

# Science Policy Training for a New Physician Leader: Description and Framework of a Novel Climate and Health Science Policy Fellowship

Jay Lemery, MD, Cecilia Sorensen, MD, John Balbus, MD, MPH, Lee Newman, MD, MA, Christopher Davis, MD, Elaine Reno, MD, Renee Salas, MD, MPH, MS, and Emilie Calvello Hynes, MD, MPH

## ABSTRACT

The accelerating health impacts of climate change are undermining global health, and the roles of the health sector in addressing the many challenges of climate change are being articulated by governments, multilateral institutions, and professional societies. Given the paucity of physician engagement on this issue to date, there now exists a clear need for health professionals to meet this new challenge with the development and cultivation of new knowledge and skill sets in public health, environmental science, policy, and communication. We describe a novel GME fellowship in climate and health science policy, designed to train a new generation of clinicians to provide the necessary perspective and skills for effective leadership in this field. This fellowship identifies available university resources and leverages external collaborations (government, medical consortiums, affiliate institutions in public health, and environmental science), which we describe as being replicatable to similar training programs of any number of medical specialties and likewise bring meaningful opportunities to their respective training programs and academic departments. The creation of this novel fellowship in climate and health policy provides a roadmap and potential path for similar programs to join us in addressing the defining health issue of this generation and many to follow.

Over the past year, physicians and other health professionals have increasingly borne witness to the effects of climate instability on the health and well-being of people throughout the world. In the United States alone, we have experienced multiple “1000-year” hurricanes in the Atlantic and Gulf of Mexico, resulting in flooded cities and the displacement of millions. Toxic wildfire smoke has blanketed the American west with degraded air quality. Extreme rainfall in California has killed scores from devastating landslides. Historic changes to our ecosystems are undermining healthy living, exacerbating illness, and worsening

health outcomes for the most vulnerable of patients.<sup>1</sup> Increases in morbidity and mortality presenting as syncope from heat stroke, acute myocardial infarction from extreme heat, dyspnea from degraded air quality and aeroallergens, vomiting and diarrhea from diminished water quality, and depression and anxiety have all been associated with extremes of temperature and precipitation and severe weather events.<sup>2–10</sup>

The imperative for informed policy and deliberate action is becoming more urgent, and despite the mounting evidence that climate change is negatively affecting human health domestically and worldwide,

From the Department of Emergency Medicine (JL, CS, CD, ECH, ER), University of Colorado School of Medicine, Aurora, CO; National Institute of Environmental Health Sciences (JB), Bethesda, MD; the Departments of Environmental and Occupational Health and Epidemiology, Colorado School of Public Health (LN), Aurora, CO; and the Department of Emergency Medicine at Harvard Medical School (RS), Boston, MA.

Received October 5, 2018; revision received December 26, 2018; accepted January 2, 2019.

The authors have no relevant financial information or potential conflicts to disclose.

Supervising Editor: Wendy C. Coates, MD.

Address for correspondence and reprints: Jay Lemery, MD; e-mail: lemery18@gmail.com.

AEM EDUCATION AND TRAINING 2019;00:1–10

the clinical community has been conspicuously absent in developing policy and initiatives to address this threat.<sup>1</sup> Initial surveys have suggested that many American physicians agree that climate change is human caused and is worsening, and most of those responding to the surveys reported that they are at least modestly knowledgeable about the association between climate change and health.<sup>11</sup> Yet a 2016 physician survey by the George Mason Center for Climate Change Communication cited significant barriers to physicians engaging in and taking action on this issue, including a lack of time, an uncertainty on how to communicate about this issue, and a lack of resources and recommendations for patients.<sup>11</sup>

In these multifaceted challenges, faculty at the University of Colorado (CU), Department of Emergency Medicine—with the assistance of many other partners— saw both a need and an opportunity. In early 2017, the Department inaugurated the first graduate medical education (GME) fellowship in climate and health science policy with a purpose to train and equip new physician leaders in climate science, education, and advocacy skills. We envision this GME fellowship to be relevant throughout the entire *house of medicine*, but starting in emergency medicine (EM) was an intuitive fit. The health impacts from climate change can be best characterized as falling largely on the most vulnerable populations—often in the setting of natural disasters. In this regard, EM is well suited to develop such a program, given its proficiency in disaster response and indefatigable care for the most vulnerable.<sup>12,13</sup>

