

Article

Understanding the Knowledge, Attitudes, and Practices of Healthcare Professionals toward Climate Change and Health in Minnesota

Madison Kircher ^{1,2,*} , Brenna M. Doheny ³, Kristin Raab ², Emily Onello ³, Stephanie Gingerich ⁴ and Teddie Potter ⁴ 

¹ Council of State and Territorial Epidemiologists (CSTE), Atlanta, GA 30341, USA

² Environmental Health Division, Minnesota Department of Health, St. Paul, MN 55164, USA

³ Department of Family Medicine and Biobehavioral Health, University of Minnesota Medical School, Duluth Campus, Duluth, MN 55812, USA

⁴ School of Nursing, University of Minnesota, Minneapolis, MN 55455, USA

* Correspondence: maddy.kircher@gmail.com; Tel.: +1-507-250-5462

Abstract: Climate change is an urgent public health issue that is impacting health locally and across the world. Healthcare professionals are on the front lines for public health, caring for people affected by climate change; yet few studies have assessed their knowledge and experiences of local climate change effects. The purpose of this study was to improve our understanding of the health impacts of climate change in Minnesota from the perspective of healthcare professionals. An electronic survey was administered by the Minnesota Department of Health (MDH) to a convenience sample of Board-certified nurses and physicians in Minnesota. Seventy-five percent of respondents agreed that climate change is happening, and 60% agreed that it is currently impacting the health of their patients. However, only 21% felt well prepared to discuss climate change, and only 4% discussed climate change with all or most of their patients. Similarly, results from open-ended questions highlighted the importance of climate change and acknowledged the challenges of discussing this topic. While most respondents recognized the health impacts of climate change, they also reported feeling uncomfortable discussing climate change with patients. Thus, there is an opportunity to develop targeted resources to support healthcare professionals in addressing climate change.

Keywords: climate change; public health; healthcare professionals; planetary health



Citation: Kircher, M.; Doheny, B.M.; Raab, K.; Onello, E.; Gingerich, S.; Potter, T. Understanding the Knowledge, Attitudes, and Practices of Healthcare Professionals toward Climate Change and Health in Minnesota. *Challenges* **2022**, *13*, 57. <https://doi.org/10.3390/challe13020057>

Academic Editor: Susan Prescott

Received: 15 September 2022

Accepted: 14 October 2022

Published: 1 November 2022

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1. Introduction

Human health is inextricably linked to the health of the biosphere, yet human caused disruptions of the Earth's natural systems persist and must be urgently addressed. While other planetary health threats have impacts on human health, climate change is perhaps the most visible planetary health crisis for healthcare professionals. From the perspective of international and national health organizations, the connection between climate change and human health could not be clearer. "Climate change is the single biggest health threat facing humanity", "a health emergency", and a "code red for humanity" [1–3]. Evidence points to a multitude of climate related impacts, including heat-related illnesses, respiratory illnesses, zoonotic and vector-borne diseases, water and food-borne diseases, impaired mental health and well-being, and injury and death related to severe weather event [1]. Between 2030 and 2050, it is estimated that climate change will cause an additional 250,000 deaths and the migration of 216 million people across six regions [1,4]. Addressing climate change can have the co-benefit of improving human health, and the health of all life on the planet.

Every region faces unique climate challenges and Minnesota is no exception. Between 1895 and 2020, Minnesota's average temperature warmed 3.0 degrees F, with winter warming driving the overall trend [5]. Average daily minimum or low temperatures rose at more

than twice the rate of average daily maximum temperatures [5]. Annual precipitation also increased by an average of 3.4 inches during the same period [5]. Much of this gain has been delivered by heavier rainfall, including 3-inch precipitation events that have increased by 65% and these trends are projected to continue [5,6]. According to the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (2021), Minnesota is projected to face severe climate variability in the future. The IPCC report (2021) finds a high degree of certainty that Central North America will experience larger increases in temperature from the norm than much of the world, particularly in the winter months [7]. There will also be increased annual precipitation with particular risk of extreme precipitation and flooding [7]. Minnesotans will likely experience hotter temperatures, with extended heat waves, increased periods of drought, and more wildfires [7]. The growing season will also continue to expand, extending the pollen season [7].

All of these climate changes impact the health and wellbeing of Minnesotans. Causal pathways include injuries and deaths from heat waves and floods; vector-borne diseases from changing tick and mosquito populations; illnesses from contaminated drinking water from flooding; respiratory and cardiovascular illnesses from increases in wildfires, ozone, fine particulate matter, pollen, and mold; and mental health impacts from experiencing an extreme weather event or from a loss of sense of place. Climate change can also impact livelihoods, such as farming, commercial fishing, and recreational businesses. Extreme weather events can cause loss of property, land, and pets, and disrupt people's sense of safety. People at particular risk for eco-anxiety and disruptions of well-being due to climate change include youth and communities of color [8,9].

Healthcare professionals need to understand the health impacts of climate change and must be ready to practice in a climate-changed world. Previous studies have explored physicians' attitudes toward climate change and health through surveys conducted at the national level. Results from these studies have shown that physicians believe climate change is affecting the health of their patients, but they feel unprepared to address these issues with their patients [10–13]. One limitation of these studies is that they have focused on the perspectives of physicians in specialties with direct connections to the health impacts from climate change without assessing the attitudes of physicians in different specialties or comparing their perspectives with other healthcare professionals, such as nurses.

The perspective of nurses is important because they are the largest portion of the healthcare workforce in the United States [14]. Nurses are also trusted healthcare professionals who assess, treat, and educate patients about health risks. A survey of 489 nurses indicated moderate levels of awareness, yet high levels of concern about the health impacts of climate change [15]. The survey also revealed that primary barriers are lack of knowledge about what to do and feeling overwhelmed by the magnitude of the problem [15].

