Climate Resilience Consulting and Abt Global

Extreme Heat Social and Behavioral Science Research

**Final Report
March 1, 2024**

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Extreme Heat Social and Behavioral Science Research Report

I. EXECUTIVE SUMMARY

Hundreds of deaths and thousands of illnesses are attributed to recent heat disasters in the United States.[1, 2] Heat ranks each year among the top weather hazards contributing to fatalities.[3] Consequently, the National Weather Service (NWS) in late 2022 launched a study to identify best practices for communicating and messaging impacts of heat on human health. They included best practices for reaching historically underserved and overburdened populations. With this information, NWS seeks to provide equitable and informed heat products and services to protect public health and prevent the loss of life.

The study involved three research areas: a literature review, online survey, and virtual focus groups. The **literature review** screened hundreds of abstracts and summarized the content of more than 80 reports and journal articles on topics that included heat risk perception, risk awareness, decision-making, and protective actions. The **focus groups** comprised six guided conversations with 40 individuals who play a role in messaging and assisting with behavior change to improve extreme heat outcomes. Key topics included the use of weather forecasts and information, heat-messaging challenges, reaching underserved populations, and opportunities to improve heat messaging.

The **online survey** captured 1,008 responses to 33 questions across six substantive topics encompassing household characteristics, risk perception to extreme heat, communication methods, communication framing, personal actions during extreme heat, and demographic metrics. Most participants indicated a prior heat wave experience (91.4%). Of those, most indicated that it was less than one year ago (60%). Cross-cutting findings of the research appear below.

This report is organized into sections:

- **Introduction** – Background on extreme heat events and the context of the study.
- **Methods** – Study design of the literature review, focus groups, and online survey.
- **Findings** – High-level findings and data from the literature review, focus groups, and online survey.
- **Conclusions** – Application of knowledge including the applicability of overarching study area themes to NWS heat messaging.
- **Future Research Opportunities** – Emerging research questions and topics for future exploration.
- **Appendices** – Study instruments and detailed results.

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[1] Schramm PJ, Vaidyanathan A, Radhakrishnan L, Gates A, Hartnett K, Breysse P. (2021) Heat-Related Emergency Department Visits During the Northwestern Heat Wave — United States, June 2021. Morbidity and Mortality Weekly Report 70:1020–1021.

[2] Vaidyanathan A, Malilay J, Schramm P, Saha S. (2020) Heat-Related Deaths — United States, 2004–2018. Morbidity and Mortality Weekly Report 69:729–734.

[3] National Weather Service. (2023) Weather Related Fatality and Injury Statistics. Accessed Jan 12, 2024.

1.1. Cross-Cutting Heat Communication Findings and Recommendations

This cross-cutting section includes concurrent themes across the survey, the focus group, and the literature review. It corroborates the mixed-method research data reflecting the study's three sources of information.

Emphasize actions to improve health outcomes among those at greatest risk

- Explicit instructions and descriptions should be tailored for people who may not believe they are at risk for negative heat impacts and, consequently, do not act to prevent impacts during dangerous heat.
- People may not always identify certain factors as risk characteristics (e.g., limited English proficiency, racial or ethnic minorities, those living alone, those without a vehicle, those with lower incomes). NWS may play a role in greater education on high-risk characteristics or groups or targeting communication to these high-risk groups.
- Imperative heat-related instructions specifically benefit users of prescription drugs, those with substance abuse disorders, or those needing mental health support.
- Various methods are needed to reach the diverse population of people with disabilities; and others with medical or health conditions, including the deaf, those who use screen readers, and those with cognitive barriers for understanding complex messages.
- Older adults seemed to indicate they are very prepared for heat events, but at the same time identified few needs or immediate risks for heat events; additional engagement may be needed to further prepare this group.
- Involvement of a variety of intermediaries[4] is important, including public health advocates, workers' rights advocates, community leaders, and others who can reinforce messages. Friends and family are trusted sources of information for personal health decisions.

Enact measures to overcome messaging barriers to those at greatest risk

- Trusted intermediaries with cultural competencies who already interact with underserved communities are capable messengers and should be considered beneficial "force multipliers."
- Mass texts that nonprofits send to their network can deliver messages directly to households, especially in areas with lower internet or TV connectivity.
- Radio stations, including non-English stations, are important communication vehicles for immigrant populations.

