

Project Report

Healthcare Sustainability: Educating Clinicians through Telementoring

Neil F. Katzman ¹, Navin Pandey ², Kent Norsworthy ², John-Michael Maury ³, Sabrina Lord ⁴
and Laura E. Tomedi ^{2,*}

¹ Department of Integrative Biology, Harvard University, 16 Divinity Ave., Cambridge, MA 02128, USA; nkatzman@college.harvard.edu

² Project ECHO, University of New Mexico Health Sciences Center, 1650 University Avenue, Albuquerque, NM 87131, USA; napandey@salud.unm.edu (N.P.); knorsworthy@salud.unm.edu (K.N.)

³ Professional Development Center, School of Medicine, University of California San Diego Center, 9500 Gilman Drive, La Jolla, CA 92093, USA; jmichaelmaury@gmail.com

⁴ Second Nature Solutions, 516 12th Street NW, Albuquerque, NM 87102, USA; skllsoln@gmail.com

* Correspondence: ltomedi@salud.unm.edu

Abstract: Climate change is the most serious planetary emergency of our time. Carbon emissions secondary to the healthcare industry account for about ten percent of all emissions in the United States. Health professionals, including all clinicians, public health professionals, community health workers, first responders and hospital administrators, therefore, need to understand how they can make a difference in their profession, by understanding the health-related impacts of climate change and the importance of healthcare sustainability. An 8-week telementoring Climate Change Healthcare Sustainability ECHO series was developed to educate healthcare professionals in these topics, such as the health-related effects of climate change, healthcare sustainability, quality healthcare and carbon accounting. A total of 376 participants from throughout the US and 16 other countries completed this 8-week, 1 h per week virtual series and received no-cost continuing medical education credits. The evaluation consisted of pre- and post-Zoom polls, weekly post-session surveys and the registration demographics. Participants were primarily physicians and public health professionals. Participants who elected to complete the post-session survey stated that they increased their knowledge and communication skills regarding talking to patients and colleagues about sustainability. Future training will include additional quantitative and qualitative surveys to measure improvements in knowledge and behavior over time. This may include focus groups as well as surveys after 3 and 6 months.

Keywords: climate change; healthcare sustainability; carbon emissions; planetary health; telementoring; decarbonization



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1. Introduction

Most credible scientists around the globe consider climate change to be the planet's greatest threat [1]. Last year was the 30th anniversary of the signing of the United Nations Framework [2]. The United Nations Framework Convention on Climate Change (UNFCCC) is a 198-country consortium that ratified an agreement on 21 March 1994, with the objective to stabilize greenhouse gas concentrations “at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system” [2,3]. Since this time, there have been several amendments to the initial accord; however, the industrialized countries, named Annex 1 countries, are expected to decarbonize significantly more since they emit more carbon [2]. The Fifth National Climate Assessment for the United States, released on 13 November 2023, is a major climate change report for health threats, responses, and strategies [4]. The report identified that US carbon emissions declined 12 percent between

2005 and 2019. Alternative energy sources, such as zero- and low-carbon fuels, have been increasing [4].

Last year was also a year of extreme weather events throughout the world—with extreme heat, wildfires, hurricanes, droughts, and floods on every continent [3,5,6]. In the last 5 years, the US has experienced numerous “billion-dollar” weather-related weather events, causing morbidity and mortality. From 2018 to 2022, there were an average of 350 deaths per year, costing the US federal government USD 124 billion [7]. Extreme weather events increase the energy cost to healthcare systems whenever and wherever these regional disasters take place across the globe [8]. For instance, as extreme heat worsens in future years and decades, there will be a need for the physical infrastructure of hospital systems to use more energy to keep up with increased cooling demands [8]. Preparing local communities for disaster risk management and resilient communities is another vital task [9].

Extreme heat and air pollution alone cost millions of lives each year, while extreme weather events continue to increase in frequency and severity [10–12]. The last eight years represent the hottest years on record since the pre-industrial revolution [13]. According to the World Health Organization (WHO), the number of people exposed to heat waves throughout the globe between 2000 and 2016 increased by 125 million [14]. Similar to extreme weather events, extreme heat also affects the health of the population and the healthcare system. One study in Nicaragua showed how simple pre-hospital interventions of water, shade structures and rest could prevent heat exhaustion, kidney disease and hospital visits [15].