Public attitudes about climate change have shifted over time. According to a study from the Yale Program on Climate Communication in 2020, 72% of Americans think global warming is happening compared to 57% in 2010 [16]. Additionally, the study found that 71% of Minnesotans think global warming is happening [17]. These data may indicate that patients across the country, as well as in Minnesota, have increased receptivity to learning about the health impacts of climate change.

To gain a better understanding of the health impacts of climate change in Minnesota, the Minnesota Department of Health (MDH) conducted a statewide survey of licensed physicians and nurses on their knowledge, attitudes, and practices toward climate change and health. The study expanded on previous research by surveying physicians and nurses in the same study to compare healthcare professionals' perspectives toward climate change and health. The study also explored the barriers healthcare professionals are facing in addressing climate change with their patients. The information can be used by educational institutions, state agencies, licensing boards, and other organizations to educate healthcare professionals and develop patient-centered educational materials and resources, aiding healthcare professionals in addressing climate-related health outcomes.

2. Materials and Methods

A multidisciplinary research team, including nurses, research scientists, and a physician advised the study and developed the cross-sectional survey for data collection. The team selected and modified several questions from previously conducted surveys of healthcare professionals on climate change and health and developed and evaluated new questions to meet the study objectives [10–13,18]. Each question was formatted as single- or multiple-response or open-ended depending on the nature of the question. The survey was developed and administered using Verint survey software. A sample of nurses and physicians in Minnesota piloted the survey tool. The MDH institutional review board (IRB) evaluated the study's protocol and deemed it minimal risk, exempting it from further IRB review.

2.1. Respondents

In 2021, MDH administered the 21-item electronic survey to a convenience sample of nurses and physicians in Minnesota. The Minnesota Board of Nursing disseminated the survey to 131,496 nurses in Minnesota, including registered nurses (RN), advanced practice registered nurses (APRN), and licensed practical nurses (LPN). Additionally, five healthcare professional organizations in Minnesota, including two nursing and three physician organizations, disseminated the survey in newsletters or separate emails to their mailing lists. In total, the survey was sent to approximately 152,785 nurses and 12,344 physicians, but not all were Board certified and actively practicing in Minnesota. Participants received an email containing an explanation of the research project and a link to the online survey. A follow-up email was sent approximately one week after the initial email was sent. Completed surveys were returned anonymously.

2.2. Survey Tool

Two screening questions assessed whether respondents were licensed and currently practicing in Minnesota. If respondents were not licensed and actively practicing, they were directed out of the survey. Seven survey questions addressed participant demographics, including type of license, practice, or type of work, setting, and area where their patients reside. Additional demographic questions assessed the number of years practicing, age, and gender. Two closed-ended questions assessed belief in climate change and the health impacts of climate change. Respondents who disagreed or strongly disagreed that climate change was impacting the health of their patients, clients, or community members skipped to the last section of the survey. In the next section, questions assessed the role of climate change in causing or exacerbating specific health conditions; respondent's level of concern, comfort, and preparation in discussing climate change and health with patients; whether healthcare professionals are positioned and should have an active role in addressing climate change with patients or clients; proportion of patients with which they discuss climate change; and barriers to addressing climate change. Two additional open-ended questions in this section assessed conversations respondents have had about climate change with patients or clients and what else they are currently doing to address climate change. All respondents saw the final four questions of the survey, which included two closed-ended questions that assessed resources needed and how respondents received the survey and two open-ended questions about current sources of information about climate change and other thoughts about climate change and health. Participants could omit answers to any of the questions. Data collection occurred from 20 April to 17 May 2021.

2.3. Data Analysis

Respondents who indicated they were not licensed or currently practicing in Minnesota were removed from analysis. Additionally, only surveys that met a predefined minimum completion of 80% of the questions were retained for data analysis. The percent of completed questions was calculated based on the total number of questions each respon-

dent was shown to account for the survey's skip pattern. The survey and skip pattern can be viewed in Appendix A.

Descriptive statistics were used for initial analysis of all responses. Chi-squared testing compared age groups to belief in climate change. Statistical significance was defined as $p < 0.05$. Normally distributed data are presented as mean \pm SD.

Responses to open-ended questions were qualitatively analyzed independently of the quantitative survey responses. A thematic coding framework was empirically developed for each question, and all responses were independently coded by two members of the research team. Responses that were unrelated to the question or incomprehensible were removed from analysis. Results were quantitated by counting the frequency of each theme, and percentages were calculated as the frequency of a given category or subcategory out of the total number of valid responses.

3. Results

3.1. Demographics

MDH received 6572 survey responses. A total of 4453 completed surveys were included in the analysis. Out of the 4453 responses, 87% of respondents identified as female and 10% of respondents identified as male. The mean age was 50.5 ± 12.9 years. The majority of the respondents were nurses (97%), including RN (78%), LPN (14%), and APRN (8%), while less than 1% of respondents were physicians. Respondents had practiced for a mean of 22.6 ± 13.8 years. The majority of respondents reported practicing in hospitals (39%) or in clinic/ambulatory settings (27%). Almost half (48%) of respondents indicated that the majority of their patients reside in suburban areas, 44% selected rural areas, 43% urban areas, and only 5% selected tribal areas (Table 1).

Table 1. Respondent demographics and relation to belief in climate change.

Demographic Factor	Number of Respondents n (%)	Respondents Who Agree or Strongly Agree That Climate Change Is Happening n (%)
Gender		
Female	3863 (87)	2950 (76)
Male	434 (10)	289 (67)
Prefer not to answer	93 (2)	32 (34)
Other	10 (0)	3 (30)
No response	53 (1)	
Total	4453 (100)	
Age (y) ¹		
18–29	267 (6)	233 (87)
30–44	1177 (26)	917 (78)
45–59	1581 (36)	1084 (69)
60+	1328 (30)	1014 (76)
No response	100 (2)	
Total	4453 (100)	
Years practicing (y)		
0–4	426 (10)	350 (82)
5 to 9	535 (12)	432 (81)
10 to 14	550 (12)	408 (74)
15 to 19	446 (10)	304 (68)
20+	2463 (55)	1791 (73)
No response	33 (1)	
Total	4453 (100)	

Table 1. Cont.