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[4] The word "intermediary" used throughout this report describes an institution that serves populations of concern, such as school districts, Occupational Safety and Health Administration, health departments, clinics, religious organizations, libraries, case workers, and fire departments.

Make messages clear and concise, but use the strongest warning language strategically to avoid message fatigue.

- Message effectiveness decreases if too many details about heat warnings and watches are provided, reflecting that 3 in 5 U.S. adults did not graduate from college and 1 in 5 has literacy challenges.
- Intermediaries can help develop and design messaging, including concise terminology, to reduce confusion by the public.
- Messages that are most helpful describe the risks of heat-related illness and death and actions to the general public, populations of concern,[5] the private sector and government. The least helpful messages focus on mortality and morbidity or on temperature.
- The use of more severe terms like "deadly" do catch people's attention, but may need to be used judiciously versus becoming part of routine heat messaging.

Tailor specific messaging in terms of location, severity, and other locally relevant factors, including language

- Local context allows for cultural competence and local specificity of actions, especially in immigrant or Black, Indigenous, and People of Color (BIPOC) communities.
- Messaging with local data (e.g., temperature within a neighborhood, proximity to a landmark) helps gain people's attention.
- Educational material, funding, and other support help case workers reach those experiencing homelessness and learn more about their culture, including their gathering places, information networks, and their needs.
- Craft appropriate messaging when a particular heat event differs from prior events (e.g., length, temperature, frequency, time of year).

Use multiple platforms to distribute messages and employ systematic means for partners to amplify information

- Multiple trusted intermediaries help since people often look for confirmation among people around them.
- Partners may have stories that describe impacts and solutions, helping create an emotional connection, and changing attitudes and behaviors.
- Heat messages should be tailored to the likely end user, by platform and information source.

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[5] The focus group results include a list of populations of concern. These are key groups of stakeholders indicated by focus group participants as at greater risk of negative extreme heat impacts, and may also include but are not limited to historically underserved or marginalized groups.

Issue heat-related communication sooner

- Some people (including some outdoor and indoor hourly-wage workers) cannot alter their behavior if they only become aware it will be a high heat day that morning and they are expected at work where it could be extremely hot.
- People need a plan of action for high heat periods so they may take action during the event.
- Heat-related watch communication could include suggested proactive steps such as planning for cooler situations for loved ones, drinking more water, bringing electrolytes to work and making alternate transit arrangements.
- While most households surveyed only needed less than 24 hours to prepare for a heat event, one-in-10 households may need more time to prepare. Across survey participants, one-third requested more advance notice.

Expand the network of trusted intermediaries disseminating messages to include medical professionals, social workers, and such community members as faith leaders

- Heat is a multifaceted issue that impacts and is affected by health, housing, and other economic and social factors; trusted intermediaries need a rationale (related to illness and death) to want to become part of extreme heat communications and other solutions.
- Partnerships with public health and nongovernmental institutions as well as other units of federal, tribal, and sub-sovereign governments can help ensure that NWS messaging pairs with resources that help populations of concern take action.
- The use of many partners offers the opportunity to try myriad messaging strategies to overcome access challenges commonly found in underserved communities.
- Besides WhatsApp, Facebook, Instagram, and websites (including downloadable information) are effective in sharing cooling center locations, and this information can be distributed at libraries, laundromats, grocery stores, schools, and bus stops.

Coordinate with local institutions on a regular basis to leverage their capabilities and networks when heat events occur

- Intermediaries can provide instructions on accessing resources when extreme heat is combined with other climate or safety issues.
- Local institutions benefit from instructions about secondary or tertiary risks that extreme heat may cause (such as foodborne illness or drowning deaths).
- Cooling shelter can change policies for greater appeal (e.g., to allow shopping carts, pets, napping, omit requirements for signing in).

Better define federal agency roles about heat to achieve unified messaging and goals

- [National Integrated Heat Health Information System (NIHHIS)](#) partners[6] might inform and inspire local government and community actions to reduce heat impacts in underserved communities since locals best understand the community context. These communities may lack historical investment in cooling solutions that address issues up the causal chain, such as urban design, urban canopy, bus shelter placement, public water fountains, and building integrated shading.
- The desire exists for other agencies to message decision makers about non-polluting ways to expand thermal comfort without significantly raising individual/household energy bills. These ways include tree canopy expansion, cool roofs, splash pads, public water fountains, district cooling systems, bus stop shade and misters, solar power air conditioners, and energy-efficient air conditioners.

