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Climate Change and Public Health:  
The Perceptions and Roles of Healthcare Providers

A Thesis submitted in partial satisfaction of the requirements  
for the degree  
Master  
of  
Public Health with Specialization in Human Centered Design

by

Anna Hulseman

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2023

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University of California San Diego

2023

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ABSTRACT OF THE THESIS

Climate Change and Public Health:  
The Perceptions and Roles of Healthcare Providers

by

Anna Hulseman

Master of Public Health with Specialization in Human Centered Design

University of California San Diego, 2023

Professor Wael Al-Delaimy, Chair

## Background

Climate change poses a significant threat to public health. The purpose of this research was to learn how healthcare providers perceive the relationship between climate change and health, and their role in mitigating this impact.

## Methods

The CHANT Survey was modified in Qualtrics and distributed to healthcare providers in the UC San Diego Health System via email distribution lists. Convenience sampling was used, resulting in 191 participants. R studio was used for statistical analysis. Linear regression models were used to compare the primary variables of interest: familiarity, motivation, optimism, action, and communication. The models were adjusted for gender and job role.

## Results

A clear 87% (n=164) of providers from the sample were concerned about the impact of climate change on health, but 38% (n=71) were not familiar with the impact that health systems have on the environment. Most providers in the sample (62%) stated that they wanted to change their practices to reduce greenhouse gas contributions. There were significant relationships between familiarity, concern, motivation, and communication ( $p < 0.05$ ), but these were not significant when adjusted for job role. About 80% of respondents were pessimistic that humans will prepare for the impacts of climate change and prevent further climate change.

## Conclusion

Healthcare providers are motivated to improve the sustainability of their workplaces but need more education about climate change and health, and the impacts of healthcare on carbon emissions and global warming. Providers can use their position in the community to educate patients about the health impacts of climate change and advocate for sustainable policies.

## CHAPTER 1

### I. Introduction

Climate change poses an indisputable threat to human health.<sup>1</sup> Changes in the environment due to climate change have been associated with acute injury and illness, chronic diseases, respiratory conditions, cardiovascular diseases, allergies, and mental health challenges.<sup>2</sup> Additionally, climate disasters can lead to destabilized housing, destruction, and displacement of communities, and jeopardize food and water sources.<sup>3</sup>

The impacts of climate change have a disproportionate impact on vulnerable populations across the world. People who are living in poverty, the elderly, indigenous communities, pregnant women and children, and people with preexisting medical conditions, are among the most vulnerable to succumb to consequences attributable to climate change.<sup>2</sup> Additionally, communities that contribute the least to global emissions inevitably bear a greater burden of the implications of climate change compared to communities and countries who contribute the most to global emissions.<sup>4</sup>

Greenhouse gas emissions (GHGE), such as carbon dioxide, methane, and nitrous oxide, have led to global warming by trapping heat on the planet when these gases are emitted into the atmosphere.<sup>3</sup> As the planet warms more frequent extreme weather events have led to climate change overtime.<sup>3,5</sup> The United States is disproportionately responsible for climate change by contributing about 12% of global carbon emissions as of 2019<sup>6</sup> despite accounting for approximately 4.2% of the global population.<sup>7</sup> About 8.5% of carbon emissions in the United States can be attributed to the healthcare sector, and the emissions from US health systems are responsible for about 25% of global emissions from health sectors.<sup>8</sup> Within these systems, energy use, facility emissions, manufacturing and materials, agriculture, and transportation

contribute the most to the large footprint of the healthcare industry.<sup>9</sup> While a significant amount of emissions from health systems are attributable to systemic factors, decisions that are made on the individual and local level can have a large impact.<sup>10</sup> Due to the paradoxical relationship between climate change and health, healthcare professionals are uniquely situated in their ability to address these risks and mitigate the carbon footprint of health systems.

To understand the existing literature and research on this topic, a literature review of PubMed and Embase was conducted. Publications that were more than 10 years old (prior to 2013) were excluded from the search. The literature review from PubMed resulted in a total of 199 articles, 31 of which were included in the final review. The search in Embase resulted in 11 articles, 4 of which were included in the final search. Articles were excluded from the review if they were not relevant to the topic, as evidenced by their titles and abstracts, or if the article was not available through institutional access.

#### Search Strategy:

1. PubMed: “Climate Change”[MESH] OR “climate change” OR global warming  
AND “Attitude of Health Personnel”[MESH] OR survey\* OR questionnaire\*  
AND “Physician’s Role”[MESH] OR physician\* OR nurse\* OR doctor\* OR clinician\*
2. Embase: ‘climate change’/exp OR ‘climate change’ OR global warming  
AND ‘health personnel attitude’/exp OR survey\* OR questionnaire\*  
AND Role AND (physician\* OR nurse\* OR doctor\* OR clinician\*)

Table 1 shows the studies that were included in this review. The results from this literature review show that there is consensus that health professionals are in a unique position to mitigate the impact of climate change on the health of the public through their role as leaders in the community, their ability to educate patients, their ability to invoke change within health

institutions and improve sustainability practices, and their power to influence policies on a broader level. There is a growing body of literature that demonstrates the need for climate education in nursing and medical school curriculum. Some experimental studies have tested the effectiveness of implementing sustainability curriculum within medical training programs. For example, a quasi-experimental, cross-sectional study by Moustafa Saleh et al. compared the effectiveness of an educational intervention among nursing students, and whether nurses would apply their knowledge from the intervention into their healthcare practices.<sup>11</sup> The study showed that there was an increase in the knowledge that the students had about sustainability and climate change, and that this kind of education can support nurses to change their health practices, however barriers such as confidence exist for people to change their policies.<sup>12</sup> Additionally, multiple studies have shown that healthcare professionals are generally knowledgeable about climate change and some of its implications, they are interested in learning more about climate change and health and would welcome the inclusion of this material into their school curriculums.<sup>12,13</sup>

Some surveys have been conducted to assess the attitudes and perceptions of health professionals towards climate change. A cross-sectional survey by Ryan et al. at Yale University was conducted to assess attitudes and opinions of medical students from various disciplines towards climate change and health, waste generated by health systems, and what the amount of responsibility that health professionals should bear. This study showed that health professionals are aware of, and concerned about, the impacts of climate change and health, but they are less familiar with the contributions of health systems towards climate change. About half of the respondents of this study felt that health professionals do have a role in addressing the impact of climate change and health, but that it was not a topic that they are interested in. Barriers that

prevent healthcare workers from addressing this impact included lack of education about the relationship between diseases and climate change, and not having enough time, which results in inefficient use of resources.<sup>14</sup> A survey by Boland et al. found that, despite physicians agreeing that climate change impacts health and is relevant in primary care settings, less than one third of respondents felt that physicians should actively address climate change with their patients.<sup>15</sup>

There are limited results in this literature review that address waste within healthcare systems, however a survey among obstetricians and gynecologists in the United States found that most physicians agreed that there is an excessive amount of medical waste generated. However, only 20% preferred using reusable tools that were available to them.<sup>16</sup> A cohort study found that about 83% of nurses felt that they were unable to change their workplaces due to lack of confidence, resistance, practicalities, and attitudes.<sup>17</sup>

Finally, the American Thoracic Society conducted a survey (2015) with its members to understand their member's perceptions of climate change, what they have experienced so far, and what their preferred policy responses are to climate change. This survey similarly showed that the physicians are familiar with climate change but were less knowledgeable about the relationship between climate change and health. A large majority of the survey respondents believed that physicians should respond to climate change through communicating to the public about health implications of climate change and advocating for increased sustainability efforts within health systems.<sup>18</sup>