Demographic Factor	Number of Respondents n (%)	Respondents Who Agree or Strongly Agree That Climate Change Is Happening n (%)
License ²		
MD	36 (1)	31 (86)
DO	7 (0)	2 (29)
RN	3474 (78)	2606 (75)
APRN	364 (8)	281 (77)
LPN	607 (14)	416 (69)
Other	39 (1)	31 (79)
No response	27 (1)	
Practice or type of work ²		
Primary care	952 (21)	700 (74)
Critical care	642 (14)	465 (72)
Surgical care	546 (12)	392 (72)
Other specialty care	1362 (31)	1040 (76)
Scientific research	56 (1)	37 (66)
Other	1285 (29)	974 (76)
No response	24 (1)	
Setting ²		
Clinic or ambulatory	1185 (27)	882 (74)
Hospital	1721 (39)	1264 (73)
Professional office	164 (4)	111 (68)
Academic	154 (3)	118 (77)
LTC	757 (17)	575 (76)
Other	701 (16)	544 (78)
No response	112 (3)	
Patient residence ²		
Tribal	241 (5)	177 (73)
Urban	1929 (43)	1499 (78)
Suburban	2130 (48)	1609 (76)
Rural	1951 (44)	1392 (71)
Other	150 (3)	106 (71)
No response	50 (1)	

¹ Chi-squared (χ^2), p -value: 45.0, <0.05 , compared belief in climate change to age group. ² Respondents were able to choose more than one option to answer the question.

3.2. Attitudes toward Climate Change and Health

Of the total respondents included in the analysis, 75% ($n = 3303$) strongly agreed or agreed that climate change is happening, and 60% ($n = 2696$) strongly agreed or agreed that “Climate change directly or indirectly impacts the health of my patients, clients, or community members”. More females (76%) agreed that climate change is happening than males (67%). There was an association between belief in climate change and age, with individuals aged 18–29 ($n = 267$) more likely to strongly agree or agree that climate change is happening ($\chi^2 = 45.0$, $p < 0.05$) than the other age groups. Eighty-seven percent of individuals between the ages of 18–29 believed in climate change compared to 78% of ages 30–44, 69% of ages 45–59, and 76% of ages 60 and over (Table 1).

Among those who strongly agreed, agreed, or neither agreed nor disagreed that climate change impacts health ($n = 3468$, 78%), more than two-thirds considered climate change to always, often, or sometimes play a role in causing or exacerbating respiratory problems (74%) and mental health issues (66%). Lower percentages of respondents indicated that climate change caused or exacerbated extreme heat illness (55%), vector borne diseases (47%), and physical trauma related to extreme weather (41%) (Figure 1). More than three-quarters of the respondents reported feeling concerned about the health impacts of climate

change on patients/clients (76%). In addition, the majority of respondents (59%) strongly agreed or agreed that “Healthcare professionals are positioned to help patients/clients understand the health impacts from climate change”.

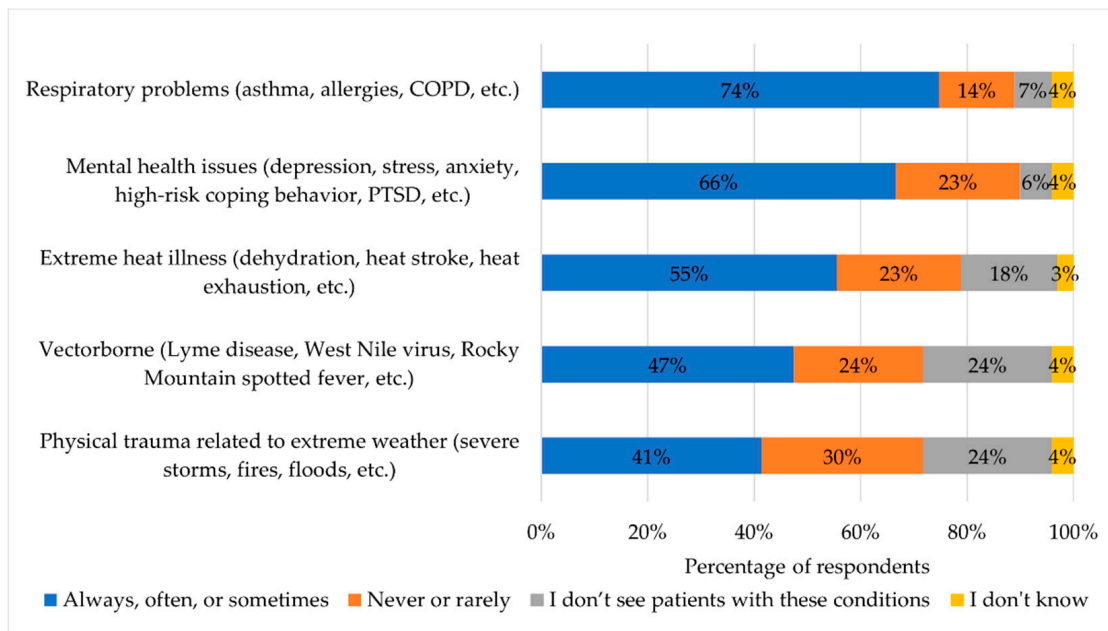


Figure 1. Perceived impact of climate change on patient or client health conditions (n = 3443).