Emphasize preparedness

- Advance outreach and education are needed around heat events, including back-up plans. A subset of survey participants indicated they would not take any actions to stay cool or would not take actions until it becomes hot indoors or someone becomes ill. Additionally, nearly 30% of participants indicated they could not protect themselves at all or not do so easily if a cascading emergency were to occur (such as power outage concurrent with a heat event).
- Core needs to prepare for heat events include access to air conditioning, funds, water, shade, and work flexibility. Federal agencies and partners should seek to close gaps for community members seeking access to these resources. NWS and partners should support advance planning through tabletop exercises, weather briefings, and other means.
- Reinforce the myriad measures that residents can use to protect themselves, including "no cost" protective actions (e.g., avoid time outdoors, seek shade, limit strenuous activity, wear lightweight clothing) that lower-income residents may be able to adopt more readily.

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[6] NIHHIS Federal partners include National Oceanic and Atmospheric Administration, Centers for Disease Control and Prevention, Administration for Community Living, Administration for Children and Families, Administration for Strategic Preparedness and Response, Environmental Protection Agency, Department of Housing and Urban Development, Federal Emergency Management Agency, Department of Defense, Department of Energy, Department of Transportation, National Institute for Occupational Safety and Health, Department of Veterans Affairs, U.S. Census Bureau, Forest Service, National Park Service, Department of Health and Human Services, National Institute of Environmental Health Sciences, Occupational Safety and Health Administration, Substance Abuse and Mental Health Services Administration, and United States Agency for International Development.

2. INTRODUCTION

The National Weather Service (NWS) has set a priority to enhance services for historically underserved and overburdened communities at greater risk for negative health impacts from extreme heat. [Underserved communities are defined and highlighted in Executive Order 13985, Advancing Racial Equity and Support for Underserved Communities Through the Federal Government].

While the NWS continues to enhance its heat-related products and services, room for significant improvement persists, particularly in bridging the gap between physical science information and how it is received and acted upon by the public and partners.

This study identifies best practices for communicating and messaging the impacts of heat on human health by using a multifaceted study that analyzes public perception and understanding of heat. The goal is to identify best practices for communicating and messaging the impacts of heat on human health by drawing from relevant literature and analyzing public perception and understanding of heat. The results will inform NWS messaging at the national, regional, and local levels so the public and at-risk populations take appropriate actions to prepare and protect against heat impacts. As a co-lead of NIHHIS, the NWS will share this report with partner federal agencies to inform interagency efforts on heat and heat health messaging.

This report's audience is NWS leadership and the NWS Public Weather Services Program (Public Program) that focuses on policies, procedures, and tools for extreme heat. NWS project leads hope to inform the Public Program's messaging efforts, practices, and future research.

The study used a mixed methods approach, including a literature review, a series of virtual focus groups, and public survey. The focus groups explored how public, nonprofit, corporate, and academic stakeholders message heat information and resources, particularly for underserved communities. The quantitative survey used a sample of the U.S. population and concentrated more broadly on conceptualizing the public's perception and understanding of heat.

The study identified populations of concern, inclusive of historically underserved communities, and addressed these questions:

- **Question 1:** How do people perceive the dangers of heat on the human body?
- **Question 2:** How do people perceive their personal risk of experiencing negative impacts from heat?
- **Question 3:** How do location and experience impact public perception and understanding?
- **Question 4:** What information do people use to make decisions on protecting themselves and/or others from the impacts of heat?
- **Question 5:** Do people know how to protect themselves and/or others from the impacts of heat on the human body?

Study Background

A. Heat-related Impacts
- More than 1,200 deaths and 28,000 hospitalizations annually are attributed to heat exposure, making it a leading weather-related killer.[7]

B. Climate Change Connection
- Extreme heat links closely to climate change with National Oceanic and Atmospheric Administration's global analysis showing the 10 warmest years on record occurred since 2005.[8]
- Heatwaves are more frequent and more intense and prolonged.

C. Vulnerability of Underserved Communities
- Historically, underserved and socially vulnerable communities face increased vulnerability because of such factors as low incomes, a lack of housing, physical disabilities, and language barriers.

D. NWS Response
- The NWS acknowledges the need to enhance services for underserved communities and address the rising heat-related impacts.
- The NWS has expanded its modeling and forecasting capabilities, offering such tools as the Wet Bulb Globe Temperature forecasts and a prototype HeatRisk index.