In this paper, we describe the specifics of this fellowship and provide a rationale and blueprint for replication in other GME programs. We present this material structured in best practice norms for medical education curriculum development, a six-step approach synthesized by Kern et al.<sup>14</sup>

## **PROBLEM IDENTIFICATION AND GENERAL NEEDS ASSESSMENT**

---

Despite the accumulation of scientific evidence clarifying climate change and its health impacts, there still remains a conspicuous absence of clinicians in societal discourse on the subject. Much like when the International Physicians for the Prevention of Nuclear War distilled the complex geopolitics of nuclear proliferation to an essential health issue (and won the Nobel

Prize in 1985), there exists an analogous opportunity for medicine to dispel myths and to provide accurate, dispassionate risk information on climate change and its related health impacts.

Consider the current state of engagement between known climate science and health care. The science linking current and future changes in climate variability and weather events to increases in morbidity and mortality is strong.<sup>15–17</sup> The resulting increase in health-related costs, especially for those with acute and chronic medical and psychological needs as well as specific vulnerable populations (i.e., children, women, workers) has also been documented. For example, between 2000–2009, heat waves are estimated to have contributed to over \$5 billion in direct health care costs in the United States.<sup>18</sup> The Zika epidemic in the Americas, which may have been facilitated by permissive climatic conditions that increased mosquito vector abundance, led to \$1.1 billion of public spending for response and preparedness alone.<sup>19,20,21</sup> Another study estimated that just six climate-related events resulted in over \$14 billion of health-related costs from provision of medical services and loss of life and productivity.<sup>22</sup> However, the health care costs and needs of those impacted by climate-related events are rarely factored into health policy decisions. Attribution of mortality and morbidity from climate-related events is hindered by a lack of aggregated health data in many regions of the United States (and globally) as well as the challenge in assigning causality of a specific environmental event to climate change.<sup>23</sup> Additionally, there is a dearth of interdisciplinary collaboration and scientific investigation into the direct impacts of climate change on health care cost and utilization, and analyses are almost always retrospective in nature. Compared to other significant environmental health issues, there has been insufficient research investment in the subject to support accurate projections and to form sound policy decisions.

The emerging complexities of climate and health issues necessitate development and dissemination of new knowledge sets. In 2015, this sentiment was supported at the highest levels of the U.S. government when President Obama convened scores of deans and staff from the medical, public health, and nursing colleges and schools to make a public commitment to establish goals, align objectives, and organize actions for education and training on the health impacts of climate change.<sup>24</sup> Unfortunately the follow-through on

these pledges has been inconsistent, and the need remains for health care providers who can effectively identify these risks and provide critical analysis.

Why is there a need for a physician fellowship? *Lancet* has characterized climate change as the greatest global health threat (and opportunity) of the 21st century.<sup>25</sup> Yet there has been a paucity of physician engagement on this topic to date. We believe that a fellowship can fill this gap with physicians capable of assuming leadership, disseminating knowledge, and influencing health care policy—integrating all in a multidisciplinary manner. We also differentiate this novel training from a traditional masters of public health (MPH) program. As there have been increasing calls for physicians to become more engaged in this issue, we propose that formal training in governmental and NGO advocacy, education and curriculum development, and science communication will fulfill a need for physician leadership more precisely than an orthodox, 2-year MPH curriculum.<sup>26,27</sup>

There is also a business case to be made. For health care policy makers, greater awareness of the magnitude and specifics of climate-driven health events could lead to better care and reduced costs. Physicians trained in blending climate science, policy, and research have the ability to advocate for patient health and to better contribute to the conversation on the systemwide financial risks of climate change on health care expenditure. Physicians knowledgeable in these areas have an opportunity to shape multidisciplinary (i.e., engineering, operations, development) decisions on health care systems' investment in climate-resilient hospital infrastructure, designed to ensure continuity of services during extreme weather events and prevent the downstream negative health outcomes due to lack of access to care following disasters.