The healthcare sector is one of the most significant contributors to carbon emissions throughout the world today. In the United States specifically, approximately ten percent of total carbon emissions are a byproduct of the healthcare industry [16]. Eckelman and Sherman describe the specific types of services that contribute to the ten percent carbon emissions in the United States. In one study, these included the following: hospital care (36%), physician and clinical services (12%) and prescription drugs (10%), not including releases of waste anesthetic gases [16]. In another study, they estimated the disease burden from these significant carbon emissions [17].

Education in healthcare sustainability, therefore, is critically important for health professionals given this planetary health crisis. The leading global professional organizations for physicians, nursing and public health have declared the climate crisis to be a public health emergency [18]. Additionally, most medical societies have recommended, or even mandated, the development of curricula to train their learners [19].

Project Extension for Community Healthcare Outcomes (ECHO), a global telementoring initiative, developed an eight-week Healthcare Sustainability ECHO series with the goal of increasing health professionals’ knowledge, self-efficacy and communication skills to teach their patients and community members the importance of decarbonization.

2. Research Strategy

2.1. Materials and Methods

2.1.1. The ECHO Model

Project ECHO began in 2003 to provide just-in-time knowledge to rural health professionals. This model was proven to increase the capacity of health professionals working to provide better care to their patients and communities where they live [11]. Project ECHO is a synchronous telementoring learning program that freely shares up-to-date best practice information, using case-based learning with the goal of improving lives around the world [12]. “Project ECHO believes that the right knowledge at the right time can save millions of lives. Additionally, the benefits of knowledge are a social good that should be freely available to anyone” [12]. This year, the ECHO model was used over four million times in 48 U.S. states and in over 195 countries to address urgent public health challenges, such as substance use disorder, chronic pain, diabetes, climate change and autism [12,13]. The four guiding principles of Project ECHO include (1) disseminating evidence-based in-

formation through the sharing of information to reduce disparities, (2) case-based learning to master complexities, (3) tele-technology to leverage scarce resources and evaluation of outcomes to increase impact [12].

In addition, the ECHO model has proven methodologies in terms of healthcare outcomes. In 2011, a very large prospective cohort study at the University of New Mexico was performed to evaluate the effectiveness of hepatitis C treatment at the university using the ECHO model, as compared to treatment as usual. The results demonstrated that using the ECHO model and training rural providers were superior to patients waiting to be treated in the outpatient clinic [20]. This study has been replicated by other universities, and other ECHO conditions using the ECHO model have also proven beneficial [21,22].

2.1.2. Climate Change and Human Health ECHO

The Climate Change and Human Health ECHO began in January 2021 to educate health professionals throughout the US and internationally. The original 8-week series was endorsed by the US Global Change Research Program’s Interagency Crosscutting Group on Climate Change on Human Health. Member organizations included the US Centers for Disease Control and Prevention (CDC), the National Oceanic and Atmospheric Administration (NOAA) and the US Health and Human Services (HHS) [23]. This initial series included 625 unique participants from 45 US states and 25 other countries [24]. The curricular topics included the science of climate change, the health-related effects of climate change, extreme heat and degraded air quality, water- and vector-borne illness, environmental injustice and health inequity, healthcare sustainability and climate communication. By February 2022, the Climate Change and Human Health ECHO created many more series to educate healthcare and public health professionals, realizing that there is very little no-cost post-licensure education available. Topics included the following: climate change and mental health, emergency preparedness, extreme heat, climate change tools for healthcare providers, and simulated climate cases. These series were evaluated with weekly Zoom Polls to understand both knowledge and confidence gained pre- and post-series. On average, 91% of the participants, who were primarily nurses and physicians, rated their understanding and self-efficacy as excellent or very good regarding the above [25].

2.1.3. Healthcare Sustainability Series

The Healthcare Sustainability ECHO series began in February 2022. Due to the previously successful Climate Change and Human Health ECHO series, the Climate ECHO team realized that Sustainability ECHO could be successful as well. This series consisted of weekly one-hour live virtual telementoring sessions conducted over eight weeks. The only exception was the final (eighth) session, which was 90 min long (see Table 1) [26].

Table 1. Climate Change ECHO: Healthcare Sustainability series curriculum.