Healthcare institutions have begun to address the relationship between climate change and healthcare and acknowledge the role that providers may serve. The Emergency Nurses Association stated that emergency nurses can help to decrease the impacts of climate change on health through advocacy work, promoting research, education, promoting sustainable practices at



the workplace, and calling for political action.<sup>19</sup> Additionally, the American Academy of Family Physicians declared climate change as a public health emergency in 2019.<sup>20</sup> Pediatricians have been called on to increase their awareness about climate change due to the vulnerability of children to respiratory illnesses. Specifically, children under five years old are particularly susceptible due to behavior differences, such as spending more time playing outdoors, and physiological differences, such as having smaller airways, higher ventilation rates, and lower ability to regulate temperatures when exposed to heat stress.<sup>21</sup>

Overall, the results from this literature review show that there are gaps in the knowledge that health professionals have about the impacts of climate change on health. While most people agree that it is important to improve the sustainability of health systems in general, there is disagreement between how much responsibility medical professionals have at an individual level to address these issues within their health systems, communities, and politics. Some health organizations have voiced their support regarding increasing the involvement of healthcare professionals in addressing this issue. While previous literature has surveyed subgroups of healthcare professionals about their perceptions of climate change and health, it is notable that many of these studies were conducted internationally. The results of this literature review show that there are also gaps in the research with regards to comparing different types of healthcare professionals within a healthcare setting and studying the perceptions of healthcare professionals towards vulnerable populations.

The purpose of this research was to learn about how healthcare professionals at UC San Diego Health perceive the relationship between climate change and healthcare, and how they understand their role in mitigating this impact. The CHANT survey was modified to gather

information about the knowledge, motivations, and barriers that healthcare professionals perceive regarding climate change and healthcare.<sup>22</sup>

Table 1.1: Literature Review Results of PubMed and Embase Databases – Editorials

First Author, publication Year	Title	Key findings	US or International
<b>Wortzel 2022</b>	Climate Change and the Professional Obligation to Socialize Physicians and Trainees into an Environmentally Sustainable Medical Culture	Reviews factors that contribute to the carbon footprint of the medical industry, unsustainable healthcare, and efforts to increase the sustainability of healthcare. Both systemic factors and personal decisions can have a big impact.	US
<b>Kolbuk 2021</b>	Mitigating the Effects of Climate Change on Health and Health Care: The Role of the Emergency Nurse	Statement by Emergency Nurses Association. Article; States position of the Emergency Nurses Association. Provides examples of improving sustainability at the workplace and advocacy that can take place	US
<b>Nicholas 2020</b>	Mental Health Impacts of Climate Change: Perspectives for the ED Clinician	Provides background and context about the impact of climate on mental health. ED clinicians are important figures in diagnosing, treating, evaluating, and long term follow up. Provides information about integrating various techniques to approach climate related mental illness in the ED	US
<b>Hastings 2020</b>	Climate Change Impact and the Role of the Emergency Nurse	Gives broad overview of health impacts of climate change and the relevance of nurses.	US
<b>Kemper 2020</b>	Research about climate advocacy: Directions from a pilot survey of academic pediatricians	Pilot survey conducted to test feasibility of surveying physicians about climate change. Results show that this is feasible and conducting a survey can be an intervention by itself. Encourages other research institutions to do more work like this as it pertains to climate change	n/a
<b>Wellbery 2019</b>	Climate Change Health Impacts: A Role for the Family Physician	AAFP joined other health institutions to declare climate change a public health emergency. Physicians need to be aware of the impacts of climate on health and the responsibility that the health industry plays in carbon emissions.	US
<b>Swartz 2019</b>	Taking on Climate Change Through a Health Care Lens	Broad overview of background and health alliances that are trying to increase awareness in the field of the health impacts of climate change	US
<b>Cook 2019</b>	Nurses and Climate Action	provides background of environmental impact of hospitals on climate change. ANHE developed the Nurses Climate Challenge, the CHANT survey, and WHAM tool. WHAM grid can help nurses understand what actions they can take	US
<b>Leffers 2018</b>	Nurses play essential roles in reducing health problems due to climate change	American Academy of Nursing on Policy calls on nurses to advocate for “agencies and organizations to assure robust systems for climate change monitoring and public health tracking ... advance training initiatives that advance nurses’ ability to implement sustainability initiatives in health care systems”.	US

Table 1.1: Literature Review Results of PubMed and Embase Databases – Editorials (cont.)

<b>First Author, publication Year</b>	<b>Title</b>	<b>Key Findings</b>	<b>US or International</b>
<b>Rice 2015</b>	Climate change at the bedside? Observations from an ATS membership survey	Changes in the environment and ozone are associated with increased rates of illness and death. Results from the survey indicate that physicians are more trusted than climate scientists, and therefore may play an important role in communicating information about climate to the public.	US
<b>Nicholas 2021</b>	Climate Change and Population Health: Incorporating Stages of Nursing's Political Development	Provides overview and background of the relationship between climate change and health. Reviews factors that contribute to how vulnerable people are to climate change. Applies the Stages of Nursing's Political Development to climate policy and action and recommends that a public health framework is integrated into nursing education, advocacy, and policy.	US

Table 1.2: Literature Review Results of PubMed and Embase Databases- Research Articles

First Author, publication Year	Title	Study design	Population of interest	Key findings	US or international
Tehrani 2023	Faculty Development for Sustainable Health Care: A University System-Wide Initiative to Transform Health Professional Education	Mixed methods	Health professional faculty and teachers	Education for Sustainable Health Care (ESHC) is the first step to developing Health Care practitioners to think about and act on climate crisis and address 3 goals: 1) educate faculty on eco-medical literacy, 2) empower faculty to build community and lead ESH at their institutions, 3) expand coverage of ESH. implemented university wide development program to educate health providers about ESHC	US
Lopez-Medina 2022	Perceptions and concerns about sustainable healthcare of nursing students trained in sustainability and health: A cohort study	Cohort study	Undergraduate nursing students	Results indicated that nurses wanted more education on sustainable healthcare and 'low environmental impact nursing care'. Nurses expressed concern about healthcare waste.	International
Moustafa Saleh 2022	Integrating sustainability development education program in nursing to challenge practice among nursing interns in health care	Quasi-experimental, cross-sectional	Nursing interns	Nurses can benefit from sustainability training. The implementation of training strategy improved student nurses' knowledge about sustainability development.	International
Patrick 2022	Prevalence and determinants of mental health related to climate change in Australia	Cross-sectional	Adults in Australia	1 in 4 people in Australia who experience a climate change related event met criteria for PTSD. Younger people are more affected by eco-anxiety. People who have not directly experienced a climate related event experience pre-trauma.	International

Table 1.2: Literature Review Results of PubMed and Embase Databases- Research Articles

First Author, publication Year	Title	Study design	Population of interest	Key findings	US or international
Katzman 2022	Educating Community Health Professionals About the Health-Related Effects of Climate Change Through ECHO Telementoring	Cohort study	Health professionals	implementation of Climate Change and Human Health (COHH ECHO) synchronous telemonitoring course increased the knowledge, self-efficacy, and communication skills for health professionals in this subject area.	International
Bernstein 2022	Risk Factors for Climate-Related Health Effects in an Ambulatory Population	Cohort study	Adults in ambulatory health settings	NAMCS identified risk factors for illness related to heat or air pollution exposure. 91.4% of ambulatory care patients included in the analysis had at least 1 risk factor for the illnesses related to heat or pollution exposure.	US
Gershber 2022	US students' perceptions on environmental sustainability in dental school	Cross-sectional	Dental students	Survey intended to assess whether dental students received training on environmental sustainability in dentistry, and if they are interested in including these topics into their education. Findings indicate that dental students believe that it is important to learn about environmental sustainability, but they do not feel knowledgeable about this topic	US
Álvarez-Nieto 2022	Nursing students' attitudes towards climate change and sustainability: A cross-sectional multisite study	Cross-sectional	Nursing students	Survey given to nursing students in multiple countries. Found that students are open to including sustainability in the curriculum.	International
Ergin 2021	A mixed method study on global warming, climate change and the role of public health nurses from the perspective of nursing students	Mixed methods	Nursing students	Study aim was to evaluate the knowledge and awareness of nursing students towards global warming, climate change, impact of climate change on health. Survey results are mostly descriptive, students want to learn more and have the topics in the curriculum. Study included nursing students enrolled in public health nursing course	International