E. Equitable Communication Strategies
- NWS has improved national heat messaging by incorporating information on populations susceptible to heat impacts.
- Accurate forecasts must be complemented by Social, Behavioral, and Economic Sciences to ensure effective communication and messaging, which is what sparked NWS to program this study.

F. Challenges and Research Needs
- Challenges include the perception of heat as a 'silent killer' because of inconsistencies in reporting, localized impacts, and the difficulty of visually representing extreme temperatures.
- Heat's impacts are local and vary at the individual level, posing challenges in developing outreach materials and community action plans.
- Risk perception doesn't necessarily align with actual risk, with specific research needs identified, such as rural locations, large representative samples, and understanding social/cultural components of interventions.
- High risk populations need more than heat messages to protect themselves from heat. Work, transportation, housing and other institutional systems need to allow for them to stay cool.

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[7]CDC. (2024) Extreme Heat.
[8] CDC. (2024) Climate.gov.

3. METHODS

This project was mixed methods; employing a literature review that used snowball sampling, a public survey of 1,000 respondents, and focus groups with 40 experts from various sectors.

3.1. Literature Review

To investigate best practices for heat-related communications and messaging, the contractor team led by Climate Resilience Consulting (CRC) and Abt with support from Kim Lundgren Associates (KLA) and advice from academic experts, undertook a literature review to analyze public perception and understanding of heat. The review occurred in October and November 2022.

The review examined these research questions as determined with NWS:

- **Question 1:** How do people perceive the dangers of heat on the human body?
- **Question 2:** How do people perceive their personal risk of experiencing negative impacts from heat?
- **Question 3:** How do location and experience impact public perception and understanding?
- **Question 4:** What information do people use to make decisions on protecting themselves and/or others from the impacts of heat?
- **Question 5:** Do people know how to protect themselves and/or others from the impacts of heat on the human body?

The CRC team further collaborated with NWS to determine key search terms and conduct searches using combinations of these terms.

Literature Review Search Strings	
String	**Terms**
String 1	"extreme heat" or "heat wave" or "hot weather" or "excessive heat" or "heat event"
	AND
String 2	"United States" or "Alabama" or "Alaska" or "Arizona" or "Arkansas" or "California" or "Colorado" or "Connecticut" or "Delaware" or "Florida" or "Georgia" or "Hawaii" or "Idaho" or "Illinois" or "Indiana" or "Iowa" or "Kansas" or "Kentucky" or "Louisiana" or "Maine" or "Maryland" or "Massachusetts" or "Michigan" or "Minnesota" or "Mississippi" or "Missouri" or "Montana" or "Nebraska" or "Nevada" or "New Hampshire" or "New Jersey" or "New Mexico" or "New York" or "North Carolina" or "North Dakota" or "Ohio" or "Oklahoma" or "Oregon" or "Pennsylvania" or "Rhode Island" or "South Carolina" or "South Dakota" or "Tennessee" or "Texas" or "Utah" or "Vermont" or "Virginia" or "Washington" or "West Virginia" or "Wisconsin" or "Wyoming" or "Puerto Rico"
	AND
String 3	"human" or "people" or "population" or "individual" or "community member" or "resident" or "citizen"
	AND
String 4	1) "impact" or "exposure" or "risk" or "death" or "mortality" or "hospitalization" 2) "vulnerable" or "age" or "language" or "race" or "underserved" or "income"
String 5	a) "response" or "behavior" or "adapt" or "resilience" or "action" or "intervention" or "measure" b) "perception" or "understand" c) "communicat*" or "messag*" or "warn" or "SMS"

The CRC Team collaborated with Abt's in-house library staff to search approved topics among scientific research databases (e.g., EBSCO, JSTOR, PubMed, Science Direct, Google Scholar), access full texts, and track them in a spreadsheet. As part of the literature review, the team searched for the terms shown in the figure. Especially because this project considers public perception, the CRC Team further included gray literature sources and additional trusted sources of information in this literature review, including federal assessments or agency publications; reports from intergovernmental or nongovernmental organizations; and government, nonprofit, or other reports/work products that haven't undergone formal peer review.

The CRC Team used a spreadsheet to review and summarize priority records and recorded information about the data and methods applied in the studies and other information NWS deemed vital. From this spreadsheet, the team drafted a summary memorandum and report that summarized themes, gaps, and recommendations identified across the literature. The results of this literature review are highlighted later in this report. The list of citations from the literature review appears in the Appendix.