## TARGETED NEEDS ASSESSMENT

In early 2015, diverse members of the CU came together from its four constituent campuses to form the CU Consortium on Climate Change and Health (CUconsortium.org). Recognizing the complex science behind climate change and the many benefits to address its challenges from a multidisciplinary approach, the Consortium attracted faculty from health research basic science, environmental science, public health, public policy, and disparate clinical disciplines such as nephrology, immunology, occupational and environmental medicine, and emergency

medicine. A conference in September 2016 sponsored by the Aspen Global Change Institute codified the mission of the consortium to establish a multidisciplinary approach to climate research, education, and policy.<sup>28</sup>

Through these meetings, new and existing collaborations flourished. Private sector entities and colleagues at government agencies who focused on climate and health issues (CDC, NIEHS) saw strategic synergies in working with academia. Subsequently, the Denver-based non-profit Living Closer Foundation agreed to underwrite a GME fellowship to “train physicians in climate education, meaningful engagement, and effective communication to create leaders in the field of climate change and health.”<sup>29</sup> Funds were specifically earmarked to 1) support a significant portion of the fellow's time toward scholarship and research and 2) support travel to off-site preceptorships at the NIH/NIEHS Office of the Director (Bethesda MD) and the CDC (Atlanta, GA). These off-site preceptorships were crafted for the fellow to have access to and training for active policy discussions, such as transagency committees and advisory councils as well as interagency committees and working groups. By establishing official volunteer status within the agencies, the fellows' unique exposure to governmental meetings facilitated opportunities to participate in authorship and presentations and to play a meaningful role in the review and preparation of science policy documents.

Although other well-established GME science policy fellowship opportunities do exist (American Association for the Advancement of Science, Robert Wood Johnson Foundation), we envisioned our program to better utilize the clinical expertise of the fellow and to be less geographically constricted to Washington, DC. We also understood that climate change and health issues have not been a historical priority for these fellowships, and we were committed to establishing a physician science policy fellowship where this issue had unequivocal primacy. Furthermore, we believe that clinical work confers credibility and a too often absent perspective in policy deliberations for effective leadership in this area.

We have differentiated this fellowship from a traditional course of study through a MPH program and do not believe a concomitant degree is a precondition for a physician to lead on this issue. Yet we do recognize the value of this training to early-career physicians seeking to work within the public health sphere.

Accordingly, we have utilized a close relationship between the CU School of Medicine and the Colorado School of Public Health to offer an optional 2-year fellowship MPH track within our fellowship.

## GOALS AND OBJECTIVES

After careful evaluation of existing educational competencies in multiple fields of public health and clinical medicine, we have proposed this set of competencies as a pilot for the Climate Change and Health Science Policy (CCHSP) fellowship—understanding that such competencies may evolve over time. The core list represents essential skills for the fellow given the unique opportunities of partner institutions and the CU. While we believe that these competencies have universal value, other institutions may change these competencies and their relative emphasis given their own strengths, weaknesses, and resources (Table 1).

## EDUCATIONAL STRATEGIES AND IMPLEMENTATION

### Policy/Advocacy Mentorship

A key facet of the fellowship is to leverage the work of site preceptors and partners to gain experience and exposure to organizations in working on climate and health issues, as a way to consistently reinforce fellowship objectives. Projects the fellow has participated in to date:

- Technical contributor to the U.S. Government Fourth National Climate Assessment.
- National Institute of Environmental Health Science, Global Environmental Health Program: developed and spoke at conference session on the impact of the environment upon women's health in India, leading to two manuscripts; also participated in meetings with Indian government health officials.
- The World Bank—assessment documents on climate and health – Fellow provided content inputs and critical review.
- Society for Academic Emergency Medicine, leadership within the newly created climate change and health interest group.
- Physicians for Social Responsibility, founding member of Colorado working group.
- Fellow lead collaborative meetings with the Colorado Department of Public Health and Environment

to discuss official state reports and the department's ongoing air and water monitoring activities.

- Citizens climate lobby—clinical advisor.
- Fellow presented to state representatives on climate and health issues in Colorado.
- The Global Consortium on Climate and Health Education at the Columbia University Mailman School of Public Health—fellow contributed to content and review of core educational objectives.
- American Geophysical Union—participant in the Resilience Dialogues, which partners experts with communities to explore their risks from climate variability and change.

Considering future additional fellowships at academic other academic sites, we conclude each subcategory of Educational Strategies and Implementation with “replicable aspects.”

### Replicable Aspects for Policy/Advocacy Mentorship.

Many of the aforementioned organizations have abundant opportunities and needs for physician fellows to contribute to their missions and in turn gain valuable training. We envision these groups to be the nidus of a training network for additional fellowships in this field.

### Education

A core objective is to develop the fellow's capacity to be an effective educator—through curriculum development, lecturing (classroom/conference), and social media platforms. The fellow is primarily charged with administering and assistant teaching for the climate and health electives at the Colorado School of Public Health (weekly, fall semester) and at the CU School of Medicine (2-week intensive, spring semester). The fellow is also tasked with other projects, such as spearheading the development of educational products for affiliate partners and constituents (e.g., CME curricula for the Medical Society Consortium on Climate and Health).