Table 1.2: Literature Review Results of PubMed and Embase Databases- Research Articles

First Author, publication Year	Title	Study design	Population of interest	Key findings	US or international
Schenk 2021	Climate, Health, and Nursing Tool (CHANT): Initial survey results	Cross-sectional	Nurses	Overview of CHANT tool, role of nursing, use tool to assess nurses' awareness, experience, motivation, and behaviors related to climate change.	US
Ryan 2020	Medical, nursing, and physician assistant student knowledge and attitudes toward climate change, pollution, and resource conservation in health care	Cross-sectional	Medical, nursing, physician assistant students	Cross sectional survey of health professional students to assess knowledge, attitudes, and opinions about climate change and health, pollution generated by the healthcare sector, and health professional responsibility.	US
Yang 2020	Local actions to health risks of heatwaves and dengue fever under climate change: Strategies and barriers among primary healthcare professionals in southern China	Mixed methods	Primary healthcare professionals	Survey conducted in China to measure the perceptions and attitudes of healthcare providers towards health impacts of climate change, and individual actions/institutional actions to respond to climate change. Only 53% of respondents attributed climate change to human behaviors, 93% agreed that more attention needs to be given to people who are vulnerable to the impacts of climate change. Barriers include funding, lack of prioritizing, lack of workforce.	International
Aronsson 2020	Student nurses exposed to sustainability education can challenge practice: A cohort study	Cohort study	Nursing Students	Aim of the study was to expose nurses to sustainability education and explore if they were able to apply it to their practices and challenge unsustainable practices at work. 200/240 nurses felt unable to change their workplace practices. The most common reasons why they felt unable to change practices was lack of confidence, resistance, practicalities, and attitude.	International
Boland 2019	Family Medicine Patient and Physician Attitudes Toward Climate Change and Health in Wisconsin	Cross-sectional	Adult healthcare patients and physicians	Survey conducted among population in WI that participated in similar 1998 survey. Less than 1/3 of respondents felt that physicians should have an active role in addressing climate change with their patients. 48% of physicians were uncomfortable discussing climate change and health with patients. Family medicine should be considered as a resource for health impacts of climate change.	US

Table 1.2: Literature Review Results of PubMed and Embase Databases- Research Articles

First Author, publication Year	Title	Study design	Population of interest	Key findings	US or international
Kurth 2017	Planetary Health and the Role of Nursing: A Call to Action	Literature review	Nurses	Nurses are important people to include when trying to accomplish sustainable development goals and promote environmental sustainability and human health. Nurses can help support health system resilience efforts by partnering with groups, advocating, encouraging sustainable practices	US
George 2017	Climate Change, Climate Justice, and Environmental Health: Implications for the Nursing Profession	Literature review	Nurses	Literature review of articles related to climate change, climate justice, and human health. The people who contribute the least to climate change will be disproportionately impacted by the health implications. CNA recommended that nursing needs to be a leader in reducing the emissions of their practices, and that associations need to support policy efforts to reduce greenhouse gases	US
Thiel 2017	Attitude of US obstetricians and gynecologists to global warming and medical waste	Cross-sectional	Obstetricians and gynecologists at the University of Pittsburgh	Doctors were favorable to using reusable tools and reducing waste when it is clinically equivalent, but only 20% preferred the reusable tools that are available to them. Beliefs about global warming were influenced by gender and physician role and age.	US
Maibach 2015	Do Americans Understand That Global Warming Is Harmful to Human Health? Evidence From a National Survey	Cross-sectional	US adults	Survey about the health threats of climate change given to Americans in 2014. Most people had not previously considered the health impacts of climate change prior to taking the survey, and most people were not sure or did not see a difference in vulnerabilities among groups of people.	US
Sarfaty 2015	American Thoracic Society member survey on climate change and health	Cross-sectional	Members of the ATS	Most respondents agree that climate change is happening, and most agreed that it was due to human driven activities and that it impacts health. Only 38% of respondents felt knowledgeable about the association between climate and health. There was support for more education on the topic, and the survey shows the growing consensus among doctors that climate change is impacting health.	US

Table 1.2: Literature Review Results of PubMed and Embase Databases- Research Articles

First Author, publication Year	Title	Study design	Population of interest	Key findings	US or international
Sarfaty 2014	A survey of African American physicians on the health effects of climate change	Cross-sectional	Members of the National Medical Association	Majority of physicians agreed that climate change is harming people in their city or country, and that it is impacting their patients. Respondents agree that some groups of people will be disproportionately impacted by climate change. Physicians identified barriers to talking about this topic with their patients, and they agreed that there needs to be more significant steps taken to address climate change on policy level	US
Nicholas 2017	Climate Change, Climate Justice, and Environmental Health: Implications for the Nursing Profession	Literature review	Nurses	Provides overview of the health implications of climate change and what climate/environmental justice is. "Inherent in the concept of climate justice is the recognition that those least responsible for climate change experience the greatest negative impacts to their well-being". Calls on the nursing profession to seek in climate justice.	US
Di Ciccio 2020	Climate Change and Childhood Respiratory Health: A Call to Action for Paediatricians	Literature review	Pediatricians	Calls on pediatricians to educate their patients about climate related illnesses and help people prepare for and prevent these illnesses.	International
Ergin 2021	A mixed method study on global warming, climate change and the role of public health nurses from the perspective of nursing students	Mixed Methods	Nursing students	Mixed Methods study design was used to understand what senior nursing students knew about climate change and global warming, and the results were used to guide curriculum recommendations for nursing students. Identified nurses as leaders and educators for preventing climate change, but people were unsure of actions to take.	International



## CHAPTER 2

### I. Manuscript

#### Background

Climate change poses an indisputable threat to human health.<sup>1</sup> Changes in the environment due to climate change have been associated with acute injury and illness, chronic diseases, respiratory conditions, cardiovascular diseases, allergies, and mental health challenges.<sup>2</sup> Climate disasters can lead to destabilized housing, destruction, and displacement of communities, and jeopardize food and water sources.<sup>3</sup>

The impacts of climate change have a disproportionate impact on vulnerable populations across the world. People who are unhoused, living in poverty, the elderly, and young people, are among the most vulnerable to succumb to consequences attributable to climate change. Additionally, communities that contribute the least to global emissions inevitably bear a greater burden of the implications of climate change compared to communities and countries who contribute the most to global emissions.<sup>4</sup>

Greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, have led to global warming by trapping heat on the planet when these gases are emitted into the atmosphere.<sup>3</sup> As the planet warms, weather patterns increase in severity and have led to climate change over time.<sup>3,5</sup> The United States is disproportionately responsible for climate change by contributing about 12% of global carbon emissions as of 2019 despite accounting for approximately 4.2% of the global population.<sup>6,7</sup> About 8.5% of carbon emissions in the United States can be attributed to the healthcare sector, and the emissions from US health systems are responsible for about 25% of global emissions from health sectors.<sup>8</sup> While a significant amount of emissions from health systems are attributable to systemic factors, decisions that are made on the individual and local level can have a large impact.<sup>9</sup>

Previous research has surveyed healthcare providers about their perceptions and attitudes towards climate change. This study adds to the body of literature on this topic by surveying health providers from a range of roles and comparing responses from nurses and physicians. Additionally, this survey studied how healthcare providers perceive the vulnerability of populations.