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3.2. Survey

Purpose

As part of the study, the project team conducted a national web survey to assess the public's experiences with extreme heat, risk perception related to heat, preferred communication methods, and readiness for future heat waves. Through gathering this information, NWS intended to better understand the public's perception of heat and identify opportunities to improve messaging and outreach on extreme heat, particularly for those at the greatest risk for negative health outcomes.

Design

The survey comprised 33 questions across 6 substantive topic modules, including those identifying: (1) household characteristics, (2) risk perception to extreme heat, (3) communication methods, (4) communication framing, (5) personal actions during extreme heat, and (6) demographic metrics. The survey was designed for online participants to complete in 15 or fewer minutes and was pre-tested using cognitive interviews with nine individuals. The survey was reviewed and approved by the Office of Management and Budget and the Abt Global Institutional Review Board. The final survey instrument appears in Appendix A.

Execution

An online survey panel provider distributed a web link to the NWS heat survey, which was programmed and hosted by Abt Global. The panel provider targeted survey invitations to participants matching key demographics for the U.S. adult population. Fielding of the survey occurred in November 2023. In total, 1,008 participants completed the survey. Each participant received a small incentive upon completion, consistent with its standard incentive program.

Limitations

In line with the resources and timeframe for this project, the survey's data collection relied on a non-probability opt-in panel. This method collects responses from diverse individuals who reflect a general alignment with national demographics and who agree to take surveys on various topics for a small incentive. Such opt-in panels approximate the makeup of the U.S. population, but are not as rigorous as probability-based samples. Following survey fielding, the project team reviewed the participation rate and did not identify non-participation concerns. Accordingly, the analysis does not conduct weighting of the results to account for underrepresentation among any demographic categories. Given these limitations, the results and data from this survey should be considered informative rather than conclusive.

3.3. Expert Focus Group

The CRC convened expert focus groups to bridge the gap between physical science information and how the public and institutions receive and act upon it. Focus group participants were screened and recruited to include a mix of local government, nonprofit, corporate, media and academic professionals with a role in messaging and assisting with behavioral change to improve extreme heat outcomes.

These national leaders provided expertise in extreme heat, community service, and/or communicating heat information to populations at greater risk for heat impacts, as well as engaging communities to plan and respond to heat. A diverse mix of focus group participants featured perspectives that address potential variations across regions of the country as well as the populations they serve.

This sample of experts participated in six 90-minute focus groups. Each included three-to-seven participants for a total of 39 participants. Among them, 44% were male, 56% were female, and 28% may identify as BIPOC. Six focus group questions were prepared as well as probing questions to expand on potential answers. These questions were used in each focus group to standardize the data collection. Groups were led by trained moderators; transcripts and videos ensure verbatim records were captured.

3.4. Expert Advisors

Throughout the project, the CRC team sought input from two external academic advisors with specific expertise in extreme heat messaging:

- Melissa Guardaro, Ph.D., is an assistant research professor in the Global Institute of Sustainability and Innovation at Arizona State University and works for the Knowledge Exchange for Resilience. Her research focuses on adaptation, equity, vulnerability, urban policy, and governance for the mitigation and adaptation to extreme heat and urban heat island effects.
- Zoé Hamstead, Ph.D., is an assistant professor in the Department of City and Regional Planning at the University of California, Berkeley. Her work focuses on environmental planning, sustainability, urban governance, and environmental justice, particularly in the context of climate change.

Both provided input on the sources, design, and summary of the literature review; suggested focus group participants and reviewed focus group questions; and reviewed and critiqued this final report.

4. FINDINGS

4.1. Literature Review

The consultant team presents these literature results in seven themes. These initial results are refined further through the subsequent mixed-method research results to produce the conclusions found later in this report.

4.1.1. Consistent communication by local weather offices may contribute to improved local extreme heat response; emphasize streamlined and culturally appropriate messages

The risk literature finds that, when possible, established standard and concise terms – including about who is most at risk and what actions to take – reduce confusion and increase trust. Consistent communication about how extreme heat impacts health and well-being are important (reference recommendation 4.1.3 below). While heat impacts people differently, local, and regional contexts necessitate different communications. For example, the NWS HeatRisk Prototype, which includes a simple numeric and color scale, provides a consistent evaluation of heat risk for any location. Expanding upon this pilot project, NWS should provide recommended messages associated with each category that communities can use and adapt to meet local needs.