Fellow participation in other departmental educational endeavors bolsters their facility with podium presentations and effective science communication (e.g., resident conferences, department/section educational programs for laypeople and undergraduates). Monthly didactic sessions occur during which the fellow meets with identified topic-expert preceptors to discuss key competencies. These meetings occur both in Denver as well as at stakeholder sites (e.g., NIH in greater

**Table 1**  
Set of Competencies as a Pilot for the CCHSP Fellowship

Objectives	Measurements
<i>Goal 1. Fluency with climate and health impacts: understanding how these perturbations in earth science impact human well-being—both pathophysiologic and societal.</i>	
Understand scientific foundations	
Recognize basic science of climate change and identify the sources of greenhouse gases	By 6 months, the fellows will be able to accurately list and describe these objectives during formative individual assessments through structured mentorship meetings with core faculty.
Describe current climate change projections: U.S. and global	
Illustrate systems’ (physiologic, ecologic, social, etc.) interactions and exposure pathways resulting in health impacts of climate change	By 6 months, the fellows will be able to accurately list and describe two of these objectives during formative individual assessments through structured mentorship meetings with core faculty. At 12 months, the fellows will be able to describe all four of these objectives. Evaluations of scholarship directly incorporating these objectives (at least two of the four) via peer review or editorial process, presentation evaluations, and direct mentorship from core fellowship faculty.
Recognize policy analysis methods and principles	
Define an understanding of research methods: Epidemiologic research methods Community and field-based research methods Intervention science: dissemination, implementation, and evaluation methods	
Discriminate policies outside of health (urban planning, education, business sustainability/corporate social responsibility, etc.) that could be health-relevant	
<i>Goal 2. Facility with concepts of mitigation and adaptation as actions within public and private entities and to evaluation quality and effectiveness of such actions related to health impacts.</i>	
Interpret the health implications of climate change, including:	
Health impacts in the United States	By 3 months, the fellows will be able to accurately list and describe these objectives during formative individual assessments through structured mentorship meetings with core fellowship faculty.
Health impacts in other parts of the world	
Articulate the potential health benefits from climate mitigation and adaptation measures	By 3 months, fellows will be able to accurately describe this objective during formative individual assessments through structured mentorship meetings with core fellowship faculty. Evaluation of scholarship directly incorporating this objectives via peer review or editorial process (by the end of fellowship).
Appreciate sustainable and climate resilient health care facilities	This objective is directly assessed through formative individual assessments through core and affiliate fellowship faculty directly engaged with the fellow’s work with healthcare without harm.
Understand U.S. government and relevant state policies and institutions	
Differentiate Federal agencies, including facility with the work of the CDC and the NIH	The following objectives are directly assessed through formative individual assessments through core and affiliate faculty directly engaged with the fellow’s work at the NIH and the U.S. Global Change Research Program.
Explain the clean power plant rule and other executive and legislative measures	
Recognize U.S. Global Change Research Program and other federal interagency activities	
Recognize Executive branch institutions (Office of Science and Technology Policy, Council on Environmental Quality, National Security Council, etc.)	
Explain legislative structures and processes	
Explain U.S. medical societies’ positions on climate change and health	This objective is directly assessed through formative individual assessments through core and affiliate fellowship faculty directly engaged with the fellow’s work at the Medical Society Consortium on Climate and Health.

(Continued)

Table 1 (continued)