The purpose of this research was to learn about how healthcare professionals at UC San Diego Health perceive the relationship between climate change and healthcare, and how they understand their role in mitigating this impact. The CHANT survey was modified to gather information about the knowledge, motivations, and barriers that healthcare professionals perceive regarding climate change and healthcare.<sup>10</sup>

## Methods

### *Study Design and Participants*

This study was a cross-sectional survey that was conducted to understand how healthcare providers within the UC San Diego Health System perceive the relationship between climate change and healthcare, and what they consider to be their role in mitigating this effect. The Climate, Health, and Nursing Tool (CHANT) was modified for use this study.<sup>10</sup> Relevant questions were transferred into Qualtrics, and additional questions were added as necessary.<sup>11</sup>

The final survey consisted of 23 questions. There were four questions to ask about the participant's job roles and gather demographic information. Ten questions were asked using Likert scales to measure how familiar people are with evidenced based statements about climate change, how concerned they are, how motivated they are to change their personal practices, their optimism, and how often they communicate with others about climate change. The remaining questions asked participants to identify where they get information about climate change and

health, reasons that they are motivated and not motivated to change their behaviors, identify vulnerable populations, and answer true/false questions. A full copy of the survey questionnaire is listed in the appendix.

#### *Data Collection and Analysis*

The survey and distribution were created with the assistance of the Department of Sustainability within UC San Diego Health. We obtained approvals from UC San Diego Health Administration to distribute the survey through email distribution lists within the health system. These distribution lists included Nursing Leadership, Nurse Educators, Medical Directors, Infectious Disease Division, Internal Medicine Residency Leadership, and the Surgical Quality department. A link and QR code were sent to UC San Diego Health email distribution lists with a description of the survey. The survey was also advertised in the Physician Weekly Newsletter for providers. Finally, medical leadership staff were asked to share the survey with their staff. Data was collected from 7/1/2022 to 8/5/2022. A second email was sent on 8/1/2022 to encourage greater participation with the survey. Participation in this survey was voluntary, and there were no incentives offered. All responses were recorded in Qualtrics. The primary variables of interest were measured by converting the Likert Scale responses to numeric values. Responses per question were averaged, and associations between variables were measured using linear regression models. Linear regression models were adjusted for job title and gender. All analyses were conducted using R Studio Version 2021.09.1+372 “Ghost Orchid”.<sup>12</sup> The study was approved by the University of California, San Diego Institutional Review Board on June 27<sup>th</sup>, 2022.

## Results

### *Demographics*

There was a total of 191 responses recorded. About 71% of the sample identified as female, while about 28% identified as male. 45% of the sample were nursing staff, and 35% of the sample were physicians. 19.4% of the sample listed their primary role as “other”. This category included administrative staff, social workers, health system management, educators, and midwives. The majority of the sample identified their primary race to be White/Caucasian (66.5%, n=127), 16.2% Asian/Asian American (n=31), 6.8% Hispanic/Latino (n=13), and 4.2% Black/African American (8). Only 1% (n=2) of the sample identified Native Hawaiian/Pacific Islander as their primary race, and less than 1% identified as American Indian/Alaskan Native. The demographics of the survey participants is summarized in Table 2.1. Approximately 41% (n=78) of the healthcare workers primarily work in a hospital setting, 21% work in specialty care settings and 19% (n=37) work in primary healthcare settings. The remaining participants in the sample primarily work at emergency/urgent care, surgical/procedural, and other medicine/non-procedural.

### *Climate Related Illnesses and Observations*

Among the most observed climate related illnesses reported at the providers’ work are respiratory problems and mental health challenges: 71% (n=132) reported seeing mental health problems frequently at work, and 63% (n=117) of respondents reported frequently seeing respiratory problems at work. Similarly, the most common climate-related illness that providers see among their family, friends, and acquaintances are mental health issues and respiratory problems: 43% (n=82) reported observing mental health problems among people that they know and 35% (n=67) of providers reported that they observe respiratory problems frequently among

people that they know. Providers reported rarely or never observing physical trauma related to severe storms, and vector-borne illnesses both at work and among people that they know. The most common extreme weather events that providers reported observing at the time of this study were droughts, wildfires, and extreme heat.

### *Familiarity and Concern*

The variable of familiarity was measured by using a Likert Scale to understand how familiar the respondents were with six evidence-based statements. Most survey respondents were either ‘somewhat’ or ‘extremely’ familiar with evidence-based statements about the relationship between climate change and healthcare. There was the least amount of familiarity with the impact that healthcare delivery has on carbon emissions. About 28% (n=34) of respondents were ‘extremely familiar’ with the statement that healthcare delivery is responsible for approximately 8.5% of greenhouse emissions in the US, whereas 37% (n=71) of respondents were ‘not at all familiar’ with this. Physicians were significantly more familiar with the evidence-based statements than nurses (p=0.002), but there was no significant difference between physicians and other healthcare workers (p=0.898).

There was a high amount of agreement (84%-87%) with providers’ reported concern regarding the financial impacts of climate change, the impact of climate change on the planet, and the health impacts of climate change. A large majority of participants (91%) were moderately or extremely concerned about the overall impact on future generations, and 92% were moderately or extremely concerned about the impact of climate change on the planet.

### *Optimism and Motivation*

Overall, the respondents were pessimistic about humans’ ability to decrease the impacts of climate change. About 82% of respondents were either not at all, or slightly optimistic that

humans will prevent further climate change. Similarly, 80% were either not at all or slightly optimistic that humans would adequately prepare for the impacts of climate change; however, there were reasonably supportive responses to taking action. Most respondents indicated that they were motivated to modify their behaviors in the workplace to be more sustainable. Specifically, 62%(n=119) stated that it is ‘very true’ that they wanted to change their practice to reduce greenhouse gas emissions, and 41% (n=78) stated that it is ‘very true’ that they want to teach patients, clients, and community members about the health impacts of climate change. About 56% (n=106) indicated that it is very true that they want to prepare for the health impacts of climate change in the workplace. The five most common reasons that people listed for being motivated to address climate change are for clean air and water, the future, to protect the planet, their families, and health impacts. The most common reasons that respondents do not address climate change were that they do not know what to do, they are overwhelmed, they are too busy, it costs too much, and they are not confident enough to act.

#### *Sources of Information about Climate Change*

The most common sources of information about climate change were the internet, TV news, print media, and social media. Only 6.5% of respondents said that they get this information from UC San Diego Health, and only 5.81% reported that they get this information from other professional institutions, and 4.72% have heard about climate change from professional courses.

#### *Linear Regression Models and Primary Variables of Interest*

Table 2.2 shows the regression coefficients and p-values for linear regression models comparing the primary variable of interest. There were significant relationships between most of the primary variables of interest ( $p < 0.05$ ), however most of these associations were not

significant when adjusted for job title. The relationship between motivation and familiarity, and concern and familiarity were significant after adjusting for job title. Most providers reported that they were ‘extremely concerned’ with the health, financial, environmental, and other overall impacts of climate change on health (Figure 2.1). This concern level was significantly associated with the outcome measures of familiarity, motivation, optimism, and frequency of communication about this topic. The linear regression models for the seven variables of interest were also adjusted for gender. Gender had a significant impact on communication as a predictor of action at work ( $p=0.04$ ) but did not have a significant impact on the relationships between the other variables.

The respondents were more likely to engage in sustainable practices when they were at home, compared to at work. When at home, people often or always reduce waste through recycling, reusing, and composting (75%,  $n=141$ ), and conserve energy through turning off lights, keeping moderate temperatures, and energy efficient appliances (77%,  $n=144$ ). When at work, people are less likely to engage in behaviors that reduce waste and emissions, such as conserving energy (54%,  $n=101$ ) and reducing waste (51%,  $n=97$ ). In their personal lives, 41% ( $n=77$ ) of people said that they use less gasoline often or always by driving fuel efficient vehicles, public transit, or walking/biking; however, only 11% ( $n=21$ ) regularly commute to work using public or active transportation. Frequency of sustainable actions at home were a significant predictor of action at work ( $p<0.05$ ). Additionally, familiarity, concern, motivation, and communication were all significant predictors of action ( $p<0.05$ ).

