Implementing and Assessing Climate Change Education in a Pediatrics Residency Curriculum

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ABSTRACT

Background For physicians to effectively combat the growing health crisis that is climate change, they should begin learning during medical training about its health implications. However, there is little data on residents' knowledge of the climate crisis, and even less data regarding the effectiveness and acceptability of climate change education in graduate medical training programs.

Objective To incorporate a new educational session on the health implications of climate change into a residency curriculum and evaluate the acceptability of the session and its effects on residents' knowledge, attitudes, and perceptions of the topic.

Methods In July 2021, a 90-minute, interactive, small-group format educational session on the health implications of climate change was incorporated into the first-year curriculum of a pediatric residency program. From July 2021 through June 2023, resident participants completed pre- and post-session surveys that assessed their knowledge, attitudes, and perceptions regarding health implications of climate change. Likert scale data were analyzed using Wilcoxon signed-rank tests.

Results Of the 109 residents scheduled to participate, 50 (46%) completed both the pre- and post-session surveys. Session participation increased residents' self-reported knowledge of how climate change impacts health and how physicians can act as climate advocates. Ninety-eight percent of all post-session respondents (58 of 59) agreed that they would recommend the session to other residents. With 3 facilitators, the monthly session required $\leq$4 hours of preparation and $\leq$12 hours of direct teaching time per facilitator each academic year.

Conclusions A single educational session improved residents' self-reported knowledge of the health implications of climate change and was well-received by participants.

Introduction

The World Health Organization has stated that climate change "is the single biggest health threat facing humanity."[1] The evolving climate crisis is likely to exacerbate health inequity by disproportionately impacting low-income, disadvantaged, and vulnerable communities and populations.[2-6] In 2019, more than 70 health care organizations joined to declare climate change a public health emergency and to call for urgent action.[7] That same year, the American Medical Association adopted a policy to support climate change instruction across the medical education continuum.[8] It is critical that clinicians understand the health risks associated with climate change and feel prepared to address them within their professional practices.[9-11]

Despite a widespread recognition that medical trainees should learn about the health implications of climate change, the issue has not yet been widely integrated into medical curricula nor mandated by governing bodies of medical education.[10] One international survey of medical students from 2019 to 2020 found that only 15% of medical schools (414 of 2817) were teaching about climate change.[12] A recent study from 2021 revealed that only 13% of surveyed U.S. medical students were exposed to climate change education.[13] At the graduate medical education (GME) level, the data are even more sparse; in one recent survey of 663 pediatric residents, only one-third of respondents indicated that their training program delivered any type of climate-change related education.[14] Some residency and fellowship programs have already started integrating climate content into their curricula.[15,16] However, since there are not yet any climate-related competencies required by the Accreditation Council for Graduate Medical Education, there exists a considerable amount of variation among specialties and individual training programs when it comes to climate-related curricula.

Over the past few years, several frameworks have been published to help GME training programs integrate climate change-related elements into their curricula.[9,17-19] Crowd-sourced repositories, like the Climate Resources for Health Education, can also help medical educators integrate climate change content

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Editor's Note: The online supplementary data contains the surveys used in the study and further data.

where appropriate.[20] Although some residency programs have begun teaching residents about the health impactions of climate change, there have not yet been, to our knowledge, any published studies that evaluate the efficacy or acceptability of such educational initiatives at the GME level. As medical educators develop and implement climate curricula, it will be important for them to know whether similar interventions have been successful.

This study aims to address that knowledge gap by evaluating the impact of an educational session on pediatric residents' knowledge, attitudes, and perceptions of the health implications of climate change.

KEY POINTS

What Is Known
Few climate and health educational interventions have been studied in graduate medical education, including US pediatrics residencies.

What Is New
From 2021 to 2023 a required climate and health educational session was implemented in a pediatrics residency, with improvements in self-reported knowledge and attitudes, high resident acceptability, and little faculty time required.

Bottom Line
Required climate and health educational sessions appear feasible and highly acceptable in pediatric residency programs.

