


Educating Community Health Professionals About the Health-Related Effects of Climate Change Through ECHO Telementoring

Journal of Primary Care & Community Health
Volume 13: 1–8
© The Author(s) 2022
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/21501319221102033
journals.sagepub.com/home/jpc


Joanna G. Katzman¹ , Laura E. Tomedi², David Herring³, Hunter Jones³ ,
Ralph Groves⁴ , Kent Norsworthy², Chamron Martin², Jinyang Liu²,
Briana Kazhe-Dominguez², and Sanjeev Arora⁵

Abstract

Introduction: Climate change is a global public health emergency causing extensive morbidity and mortality worldwide. Although most large medical organizations endorse the need to train health care professionals in climate change, such trainings are not readily available. **Methods:** This article describes the results of an 8-week, 75-min per week, Climate Change and Human Health ECHO (CCHH ECHO) synchronous telementoring course for post-licensure health professionals. The primary goals were: to increase knowledge, self-efficacy, and communication skills. Participants were eligible to receive up to 10h of no-cost continuing education credits and a certificate for completing the program. **Results:** The 8-week course included 625 unique participants from 25 countries. An interprofessional group of clinicians, health professionals, and educators included: 130/28% PhD, 92/20% MD/DO, 52/12% RN/NP/PA, 50/11% MPH. The prospective survey demonstrated a significant improvement in knowledge, confidence, attitudes ($P < .001$) and communication skills ($P = .029$) at 3 months post course. **Conclusions:** The climate crisis is a public health emergency, and health professionals worldwide are considered the most trusted source of health information. Training current and future health professionals regarding the health-related effects of global warming is vital. The CCHH ECHO may be a successful model to facilitate knowledge transfer and promote communication skills between subject matter experts and course participants.

Keywords

primary care, telementoring, public health education, climate change education, community health

Dates received: 18 March 2022; revised: 4 May 2022; accepted: 4 May 2022.

Introduction

Health leaders worldwide recently called for urgent climate action due to significant health-related effects of climate change.¹ Scientists at the National Oceanic and Atmospheric Association (NOAA) have identified July 2021 as the hottest month recorded on Earth.² The health-related effects of climate change are broad, and vary depending on geographic location, with vulnerable and marginalized communities impacted most severely. These climate-related impacts are attributed to: extreme heat and drought, degraded air quality, increased transmission of vector and water-borne illness,

¹University of New Mexico School of Medicine, Albuquerque, NM, USA

²University of New Mexico, Albuquerque, NM, USA

³National Oceanic and Atmospheric Administration (NOAA), Silver Spring, MD, USA

⁴Office of Assistant Secretary for Indian Affairs, Albuquerque, NM, USA

⁵University of New Mexico Health Sciences Center, Albuquerque, NM, USA

Corresponding Author:

Joanna G. Katzman, Department of Neurosurgery, University of New Mexico School of Medicine, 1 University of New Mexico, MSC 07-4245, Albuquerque, NM 87131, USA.

Email: JKatzman@salud.unm.edu



and extreme precipitation.³⁻⁵ There is an imperative for quick action on many fronts: to recognize and respond to climate-driven health threats; to prevent climate change at its source by reducing heat-trapping greenhouse gas emissions; to support “greener” infrastructure systems throughout the economy, including health care; to understand the health co-benefits of adaptation and mitigation; and to communicate effectively about these issues for the sake of safeguarding human health.

Many higher education institutions in the United States (U.S.) and abroad, including those for health professionals, have recognized the need for climate change education. The Global Consortium for Climate Health Education (GCCHE) includes 230 health professional schools worldwide that have pledged to train their students in climate and health.⁶ Additionally, over 20 U.S. health professional societies now support climate action on behalf of health professionals.⁷ Despite the fact that health professionals are considered one of the most trusted sources for health information, there remains a large gap between the recognized need for health workforce climate education and the availability of dedicated curricula and subject-matter experts (SME) to provide that education.⁸⁻¹⁴ For practicing health professionals with a significant knowledge gap of the health effects of climate change, there are even fewer options for professional medical training.¹⁵