For messages in Spanish, consult with certified language professionals and use dialects found in the target population.

4.1.2. Build on existing knowledge and mechanisms through the establishment of a heat committee or task force

Heat committees or task forces – consisting of, NIHHIS at the national level, the Integrated Warning Team at the local level, local government health, emergency management, mayor's offices; electric utilities; faith-based institutions; nonprofits; media outlets – would exist before, during and after heat season.[9] They would discuss messaging effectiveness for their communities; identify trusted messengers; and agree to follow consistent messaging. Other roles could include measuring progress on heat mitigation tactics. Throughout the heat season, trusted messengers including faith-based institutions and medical professionals can help endorse, disseminate, and interpret risk messages.

4.1.3. Direct messaging and narratives emphasizing heat-health outcomes are powerful

Messages and narratives can counteract perceptions that heat does not kill people or only kills a small subset of people. Providing guidance around localizing and personalizing agreed-upon messaging can make impacts and solutions more important and tangible. Inaction may also reflect the belief that measures will not prove

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[9] Heat season is a phrase that emerged in the focus group discussions, which participants used to describe when heat-related announcements begin in that location.

effective because of perceived barriers. Messaging should address solutions to common barriers. These include transportation options to cooling resources, financial assistance for energy costs, and debunking the social and cultural stigmas associated with seeking resources. Keep in mind that gain-framed messages tend to be more effective for promoting prevention behaviors (e.g., knowing where to go during an extreme heat day), while loss-framed messages tend to be more effective when promoting detection behaviors (e.g., knowing the signs of heat illness). Beyond narrative, use time- and action-related icons when messaging. These graphic icons help convey the same level of urgency for non-English speakers and minimize anything lost in translation.

 Specific information could include:

- Time-specific and local place-specific information along with relative information for adjacent geographies.
- Maps with iconic information about affected or at-risk areas.
- Suggested timing of actions (e.g., before, during, after), and highest priority recommended actions.
- Graduated heat alert protocols to warn for low, moderate, and peak adverse health impacts.
- Recommended actions for low, moderate, and peak health impact levels.
- Clarification that detection behaviors – physical discomfort such as sweating, dehydration, and fatigue – are serious health threats and more than a nuisance.

4.1.4. Develop core messaging to share with intermediaries to reinforce their role in reducing heat risk (e.g., faith leaders, health care workers, social service providers)

These community-level actors play a pivotal role in bolstering public awareness and response efforts. Providing them with consistent and comprehensive messaging can communicate effectively the dangers of extreme heat, encourage preventive measures, and guide higher-risk populations toward available resources and support networks. This collaborative approach ensures that behavioral health messaging can reach diverse communities and foster a collective commitment to safeguarding individuals from the adverse impacts of extreme heat.

4.1.5. Partner with the City of Phoenix and Arizona State University's 'HeatReady' certification program

The program may benefit from identifying basic institutional heat mitigation strategies for cities to commit to. Messaging to institutions about their behavior change is key. The literature suggests addressing institutional barriers that include access to, or awareness of, cooling centers, public transit and shading accommodations, energy financial assistance, and workplace safety, proves critical for reducing heat deaths. Messaging around certification will be an important leverage point to bolster awareness of cooling strategies.

4.1.6. Coordinate Federal efforts and messaging to address heat

The National Oceanic and Atmospheric Administration is in a position to support integrated messaging with other agencies since NWS forecasts the impending heat and administers heat warnings. NWS plays a vital role in NIHHIS, a collaboration of federal partners that coordinate integrated information services to support equitable heat resilience. Agencies in that collaboration play key roles for messaging, including the Environmental

Protection Agency for its heat mitigation guidance and the Centers for Disease Control and Prevention for its public health information and tracking of heat-related illnesses.

While each agency communicates about heat differently and uses different timelines from the immediate to the long-term (e.g., as a public emergency, public health issue, climate disturbance), better message coordination will instill public trust, reinforce messages, deepen awareness, reach additional stakeholders, and prevent confusion while creating government efficiencies. Future efforts can seek to disseminate products and resources at regional, state, tribal and local levels; or replicate similar coordination models within and across these levels and including actors in the public and private realms.

4.2.   National Survey

The research team identified a set of 10 findings of survey participants' experiences with extreme heat, risk perception related to heat, preferred communication methods, and readiness for future heat waves. The survey instrument appears in the appendix.