Program Focus by Date	
Date	Title
1-Feb	Health-Related Effects of the Climate Crisis
8-Feb	Healthcare Decarbonization: How Health Professionals Can Affect Change at the Workplace
22-Feb	Healthcare Sustainability and Quality Clinical Care
1-Mar	The Road to Zero: Climate Goals, Measures, Reporting
8-Mar	Climate Change Communication: How Health Professionals Can Affect Change at their Work Place—with live simulated case
15-Mar	Climate Change, Community Health, and Health Equity
22-Mar	Panel: Clinicians as Advocates for Climate Action and Policy Change (90 min)

The weekly sessions were open to all health professionals, including physicians, nurses, public health professionals and community health workers. Six of the eight sessions consisted of two brief (15–25 min) evidence-based didactic lectures, including moderated question-and-answer sessions. One of the sessions included a simulated case. The last

session was a 90 min panel discussion including presentations by health professionals who participate in a variety of climate-related non-profit organizations. Project ECHO's dedicated librarian entered evidence-based journal articles and other pertinent resources into the online platform chat box that the subject matter experts discussed during the session presentations. Course presentation slides, video recordings and digital librarian resources were also made available each week to the participants on the Project ECHO CCHH webpage. A total of 8 1/2 h no-cost continuing education units (CEUs) were offered to each participant, and CEUs could be collected at individual sessions. Course participants also received a certificate of completion if they attended at least seventy-five percent of the sessions (six out of eight) in the series.

2.1.4. Attendance and Registration

Participants registered prior to the program via an online survey (Zoom) and provided demographic information (gender, age, race/ethnicity, location and scope of practice). Attendance data were tracked using reports generated by the Zoom platform. Unique attendees were defined as people who attended at least once and for at least 10 min. Registration and attendance data were linked together using name and email.

2.1.5. Zoom Poll

Zoom polling was used at the first and last session to measure the participants' immediate pre- and post-responses to their self-efficacy and knowledge. The two questions were as follows:

1. "Please choose your level of agreement with the following statement: I understand ways to reduce greenhouse gas emissions in the healthcare sector".
2. "Please choose your level of confidence for the following statement: I am confident that I can take effective action(s) that support reducing greenhouse gas emissions in my workplace".

Response options ranged from strongly agree to strongly disagree for level of understanding, and completely confident to not confident for level of self-efficacy. Each of the Zoom Polls (Session 1 and Session 8) were evaluated individually and then linked. The authors used a non-parametric test—specifically, a Wilcoxon signed ranked test to determine the significance of the data.

2.1.6. Post-Session Evaluation

During the last 10 min of each session, participants were invited to complete a post-session evaluation survey, which was linked to their acquisition of CEUs. The evaluation questions included whether the objectives of the course were met, whether the content was evidence-based and if participants were able to ask questions to the course facilitators during the session. Additionally, participants were asked if they are likely to use the knowledge they obtained and if they felt they were better able to communicate after the training. The options for responding to these evaluation questions ranged from strongly agree to strongly disagree. Lastly, participants were asked what changes they might consider making to their practice after the training. These responses were grouped into broad categories (e.g., improve my health education techniques, increase my climate change education to my patients, etc.). The eight most common response categories are reported.

2.1.7. Curriculum Development and Case Simulation

The 8-week healthcare sustainability evidence-based curriculum was developed by the course speakers. The course creators initially proceeded with an extensive-needs assessment. The Climate ECHO (the umbrella for the Sustainability series) had been meeting weekly for 3 years. Additionally, the participants routinely gave the ECHO staff and hub team many suggestions regarding their desire to have a sustainability course. The speakers on this Sustainability course are all key stakeholders and subject matter experts in sustainability as well. These items were all incorporated during curriculum development.

Each didactic involved learning at least three objectives, which were required in order for CME/CEU to be offered.

The content was developed as an introductory course for health professionals to teach the following: the science of climate change, the most important health-related effects of climate change (including extreme heat and air pollution) and the basic elements of decarbonization (including carbon counting and how health professionals can affect change in their workplace).