Not only is there a lack of climate science courses available for most health professionals, there is also a gap in teaching climate communication skills.^{16,17} In order for health professionals to best serve their patients, they need to learn communication skills regarding the health-related effects of climate change. Short programs in communication skills are generally not taught in most health professional programs and, if so, they are primarily focused on topics such as, “Breaking Bad News.”^{18,19} Programs at both the University of Michigan and the University of Utah have studied the benefits of case-based simulation to increase knowledge and communication skills related to climate change and environmental education.^{20,21} Similarly, Project ECHO (Extension for Community health care Outcomes) has incorporated medical simulation trainings to optimize facilitation skills among physicians and other medical clinicians.^{22,23}

This article describes the results of an 8-week, 75 min per week, Climate Change and Human Health ECHO (CCHH ECHO) telementoring program for health professionals.²⁴ The primary goals of the course were to: (1) increase knowledge, self-efficacy, and communication skills about the health-related effects of climate change for primary care providers and public health professionals working in the community, and (2) promote effective engagement on this topic with patients, students, and community members. The secondary goals were to increase interest in advocacy and policy regarding the health-related effects of climate change.

Methods

Project ECHO Telementoring

This CCHH ECHO course used the University of New Mexico (UNM) Project ECHO telementoring model of virtual and synchronous learning.²⁵ Telementoring specific to Project ECHO refers to the training of learners by subject matter experts using a virtual platform. Learners have ample time to ask questions and receive feedback in real time. ECHO telementoring sessions have proven effective at diffusing knowledge and capacity building by the learners through transferring their knowledge to both their peers and patients.²⁵

Project ECHO was founded in 2003 to increase the capacity of health professionals working in rural and urban underserved areas to provide evidence-based care to their patients.²⁵ In ECHO programs, interdisciplinary teams of specialists (“hub”) connect with community based or local members of a given workforce (“spokes”) to learn from and with each other.²⁶ The ECHO model disseminates current best practices through a combination of short, evidence-based didactics and real, de-identified or simulated case-based learning.²⁷ Many improvements in patient care have been demonstrated using the ECHO model, including increased survival of liver disease, decreased opioid prescribing and increased access to autism diagnosis.²⁸⁻³⁰ Currently, the ECHO model has been used by more than 3.3 million participants, with more than 600 ECHO partners in 48 U.S. states and over 190 countries to address urgent medical and public health challenges for 75 conditions, including COVID-19, opioid use disorder, chronic pain, diabetes, tuberculosis, autism, and first responder resiliency.³¹

Climate Change and Human Health ECHO (CCHH ECHO) Curriculum (Including Standardized Patient Simulations)

The 8-week CCHH ECHO series curriculum was designed to address key knowledge and skill areas in climate and health for clinicians, public health professionals, and educators.⁶ These include the science of climate change, extreme heat, water-borne, vector-borne and food-borne illnesses, degraded air quality, extreme precipitation, the mental health effects of climate change, extreme-weather events and disaster preparedness, and climate communication. This curriculum was endorsed by the Co-Chairs of the U.S. Global Change Research Program’s Interagency Working Group on Climate Change and Human Health (CCHHG).³²

Each weekly session was 75 min, and included 2 short didactic presentations, given by SMEs, followed by a robust question and answer section. An experienced digital librarian, from the ECHO Climate team, entered links to

Table 1. Project ECHO Climate Change and Human Health Program Pilot Curriculum, February to April 2021.

	Topic
Week 1	The Science of Climate Change
Week 2	Connecting Climate and Human Health Outcomes
Week 3	Global Warming, Extreme Heat, and Vulnerable Populations
Week 4	Climate Change, Air Quality, and Respiratory Illness
Week 5	Climate, Heavy Precipitation, and Water and Vector-Borne Diseases
Week 6	Climate Change and Food Security; Climate Change and Mental Health
Week 7	Extreme Weather Events and Disaster Preparedness
Week 8	Climate Change Communication

evidence-based information into the chat box in real time throughout each session.

For 5 of the 8 sessions, there were also live, simulated patient interviews between a clinician and a professional actor/standardized patient. These simulated cases demonstrated the health-related effects of climate change and highlighted how a “climate-lens” focus can improve clinical communication and patient care in the following areas: (1) extreme heat, (2) mental health, (3) degraded air quality, (4) extreme precipitation and water-borne illness, and (5) social/environmental justice issues, such as urban heat islands affecting vulnerable populations. Useful climate-specific tools were also taught to the participants during each case. See Table 1.