The findings:

4.2.1. Broad heat event awareness exists

Informed by responses to questions on past experience with heat and the nature of heat, general awareness of heat waves as an extreme weather event was broad. For households, the most likely results of a heat event were changes in daily activities and/or a move to a cooler part of work or home. Some consensus emerged among participants that the nature of heat is changing. In particular, more highly educated participants, households with compromised health, and participants with older household members were more likely to respond that the nature of heat events are changing.

4.2.2. Awareness of heat risk factors may be lagging

Of the survey response options offered, participants identified the five groups least at risk for heat impacts as those with limited English proficiency, racial or ethnic minorities, those living alone, those without a vehicle, and those with lower incomes. The lower ranking of risk characteristics is a departure from the findings in the focus group and literature review portions of this study, which identified these groups as relatively at high risk for heat-health impacts.

4.2.3. Some participants are behind the curve on preparedness

Most survey participants indicated they were well-prepared for heat events and would take precautionary measures ahead of time. To stay safe, participants identified core needs to prepare for heat events such as access to air conditioning, funds, water, shade, and work flexibility. Yet, a subset of participants nearing 15% indicated they would not take any actions to stay cool, or would not take actions until it became hot indoors or someone became ill. Additionally, nearly 30% of participants indicated they could not protect themselves if a cascading emergency occurred (such as power outage concurrent with a heat event).

4.2.4. Heat event readiness and needs vary by race

Across participants, preparedness for heat events and needs to stay safe varied and a consensus didn't emerge. White participants were more likely to identify as being able to protect themselves, and they flagged no additional needs to stay safe. Those with two or more races were less likely to identify as being able to protect themselves. They identified air conditioning, money, and transportation as needs to stay safe. Black participants were least likely to identify as being very prepared for heat events. They were most likely to need information and sports flexibility (e.g., adjusting the intensity, timing, or location of training) to stay safe. American Indian participants were most likely to need water and shade to stay safe. They also indicated higher likelihoods of missing work, seeking medical care, and death.

4.2.5. Retirees and households with older adults feel more prepared

Retirees highly indicated they could easily protect themselves and required no additional needs to stay safe during heat events. Similarly, households with older members identified few or no potential heat risks. In contrast, households with young children identified greater heat event risks, including difficulty performing normal activities, irritability, harmful health symptoms, and difficulty commuting. These households indicated they may need help moving to a cooler location or may have to miss work to stay safe during heat events.

4.2.6. Actions are influenced by means

Across several survey questions, results indicate that those with lower incomes are less prepared for heat events and are at higher risk for certain negative outcomes. Specifically, lower-income participants needed more time to prepare for heat events. Additionally, lower-income participants identified greater risks and results of a heat event as extreme discomfort, difficulty with daily activities, harmful health symptoms, difficulty commuting, needing help moving to a cooler location (such as a different building), needing a doctor's care, calling 911, or death. Household income also seemed to connect with certain proactive actions. For example, participants in the highest income bracket were more likely to use air conditioning, while the inverse was true for using fans. At the same time, the lowest income participants indicated they were less likely to avoid time outdoors, seek shade, limit strenuous activity, or wear lightweight clothing. To protect themselves during future heat events, lower income participants were more likely to need air conditioning, money to spend on protecting themselves, shade, and transportation.

4.2.7. Residents in manufactured housing may be acutely aware of risks

The research team intentionally asked participants to identify if they reside in manufactured or mobile homes because research and reports detail negative health outcomes for these residents. Residents of manufactured homes indicated they are less likely to be prepared for and protect themselves during heat events. They also are most likely to identify money, air conditioning, and information as necessary resources to protect themselves. At the same time, these residents indicated they could easily protect themselves should cascading emergencies occur (e.g., a concurrent heat wave and power outage), which is contrary to the other findings for this group.

4.2.8. Households with compromised health possess greater needs

The research team looked into whether participants identifying as having some indicator of compromised household health (i.e., a household member with a physical disability, medical condition, or pregnancy) provided different responses to survey questions. These households were less likely to identify as being prepared and able to easily protect themselves, including in a cascading emergency situation. To remain safe, these households flagged money as a key need. Notably, the broader set of survey participants identified the likely results of a heat event as changing daily activities and/or moving to a cooler part of work or home. These may not be viable options for households with compromised health.