The case simulation, which occurred during the sixth week of the Climate Change ECHO: Healthcare Sustainability series, was developed to demonstrate the importance of communication aspects in the hospital setting. The scenario involved a first-year medical resident who disagreed with the hospital's decision to transition from paper back to cloth patient gowns. The scene began with the medical resident speaking with the hospital's Head of Sustainability. The Lead Sustainability Officer stated the best-practices evidence that cloth gowns are just as sanitary as paper and much safer for the environment. The resident remained skeptical, however, and requested to speak with the physician leading the Division of Infection Protection Control (IPC). The IPC doctor corroborated the Sustainability Officer's information and added additional data, illustrating both the safety and economic benefits of cloth gowns. By the end of the conversation, the resident felt satisfied and embraced the decision.

This live case simulation was led and developed by professional actor and simulated patient educator (John—Michael Maury), who also portrayed the role of the medical resident during the simulation. The other two roles were portrayed by Healthcare Sustainability ECHO facilitators.

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

3. Results

3.1. Demographics and Attendance

During the eight-week Climate Change ECHO: Healthcare Sustainability series, there were a total of 376 unique participants, with most attending many sessions. There were 986 non-unique attendances for this program. Many of the Zoom registration items were elective, including gender, race/ethnicity and geographic location. Hence, 36–58 percent of the participants elected not to fill out this information. However, the Zoom registration data that were collected reveal that 30 percent of the participants were female, 12 percent were male and 1 percent were gender non-conforming. Nearly half of the participants who reported their scope of work identified themselves as physicians (16%), public health professionals (10%), nurses (7%) or educators (4%). Lastly, there were over 200 participants from throughout the US and over 38 international participants from over 16 countries (see Table 2).

Table 2. Demographics of Climate Change ECHO: Healthcare Sustainability series.

Demographics	# of Responses	Percentage	
Gender	Missing	212	56.38%
	Female	114	30.32%
	Male	45	11.97%
	Non-conforming	3	0.80%
	Prefer not to answer	2	0.53%
Geography	United States	200	53.19%
	Missing	138	36.70%
	Canada	16	4.26%
	Saint Kitts and Nevis	5	1.33%
	Brazil	2	0.53%
	Colombia	2	0.53%

Table 2. Cont.

Demographics	# of Responses	Percentage
India	2	0.53%
Austria	1	0.27%
Belize	1	0.27%
Côte d'Ivoire	1	0.27%
Germany	1	0.27%
Liberia	1	0.27%
Madagascar	1	0.27%
Mali	1	0.27%
Saint Lucia	1	0.27%
Sudan	1	0.27%
Trinidad and Tobago	1	0.27%
Virgin Islands (British)	1	0.27%
Job Scope		
Missing	138	36.70%
Other (please describe below)	77	20.48%
Clinician-Doctor	59	15.69%
Public-Health Practitioner	39	10.37%
Clinician-Nurse	26	6.91%
Educator	16	4.26%

3.2. Certificate of Completion

The Climate Change ECHO: Healthcare Sustainability series course offered a certificate for participants who completed at least 75% (six out of eight sessions) of the course. Approximately 11% (42 of the 376 unique attendees) completed at least six of the Healthcare Sustainability ECHO sessions. Within one week of course completion, each of these participants was sent a Certificate of Completion.

3.3. Post-Session Evaluation

On average, 40 participants completed the post-session evaluation survey each week. These post-session surveys are combined, and we do not have individual surveys to evaluate. Overall, however, participants stated that the course improved their knowledge by 93 percent, their skills by 25 percent and their performance at work by 16 percent. When participants rated their knowledge of each topic before, versus after, they attended the session, their knowledge increased, on average, from 9% to 32% in terms of understanding very well or significantly. When asked what they will use what they learned in the sessions, 70% of the participants responded with a very good (4) or excellent (5) score on a Likert scale (1–5). Eighty-five percent of participants reported that they intended to both apply the knowledge they acquired and that they were better able to communicate with other interprofessional team members (see Table 3).

3.4. Zoom Polls

As mentioned in the Materials and Methods section, two Zoom Poll questions were delivered to the participants during Session 1 and Session 8 (the first and last sessions). During Session 1, a total of 107 participants answered the Zoom Polls, while 69 answered them in Session 8. Thirty-one participants answered both sessions' polls.