Despite this, only 20% strongly agreed or agreed that they feel well prepared to discuss the health impacts of climate change with patients or clients. Similarly, only 21% felt comfortable counseling patients/clients about climate change and health (Figure 2). Even fewer, 4%, reported that they discuss the impacts of climate change on health with all or most of their patients, while 13% said they discuss this with some of their patients, and 83% with a few or none of their patients.

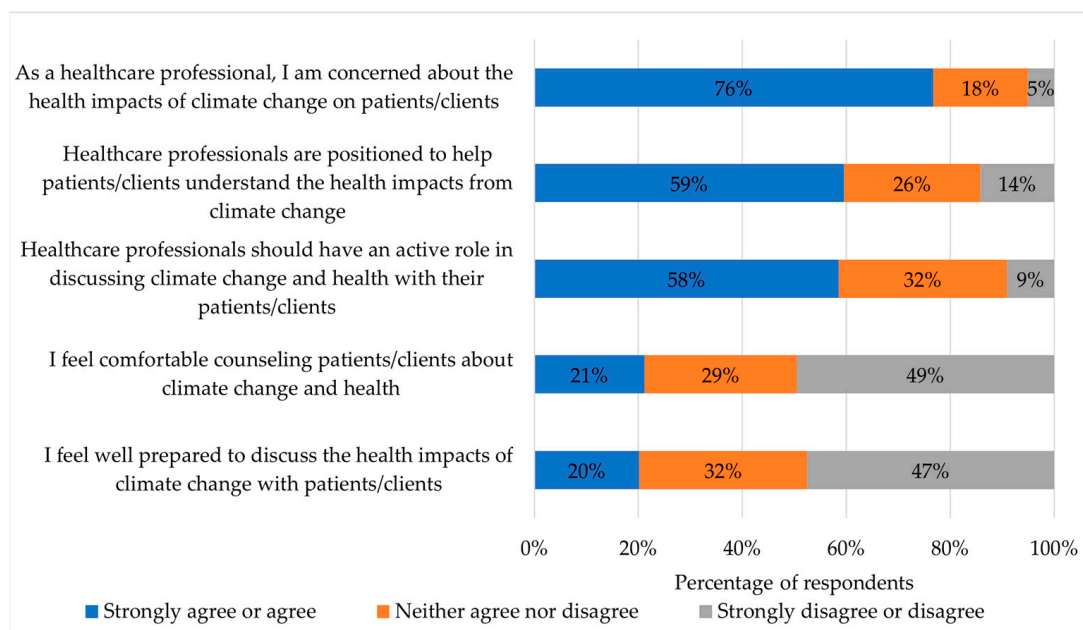


Figure 2. Respondent self-reported level of concern, preparation, comfort, role in addressing climate change, and whether they feel positioned to help patients or clients (n = 3448).

3.3. Barriers to Discussing Climate Change and Desired Resources

Figures 3 and 4 presents summary statistics for barriers to discussing climate change with patients and resources needed to address climate change. The three most commonly reported barriers were lack of knowledge regarding how to approach this issue with my patients or clients (57%), lack of time (40%), and perceived lack of patient interest (29%). Respondents most often selected the following resources as being helpful in discussing climate change with patients: continuing education courses (57%), research articles (46%), patient or client education materials (46%), and case studies or clinical care examples (38%).

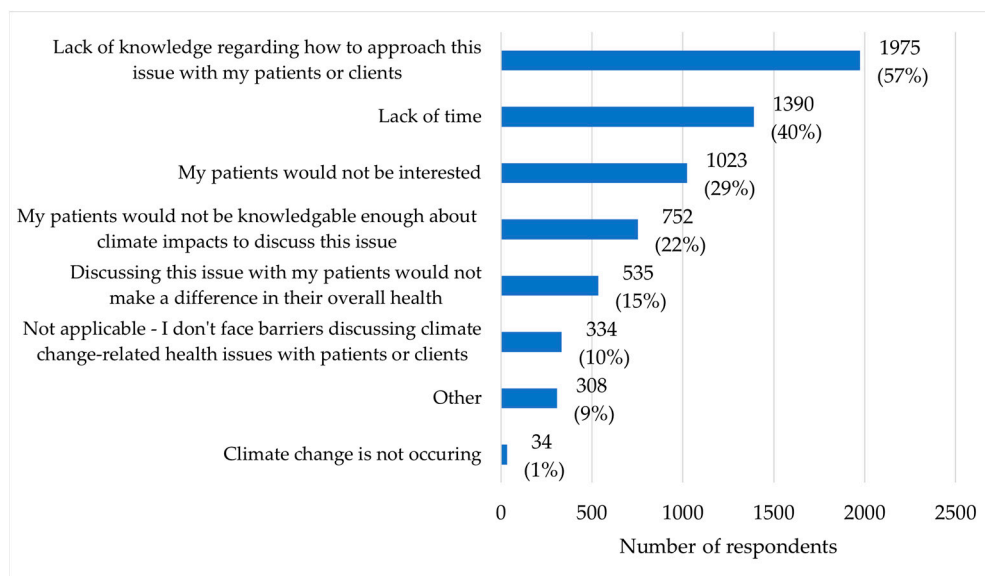


Figure 3. Barriers to discussing climate change with patients or clients (n = 3381).