Providers were not optimistic that humans will prevent further climate change and adequately prepare for the impacts of climate change; however, optimism was not a significant predictor of motivation, communication, or action at home or at work. About 85% ( $n=162$ ) of

respondents rarely or never communicate with elected officials or community leaders about climate change and health, and 70% (n=131) rarely or never communicate with patients and colleagues about climate change and health. To contrast, about 35% (n=62) of people communicate rarely or never with personal acquaintances, such as friends, family, and neighbors, about this topic. The respondents identified people experiencing homelessness, farmworkers, low-income populations, firefighters, and refugees as some of the most vulnerable to the impacts of climate change. Table 2.3 shows a summary of the responses from four true and false questions. Due to the small sample size of responses in the subcategories, comparative statistics were not able to be calculated. Most respondents agreed on the responses for each of these questions.



Table 2.1: Sample Demographics and Job Role

	<b>Nursing Staff %(N)</b>	<b>Physician/Surgeon %(N)</b>	<b>Other</b>	<b>Total %(N)</b>
<b>Gender</b>				
Male	17.2%(15)	49.3%(33)	13.5%(5)	27.7%(53)
Female	81.8%(71)	50.7%(34)	83.8%(31)	71.2%(136)
Prefer not to say	1.1%(1)	0.0%(0)	2.7%(1)	1.0%(2)
<b>Primary Race</b>				
White/Caucasian	64.4%(56)	68.7%(46)	67.6%(25)	66.5%(127)
Hispanic/Latino	6.9%(6)	3.0%(2)	13.5%(5)	6.8%(13)
Black/African American	4.6%(4)	3.0%(2)	5.4%(2)	4.2%(8)
American Indian/Alaska Native	1.1%(1)	0.0%(0)	0.0%(0)	0.5%(1)
Asian/Asian American	18.4%(16)	19.4%(13)	5.4%(2)	16.2%(31)
Native Hawaiian/Pacific Islander	2.3%(2)	0.0%(0)	0.0%(0)	1.0%(2)
Other	2.3%(2)	6.0%(4)	8.1%(3)	4.7%(9)
<b>Total Count</b>	45.5% (87)	35% (67)	19.4% (37)	191

*Table 2.1 shows the demographics of the sample population for survey respondents. The sample is stratified by Job Role to understand what capacity the healthcare providers work in. “Other” includes administrative staff, management, and other job roles disclosed by participants. Note: Transgender, Non-Binary, and Other were included as gender categories, however no respondents identified as being in any of these categories, so they were omitted from the table.*

Table 2.2: Linear Regression Coefficients for Models Adjusted for Job Role

<b>Predictor</b>	<b>Familiarity <math>\beta</math> (p-value)</b>	<b>Concern <math>\beta</math> (p-value)</b>	<b>Optimism <math>\beta</math> (p-value)</b>	<b>Motivation <math>\beta</math> (p-value)</b>	<b>Communication <math>\beta</math> (p-value)</b>
<b>Familiarity</b>	-	0.554 (3.34e-07)	-0.093 (0.418)	0.823 (2.27e-07)	0.684 (1.88e-10)
<b>Concern</b>	0.235 (3.34e-07)*	-	-0.201 (0.021)	1.135 (<2e-16)	0.435 (4.93e-10)
<b>Optimism</b>	-	-	-	-0.194 (0.058)	-0.157 (0.051)
<b>Motivation</b>	0.163 (2.27e-07)*	-	-	-	0.316 (2.59e-11)
<b>Communication</b>	0.516 (7.42e-12)	0.435 (4.93e-10)	-0.137 (0.051)	0.677 (2.59e-11)	-

Table 2.2 shows the Beta Coefficients and p-values calculated in using linear regression models in R Studio. Variables on the right side were used as predictors for the outcome measures to determine associations between these factors. All models were adjusted for job role and gender.

\*Indicates a significant association when adjusted by job role

Definitions:

*Familiarity- familiarity of respondents with evidence-based statements about the relationship between healthcare and climate change*

*Concern- concern level of respondents with regards to the impacts of climate change*

*Optimism- optimism levels of respondents with regards to climate change*

*Motivation- motivation of respondents to change their behaviors to reduce GHGs*

*Communication- how frequently respondents communicate with others about climate change*

Table 2.3: Health Providers' Responses to True/False Questions

	True % (N)	False % (N)	Unsure % (N)
<i>Human health is not sensitive to extreme weather events and other aspects of climate change</i>	5.29% (10)	91.53% (173)	3.17% (6)
<i>The impact of climate change will require significantly more resources within the healthcare sector</i>	94.64% (159)	5.36% (9)	
<i>Governments should prioritize reducing their carbon emissions and increase the amount of green space available as strategies to reduce the unhealthful impacts of climate change</i>	93.44% (171)	6.56% (12)	
<i>The health impacts of climate change have a negative impact on the financial well-being of my patients</i>	90.26% (139)	9.74% (15)	
<i>Climate change does not impact the spread of vector-borne diseases and novel viruses.</i>	6.21% (10)	93.79% (151)	

Table 2.3 shows the proportion of respondents identified each statement as true or false. Due to the small sample size, further statistical analysis was unable to be conducted. All questions listed an 'unsure' option, however participants only selected this option for the first question.

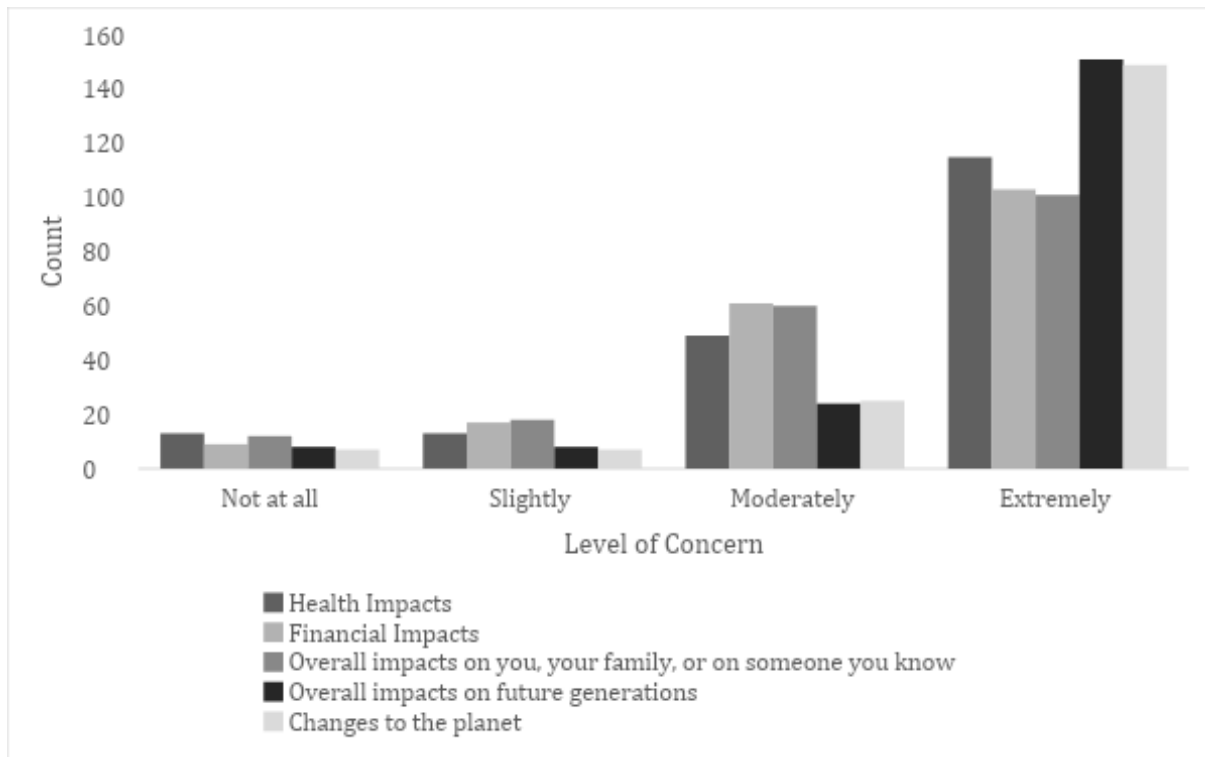


Figure 2.1: Health Providers' Concern Levels Regarding the Impacts of Climate Change

Figure 2.1 shows the respondents' answers to how concerned they are regarding each of the impacts of climate change. Providers were asked to state how concerned they were on this four-point Likert Scale question. Respondents mostly agreed that they are extremely concerned about all the impacts of climate change.