Methods

Intervention

In response to the American Medical Association's call for climate education, program leaders of the pediatrics residency program at Baylor College of Medicine (BCM)/Texas Children's Hospital (TCH) sought to integrate climate-related content into the curriculum. The BCM Pediatrics program trains about 50 residents per class; a majority of training time is spent at TCH, an urban academic teaching hospital with more than 900 beds. In 2020, an associate program director and a resident with prior experience in climate science partnered to create an introductory educational session for postgraduate year (PGY) 1 residents regarding the health implications of climate change. Session contents (available upon request) and pre-session reading materials[21] were constructed and selected, respectively, around 4 learning objectives (FIGURE 1). The virtual session was designed to include didactic portions and interactive, case-based discussions. Although the session was designed and delivered virtually to comply with COVID-19 pandemic-related restrictions, it could easily be adapted to an in-person format.

In July 2021, the session was integrated into the required PGY-1 "Pedi 101" rotation, which includes a broad range of topics, such as health equity, professionalism, health systems, and teaching strategies. The 90-minute, interactive session was delivered virtually each month in a small-group setting of 3 to 7 residents and 1 to 2 facilitators. During the first 2 years, 109 different PGY-1 pediatrics residents were scheduled to participate; several missed the session due to illness. The initial group of facilitators included an academic pediatrician, a chief resident, and a hospital medicine fellow. Prior to implementation, facilitators spent 3 to 4 hours reviewing session materials and meeting to discuss content and salient discussion topics. Each facilitator would lead or co-lead about 7 to 8 sessions throughout the academic year, totaling 10.5 to 12 hours of direct teaching time. During the second year, a new facilitator observed 2 sessions, reviewed all materials, and met with current facilitators prior to leading sessions the following academic year. The session continued being delivered in the Pedi 101 curriculum after data collection concluded in June 2023.

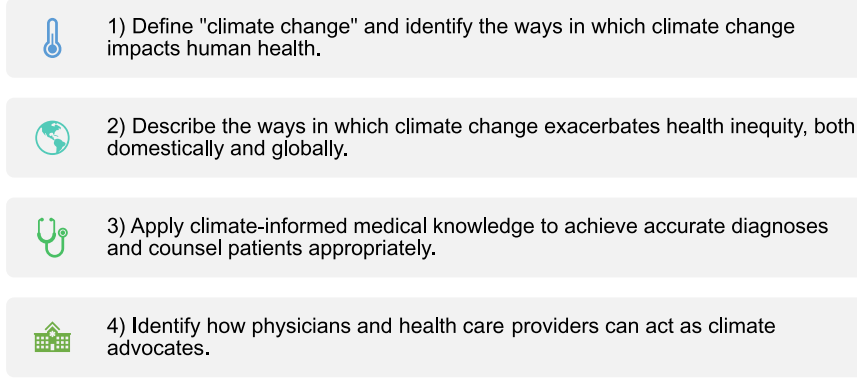

FIGURE 1
Learning Objectives for the Introductory Climate Change and Health Session

Outcomes and Evaluation

During the first 2 years following implementation (July 2021-June 2023), residents were asked to complete pre- and post-session surveys to (1) assess their self-reported knowledge, attitudes, and perceptions of the health implications of climate change, and (2) evaluate whether their knowledge, attitudes, and perceptions were affected by the educational session. The pre-session survey was sent to residents via email 3 to 5 days prior to the session. The post-session survey was sent to participants via email 1 to 2 days after the session, with one reminder email sent 5 to 7 days after the session. Given the absence of prior relevant and validated survey instruments, we developed a 15-item pre-session survey and a 23-item post-session survey with 5-point Likert scale questions and several free-response prompts, to assess the residents' knowledge, attitudes, and perceptions and to collect feedback on the session's acceptability, delivery, and its facilitators. The surveys (provided as online supplementary data) were reviewed by experienced clinician educators but were not previously validated. We hypothesized that session participation would improve participants' self-reported knowledge of the health implications of climate change and the rates at which they believed physicians should act as climate advocates.