Objectives	Measurements
Describe international institutions relevant to climate change and health, including: Intergovernmental Panel on Climate Change United Nations Framework Convention on Climate Change World Health Organization United Nations Environment Program World Bank Multinational corporations International nongovernmental organizations	By 3 months, the fellows will be able to accurately describe this objective during formative individual assessments through structured mentorship meetings with core faculty.
<i>Goal 3. Capacity to lead effective climate and health programmatic development within the academic, public, and private sectors.</i>	
Describe climate change health impacts and vulnerability assessment skills	
Explain CDC “Building Resilience Against Climate Effects” (BRACE) framework and other impact and vulnerability assessment protocols	By 6 months, the fellows will be able to accurately explain these protocols during formative individual assessments through structured mentorship meetings with core fellowship faculty.
Conduct literature review on specific topics in climate change and health	By 1 month, the fellows will have accomplished this objective, attested during formative individual assessments through structured mentorship meetings with core faculty.
Participate in design and conduct of transdisciplinary research, including health, meteorology, and climatology, among other disciplines	This objective will be assessed via successful peer review publication(s), in conjunction with affiliate and core faculty.
Discriminate the interaction of emerging health systems and the impact of climate	By 6 months, the fellows will be able to describe these interactions during formative individual assessments through structured mentorship meetings with core faculty.
Articulate health care system vulnerabilities from climate change and to be well versed in preparation and resiliency strategies for climate-related events	By 3 months, the fellows will be able to describe these interactions during formative individual assessments through structured mentorship meetings with core faculty.
<i>Goal 4. Outstanding science communication skills to effectively articulate the impacts of climate change upon human health—both in academia and through lay communication.</i>	
Excel at public speaking	Formative individual assessments through structured mentorship meetings with core faculty. Evaluations of science communication skills come from core and affiliate faculty integrating data from formal presentation evaluations, formal student feedback, or other direct audience feedback. Subjective assessments are also integrated into formal assessments, such as audience reactions, social media response, and third-party feedback (lay public, non-fellowship faculty, etc.).
Give professional formal testimony	
Engage in TV/radio/print media interviews	
Author opinion-editorial and narratives	
Produce effective social media	
Teach—with a particular emphasis on medical student and public health student curricula	
Engage with policy makers	

CCHSP = Climate Change and Health Science Policy.

Washington DC). Other projects the fellow has contributed to: National Institute of Environmental Health Sciences Educational Curriculum on Climate and Health—curriculum development and content contribution; Medical Society Consortium on Climate and Health—lead of continuing medical education; clinical correlates editor of a major textbook on global climate change and human health; and podcast presenter for the Environmental Defense Fund. To further ensure competency with educational objectives, the fellow has regular meetings with fellowship

directors and preceptors to discuss key readings on specific climate and health topics.

**Replicable Aspects for Education.** Most GME training programs have deep connectivity with their respective medical schools, undergraduate campuses, and medical campus community outreach programs. There are readily available and accessible curricula on this topic to support a fellowship program (i.e., fellows + faculty) to stand-up educational programs within their affiliated academic communities.

## Research/Scholarship

Through collaborations with a broad diversity of actively engaged experts in the fields of public health, clinical medicine, and policy, the fellow has access to mentors and relevant primary data to advance scholarship in this area and to augment proficiency with fellowship educational objectives. The fellow's successful publications have included primary research, policy papers, conference proceedings, and systematic review articles, including:

- Assessment of excess mortality in Puerto Rico from Hurricane Maria (2017).
- Biomarker assessment of chronic kidney disease from heat stress in Guatemalan field workers.
- Assessment of climate change on vector borne disease in Ecuador.
- An inventory of climate change exacerbations of emergency medicine presentations in the United States.

## Replicable Aspects for Research/Scholarship.

We discussed that many of these opportunities may be available to a network of fellows through an established training network, many GME programs have access to “local” talent through affiliate academic campuses, in the fields of environmental science, basic medical science, global health, law, human rights, etc. This approach to a multidisciplinary team of mentorship reflects the very nature of climate change and health—that it is a multisector issue well beyond the traditional boundaries of medicine.

## Clinical Practice

Clinical practice supports the fellow's proficiency of the educational objectives by partially offsetting his/her salary by working clinical shifts in the UHealth Emergency Medicine System (CU Hospital, affiliate UHealth community hospitals and UHealth free-standing emergency departments) as an attending physician. Fellow(s) are American Board of Emergency Medicine board-eligible/board-certified. Like many other GME fellowships, this clinical work is an economic necessity to sustain the long-term viability of the fellowship. We also believe that active clinical experience is a positive differentiator in this field, currently dominated by those with traditional training in public policy and public health. We believe that clinical experience helps to add credibility and a necessary perspective for advocacy and effective leadership in this field. By example,

the fellow is currently an investigator on a Colorado School of Public Health study in Guatemala performing physical examinations and collecting urine and serologic data to assess at-risk populations under conditions of heat extremes. Other fellowship activities with clinical relevance have included field projects in Ecuador, clarifying climate drivers of the Syrian refugee crisis (Lebanon based), and a posthurricane vulnerability assessment in Puerto Rico.<sup>30</sup> Fellowship funds are specifically earmarked to “buy-down” clinical work, which increases the amount of time the fellow may spend on research and policy scholarship.