### Discussion

Overall, these results provide insight into how health providers at UC San Diego Health perceive the relationship between climate change and healthcare, and their role in mitigating this impact. This survey found that most respondents are knowledgeable about climate change and health, however they are less familiar with the impact that health institutions have on the environment. These findings are consistent with previous research on this topic. Safarty et al (2015) found that only 38% of surveyed individuals were knowledgeable about the environmental impact of health systems.<sup>13</sup> This gap in knowledge may have an impact on patients' health and outcomes; Bernstein et al (2022) found that 91.4% of patients in an

ambulatory care setting had at least one risk factor for illnesses related to heat or pollution exposure.<sup>14</sup> This highlights the pervasive influence that climate change can have on human health, and the urgent need for health providers to understand this relationship.

### *Motivation*

The survey results show that while people are individually motivated to address climate change, they are overall pessimistic that humans will adequately prepare for the impacts of climate change and prevent further climate change. Despite people feeling pessimistic about the future of climate change, there was not a significant relationship between this feeling and motivation to change their personal or work practices. There was also no significant relationship between optimism and action. This indicates that people's pessimism is a less important factor for their individual wellness to change. Health institutions can use this information to inform their policies and practices in a way that focuses on individuals' abilities to make an impactful difference. If people see each other and institutions starting to prioritize sustainability initiatives, then it is possible that they will feel more optimistic about human behavior in general and be more motivated to continue to act.

There are significant relationships between familiarity and concern, motivation, action, and communication. These results indicate that increasing familiarity among healthcare providers about climate change and health will help to raise the concern and motivation that people have towards this topic. Additionally, increasing these variables can promote communication on the topic and the implementation of sustainable actions and practices both in providers' personal lives and at work. Increasing knowledge, concern, and motivations may reinforce each other and cultivate workplaces that are both aware of the health implications of climate change, and that support sustainable policies internally.

### *Education*

A small portion of the sample stated that they currently receive information about climate change and healthcare from scientific journals and professional courses. This result highlights the opportunity that health and educational institutions have to incorporate information about climate change and sustainability practices into their training and curriculum. Previous research has found that healthcare professionals are favorable towards having more education about the impact of climate change on healthcare. López-Medina et al (2022) found that nursing students are in support of sustainability education and learning about ways to reduce waste in the nursing profession. Nursing students have expressed concern about the lack of knowledge of these problems, and the lack of power to change their healthcare practices.<sup>15</sup> Arronson et al (2020) found that 200/240 nurses felt unable to change their practices due to lack of confidence, resistance to change, attitudes, and practicalities within their work environments.<sup>16</sup>

### *Environmental Justice*

Finally, this survey found that healthcare professionals agree that vulnerable populations are more likely to be impacted by climate change. Nicholas et al (2016) outlines seven principles of climate justice and their relevance to the nursing profession.<sup>17</sup> There is an intersectional relationship between justice, equity, healthcare, and the impacts of climate change. Therefore, it is critical for healthcare professionals and institutions to be educated on the relationship between climate change and health, share this knowledge with their communities and patients, and advocate for sustainable practices and policies within their local settings and in the community at large.

### *Engagement and Activism*

These cumulative results suggest that healthcare workers need to be both educated and empowered to make changes in their work environments. Workplaces can empower their employees by cultivating an environment that is receptive to new ideas to improve the overall sustainability of the workplace. Health institutions can show their commitment to sustainability by implementing programs such as expanding access to recycling and introducing composting and investigate system-wide processes that may have detrimental environmental impacts, such as the supply chains for medical instruments and materials. Leadership teams can offer incentives for using more sustainable transportation options, such as carpooling or using public transportation. Healthcare professionals can also participate in community events to bring awareness to this issue and help educate the public. With more education and training, healthcare professionals can leverage their role as scientists and educators to change healthcare practices within their work facilities, educate their patients about how climate change may impact their health, and expand their work in the community to support policies that prioritize sustainability. On a systematic level, health institutions can analyze their energy usage, supply chains, and food products that are served onsite. By exploring clean energy alternatives and reducing the meat and dairy products that are served, health organizations can make progress towards decreasing their institutional footprints.<sup>18</sup>

### *Strengths and Limitations*

Strengths of this study included having a sample of healthcare professionals in many different disciplines and roles at UC San Diego Health. Some of the limitations of this research were the small sample size, which limited the amount of statistical analysis that was able to be

completed. Additionally, convenience sampling methods were used which may have introduced bias into the sample.

### Conclusion

Healthcare providers and institutions are uniquely situated to combat the climate crisis. Due to the intersectionality of climate change and healthcare, improving the sustainability of our health systems can have a positive and lasting impact on our environment and public health. Healthcare providers can leverage their role as community leaders and advocates to educate patients on the relationship between climate change and health, and advocate for sustainable policies within the community. Finally, to demonstrate their commitment to public health and justice, health institutions need to prioritize the implementation of sustainable policies and practices.

Chapter 2 is currently being prepared for submission for publication. The thesis author was the primary author of this chapter and was co-authored with Dr. Al-Delaimy.



## CHAPTER 3

### I. Discussion

Climate change poses an immediate threat to health, and healthcare providers are extremely concerned about the impact that climate change will have on various aspects of life. Most respondents are knowledgeable about climate change and health; however, they are less familiar with the impact that health institutions have on the environment. As global warming worsens, the corresponding health threats will undoubtedly increase, and it is critical that healthcare providers understand the health implications and the role that their industry has in mitigating these effects.

Respiratory and mental health problems are the most common climate-related health issues that are observed by the respondents at UC San Diego Health, and among people that they know. The most frequent extreme weather events that the sample observes are extreme droughts and wildfires. Data from the Community Health Needs Dashboard shows that San Diego has relatively high rates of air pollution, and low access to tree canopy in comparison to national averages.<sup>23</sup> These environmental factors support the results that providers are seeing the highest rates of asthma and mental health challenges at work and among friends and family.<sup>24,25</sup>

The evidence from previous studies have highlighted healthcare workers' concerns about not feeling educated on this topic, and not feeling confident enough to challenge attitudes and practices in the workplace.<sup>17,26</sup> Health institutions can use the information from this study to help people utilize their motivations and identify actionable steps that can be made to have a positive impact on their environments. If healthcare professionals increase their knowledge, engage with this topic more, and increase the actions that they take, these factors have the potential to reinforce each other and cultivate workplaces that are very aware of the health implications of climate change, and that make changes within their practices to become more sustainable.

