increasingly recognized need for health professionals to become competent in systems thinking related to health care delivery, public health, population health, health policy, and advocacy (American Medical Association, 2023). Also within this framework, concepts like environmental and climate justice, as well as scientific inquiry are suggested

Learning Domains for Integration of Climate Change and Health		
Learning Domain	**Key Theme Addressed**	**Examples of Specific Topics Taught**
Communication & Collaboration	How to effectively communicate about the links between climate change and health to a diverse audience. How to identify, engage and collaborate with interdisciplinary stakeholders while addressing climate change and health issues.	Behavioral science related to science. health, and risk communication. Motivational interviewing skills for health-promoting behavior change.
Biopsychosocial & Environmental Health	What is climate change? What are the myriad health and equity impacts related to climate change?	Climate science. Impacts of degraded air and water quality and security. Impacts of extreme weather, disasters,and heat. Mental health impacts of environmental degradation. Infectious and vector-borne disease management. Global and refugee health.
Clinical Practice	How to recognize and identify climate-sensitive health conditions at the point of care. How to prevent and manage climate and health impacts at the point of care while addressing climate and environmental injustices. How to promote healthy behaviors that have environmental co-benefits.	Emergency and disaster management. Occupational and environmental health risk assessment. Prevention and management of health conditions exacerbated by poor air quality and heat stress. Promotion of nutritious diets that have environmental co-benefits.
Practice Management & Improvement	How to define and practice climate-smart and climate-ready health care using principles of continuous quality improvement.	Integrating environmental sustainability measures into clinical quality improvement. Integrating climate resilience measures into emergency and hospital preparedness planning.
Public & Population Health Determinants	How to anticipate and manage climate-related health risks and impacts at a community, regional, and population health level.	Public health emergency preparedness. Public health interventions to reduce impacts of vector-borne disease outbreaks. Public and population health interventions to improve nutritional outcomes. One Health principles.
Policy Determinants & Advocacy	How to critically analyze policies that influence health outcomes and health disparities related to climate change. How to advocate effectively with, and on behalf of, communities whose health is disproportionately impacted by climate change. How to restore, preserve and protect a healthy environment for future generations.	Intersections between human health, climate change, and energy, housing, and transportation policy. Local, national, and international environmental policy impacts on health and climate change. Global health policy and sustainable development. Advocacy skills.

TABLE 1 | Learning Domains for Integration of Climate Change and Health
SOURCE: Created by authors.

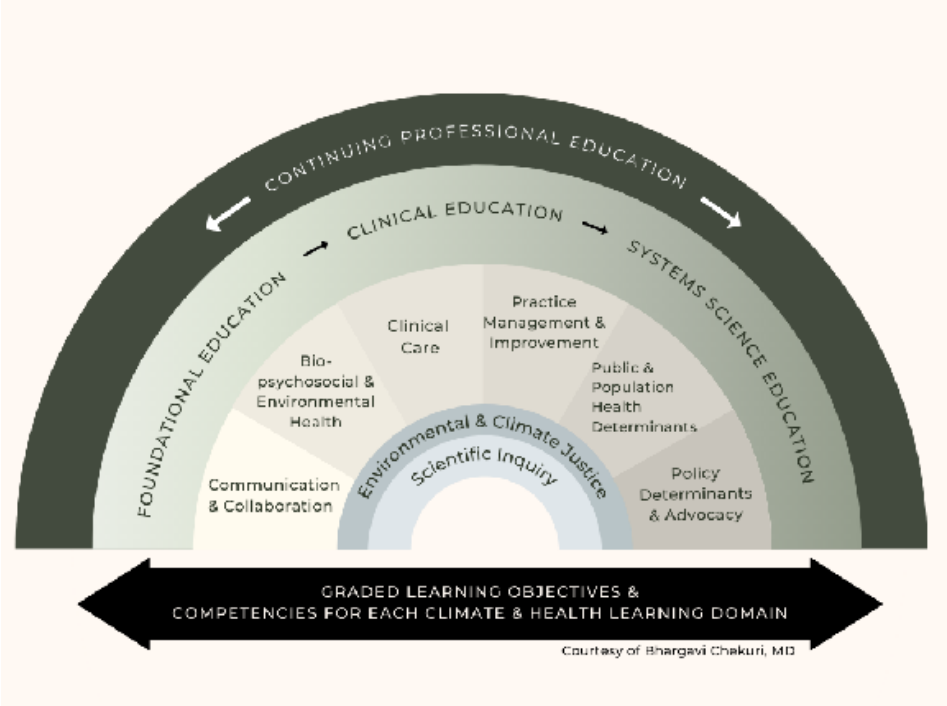

FIGURE 1 | A Framework: Climate Education for Clinical Health Professionals
SOURCE: Created by Bhargavi Chekuri, MD.

as longitudinal threads that are explored continuously throughout health professional training.