When asked "Please choose your level of agreement with the following statement: I understand ways to reduce greenhouse gas emissions in the healthcare sector", a significant ($p = 0.013$) number of participants increased their knowledge at the end of the eight-week course compared to the beginning (see Table 4). When asked "Please choose your level of confidence for the following statement: I am confident that I can take effective action(s) that support reducing greenhouse gas emissions in my workplace", there was no significant change in self-efficacy ($p = 0.829$) (see Table 5).

Table 3. Post-session survey results of Climate Change ECHO: Healthcare Sustainability series.

	1	2	3	4	5	N/A
Rate your knowledge of the session topic before the session.	8%	50%	33%	7%	2%	
Rate your knowledge of the session topic after the session.	0%	12%	56%	27%	5%	
Will you use what you learned in this session in your work?	0%	1%	22%	28%	42%	7%
I intend to apply the knowledge and/or skills I have acquired from this activity to my work when in a team environment.	1%	1%	14%	53%	32%	
I am better able to communicate/collaborate with other members of multidisciplinary teams.	1%	0%	14%	57%	28%	
I am better able to discuss how teamwork can contribute to continuous and reliable patient care.	1%	2%	24%	49%	24%	
This session has increased, improved, or positively impacted my: (Select all that apply)						
Knowledge						93%
Skills						25%
Performance						16%
Patient Outcomes						8%
No Change						3%
What factors will keep you from using the content of this session in your work? (Select all that apply)						
No opportunities to apply in my work						14%
Need more training						30%
Lack of time						25%
Lack of resources						29%
Other (describe below)						13%
There are no barriers to using what I learned						26%

Table 4. Zoom Poll Results of Climate Change ECHO: Healthcare Sustainability series: “I understand ways to reduce greenhouse gas emissions in the healthcare sector”—and post-responses to the question: “Please choose your level of agreement with the following statement: I understand ways to reduce greenhouse gas emissions in the healthcare sector” for the participants who answered both surveys in Climate Change and Human Health ECHO, 1 February 2023 (pre-zoom) and 22 March 2023 (post-zoom).

	Pre-Zoom N = 31 n (%)	Post-Zoom N = 31 n (%)
Strongly agree	4 (12.9%)	6 (19.3%)
Agree	15 (48.4%)	21 (67.8)
Neither agree nor disagree	7 (22.6%)	4 (12.9%)
Disagree	5 (16.1%)	0 (0.0%)
Strongly disagree	0 (0.0%)	0 (0.0%)

p-value from Wilcoxon signed rank test = 0.01251 (significant).

Zoom Poll analysis of the pre-Zoom and post-Zoom responses for the Climate Change and Human Health ECHO was conducted on 1 February 2023 (pre-Zoom) and 22 March 2023 (post-Zoom).

Table 5. Zoom Poll results of Climate Change ECHO: Healthcare Sustainability series: “Please choose your level of confidence for the following statement: I am confident that I can take effective action(s) that support reducing greenhouse gas emissions in my workplace”. Pre- and post-responses to the question: “Please choose your level of confidence for the following statement: I am confident that I can take effective action(s) that support reducing greenhouse gas emissions in my workplace.” for the participants who answered both surveys in Climate Change and Human Health ECHO, 1 February 2023 (pre-zoom) and 22 March 2023 (post-zoom).

	Pre-Zoom N = 31 n (%)	Post-Zoom N = 31 n (%)
Completely confident	2 (6.5%)	3 (9.7%)
Fairly confident	12 (38.7%)	10 (32.3%)
Slightly confident	5 (16.1%)	5 (16.1)
Somewhat confident	9 (29.0)	12 (38.7%)
Not at all confident	3 (9.7%)	1 (3.2%)

p-value from Wilcoxon signed rank test = 0.8287 (Not significant).

4. Discussion

The eight-week Climate Change ECHO: Healthcare Sustainability series program was the first no-cost introductory virtual program to train 376 interprofessional clinicians, public health professionals and educators from throughout the US and 16 other countries. Because the US emits approximately 10 percent of its carbon emissions in the healthcare industry, the authors believe that health professionals and health systems could take an active leadership role in mitigating this significant burden on the environment.