CCHH ECHO Series Advertisement/Enrollment

Primary care providers, public health professionals, community health care workers, behavioral health specialists, and other health professionals from the U.S. and globally learned about the CCHH ECHO 8-week telementoring course from Project ECHO emails and other marketing flyers. When participants signed up to attend the course, they were asked about basic demographics (country, gender, race/ethnicity, age, professional degree, scope of practice), and how often they communicate to their patients or community members about climate change and health. The course was free of charge, and participants were eligible to receive up to 10h of no-cost continuing education credits.

Surveys

In order to understand if the course participants met the objectives of the 8-week course (increased climate change knowledge, confidence and communication skills), they were surveyed at 3 different time points: course registration, post-course, and 3 months post-course. The post-course survey

included additional questions about how often participants communicated with their patients or community, how confident they were that the communication was effective, and if they felt climate change was impacting their patients’ health. Additionally, participants were asked to compare their pre- and post-course confidence, knowledge, and attitudes, and also asked about their interest in advocacy. Our inclusion criteria was any person who participated at least once in the ECHO program.

While it would have been ideal to ask all evaluation questions both before and after the course, the authors decided to focus on climate change communication as the main measure to study at all 3 time intervals. In order to avoid survey fatigue and barriers to participation in the program, participants were surveyed only minimally at the time of course registration and more broadly with knowledge and attitudinal questions at the post-course time period.

Confidence was measured with a 4-point Likert scale (1-Not at all confident, 2-Somewhat confident, 3-Moderately confident, 4-Extremely confident). Knowledge and attitudes were measured using a 5-point agreement scale (1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree). Three months after the series ended, the participants received a brief email survey regarding advocacy, communication, and confidence in climate change communication.

The chi-square goodness of fit test was used to assess if the post-course and 3-month post surveys were representative of the full registration population. In order to assess change over time in the primary outcome (likelihood of communicating about climate change and human health to patients/community), responses were linked for those participants who responded to all 3 surveys. Repeated measures mixed model methodology was used to assess significant changes over time and paired *t*-tests were used to assess differences in confidence, perceived knowledge, and attitudes in the post-course survey. Analysis was conducted using Stata/SE 16.1.

This study was reviewed and approved by the UNM Institutional Review Board (#04-341).

Results

A total of 625 participants attended the CCHH ECHO, of which 452 had registration information. Sixty-six participants completed the post-course survey, while 86 completed the 3-month post-survey. Twenty-five participants completed all 3 surveys, of whom 23 participants (with registration information available) answered the communication questions at all 3 time points.

Although the majority of participants were from the U.S., 12.8% of participants resided internationally. Participants represented 45 U.S. states and 25 resided in countries. Nearly 62% of the course participants were

female, over 50% were white and over a third were between the ages of 51 and 65 years. The most common professional degree was a doctorate (29% with PhD and 20% with MD/DO) with participants most frequently stating that they worked in the public health sector (42%). The participants who responded to both the post-course survey and the 3-month post survey were reflective of the general participant population, with 2 exceptions: (1) those who responded to the post-course survey were less likely to work in public health and more likely to work in specialty care medicine, and (2) those who responded to the 3-month survey skewed older than the general participant population. See Table 2.

The 23 participants (with registration information) who completed all 3 surveys, were linked for analysis. These participants were more likely to talk to patients and/or their community members about climate change and health after the program (vs at the time of their registration) and this change was sustained for 3 months after the program.

Participants responding to the post-course survey consistently reported increased confidence and knowledge related to the subject area compared with levels reported before the training. The largest increases were in knowledge of the mental health effects of climate change (2.9-3.7, $P < .001$). The smallest increase was in participants' agreement that actions in their personal and professional life can contribute to effective action on climate change (3.7-4.0, $P = .006$). In addition, the participants significantly increased their confidence with talking to their patients and community members about climate change related to physical and mental health (2.3-3.2, $P < .001$), as well as disaster preparedness (2.2-3.1, $P < .001$). See Table 3.

Discussion

The primary goals of the course were achieved. Participants increased their knowledge, self-efficacy, and communication skills about the health-related effects of climate change. Given the current paucity of both pre- and post-licensure climate change education for both clinicians and public health professionals, this CCHH ECHO course brought valuable information directly to clinicians in the essential topics necessary for them to better serve their patients and community. Increasing knowledge and communication skills related to extreme heat, degraded air quality, disaster preparedness as well as the mental health consequences of climate change, for instance, are just a few of the topics discussed during the 8-week CCHH ECHO series. Climate advocacy, another topic during the course, is generally not taught in health professional schools so this course might be a first exposure for many participants regarding how they can become more involved in their community.