The results of this study offer additional support that healthcare professionals are motivated to change their practices. Respondents said that they are motivated to address climate change because of access to clean air and water, the future, protect the planet, their families, and health impacts. The most common reasons that providers are motivated to change, such as the future' and 'protect the planet' are very large and daunting motivators, which may lead people to feel overwhelmed. One of the primary reasons that people do not change their behaviors is because they do not know what to do. Institutions can support their staff and providers by educating them on concrete and realistic ways that they can modify their behaviors to have a positive impact. These results, in conjunction with the findings of previous studies, suggest that healthcare workers need to be both educated and empowered to make changes in their work environments. Workplaces can encourage their employees to change by cultivating an environment that is receptive to new ideas to improve the overall sustainability of the workplace. To do this, program managers, supervisors, and executive leadership must be trained on the topic and lead these conversations at work. Institutions can also promote community events and participation in sustainability initiatives. Management can offer incentives for utilizing public transportation or carpooling and offer training on reducing waste both at home and at work. For example, healthcare organizations can provide education to its employees about the economic and environmental benefits of commuting with public transportation, rather than driving. At a community level, health institutions can support local environmental organizations by promoting their work and volunteering at events. An example of this may be health institutions supporting initiatives to reduce food waste by providing education on composting, recycling, using reusable materials when appropriate, and bringing attention to community gardens and farmers markets.

Within health systems, medical leadership can offer training to their employees on how to educate their patients about these topics. This may include education on the health benefits of using public or active transportation and choosing food that is grown locally. In states such as California, health providers can provide education on how to mitigate the health impacts of exposure to extreme heat and low air quality from pollution and wildfires. If health institutions and leadership lead by example through implementing policies, incentives, education, and activities that promote improved sustainability, healthcare providers may feel more willing to engage in the conversation about how decreasing waste and emissions can promote human health, both for themselves and their communities.

Finally, this survey also found that healthcare professionals agree that vulnerable populations are at elevated risk to be impacted by climate change. The relationship between climate change and health is a health equity issue. Communities that are the least responsible for climate change will inevitably bear the greatest burden of the outcomes of climate change.<sup>27</sup> Nicholas et al outlines seven principles of climate justice and their relevance to the nursing profession.<sup>27</sup> It ought to be the mission of public health professionals to promote health equity and justice. Therefore, it is critical for healthcare professionals and institutions to be educated on the relationship between climate change and health, share this knowledge with their communities and patients, and advocate for sustainable practices and policies within their local settings and in the community at large. Unfortunately, making systematic changes to training plans, updating policies and procedures, and improving the sustainability of system operations is no small task. The existing healthcare system was not designed with a sustainability-focused mindset; however, existing programs such as UC San Diego Health's Green Clinic program demonstrate how

systems can begin to incorporate environmentally friendly programs while upholding their oath to providing high quality care.<sup>28</sup>

Healthcare organizations such as the AAFP, American Academy of Nursing on Policy, and the National Academy of Medicine have identified healthcare workers as being in unique positions to address climate change.<sup>29,30,31</sup> The book, ‘Health of People, Health of Planet and Our Responsibility’ calls on a global network of healthcare providers and organizations to engage, organize, and empower each other to spread communication about climate change and health to people across the world.<sup>32</sup> With more education and training, healthcare professionals can leverage their role as scientists and educators to 1) change healthcare practices within their work facilities, 2) educate their patients about how climate change may impact their health, and 3) expand their work in the community to support policies that prioritize sustainability.

#### Concluding Recommendations:

1. Health systems should incorporate education about the relationship between climate change and health into the curriculum for healthcare professionals.
2. Health systems can provide training and workshops to teach providers about realistic actions that they can take to decrease their individual environmental impact.
3. Health systems can provide trainings to their providers about how to talk to their patients about the impact of climate change on their health, and how to mitigate risk factors that may lead to adverse health outcomes.
4. Health systems should evaluate their energy usage, commuting needs, waste management and recycling programs, single use materials, and supply chains for their materials and food. Implementing clean energy, using materials that have lower emissions, eliminating single-use materials when possible, and serving food from more sustainable sources can have large systemic impacts.
5. Health systems should implement internal certification programs that set goals and monitor progress towards sustainability initiatives.

Copy of Survey Questions:

# Climate Change and Healthcare Survey

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Start of Block: Default Question Block

Q1 What is your primary healthcare setting?

- Primary Care (1)
  - Specialty Care (2)
  - Hospital (3)
  - Emergency/Urgent Care (4)
  - Medicine/ Non-procedural (5)
  - Surgical/ Procedural (6)
  - Other (7) \_\_\_\_\_
- 

Q2 What is your primary role?

- Nursing Staff (1)
  - Physician/Surgeon (2)
  - Other (3) \_\_\_\_\_
-

Q3 What is your primary race?

- White or Caucasian (1)
  - Hispanic or Latino (2)
  - Black or African American (3)
  - American Indian or Alaska Native (4)
  - Asian or Asian American (5)
  - Native Hawaiian or other Pacific Islander (6)
  - Non-Hispanic (7)
  - Other (8) \_\_\_\_\_
- 

Q4 What gender do you identify as?

- Male (1)
  - Female (2)
  - Transgender (3)
  - Non-binary (4)
  - Prefer not to say (5)
  - Other (6) \_\_\_\_\_
-

Q5 Please indicate your level of familiarity with the following evidence-based statements.

	Not at all familiar (1)	Somewhat familiar (2)	Extremely familiar (3)
The planet has warmed significantly since the 1850s, causing climate change. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global warming is largely due to human behaviors which add greenhouse gases to the atmosphere. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Healthcare delivery is responsible for approximately 8.5% of total greenhouse emissions in the US that contribute to global warming. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Climate change increases the likelihood of adverse health conditions, such as heat stroke, cardiovascular distress, asthma and other diseases. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vulnerable populations, such as the elderly, people experiencing homelessness, and people with chronic illnesses, experience greater adverse health impacts from climate change. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Climate change impacts the spread of vector-borne diseases and novel viruses. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q6 I have heard about climate change from these sources (check all that apply):

- Print media (1)
  - Social media (2)
  - Scientific journals and sources (3)
  - TV news (4)
  - Internet (5)
  - Professional courses (6)
  - Professional organizations (7)
  - UC San Diego Health (8)
  - Friends and/or family (9)
  - I have not heard of climate change (10)
  - Other (11) \_\_\_\_\_
-



Q7 The CDC has identified several health conditions that are worsened by climate change. How often are you seeing each of these conditions at work?

	Never (1)	Rarely (2)	Occasionally (3)	Frequently (4)	Very Frequently (5)
Respiratory problems, such as asthma, allergies, or worsening COPD (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vector-borne diseases, such as Lyme disease, West Nile virus, Rocky Mountain Spotted Fever (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme heat illness (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical trauma related to severe storms or fires (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mental health issues such as depression, anxiety, stress and/or other trauma (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8 How often have you noticed the following climate-related weather events in your area?

	Never (1)	Rarely (2)	Occasionally (3)	Frequently (4)	Very Frequently (5)
Extreme heat (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increased Humidity (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Droughts (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wildfires (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
King tides and coastal erosion (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Heavy Precipitation (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Q9 How often are you seeing these conditions among people that you know (self/family/friends/acquaintances)?

	Never (1)	Rarely (2)	Occasionally (3)	Frequently (4)	Very Frequently (5)
Respiratory problems such as asthma, allergies, worsening COPD (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vector-borne diseases such as Lyme disease, West Nile virus, Rocky Mountain Spotted Fever (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme heat illness (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical trauma related to severe storms or fires (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mental health issues such as depression, stress, anxiety and/or trauma (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q10 How concerned are you about the following, as they relate to climate change?