During preliminary data analysis, we noted that items 12 and 13 on the pre-session survey might also produce useful post-session data; since these 2 items were added to the post-session survey after data collection had already begun, their data were not included in comparison analyses. Items 15 to 20 and 22 to 23 were added to the post-session survey after completion of the first academic year to solicit formal feedback from participants about the session's acceptability, delivery, and facilitators.

Data Analysis

The Microsoft Forms platform (accessed through BCM) was used for survey creation and data collection. Survey data were analyzed using Wilcoxon signed-rank test, with 2-sided *P* values less than .05 considered statistically significant for all tests. These analyses were performed using SAS statistical software, version 9.2 (SAS Institute Inc). Representative free-response comments were selected based on the specificity and uniqueness of the feedback, to reduce redundancy in reporting.

This study was reviewed and approved by the BCM Institutional Review Board.

Results

Of the 109 residents assigned to participate in the session, 98 (90%) completed the pre-session survey, 59 (54%) completed the post-session survey, and 50 (46%) completed both the pre- and the post-session surveys (TABLE 1). Respondents were primarily female

TABLE 1
Demographics of Survey Respondents

Demographic Element	Completed Pre-Session Survey (n=98), n (%)	Completed Post-Session Survey (n=60), n (%)	Completed Both Surveys (n=50), n (%)
Age (years)			
<30	74 (75.5)	47 (78.3)	38 (76)
≥30-39	24 (24.5)	13 (21.7)	12 (24)
Ethnicity			
American Indian or Alaska Native	0 (0)	0 (0)	0 (0)
Asian, Asian American, Pacific Islander, or Native Hawaiian	21 (21.4)	13 (21.7)	10 (20)
Black or African American	11 (11.2)	6 (10)	6 (12)
Hispanic or Latinx	14 (14.3)	7 (11.7)	5 (10)
Other or Mixed Ethnicity	9 (9.2)	7 (11.7)	7 (14)
White or Caucasian	43 (43.9)	27 (45)	22 (44)
Gender			
Non-binary	0 (0)	0 (0)	0 (0)
Female	67 (68.4)	41 (68.3)	34 (68)
Male	30 (30.6)	18 (30)	15 (30)
Prefer not to say	1 (1)	1 (1.7)	1 (2)

TABLE 2
Comparison of Pre- and Post-Session Survey Responses on Residents' Knowledge, Attitudes, and Perceptions of Climate Change and its Health Impacts

Survey Item	Mean Response (Standard Deviation)		Median Response (Interquartile Range)		*P* value
	Pre	Post	Pre	Post	
1. Climate change is currently impacting the health of individuals and populations. (P)	4.36 (0.72)	4.64 (0.53)	4.5 (4-5)	5 (4-5)	.01
2. Climate change will significantly impact the health of individuals and populations during my career. (P)	4.36 (0.85)	4.68 (0.55)	5 (4-5)	5 (4-5)	.007
3. I understand how climate change exacerbates social injustice and health inequity. (K)	3.80 (0.97)	4.54 (0.50)	4 (3-5)	5 (4-5)	<.001
4. I understand how climate change directly impacts human health. (K)	3.60 (0.93)	4.58 (0.50)	4 (3-4)	5 (4-5)	<.001
5. I understand how human activities (such as burning fossil fuels) contribute to climate change. (K)	3.96 (0.75)	4.54 (0.58)	4 (3-4)	5 (4-5)	<.001
6. Physicians and health care providers should be leaders in the movement to combat climate change. (A)	3.62 (0.95)	4.40 (0.73)	4 (3-4)	5 (4-5)	<.001
7. I am aware of the ways in which physicians and health care providers can be advocates for combating climate change. (K)	2.90 (0.97)	4.40 (0.57)	3 (2-4)	4 (4-5)	<.001

Abbreviations: K, knowledge; A, attitude; P, perception.
Note: Survey item response scale: 1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree. The *P* values compare pre- and post-session median responses.

and aged <30 years; no single ethnic group formed a majority among the respondents.