**Replicable Aspects for Clinical Practice.** Many GME fellowships are supported through clinical work, and we believe that this a familiar administrative model to most EM training programs.

## Personal/Professional Development

Because of the novelty of this fellowship, regular meetings to assess overall wellness and professional development are integral to ensure success. Because the fellowship affords exposure to so many different organizations and people, much of the mentorship on this topic centers on strategies for procuring opportunities after graduation.

These meetings reassess competency with the fellowship objectives, as well as compliance with minimum expectations, which include:

- Minimum of three peer-reviewed publications each year of fellowship, ideally linking these publications to national or international meetings.
- Presentation at least two national or international meetings.
- Minimum of three editorials or blog posts targeting response to climate related current events.
- Active participation in the educational programs of the department and affiliates.
- Meet all citizenship requirements of department faculty.

## Replicable Aspects for Personal/Professional Development.

We believe that this approach establishes accountability for all fellowship principals to remain attentive to goals and objectives throughout the year. Such attention will not only ensure the fellowship meets the standards of concomitant GME training programs, but will also allow it to develop, grow, and ultimately thrive in an academic environment.

## Duration

The duration of the fellowship is either 1 or 2 years, depending on the specific goals of the fellow, in consultation with the program directors and department leadership. Two or more years' duration is necessary for completion of the fellowship with concomitant degree-seeking coursework (MPH, MA).

## Fellowship Director and Program Administration

The fellowship is administered through the Department of Emergency Medicine, Section of Wilderness & Environmental Medicine (WEM). The fellowship director and an associate fellowship director are clinical faculty at the CU School of Medicine. Site preceptors at the NIH, CDC, and Colorado School of Public Health also play important roles during the fellow's extended duration and training deployments to Washington, DC, and Atlanta, respectively. The Section of WEM provides administrative support for the fellowship.

As this is an inaugural fellowship, there is no precedent for director qualifications. The director (JL) has a background in wilderness medicine leadership and medical education, which led to over a decade of policy work in climate change and health. The commensurate network development from this work became the effective scaffolding to engage affiliate faculty to support the fellowship. The associate fellowship director (ECH) has a background in global health and is the Director of the Global Emergency Care Initiative at Denver Health/CU. Both the fellowship director and associate director are American Board of Emergency Medicine Diplomates and Fellows of the American College of Emergency Physicians.

## Fellowship Faculty and Advisory Committee

Fellowship faculty assist the fellow through scholarship and research mentorship, through access to meetings and collaborative policy working groups (government, private, public sector), and through diverse expertise and connectivity. Members of the advisory committee represent basic sciences and clinical departments within the School of Medicine, School of Public Health, and government entities such as the CDC and NIH/NIEHS and affiliate organizations (Medical Society Consortium on Climate Change and Health).

## EVALUATION AND FEEDBACK

The fellow has formative monthly meetings with the fellowship director and/or the associate fellowship director. These meetings serve as formal assessments on meeting fellowship goals and on competency with fellowship objectives. Fellowship directors incorporate formative feedback from site preceptors as well as the chief of service of the ED (clinical performance) in these meetings. A summative assessment of both the individual fellow and the overall fellowship is submitted to the department chair and the fellowship advisory committee by the fellowship director at the end of the academic year. The summative assessment incorporates survey data sent to fellowship principals and preceptors, solicited via Likert-scale questions tied to fellowship objectives competencies as well as open-ended questions allowing for qualitative feedback. Formative and summative feedback is also collected on the fellowship itself from all stakeholders, allowing for continuous curriculum maintenance (i.e., deletions and additions) and assessment of off-site projects with goals and objectives.

The fellow is likewise mandated to provide formative and summative assessment on congruence with the fellowship experience and the "boots on the ground" reality with stated goals and objectives. Given fast-paced and dynamic nature of this fellowship, we have also established a culture of less formal, "just-in-time" feedback from the fellow to the fellowship directors.

Although the fellowship is less than 2 years old to date, there are some early lessons learned. One is that of competing priorities amongst the fellowship preceptors. Although the opportunities afforded to the fellows are far and wide, the areas of activity (government policy arena, School of Public Health, national medical consortiums, and school of medicine/department of emergency medicine) often have opposing views of what is of value to the fellow's training. Such a coalition of divergent opinions in theory offer a rich educational ecosystem for a fellow, but in practice can make for a stressful and chaotic agenda. Early corrections centered on process for the initiation of fellow process and the fellowship director's better organizing communication among the preceptors. Likewise, such differing points of views obscured concordance in summative assessments among the preceptors.