These results suggest that CCHH ECHO telementoring can effectively teach climate change knowledge and skills to health professionals, who are then motivated to disseminate this knowledge to their patients and community members. The success of this climate education program suggests that others may want to provide similar trainings in order to reach large numbers of health professionals.

Limitations

It is important to note that this study took place during the height of the COVID-19 pandemic, and survey participation may have been affected by competing priorities. Because the authors did not ask participants to complete full surveys at time of pre-registration, this may have limited the ability to obtain more complete results at both pre- and post-course time points. Additionally, there was a relatively small percentage (15%, $N = 66$) of participants completing the post-survey. However, a higher percentage of participants (19%, $N = 86$) completed the 3-months post-survey, suggesting that many participants felt engaged with the course, even 3 months later. Moreover, there was a small but significant increase in climate change communication in the participants who completed all 3 surveys.

Future Directions

Due to the success of the pilot CCHH ECHO series, the authors began an ongoing weekly program for all health professionals in July 2021.³³ The weekly curriculum has included sections on the health related effects of: extreme heat, degraded air quality, mental health and eco-anxiety, disaster preparedness, and health care sustainability. Future topics, recommended by participants, will include: environmental justice, planetary health, and indigenous communities.

Future research may include: (1) understanding the impact of the novel simulated cases regarding improved communication skills for clinicians and public health professionals, (2) evaluating the impact of the CCHH ECHO on practice change for primary care providers and public health professionals in the community, and (3) identifying how the CCHH ECHO may improve climate change advocacy and policy among clinicians and public health professionals.

Conclusion

Given the global climate change emergency, the need for an abundance of climate education is essential in order to address the health-related effects of climate change throughout the world. Unfortunately, there still remains a paucity of

Table 2. Climate Change and Human Health ECHO 8Week Session-Attendee Characteristics by Survey Response, February to April 2021.

Characteristic	Registration, ^a N (%)	Post-course survey, N (%)	P value	3-month post, N (%)	P-value
Total	452 (100.0)	66 (100.0)	n/a	86 (100.0)	n/a
Country					
United States	394 (87.2)	57 (86.4)	.567	71 (82.6)	.083
Non-United States	58 (12.8)	9 (13.6)		15 (17.4)	
Gender					
Female	278 (61.5)	47 (71.2)	.697	64 (75.3)	.947
Male	101 (22.3)	18 (27.3)		19 (22.4)	
Non-binary	4 (0.9)	1 (1.5)		1 (1.2)	
Race/Ethnicity ^b					
American Indian/Alaskan Native	22 (4.9)	2 (3.0)	.484	5 (5.8)	.703
Asian or Pacific Islander	30 (6.6)	2 (3.0)	.210	7 (8.1)	.740
African American/Black	22 (4.9)	2 (3.0)	.363	9 (10.5)	.061
Hispanic/Latino/Spanish	63 (13.9)	16 (24.2)	.025	15 (17.4)	.277
White	240 (53.1)	45 (68.2)	.152	49 (57.0)	.701
Other	18 (4.0)	3 (4.6)	.793	6 (7.0)	.857
Age (years)					
20-35*	88 (23.8)	6 (10.0)	.062	7 (10.3)	.023
36-50	91 (24.6)	14 (23.3)		14 (20.6)	
51-65	118 (31.9)	26 (43.3)		26 (38.2)	
66+	73 (19.7)	14 (23.3)		21 (30.9)	
Degree					
PhD	130 (28.8)	7 (10.6)	.485	8 (9.3)	.209
MD/DO	92 (20.4)	18 (27.3)		25 (29.1)	
MPH	50 (11.1)	5 (7.6)		4 (4.7)	
RN/LPN	35 (7.7)	8 (12.1)		20 (23.3)	
LSW/Counselor	17 (3.8)	5 (7.6)		3 (3.5)	
NP/PA	17 (3.8)	4 (6.1)		4 (4.7)	
CHW	15 (3.3)	4 (6.1)		3 (3.5)	
Other ^c	96 (21.2)	15 (22.7)		19 (22.1)	
Area of focus					
Public Health**	179 (42.2)	18 (27.3)	<.001	31 (36.1)	.343
Primary Care Medicine	80 (17.0)	13 (19.7)		20 (23.3)	
Specialty Care Medicine	67 (14.2)	14 (21.2)		12 (14.0)	
Education	45 (10.0)	9 (13.6)		15 (17.4)	
Lost Term Care	11 (2.3)	4 (6.1)		1 (1.2)	
Research	6 (1.3)	5 (7.6)		1 (1.2)	
First Responder	2 (0.4)	0 (0.0)		0 (0.0)	
National Park/Land Management	1 (0.2)	0 (0.0)		0 (0.0)	
Other ^a	60 (12.7)	3 (4.6)		6 (7.0)	