	Not at all (1)	Slightly (2)	Moderately (3)	Extremely (4)
Health impacts (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial impacts (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall impacts on you, your family, or on someone you know (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall impacts on future generations (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Changes to the planet (other species, forests, oceans etc) (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q11 How optimistic are you that humans will:

	Not at all (1)	Slightly (2)	N/A (3)	Moderately (4)	Extremely (5)
Adequately prepare for the impacts of climate change? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prevent further climate change? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q12 Healthcare contributes 8.5% of Greenhouse Gases (GHG) in the US. Please indicate how true the following statements are for you.

	Very untrue (1)	Somewhat untrue (2)	Neutral (3)	Somewhat true (4)	Very true (5)
I want to change my practice to reduce GHG contributions (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I want to teach patients/clients/community members about how climate change impacts health (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I want to prepare for health impacts of climate change at the workplace (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q13 The following are reasons that I am motivated to address climate change (check all that apply):

- Personal experience with nature (1)
- Religious/faith/spiritual (2)
- Health impacts (3)
- Financial costs (4)
- Social justice/ inequity (5)
- The future (6)
- Clean air and water (7)
- Loss of property (8)
- Increasing severity of weather (9)
- Worse wildfires (10)
- Infectious diseases (11)
- Rise of sea levels (12)
- My family (13)
- To help create healthy communities (14)
- To protect the planet (15)
- Professional obligation (16)
- To reduce climate impacts of my work and workplace (17)

Not applicable- I am not motivated to take action (18)

---

Q14 The following are reasons that I do not address climate change to the extent that I would like (check all that apply):

Loss of jobs (1)

National security (2)

It costs too much (3)

I am overwhelmed (4)

Humans can't impact climate change (5)

I do not know enough about climate change (6)

I do not know what to do (7)

I do not believe the climate is changing (8)

I have more pressing concerns (9)

It is not convenient (10)

I am too busy (11)

I am not confident enough to act (12)

Not applicable- I address climate change to the extent that I would like (13)

Not applicable- I do not want or intend to address climate change (14)

---

Q15 How often do you perform the following behaviors at home:

	Never (1)	Rarely (2)	N/A (3)	Sometimes (4)	Often (5)	Always (6)
Reduce waste (buy less, reuse more, recycle, compost) (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use less gasoline (drive fuel-efficient vehicles, bike/walk, use public transportation etc.) (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conserve energy (use energy efficient appliances, turn off lights and electronics, keep moderate temperature settings etc.) (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Choose foods that require fewer resources to grow/produce (eat local/seasonal produce, use fewer animal products, less packaging) (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use non-fossil fuel based energy sources (wind or solar energy, geothermal, purchase energy offsets etc.) (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



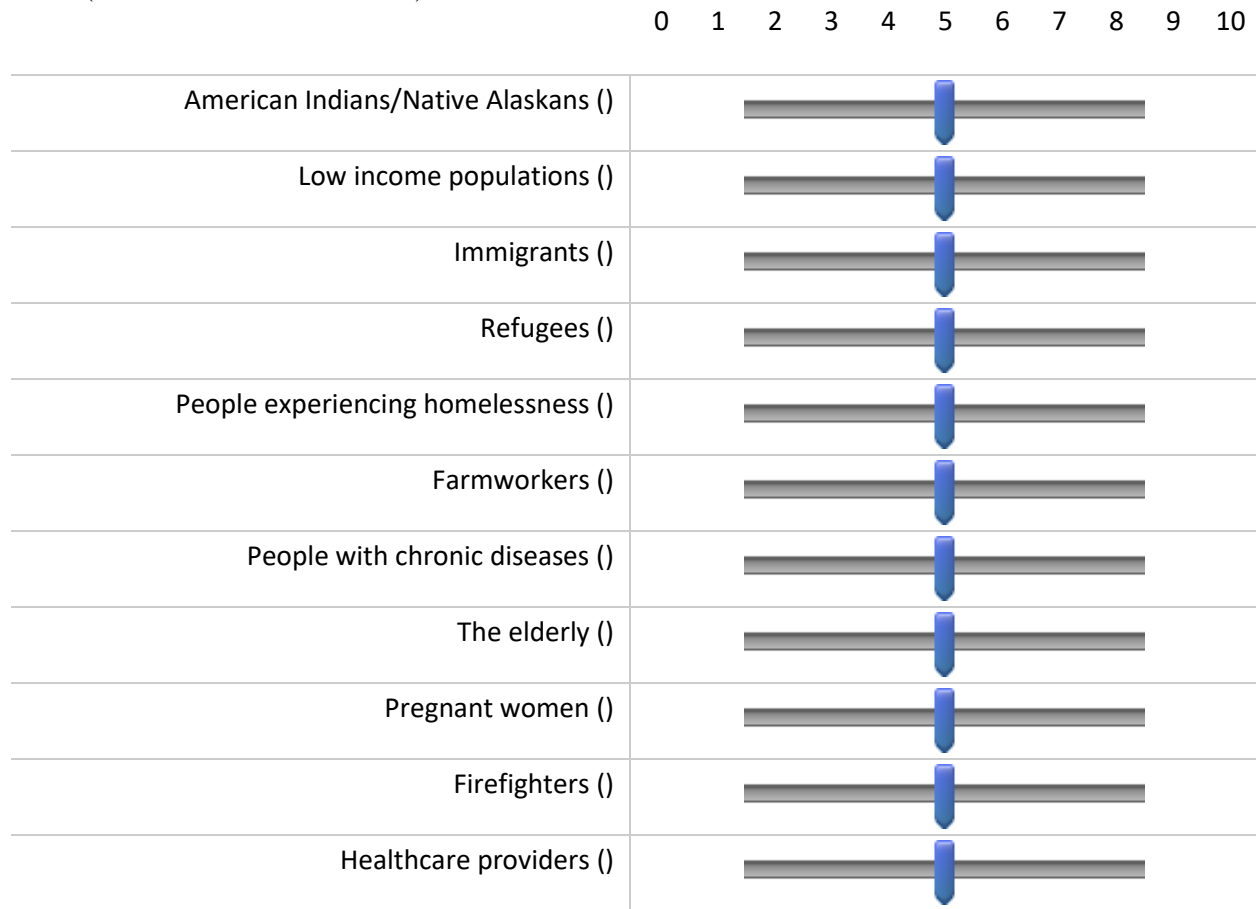
Q16 How often do you do the following behaviors at work:

	Never (1)	Rarely (2)	N/A (3)	Sometimes (4)	Often (5)	Always (6)
Conserve energy (turn off lights, turn off computer screens not in use, etc.) (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commute to work using active or public transportation (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduce waste (avoid printing, conserve materials, etc.) (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ask leaders at your workplace to support policies, products and/or processes that create fewer GHGs (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q17 How often do you communicate (in-person, phone, email, etc.) about climate change and health with these groups or individuals?

	Never (1)	Rarely (2)	Sometimes (3)	Frequently (4)
Professionally (colleagues, patients, clients) (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Personally (friends, family, neighbors) (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Elected officials or community leaders (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q18 Rank the following populations by their vulnerability to climate change on the following scale (10 is the most vulnerable):



Q33 The following statements are about the impacts of climate change on human health. Please indicate if you believe that these statements are True or False.

Q19 Human health is not sensitive to extreme weather events and other aspects of climate change.

- True (1)
- False (2)
- Unsure (3)

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Q20 The impact of climate change will require significantly more resources within the healthcare sector (such as infrastructure, planning, staffing, training, and medications).

- True (1)
  - False (2)
  - Unsure (3)
- 

Q21 Governments should prioritize reducing their carbon emissions and increase the amount of green space available as strategies to reduce the unhealthful impacts of climate change.

- True (1)
  - False (2)
  - Unsure (3)
- 

Q22 The health impacts of climate change have a negative impact on the financial well-being of my patients.

- True (1)
  - False (2)
  - Unsure (3)
- 

Q23 Climate change does not impact the spread of vector-borne diseases and novel viruses.

- True (1)
- False (2)
- Unsure (3)

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