Interprofessional Education

Health professions educators familiar with curricular development following guidance from the interprofessional education collaborative (IPEC) will find that themes in the framework described previously align closely with many of the competencies outlined in the IPEC core competencies for interprofessional collaborative practice (Interprofessional Education Collaborative, 2023). As health professions training programs in medicine, nursing, pharmacy, dentistry, and public health seek to meet accreditation standards through meaningful incorporation of IPE in their curricula, this clear alignment may serve as a strategic opportunity for simultaneous introduction and development of climate change education across multiple health professions training programs within an institution. These competencies place patients, populations, and communities at the center of interprofessional collaboration and focus on enhancing teamwork and communication, promoting health equity in the delivery of care, and implementing population health programs and policies. IPE competencies also emphasize the value of diverse perspectives and the complementary expertise of individual professions, instilling critical professional attitudes and skills that are required to effectively respond to the complexities of the climate crisis. In addition to providing a pathway for curricular integration, engagement through IPE may have the added benefit of increasing faculty knowledge and buy-in within health professions programs that have not previously worked in this realm and can bring together faculty with diverse backgrounds to serve as champions for further advancement of climate change education, research, and program development. One example of exemplary efforts in interprofessional climate and health education is the University of Minnesota Academic Health Center's 1Health climate curriculum model, a transdisciplinary collaboration across allied health professions, including dentistry, medicine, nursing, pharmacy, public health, veterinary medicine, social work, and other related programs (Demorest and Potter, 2019). An increasing number of publications have discussed IPE in the context of climate and health education, but continued efforts to create and disseminate effective transdisciplinary training strategies are needed (McKinnon et al., 2022).

Acting on the Action Collaborative on Decarbonizing the U.S. Health Sector: Empowerment and Opportunities for the Provider

The aspirational goals of the National Academy of Medicine's Action Collaborative on Decarbonizing the U.S. Health Sector will require rapid, coordinated, and sustained engagement of the health professional community.

Cultivating confidence and adequate fluency in the language of environmental sustainability will require interprofessional engagement with novel educational partners, such as civil engineers, life cycle assessment analysts, and carbon accountants. Best practices and new tools will rapidly evolve. In just the last two years Health Care Without Harm published their toolkit for achieving zero emissions in health care, the Agency for Healthcare Research and Quality released a primer on decarbonization, Practice Greenhealth published a Healthcare Emissions Impact Calculator and The Joint Commission announced environmental sustainability as a focus area (Health Care Without Harm, n.d.; Sampath et al., n.d.; Practice Greenhealth, 2022; Perlin and Lee, 2022). Although specific proficiencies in environmental sustainability and climate resilience have yet to be codified, the authors envision that these hard skills for individuals (e.g., understanding features of scope 1, 2 and 3 emissions in health care) will require a pedagogical framework to measure core competencies for skillsets that will be increasingly in demand.

Conclusion

There has been a conspicuous dearth of the health care community in the national discourse on the accelerating issue of climate change and its grave effect on our health. We need stronger clinician voices, and few in health care have been trained to deal with the complex, multifaceted environmental and climate determinants of disease and their impacts. Climate and health policy change has been slow and limited in scope due to the difficulty in translating complex earth science into convincing, articulate linkages between extreme heat and geopolitical instability; loss of biodiversity and pandemics; or extreme weather and food insecurity. Each year, our health care industry contributes 8.5 percent of the total United States' carbon emissions, ranking 14th in global national carbon outputs (Pichler et al., 2019; Eckelman and Sherman, 2018). To advocate for smart health policy related to climate change, health care leaders must possess a sound science and policy foundation to effectively influence business leaders, community leaders, and policy makers. Clinicians need fluency in digesting a vast array of metrics related to climate change and health; to lead on clear, convincing strategies on mitigation, adaptation, and decarbonization; and to advocate for the adoption of health-beneficial policies. Health professional educational programs are critically needed to meet these challenges.

In 2023 The Joint Commission surveyed health care executives on the need for environmental sustainability standards within health care. The responses were overwhelmingly negative as leaders cited existing stressors of workforce shortages, financial shortfalls, and patient disposition challenges. The authors believe this focus on short-term priorities abrogates a duty to act on behalf of long-term benefits to population health. It should be noted that the majority of responses from individuals under age 45 were in favor of mandatory environmental reporting compared to their older counterparts—indicating a profound difference in intergenerational perspectives (National Academy of Medicine, n.d.). By training and preparing a climate-savvy health care workforce, we can integrate responses to climate health threats into the professional DNA of our care providers—just as we do when we educate our patients on smoking cessation, seatbelt use, lead screening, nutritional diets and adequate exercise. Only then will health care professionals have the critical mass and political clout—within our health care organizations and communities— to effectively change our collective risk and enact effective climate policies.

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