Missing/refused-registration: gender (69), race/ethnicity (57), age (82), focus (1); 3-month: gender (2).

^aPathology, protective services, journalism, peace engineering, administration.

* $P < .05$. ** $P < .001$.

^bRace/ethnicity categories are not mutually exclusive; other includes: "Malagasy," "Too many to name," and "mixed."

^cDoctor of veterinary medicine, doctor of pharmacy, juris doctor, masters other than MPH, bachelors, student, none, etc.

pre- and post-licensure training opportunities for health care professionals. Results from this study suggest that the CCHH ECHO is a successful model to facilitate knowledge transfer between SMEs and course participants on the health impacts of climate change. The ECHO Model is both

replicable and scalable, and may therefore allow others to adapt this training to their region of the globe. Through diffusion of knowledge, participating health professionals can teach their colleagues and patients, who may then go on to educate their social networks.³⁴

Table 3. Climate Change and Human Health ECHO Behaviors, Confidence, Knowledge, and Attitudes by Survey Response, February to April 2021.

How often do you talk to your patients/community members about climate change and their health? N=23	Registration, n (%)	Post-course survey, n (%)	Three-month post, n (%)	P-value
Never	3 (13.0)	2 (8.7)	0 (0.0)	.029
Rarely, I have only had one or two conversations	4 (17.4)	3 (13.0)	4 (17.4)	
Sometimes, I have had some conversations with patients/community members	12 (52.2)	14 (60.9)	15 (65.2)	
Frequently, I almost always have this conversation	4 (17.4)	4 (17.4)	4 (17.4)	

Perceived changes in confidence, knowledge, and attitudes, Post-Course Survey, N=66

Confidence in. . .	Score before	Score after	P-value
Talking to patients/community members about climate change and how it relates to their physical and mental health	2.3	3.2	<.001
Talking to patients/community members about climate-related disaster preparedness	2.2	3.1	<.001

Agreement with. . .	Score before	Score after	P-value
My general knowledge about climate science is very strong	3.2	3.8	<.001
My general knowledge about the impacts of climate change on human health was very strong	3.1	3.9	<.001
My knowledge of heat-related effects (eg, heatstroke, heat exhaustion, cardio-respiratory illness) was very strong	3.3	3.9	<.001
My knowledge of vector borne infection (eg, Lyme, West Nile, Dengue Fever, Malaria) was very strong	2.9	3.6	<.001
My knowledge of diarrhea from food/water and vector-borne illnesses (eg, Salmonella, Giardia, Cryptosporidia) following heavy precipitation was very strong	3.0	3.6	<.001
My knowledge of injuries due to severe storms, floods, droughts, fires was very strong	3.1	3.8	<.001
My knowledge of air pollution related increases in severity of illness (eg, asthma, COPD, pneumonia, cardiovascular disease) was very strong	3.4	3.8	<.001
My knowledge of increased care for allergic sensitization and symptoms of exposure to plants or mold (visits to office/ER for asthma/allergic symptoms) was very strong	2.9	3.6	<.001
My knowledge of the mental health effects of climate change was very strong	2.9	3.7	<.001
My knowledge of the interrelatedness between social determinants of health (poverty, living situation, access to health care) and climate change was very strong	3.3	3.9	<.001