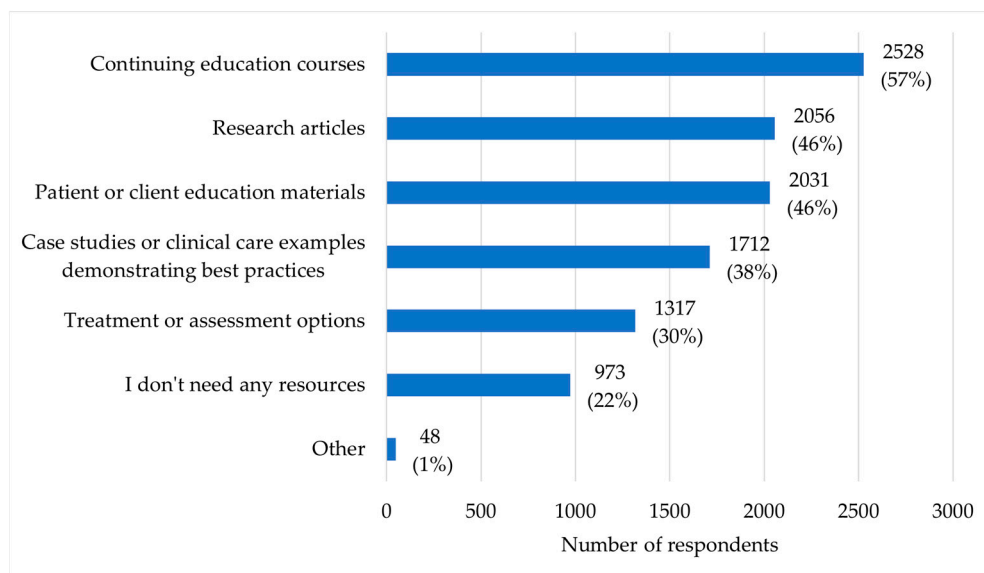


Figure 4. Resources requested by respondents (n = 4196).

A total of 510 respondents provided a valid response to the open-ended question, “Please describe sources of information on the health impacts from climate change that you already rely on or that you would recommend to other healthcare professionals.” Scientific research or journal articles (109 responses) were mentioned the most often, followed by news articles or the media (98), and internet or websites (61) (Table S1).

3.4. Climate Change Conversations

A total of 929 participants provided responses to the prompt “Please provide one or more examples of conversations you have had with patients related to climate change and health”. (Table S2). The most frequent theme of these conversations was impacts of climate change on respiratory health (355), particularly increased severity and frequency of allergies (154), and exacerbation of asthma (122) and COPD (48). A number of respondents also discussed air quality/air pollution (112) (Table S2). The second most cited theme was related to health impacts from temperature changes (276), including hotter summers and extreme heat-related impacts (133), sun and UV exposure (53), and winter weather and extreme cold (51). These conversations primarily aimed to increase patient awareness of health harms and provide recommendations. Other themes mentioned were mental health impacts (84) and impacts on underlying chronic conditions (non-respiratory) (46).

3.5. Actions or Other Thoughts Related to Climate Change and Health

A total of 439 participants provided responses to the question “What else, if anything, are you doing to address climate change with patients or clients?” Educating patients about climate change and health impacts was the theme most often shared (111). Respondents also discussed ways patients can protect themselves from the health impacts of climate change (86). The next most common response was engaging in and/or recommending individual actions for climate change mitigation (62). A total of 137 respondents indicated that they were not doing anything to address climate change with patients or clients. Reasons for this inaction included a lack of knowledge on the subject (18), prioritizing other health issues (16), viewing the issue as not relevant to their patients or practice (19), or political polarization around climate change (15) (Table S3).

A total of 856 participants responded to the open-ended question “What other thoughts do you have regarding the health impacts from climate change?” This question was presented to all survey participants regardless of their answers to the initial questions assessing belief in climate change and its health impacts. The responses were first categorized based on the respondents’ perception of climate change impacting health. A total of 373 responses expressed agreement that climate change is impacting health, whereas 383 indicated disagreement with this premise, and 100 indicated uncertainty or neutrality (Table S4).

Themes among the responses indicating agreement included that climate change is having real health impacts (163), there is a need for more resources and education (74), and challenges to discussing and addressing climate change (72), including the politicization of climate change (36) and lack of time (12). Among responses that were categorized as neutral, 21 expressed skepticism or uncertainty and a need for more evidence of health impacts of climate change and 21 indicated that other health problems were more important to address. Of the respondents disagreeing that climate change impacts health, the most frequent theme was that the issue is political (118), dismissing climate change as a political tactic rather than an actual threat. Other themes included that climate change is not occurring (74), that it is occurring but due to natural reasons rather than being anthropogenic (82), and that other health issues are more important (71).

4. Discussion

MDH conducted a survey of healthcare professionals in Minnesota to assess their observations of the clinical manifestation of climate change, examine their knowledge, attitudes, and practices toward climate change and health, and explore the barriers they are facing in addressing climate change with patients. The findings from this study identified that respondents recognize that climate change is happening, are concerned about the health impacts on patients, and believe they have a role in addressing climate change. However, we also found that they do not feel comfortable nor prepared to discuss climate change with their patients, and there are many barriers and resources needed to support healthcare professionals in addressing climate change with patients. Healthcare professionals play an important role in educating patients about a variety of health risks. Therefore, we

must address their concerns and utilize this opportunity to advance our response to climate change.

4.1. Healthcare Professionals Understand the Climate Change Is Happening

Quotes from respondents:

“This is something we all need to recognize as happening here and now”

“I think climate change related health problems are only going to increase as problems get worse (more fires, less vegetation, increased tick population, poorer air quality)”

Our findings reinforce earlier study findings that healthcare professionals believe climate change is happening and are concerned about climate change and its adverse effects on human health. The majority of respondents agreed that climate change is happening (75%), similar to but slightly lower than specialty physician studies, which found that 81–98% of respondents believed in climate change [10–13]. A study of nurses, based on a different framework, also found moderate levels of awareness about the health impacts from climate change (2.97 mean score out of 0–4) [15].