Other challenges center on recruiting an interested and capable cohort of future fellows who may be otherwise reluctant to apply to a new and unorthodox program different from the EM core competencies of residency training. Finally two persistent challenges are long-term funding for the fellowship and a lingering skepticism from a significant percentage of the medical community on the true risks of climate change on health. Although we hope that a future consortium of climate and health science policy fellowships will emerge—pooling resources to lessen the funding needed for such a fellowship to thrive—the intransigence of leaders (administrative, fundraising) throughout the medical community to promote this effort remains a challenge for dissemination.

### **DISSEMINATION: APPLICABILITY TO OTHER SPECIALTIES, INSTITUTIONS, AND CONSORTIUM BUILDING**

The unique confluence of synergies led to the financial resources and human capital required to launch this initial CCHSP fellowship. We believe that this type of opportunity not only *can* be duplicated at other institutions, it *must* be for the growth and advancement of this critical area of expertise. While we anticipate wide applicability of our outlined competencies, they were developed with our specific institution and resources as a framework. Thus, we anticipate that other institutions looking to develop a climate change and health fellowship could tailor their curriculum to highlight their respective internal strengths and unique external collaborations.

Our larger aim is to develop a consortium of institutions dedicated to developing and advancing this type of fellowship education, applicable to all medical specialties. This will allow prospective fellows from across the country access to a wide network of resources and opportunities. For example, relationships with our current collaborating agencies could be utilized (NIEHS, CDC). In addition, we are currently collaborating with climate change and health experts at the Harvard Medical School with intent to stand up a second realization of the fellowship. While the current collaborations are inherently beneficial and fruitful, this site may prove to be a future fellowship site that can duplicate the foundations of the CCHSP curriculum while catering to the unique internal strengths of the larger Harvard community.

## **CONCLUSION**

As the health impacts from climate change become more apparent, the medical community needs to continue to strive to meet the health care needs of its patients. Many of our fellowship partners—academic, private, and public sector—have welcomed participation from motivated, knowledgeable clinicians and have noted that such skill sets and perspectives are rare in policy discussions. The resounding refrain from our external partners has been, “one fellow is good . . . more would be better.” We believe that these external collaborations would be readily available to similar training programs of any number of medical specialties and likewise bring meaningful opportunities to their respective training programs and academic departments. The creation of this novel fellowship in climate and health policy provides a roadmap and potential path for similar programs to join us in addressing the defining health issue of this generation and many to follow.

## **References**

1. The Fourth National Climate Assessment. Volume II. Available at: <https://nca2018.globalchange.gov/>. Accessed November 25, 2018
2. Choudhary E, Vaidyanathan A. Heat stress illness hospitalizations—Environmental public health tracking program, 20 states, 2001-2010. *MMWR Surveill Summ* 2014;63:1–10.
3. Phung D, Thai PK, Guo Y, Morawska L, Rutherford S, Chu C. Ambient temperature and risk of cardiovascular hospitalization: an updated systematic review and meta-analysis. *Sci Tot Environ* 2016;550:1084–102.
4. Sarnat SE, Winqvist A, Schauer JJ, Turner JR, Sarnat JA. Fine particulate matter components and emergency department visits for cardiovascular and respiratory diseases in the St. Louis, Missouri-Illinois, metropolitan area. *Environ Health Perspect* 2015; 123:437–44.
5. Strickland MJ, Darrow LA, Klein M, et al. Short-term associations between ambient air pollutants and pediatric asthma emergency department visits. *Am J Respir Crit Care Med* 2010;182:307–16.
6. Curriero FC, Patz JA, Rose JB, Lele S. The association between extreme precipitation and waterborne disease outbreaks in the United States, 1948-1994. *Am J Public Health* 2001;91:1194–9.
7. Uejio CK, Yale SH, Malecki K, Borchardt MA, Anderson HA, Patz JA. Drinking water systems, hydrology, and childhood gastrointestinal illness in Central and Northern Wisconsin. *Am J Public Health* 2014;104:639–46.