Agreement with. . .	Score before	Score after	P-value
Climate change is directly relevant to patient care	3.3	3.9	<.001
Climate change is a public health emergency	3.6	3.9	<.001
Teaching about climate change and its association with health impacts should be integrated into medical and public health training	3.6	3.9	<.001
Health care professionals should have a significant advocacy role in relation to climate change and health	3.6	4.0	<.001
Health care professionals have a responsibility to bring the health effects of climate change to the attention of their patients	3.5	4.0	<.001
Health care professionals have a responsibility to bring the health effects of climate change to the attention of the public	3.5	4.0	<.001
Health care professionals should have a leadership role in encouraging offices, clinics, hospitals to be as environmentally sustainable as possible.	3.9	4.0	<.001
Professional societies should have a significant advocacy role in relation to climate change and health	3.6	4.0	<.001
The actions I take in my personal and professional life can contribute to effective action on climate change	3.7	4.0	.006
If I talk to patients/community members about climate change, it will make a difference in their health	3.4	3.9	<.001

Acknowledgments

The authors would like to acknowledge John Michael Maury, for his significant contributions to the Climate Change and Human Health ECHO program.

Declaration of Conflicting Interests


The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iDs

Joanna G. Katzman  <https://orcid.org/0000-0003-4115-1393>

Hunter Jones  <https://orcid.org/0000-0003-4588-3911>

Ralph Groves  <https://orcid.org/0000-0002-5367-5939>

References

1. Atwoli L, Baqui AH, Benfield T, et al. Call for emergency action to limit global temperature increases, restore biodiversity, and protect health. *BMJ*. 2021;374:n1734. doi:10.1136/bmj.n1734
2. National Oceanic and Atmospheric Administration. It's official: July was Earth's hottest month on record. Accessed August 13, 2021. <https://www.noaa.gov/news/its-official-july-2021-was-earths-hottest-month-on-record>
3. U.S. Global Change Research Program, Fourth national Climate Assessment. 2018. Accessed November 1, 2021. <https://nca2018.globalchange.gov/>
4. Benevolenza MA, DeRigne L. The impact of climate change and natural disasters on vulnerable populations: a systematic review of literature. *J Hum Behav Soc Environ*. 2019;29(2):266-281. doi:10.1080/10911359.2018.1527739
5. Hess JJ, Malilay JN, Parkinson AJ. Climate change, the importance of place. *Am J Prev Med*. 2008;35(5):468-478. doi:10.1016/j.amepre.2008.08.024
6. Columbia University Mailman School of Public Health. Global consortium on climate and health education, core competencies. 2021. Accessed November 19, 2021. <https://www.publichealth.columbia.edu/research/global-consortium-climate-and-health-education/core-competencies-0>
7. The Medical Society Consortium on Climate & Health. Mission & consensus statement. Accessed November 19, 2021. <https://medsocietiesforclimatehealth.org/about/mission-and-consensus-statement/>
8. Philipsborn RP, Sheffield P, White A, Osta A, Anderson MS, Bernstein A. Climate change and the practice of medicine: essentials for resident education. *Acad Med*. 2021;96(3):355-367. doi:10.1097/ACM.00000000000003719
9. Goshua A, Gomez J, Erny B, et al. Addressing climate change and its effects on human health: a call to action for medical schools. *Acad Med*. 2021;96(3):324-328. doi:10.1097/ACM.00000000000003861
10. Teaching the health impacts of climate change in many American higher education programs. *Emerald Insight*. November 6, 2018. Accessed November 1, 2021. <https://www.emerald.com/insight/content/doi/10.1108/IJSHE-04-2018-0062/full/html>
11. Leffers J, Levy RM, Nicholas PK, Sweeney CF. Mandate for the nursing profession to address climate change through nursing education. *J Nurs Scholarsh*. 2017;49(6):679-687. doi:10.1111/jnu.12331
12. Chen L, Vasudev G, Szeto A, Cheung WY. Trust in doctors and non-doctor sources for health and medical information. *J Clin Oncol*. 2018;36(15_suppl):10086-10086. doi:10.1200/JCO.2018.36.15_suppl.10086
13. Maibach E, Frumkin H, Ahdoot S. Health professionals and the climate crisis: trusted voices, essential roles. *World Med Health Policy*. 2021;13(1):137-145. doi:10.1002/wmh3.421
14. Maxwell J, Blashki G. Teaching about climate change in medical education: an opportunity. *J Public Health Res*. 2016;5(1):673. doi:10.4081/jphr.2016.673
15. Lemery J, Balbus J, Sorensen C, et al. Training clinical and public health leaders in climate and health. *Health Aff*. 2020;39(12):2189-2196. doi:10.1377/hlthaff.2020.01186
16. Nicholas PK, Breakey S, McKinnon S, Eddy EZ, Fanuele J, Starodub R. A climate: a tool for assessment of climate-change-related health consequences in the emergency department. *J Emerg Nurs*. 2021;47(4):532-542.e1. doi:10.1016/j.jen.2020.10.002
17. Macpherson CC, Wynia M. Should health professionals speak up to reduce the health risks of climate change? *AMA J Ethics*. 2017;19(12):1202-1210. doi:10.1001/journalofethics.2017.19.12.msoc1-1712
18. VandeKieft GK. Breaking bad news. *Am Fam Physician*. 2001;64(12):1975-1978.
19. Katzman JG, Katzman JW. Primary care clinicians as COVID-19 vaccine ambassadors. *J Prim Care Community Health*. 2021;12:21501327211007026. doi:10.1177/21501327211007026
20. Hardin R, Bhargava A, Bothner C, et al. Towards a revolution in sustainability education: vision, architecture, and assessment in a case-based approach. *World Dev Perspect*. 2016;1:58-63. doi:10.1016/j.wdp.2016.05.006
21. Rumore D, Schenk T, Susskind L. Role-play simulations for climate change adaptation education and engagement. *Nat Clim Change*. 2016;6:745-750. doi:10.1038/nclimate3084
22. Fowler RC, Katzman JG, Comerci GD, et al. Mock ECHO: a simulation-based medical education method. *Teach Learn Med*. 2018;30(4):423-432. doi:10.1080/10401334.2018.1442719
23. Katzman JG, Galloway K, Olivas C, et al. Expanding health care access through education: dissemination and implementation of the ECHO model. *Mil Med*. 2016;181(3):227-235. doi:10.7205/MILMED-D-15-00044
24. Arora S, Kalishman SG, Thornton KA, et al. Project ECHO: a telementoring network model for continuing professional development. *J Contin Educ Health Prof*. 2017;37(4):239-244. doi:10.1097/CEH.0000000000000172
25. Arora S, Geppert CM, Kalishman S, et al. Academic health center management of chronic diseases through knowledge