Given the large enrollment number in this introductory course, there seems to be a high level of interest in healthcare sustainability. As the US continues to develop more incentives and standards for hospitals and health systems, the authors are hopeful that the interest in learning even more about sustainable healthcare will become relevant. For instance, in April 2023, the US Health Sector Climate Pledge was announced, tasking the major health systems with reducing their carbon emissions by fifty percent by 2030. To date, many of the United States’ largest hospital systems have signed this pledge [27]. Additionally, at this year’s Council of the Parties (COP) 28, in Dubai, there will be a first-ever “health-day”, during which, strengthening the resilience of health systems and reducing carbon emissions will be major themes [28].

The introductory Climate Change ECHO: Healthcare Sustainability series participants were able to receive no-cost continuing education credits, and many participants obtained a Certificate of Participation (if they attended at least six sessions). The weekly ECHO sessions provided mitigation strategies, teaching health professionals about many aspects of reducing carbon emissions. For instance, presentations included why it is important for health professionals not to use certain anesthetics and inhalers, given rationale and supplying the communication strategy needed for clinicians to have with their hospital administrators and with their patients. Another example was showcasing a simulated case to demonstrate the importance of reusable gowns to protect the environment from healthcare waste.

The Zoom Poll results demonstrated that participants increased knowledge based on the pre–post Zoom Poll questions; however, a significant change in self-efficacy was not found. Although the Zoom Polls for self-efficacy were not significant, the post-session surveys did suggest that the participants found this program to be very beneficial in terms of communication skills. Eighty-five percent of participants (57% rated 4/5, and 28% rated 5/5) stated that they are better able to communicate/collaborate with members of multidisciplinary teams (see Table 3).

In addition, most participants improved knowledge, skills and performance based on the post-session surveys. These surveys suggested that the vast majority of participants

increased their knowledge, while many increased their skills and performance. Most participants also stated that they would use what they learned from the training.

The overarching benefit of a program such as the Climate Change ECHO: Healthcare Sustainability series is that it takes very little time away from a health professionals' work day, costs nothing for the clinician, continuing education credits are provided and the information is available on the internet for the participant to retrieve anytime. He/she can obtain the PowerPoint, the recording and even all of the up-to-date references.

Another benefit, not spoken about very often, is the community of practice that frequently develops during the weekly ECHO sessions. Participants, many who live in rural and underserved communities, get to know one another and may develop a growing professional and social network [29–31].

4.1. Limitations

Project ECHO is a voluntary program, which always has no cost to the participant, and there are never incentives to participate in the evaluations. To this end, it is strictly voluntary for participants to complete the post-session surveys and Zoom Polls. Hence, the reduced percentage of respondents reflects the voluntary nature of these ECHO activities.

In terms of research design, given that this is an ongoing program for health professionals, it is very difficult to create a robust research design unless the program has high-level grant support, and the main goal of the program is research instead of program evaluation. In this case, this is a program evaluation as part of an ongoing weekly ECHO series to allow for the maximum number of health professionals to learn about the importance of healthcare sustainability.

Similarly, the authors believe that some of the evaluation outcomes may have been difficult to interpret given the missing data. If the goal of the program is strictly research, then the Zoom registration items could have all been made mandatory. Currently, the Zoom registration only requires a few elements; therefore, many participants choose not to answer to questions in order to participate in the ECHO session.

4.2. Future Directions

This Healthcare Sustainability ECHO series was an introductory telementoring course for health professionals, providing a free, no-cost continuing education series. This was also the first Project ECHO Sustainability program. Given the success of this introductory series, the future directions of the Healthcare Sustainability ECHO series may include: (1) repeating the initial series, (2) deepening the knowledge of the series for the healthcare professionals in a second series "2.0", (3) creating additional simulation cases to allow participants to master the complexities of the healthcare environment and (4) to consider other evaluation strategies to examine if the participants are benefitting from the ECHO training. Future evaluations may include asking participants in 3 and/or 6 months after the training if they maintained their knowledge and confidence in the skills they have learned. This future training should include both quantitative and qualitative methods. If the authors are able to find a large grant, then improved registration methods would also be deployed.

5. Conclusions

The Climate Change ECHO: Healthcare Sustainability series was a successful no-cost eight-week telementoring course for a diverse group of 376 health professionals. The outcomes suggest that the participants improved their knowledge and communication skills. It is possible that further training may improve participants' self-efficacy and skills in greater depth. As the climate crisis continues, so does the need for additional training opportunities for health professionals.

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