There were statistically significant increases from pre-session to post-session responses for all 7 directly comparable survey items (TABLE 2). Regarding trainee acceptability, 86% of pre-session respondents (84 of 98) agreed (defined as response of "Agree" or "Strongly Agree") that medical residents would benefit from receiving formal education on how to address climate change within the scopes of their future practices (online supplementary data TABLES 1 and 2). Of all post-session respondents, 56 of 59 (95%) agreed that they felt better prepared to address the climate crisis as a medical professional, while 58 of 59 (98%) agreed that they would recommend the session to other medical residents (online supplementary data TABLE 3). Free-text responses from post-session surveys showed that residents liked the interactive cases. One suggestion for improvement called for resources with specific phrasing to counsel patients and families on climate change (online supplementary data TABLE 4).

Additionally, data compiled from all pre-session respondents revealed that 91% (89 of 98) agreed that climate change is currently impacting human health, yet only 57% (56 of 98) agreed that they understand *how* climate change directly impacts health (FIGURE 2 and online supplementary data TABLE 1). Only 18% (18 of 98) of pre-session respondents agreed that they had received education in medical school about climate change's health implications.

Discussion

There were significant increases in PGY-1 residents' self-reported knowledge, attitudes, and perceptions regarding the health implications of climate change after participation in a virtual, interactive educational session. Of note, the session was created, implemented, and facilitated by a team of trainees, program leaders, and academic faculty—most of whom did not possess extensive prior experience related to climate change. Post-session survey data revealed that residents perceived the climate change session as both acceptable and relevant to their training.

Our survey data, much like those reported by Cogen et al,[14] found that a minority of residents feel comfortable addressing the climate crisis, even though a majority believe that the topic should be included in graduate medical training. These results align with previously published studies, which have shown that both medical trainees and practicing physicians believe in the significance of the climate crisis. Hampshire et al found that 84% of medical students viewed climate change as an important curricular topic, even though a large majority were not receiving such education.[13] Kotcher et al found that 86% of practicing physicians felt responsible for addressing the climate crisis, yet 41% reported lack of knowledge as a barrier to climate action.[22] These survey results, like ours, highlight a conundrum facing medical education: trainees recognize the importance and relevance of climate change to their future practice as physicians, yet not