- networks: project ECHO. *Acad Med*. 2007;82(2):154-160. doi:10.1097/ACM.0b013e31802d8f68
26. Shelley BM, Katzman JG, Comerici GD Jr, et al. ECHO Pain curriculum: balancing mandated continuing education with the needs of rural health care practitioners. *J Contin Educ Health Prof*. 2017;37(3):190-194. doi:10.1097/CEH.0000000000000165
 27. Cuttriss N, Bouchonville MF, Maahs DM, Walker AF. Tele-rounds and case-based training: project ECHO tele-mentoring model applied to complex diabetes care. *Pediatr Clin North Am*. 2020;67(4):759-772. doi:10.1016/j.pcl.2020.04.017
 28. Katzman JG, Qualls CR, Satterfield WA, et al. Army and Navy ECHO pain telementoring improves clinician opioid prescribing for military patients: an observational cohort study. *J Gen Intern Med*. 2019;34(3):387-395. doi:10.1007/s11606-018-4710-5
 29. Mazurek MO, Curran A, Burnette C, Sohl K. ECHO Autism STAT: accelerating early access to autism diagnosis. *J Autism Dev Disord*. 2019;49(1):127-137. doi:10.1007/s10803-018-3696-5
 30. Su GL, Glass L, Tapper EB, Van T, Waljee AK, Sales AE. Virtual consultations through the veterans administration SCAN-ECHO project improves survival for veterans with liver disease. *Hepatology*. 2018;68(6):2317-2324. doi:10.1002/hep.30074
 31. University of New Mexico, School of Medicine, Project ECHO. ECHO Institute TeleECHO programs. 2021. Accessed November 1, 2021. <https://hsc.unm.edu/echo/partner-portal/programs/>
 32. U.S. Global Change Research Program. Interagency crosscutting group on climate change and human health (CCHHG). Accessed November 1, 2021. <https://www.globalchange.gov/about/iwgs/cchhg>
 33. University of New Mexico, School of Medicine, Project ECHO. Climate change and human health ECHO. Accessed November 1, 2021. <https://hsc.unm.edu/echo/partner-portal/programs/climate-change/>
 34. Simpson D, Marcdante K, Souza KH. The power of peers: faculty development for medical educators of the future. *J Grad Med Educ*. 2019;11(5):509-512. doi:10.4300/JGME-19-00613.1