Sixty percent of respondents agreed or strongly agreed that climate change was currently impacting the health of their patients or clients, demonstrating that healthcare professionals in Minnesota are recognizing current impacts from a changing climate. Findings from specialty physician surveys found that 64% of family physicians, 69% of thoracic physicians, and 74% of allergists reported that climate change was currently impacting the health of their patients [11–13]. The youngest age grouping, ages 18–29 years, had the highest percentage of respondents reporting that they believe in climate change (87%). These findings are similar to a recent Yale study, which found that younger adults were more likely than older adults to view global warming as personally important and report feeling concerned about climate change [16]. However, this age group also had the lowest number of respondents, making up only six percent (6%) of the total survey participants.

4.2. Healthcare Professionals Are Concerned about the Health Impacts on Their Patients

Quotes from respondents:

“I spoke with my patient about why his COPD and seasonal allergies seem to be worse over the last few years. I explained to him that our warming climate meant a prolonged pollen season and that this was affecting his health.”

“I experience climate grief often. I think it is the fundamental and primary problem we face right now, and our society has to change in fundamental ways to address it. We are connected to the earth, and affronts to the earth are affronts to ourselves and our health.”

Excluding respondents who disagreed that climate change is impacting health, more than three-fourths of respondents (76%) reported feeling concerned about the health impacts of climate change on their patients. A similar percentage of respondents (74%) reported always, often, or sometimes associating climate change with respiratory conditions among their patients, suggesting that they are concerned because they are seeing the health impacts of climate change on their patients firsthand. Two-thirds of respondents also reported always, often, or sometimes associating climate change with mental health conditions (66%) among their patients, further suggesting that climate change is already having health impacts in Minnesota. In a study of family physicians from 2019, respondents also reported most often seeing respiratory disease and mental health issues in practice [13]. Studies by George Mason University found similar results, with the majority of respondents indicating they were observing the impacts of climate change on the health of their patients, most commonly as increases in respiratory conditions due to air pollution or allergies [10–12]. These earlier studies did not include mental health conditions as an option.

4.3. Healthcare Professionals Have a Role in Helping Patients Understand the Health Impacts from Climate Change

Quotes from respondents:

"I may not talk about climate change directly, but I educate patients on how to prevent disease and injury related to climate change such as heat exhaustion, Lyme disease, fire safety, etc."

"It IS happening and we should confront it and assist as much as we can with patients NOW, because it is only going to worsen!"

As previously noted, a study of family physicians found a high level of belief in climate change (98%); however, less than one-third (31%) of the physicians in this study expressed that they should have an active role in addressing climate change with their patients [13]. Our study of a predominantly nursing cohort found that more than half (58%) of respondents believed that healthcare professionals should have an active role in addressing climate change with patients, suggesting that there is growing recognition among healthcare professionals to integrate climate change into the delivery of healthcare.

This increase may reflect an attitude difference between nurses and physicians, or it may represent a shift in the perceptions of healthcare professionals about their responsibilities. Our study occurred amid robust public and professional discourse regarding climate change and its impact on health. Many major medical journals published clear and urgent calls to action by healthcare professionals and others [19–23]. In addition, professional organizations in Minnesota, including the Minnesota Organization of Registered Nurses (MNORN) and Health Professionals for a Healthy Climate (HPHC), sponsored training opportunities to educate healthcare professionals about climate and health. Local professional medical societies, such as the Minnesota Academy of Family Physicians, adopted formal resolutions about climate change and health, and fourteen healthcare professional organizations signed on to and presented a Declaration on Climate Change and Health to the Minnesota State Legislature in 2021 [24,25].

4.4. Healthcare Professionals Do Not Feel Prepared to Address Climate Change with Patients

Quotes from respondents:

"I don't know enough about climate change and how affects health to discuss"

"This is a very important issue that I do not know enough about and is NOT talked about enough in a healthcare setting."

Despite the large portion of respondents recognizing the importance of climate change, many indicated that they were not well equipped to address climate change with patients or clients. Only 1 in 5 respondents reported feeling well prepared (20%) or comfortable (21%) counseling patients about climate change and health, while almost half of respondents disagreed or strongly disagreed with these statements. Similarly, only 4% of respondents reported that they discussed climate change with all or most of their patients, indicating that feeling unprepared or uncomfortable may be preventing healthcare professionals from engaging in conversations about climate change with patients.

More than one-third of those who responded to the question asking what else they are doing to address climate change indicated they were not doing anything, further demonstrating the gap between awareness and action. Those who did report addressing climate change with patients most often mentioned educating patients about climate change and health (25%) and discussing ways patients can protect themselves from the health impacts of climate change (20%).

4.5. Barriers to Addressing Climate Change

Quotes from respondents:

"I wish I was better prepared, with more knowledge. I have not thought about these climate change questions in a survey like this before today."

“I did not know this was something we should be discussing with patients and I think many professionals would need information regarding climate change and the impact it can have on healthcare.”

Closed and open-ended questions provide insight into the barriers preventing healthcare professionals from addressing climate change with patients. The most common barrier from the closed-ended question was a lack of knowledge regarding how to approach this issue with patients or clients (57%), which may be contributing to feeling unprepared or uncomfortable in addressing climate change with patients.

The second most common barrier reported was lack of time, which has also been identified in earlier studies [13]. On average, the length of an office visit with a primary care physician lasts about 15 min [26]. While it has been estimated that nurses may spend twice as much time with patients, they still only spend about one-third of their shift with patients [27]. Similarly, many respondents noted that patients often have urgent health conditions, including COVID-19, that they must prioritize given time constraints.

Another common barrier referenced by both respondents who agreed and disagreed that climate change was impacting health was the political positioning of climate change. In response to the open-ended question asking about other thoughts related to climate change and health, those who believed that climate change is impacting health referred to the politicization as a barrier, while those who disagreed that climate change is impacting health dismissed climate change as a political tactic rather than an actual threat. The topic of climate change remains a polarizing political issue across the nation. Political affiliation was found to correlate with belief in climate change in a recent study from Yale University [16]. In this study, respondents reporting a more conservative political affiliation were less likely to believe that climate change is happening [16].