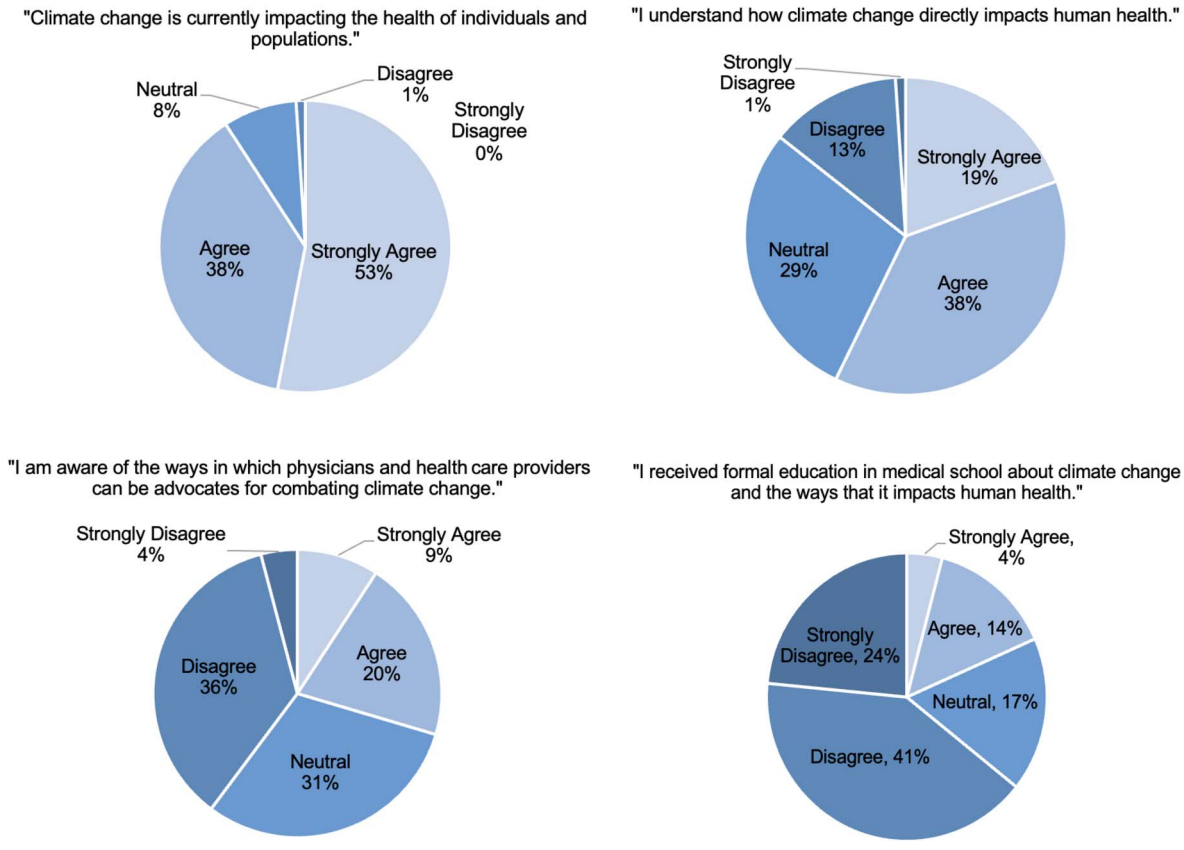

FIGURE 2
Selected Item Responses From the Pre-Session Survey

enough are receiving climate education before entering practice.

Fortunately, training programs are working swiftly to incorporate climate change into their curricula.[15,16] Bevan et al found that more than half of surveyed UK medical school courses were already addressing the climate crisis.[23] As undergraduate medical education (UME) and GME programs embrace climate change and planetary health education, it will be important for these topics to be integrated in a longitudinal fashion throughout the spectrum of medical education. Some GME programs have already partnered with their UME affiliates to develop climate curricula that stretch longitudinally from pre-clinical years through residency training.[18] As more GME training programs implement climate change education in various formats, it will be important to assess the efficacy of those new curricular elements. Although certain elements of this climate session were geared specifically toward pediatric trainees, similar sessions could certainly be tailored to meet the needs of graduate medical trainees in other specialties. Many themes—like the impact of climate change on health equity, for example—are applicable to nearly all medical specialties and can often be woven into existing curricula without carving out separate space for climate-specific sessions.[9]

Our study's results were limited by a small sample size, lack of prior power calculations, and a sizable attrition rate. The generalizability of our results may be limited by the fact that all respondents came from the same pediatric training program within a large, urban, academic institution. Since the survey questions were novel and not pretested, it is possible that some respondents interpreted questions differently than intended. Finally, our surveys provide data on self-reported knowledge, which may not accurately reflect whether trainees are truly internalizing or utilizing the concepts and tools being taught. Since the post-session responses were collected shortly after completion of the session, it is not yet clear whether trainees will change their future clinical practices in response to the intervention.

Future research could investigate whether trainees who have received climate education are adequately retaining knowledge about the health implications of climate change, utilizing this knowledge when speaking with patients, advocating for climate solutions within their communities, and attempting to improve

the environmental sustainability of their own workplaces. Our introductory session might be improved by practicing climate counseling with PGY-1 residents, as suggested in session feedback. Our next step for advancement of the climate curriculum may be to expand climate-related content in a longitudinal fashion. Building upon a foundational knowledge of how climate change impacts health and equity, senior residents could then learn climate advocacy tools and how to use quality improvement to address the problem of health care sustainability.

Conclusions

A single educational session led to significant increases in residents' self-reported knowledge of climate change's health implications and their understanding of how to engage in climate advocacy. A small team of educators and trainees can partner to implement a curricular session on climate change, even if they do not possess prior expertise or formal training related to climate change education.

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