8. Bush KF, Fossani CL, Li S, Mukherjee B, Gronlund CJ, O'Neill MS. Extreme precipitation and beach closures in the great lakes region: evaluating risk among the elderly. *Int J Environ Res Public Health*. 2014;11:2014–32.
9. Schwartz RM, Sison C, Kerath SM, et al. The impact of Hurricane Sandy on the mental health of New York area residents. *Am J Disaster Med* 2015;10:339–46.
10. Lieberman-Cribbin W, Liu B, Schneider S, Schwartz R, Taioli E. Self-reported and FEMA flood exposure assessment after hurricane sandy: association with mental health outcomes. *PLoS One* 2017;12:e0170965.
11. Physician Surveys on Climate Change and Health. George Mason Center for Climate Change Communication. 2016. Available at: <http://climatehealthconnect.org/wp-content/uploads/2016/09/PhysicianSurveys.pdf>. Accessed December 3, 2018.
12. Hess JJ, Heilpern KL, Davis TE, Frumkin H. Climate change and emergency medicine: impacts and opportunities. *Acad Emerg Med* 2009;16:782–94.
13. Lemery J. Peering through the hourglass. *Emerg Med J Emerg Med J* 2017;34:272–4.
14. Thomas PA, Kern DE, Hughes MT, Chen BY, editors. Curriculum Development for Medical Education: A Six-step Approach, 3rd ed. Baltimore (MD): Johns Hopkins University Press, 2015.
15. Crimmins A, Balbus J, Gamble JL, et al., editors. USGCRP, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Washington, DC. Available at: <https://www.globalchange.gov/health-assessment>. Accessed April 21, 2018.
16. Sheffield PE, Landrigan PJ. Global climate change and children's health: threats and strategies for prevention. *Environ Health Perspect* 2011;119:291.
17. World Health Organization. Quantitative Risk Assessment of the Effects of Climate Change on Selected Causes of Death, 2030s and 2050s. 2014. Available at: [https://apps.who.int/iris/bitstream/handle/10665/134014/9789241507691\\_eng.pdf?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/134014/9789241507691_eng.pdf?sequence=1). Accessed February 12, 2019.
18. Wang Y, Bobb JF, Papi B, et al. Heat stroke admissions during heat waves in 1,916 US counties for the period from 1999 to 2010 and their effect modifiers. *Environ Health* 2016;15:83.
19. Munoz AG, Thomson MC, Stewart-Ibarra AM, et al. Could the recent Zika epidemic have been predicted? *Front Microbiol* 2017;8:1291.
20. Caminade C, Turner J, Metelmann S, et al. Global risk model for vector-borne transmission of Zika virus reveals the role of El Niño 2015. *Proc Natl Acad Sci* 2017;114:119–24.
21. Lee BY, Alfaro-Murillo JA, Parpia AS, et al. The potential economic burden of Zika in the continental United States. *PLoS Negl Trop Dis* 2017;11:e0005531.
22. Knowlton K, Rotkin-Ellman M, Geballe L, Max W, Solomon GM. Six climate change-related events in the United States accounted for about \$14 billion in lost lives and health costs. *Health Affairs* 2011;30:2167–76.
23. Lloyd EA, Oreske N. Climate change attribution: when is it appropriate to accept new methods? *Earth's Future* 2018;6:311–25.
24. White House Archives. FACT SHEET: Obama Administration Announces Actions to Protect Communities from the Health Impacts of Climate Change at White House Summit. June 23, 2015. Available at: <https://obamawhitehouse.archives.gov/the-press-office/2015/06/23/fact-sheet-obama-administration-announces-actions-protect-communities>. Accessed September 12, 2018.
25. Wang H, Horton R. Tackling climate change: the greatest opportunity for global health. *Lancet* 2015;386:1798–9.
26. Peters JL. Mitigating the impact of climate change on human health: the role of the medical community. *AMA J Ethics* 2017;19:1153.
27. Macpherson CC, Wynia M. Should health professionals speak up to reduce the health risks of climate change? *AMA J Ethics* 2017;19:1202–10.
28. Aspen Global Change Institute. Health Impacts from Climate Change: The Importance of Public Health Partnerships. September 2016. Available at: <https://www.agci.org/event/16s2>. Accessed September 12, 2018.
29. University of Colorado, Department of Emergency Medicine, Section of Wilderness & Environmental Medicine website. Available at: <https://www.coloradownm.org/climate-health-science-policy-fellowship/>. Accessed September 12, 2018.
30. Sorensen CJ, Borbor-Cordova MJ, Calvillo-Hynes E, Diaz A, Lemery J, Stewart-Ibarra AM. Climate variability, vulnerability, and natural disasters: a case study of Zika virus in Manabi, Ecuador following the 2016 earthquake. *GeoHealth* 2017;1:298–304.