4.6. Applications to Practice

Quotes from respondents:

“CEU courses should be offered for free from organizations locally and globally to help healthcare professionals”

“I hope that in the near future hospitals will address the lack of information available to medical staff to educate the public”

While our study identified many barriers to addressing climate change within the healthcare system, respondents also highlighted resources that would be helpful and can be used to inform next steps. Respondents most often indicated that continuing education courses (57%) and research articles (46%) are needed. Providing these resources would directly address the lack of knowledge that was reported as a barrier by healthcare professionals in this study. Another important next step involves working with academic institutions to ensure that all healthcare professional schools have climate change and health content in their curriculum. This goal may be facilitated by developing partnerships with State Boards of Medicine and Nursing to discuss the urgent need for climate-ready professionals. Patient or client education materials were another commonly requested resource, potentially identifying a solution for healthcare professionals with limited time to get important information about climate change to patients.

Most respondents in our study reported believing that climate change is important and impacting health, but we also identified a proportion of respondents who appeared to be undecided about climate change and the impacts on health. Almost 1 in 5 respondents (18%) neither agreed nor disagreed that they were concerned about the health impacts of climate change on patients, suggesting that there may be an undecided or naïve group toward whom educational efforts may be targeted. We also identified a subset of healthcare professionals who care for patients with climate-related conditions, but never or rarely consider climate change as playing a role in causing or exacerbating the health conditions. This finding further demonstrates opportunities for education of healthcare professionals.

To enhance education and provide better healthcare services, future studies are needed to determine unique impacts that climate change has on vulnerable populations in Minnesota including youth; rural; elderly; and Black, Indigenous, People of Color (BIPOC). As the world heats we will need more data about demographic shifts in Minnesota related to relocation and immigration due to extreme weather events and/or inhospitable environments both inside and outside Minnesota. We also need evaluative studies to understand and promote best practices both in climate change mitigation and adaptation for health protection.

4.7. Limitations

Our study originally aimed to compare physicians and nurses on their perspectives toward climate change and health; however, relatively few physicians responded to the survey. The disproportionately low rate of physician responses limited the ability to compare and contrast their knowledge, attitudes, and practice with nurses and limited the ability to generalize the findings to physicians across Minnesota. Additionally, our study used a convenience sample, which may also impact the representativeness and generalizability of our findings to healthcare professionals in Minnesota. While recent data from MDH suggests that nursing professionals (RNs, APRNs, LPNs) outnumber physicians (MD/DOs) with a ratio of 6:1, physicians in our survey constituted less than 1% of the total response [28]. The greater response by nurses may have been due to a stronger outreach to nurses. The Minnesota Board of Nursing disseminated the survey to Board certified nurses, while the Minnesota Board of Medical Practice did not distribute the survey to physicians. An additional limitation of our study is the possibility of response bias resulting from the wording of the survey questions. While our advisory committee attempted to reduce bias in the development of the survey questions, it is possible that the wording of the questions influenced how respondents answered the questions.

5. Conclusions

While the majority of healthcare professionals who responded to the survey believed climate change is important and impacting health, we found that only about 1 in 5 respondents reported feeling well prepared to discuss climate change with patients (20%) or comfortable counseling patients about climate change and health (21%). Our study identified significant challenges facing healthcare professionals in addressing climate change with patients with respondents most often reporting lack of knowledge (57%), lack of time (40%), and perceived interest among patients (29%) as barriers to these conversations. Even though this study focused on climate change, we believe these barriers also impact discussions about other planetary health threats. Healthcare professionals are a vital source of information for patients; thus, these barriers need to be addressed through education and resource development to make progress in addressing climate change locally and across the world. Additional research is needed to investigate whether conversations by a healthcare professionals can influence a patients' knowledge and behavior related to climate change and how healthcare organizations can better develop skills in their employees for having climate-related conversations. Our findings also highlight an educational imperative to develop 'bedside' ready training for nurses and other healthcare professionals on integrating climate and planetary health conversations into patient care. Climate change and other disruptions of the Earth's natural systems drive cascading impacts not only to human health but to planetary health as well. Given the dire state of our planet and the urgent climate crisis, we call all healthcare professionals and allies to lead the way in developing a new norm—threats to planetary health are real and healthcare professionals can provide a trusted voice in helping people adapt to and mitigate climate change and other planetary health crises. With adequate education, restoring planetary health can be a core strategy at every clinic visit, in every treatment plan, and every community and public health initiative.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/challe13020057/s1>, Table S1: Analysis of open-ended question, “Please describe sources of information on health impacts from climate change that you already rely on or that you would recommend to other healthcare providers” (n = 510); Table S2: Analysis of open-ended question, “Please provide one or more examples of conversations you have had with patients related to climate change and health.” (n = 929); Table S3. Analysis of open-ended question, “What else, if anything, are you doing to address climate change with patients or clients? (n = 439); Table S4. Analysis of open-ended question, “What other thoughts do you have regarding the health impacts from climate change?” (n = 856).

Author Contributions: Conceptualization, M.K., K.R., B.M.D., E.O., S.G. and T.P.; methodology, M.K., K.R., B.M.D., E.O., S.G. and T.P.; software, M.K. and B.M.D.; validation, M.K., K.R., B.M.D. and E.O.; formal analysis, M.K.; investigation, M.K., K.R. and B.M.D.; resources, M.K.; data curation, M.K. and B.M.D.; writing—original draft preparation, M.K., K.R., B.M.D., E.O., S.G. and T.P.; writing—review and editing, M.K., K.R., B.M.D., E.O., S.G. and T.P.; visualization, M.K. and K.R.; supervision, K.R.; project administration, M.K.; funding acquisition, M.K. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported in part by an appointment to the Applied Epidemiology Fellowship Program administered by the Council of State and Territorial Epidemiologists (CSTE) and funded by the Centers for Disease Control and Prevention (CDC) Cooperative Agreement Number 1NU38OT000297-03-00. The findings and conclusions are solely those of the authors and do not necessarily reflect the views of the Centers for Disease Control and Prevention.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Appendix A

Minnesota Survey of Healthcare Professionals on Climate Change and Health.

1. Are you a nurse or physician that is currently licensed to practice or has been licensed to practice in the past 12 months in Minnesota?
 - Yes, I am a nurse that is licensed to practice or has been licensed to practice in the past 12 months in Minnesota
 - Yes, I am a physician that is licensed to practice or has been licensed to practice in the past 12 months in Minnesota
 - No
2. Are you actively practicing in your licensed field or have you practiced in the past 12 months? (Practicing in this context may involve seeing patients, clients, or community members and can include in-person or virtual appointments.)
 - Yes
 - No

Demographic Information

3. What best describes your current health provider license? (Check all that apply)
 - MD
 - DO
 - RN
 - APRN
 - LPN
 - Other _____
4. Which of the following best describes your practice or type of work? (Check all that apply)
 - Primary care (family medicine, internal medicine, pediatrics)
 - Critical or emergency care

- Surgical care
 - Other specialty care _____
 - Scientific research
 - Other _____
5. Which of the following best describes the primary setting for your practice? (Check all that apply)
- Clinic or ambulatory care
 - Hospital
 - Professional office
 - Academic (teaching or research)
 - Long-term care facility or home health care
 - Other _____
6. Which of the following describes the areas in which the majority of your patients or clients reside? (Check all that apply)
- Tribal
 - Urban
 - Suburban
 - Rural
 - Other _____
7. How many years have you been practicing? Years _____
8. What is your age? Age _____
9. What is your gender?
- Female
 - Male
 - Other
 - Prefer not to answer

Information about Climate Change and Health

The following items focus on your knowledge, attitudes, and practices related to climate change and health and your experiences in your practice with patients, clients, or community members.

10. To what extent do you agree or disagree with the following statement: Climate change is happening.
- Strongly agree
 - Agree
 - Neither agree nor disagree
 - Disagree
 - Strongly Disagree
11. To what extent do you agree or disagree with the following statement: Climate change directly or indirectly impacts the health of my patients, clients, or community members.
- Strongly agree
 - Agree
 - Neither agree nor disagree
 - Disagree
 - Strongly Disagree

Below is a list of some health conditions that may be linked to climate change.

12. When you see patients or clients with the following categories of conditions, how often do you consider that climate change is playing a role in causing or exacerbating the conditions?

	Never	Rarely	Sometimes	Often	Always	I Don't Know	I Don't See Patients/Clients with These Conditions
Respiratory problems (asthma, allergies, COPD, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vectorborne diseases (Lyme disease, West Nile virus, Rocky Mountain Spotted fever, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme heat illnesses (dehydration, heat stroke, heat exhaustion, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical trauma related to extreme weather (severe storms, fires, floods, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mental health issues (depression, stress, anxiety, high-risk coping behavior, post-traumatic stress disorder, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. Please indicate the extent to which you agree or disagree with the following statements.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
As a healthcare professional, I am concerned about the health impacts of climate change on patients/clients.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Healthcare professionals are positioned to help patients/clients understand the health impacts from climate change.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel well prepared to discuss the health impacts of climate change with patients/clients.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel comfortable counseling patients/clients about climate change and health.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Healthcare professionals should have an active role in discussing climate change and health with their patients/clients.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. With what proportion of your patients or clients do you discuss the impact of climate change on their health?

- All
- Most
- Some
- A few
- None

15. Please provide one or more examples of conversations you have had with patients related to climate change and health.

16. Which of the following barriers prevent you from discussing climate change-related health issues with patients or clients? (Check all that apply)

- Lack of time
- Lack of knowledge regarding how to approach this issue with my patients or clients
- My patients or clients would not be interested
- My patients or clients would not be knowledgeable enough about climate impacts to discuss this issue
- Discussing this issue with my patients or clients will not make much difference in their overall health
- Climate change is not occurring
- Not applicable—I don't face barriers discussing climate change-related health issues with patients or clients.
- Other _____

17. What else, if anything, are you doing to address climate change with patients or clients?

Information about Climate Change for Healthcare Professionals

18. Which of the following resources related to climate change and health, if any, would be helpful for you? (Check all that apply)
- Research articles demonstrating the link between climate change and clinical outcomes
 - Treatment or assessment options
 - Continuing education course on climate change and health
 - Patient or client education materials
 - Case studies or clinical care examples demonstrating best practices for discussing climate change and health with patients or clients
 - Other _____
 - I don't need any resources
19. Please describe sources of information on health impacts from climate change that you already rely on or that you would recommend to other health care providers.
- _____
20. Optional: What other thoughts do you have regarding the health impacts from climate change?
- _____
21. How did you hear about the survey?
- Licensing board
 - Professional organization
 - Other _____

Thank you so much for your time and sharing your feedback. Your input will be used to develop resources for Minnesota healthcare professionals on climate change and health.

Here are some immediate resources for more information on this topic:

Minnesota Department of Health: Climate & Health (opens in a new window)

Centers for Disease Control and Prevention: CDC's Climate and Health Program (opens in a new window)

American College of Physicians: Climate Change Toolkit (opens in a new window)

Alliance of Nurses for Healthy Environments: Climate Change (opens in a new window)

Health Professionals for a Healthy Climate: Climate change is a health emergency (opens in a new window)

Lancet Countdown: Tracking the connection between public health and climate change (opens in a new window)

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