4.2.9. Information needs, platforms, and sources vary

Age, in particular, seemed linked to participants' responses to questions on preferred information platforms and desired information. Younger participants appeared to seek more general knowledge and information, such as appropriate actions for preparing and staying safe. Older adults most requested information on how hot it will be and the location of the heat event, and they also favored more advanced notice. These results indicate that older adults have more experience with and existing knowledge about heat events. In terms of how to get this information to the public, websites were broadly used by all groups. TV was more often used by older participants while apps, smartphone notifications, and social media were more often used by younger participants. Similarly, information sources varied by age with older participants more likely to rely on local news and younger participants more likely to rely on employers.

4.2.10.   Direct messages resonate

Aligning with focus group and literature review findings, the most requested information included how hot it will be and where. This may signal that messaging must be tailored within regions to indicate where heat impacts are the greatest. This result may align with open-ended responses to define a "heat wave." In the open-ended responses, the temperature threshold for what constitutes extreme heat varied, indicating that messaging should align with local perceptions of extreme temperatures.

Survey questions that tested participants' perception of messaging with varying order, health impacts, and severity found the potential for message fatigue, even after just two messages (reference the boxes for detailed results).

Since surveys do not allow for additional engagement with participants to understand the "why" behind some of these results and findings, the focus group and literature review portions of the study are important resources to provide additional context. Future NWS studies may seek to further assess these results or understand the few instances where the survey results seem to diverge from the focus groups or literature review.

Messaging Best Practices

One survey module asked participants to provide their reactions to two randomly assigned messages that varied in their presentation of 1) heat severity, 2) audience, and 3) the order of those elements. Thus, participants evaluated eight potential messages that varied. Analysis of the responses indicates that neither the order of the information within messages nor the audience language had meaningful differences in participants' perception of seriousness. However, the language regarding the severity of the weather event indicating "dangerous" or "deadly" temperatures did matter. Messages with "deadly" language scored higher than "dangerous" messages.

The survey analysis also uncovered that the message a participant received as message 1 impacted the response they gave on message 2. Specifically, introducing "deadly" heat severity in message 1 influenced participants' seriousness rating of it and subsequent messages. When "deadly" messages were shown first, a softening of seriousness in a second message occurred. If participants received a "dangerous" message followed by a "deadly" message, they rated the second message as more serious. Sample results appear below and may indicate that the use of more severe terms like "deadly" do catch people's attention, but need to be used judiciously versus becoming part of routine heat messaging.

Mean scoring of heat impact messages considering order effects
Scale: 1= not at all serious, 10 = very serious

Message 1 Severity	Message 2 Severity	Mean	Mean	Difference
Dangerous	Dangerous	7.62	7.43	0.19
Dangerous	Deadly	7.45	8.10	-0.65
Deadly	Dangerous	7.81	7.52	0.29
Deadly	Deadly	7.96	7.69	0.27

4.3. Virtual Focus Groups

These are findings from six focus groups organized into five themes. Focus group questions are available in the Appendix: Focus Group Question Guide.

4.3.1. Messaging improvements may enhance extreme heat decision-making by institutions and the public

Tailoring messages to specific audiences enhances accountability and action likelihood, particularly if conveyed through intermediaries. These include institutions that serve populations of concern such as school districts, Occupational Safety and Health Administration, health departments, clinics, religious organizations, libraries, case workers, and fire departments. The future of public health messages, however, remains uncertain with the end to COVID-related funding earmarks (Focus Group E). Neighborhood-specific risk messages are deemed highly effective (Focus Group A). Leveraging the internet and social media is crucial for informing audiences and

tracking national heat discourse (Focus Group A). Year-round messaging emphasizing personal and collective responsibility is vital, especially when it targets specific audiences through culturally appropriate outlets such as radio (Focus Group A). Also essential are trigger temperatures decided transparently, combined messages during concurrent events, and quickly applicable research findings. (Focus Group F).

A context-specific, adaptable, and transparent messaging approach is necessary for addressing extreme heat challenges given government mistrust, to avoid fatigue, and to integrate heat messaging with broader issues that impact higher risk communities (Focus Group B, C, E). Urgency for a coordinated, sustained effort at local and national levels is emphasized, calling for a national heat strategy, common terminology, and continuous measurement of how effective messaging is (Focus Group C).

4.3.2. Emphasize extreme heat safety actions in underserved communities

Explicit communication about heat impacts and actionable steps is vital for underserved communities.

- Focus Groups A and E emphasized the need to illustrate heat severity both in terms of temperature or index and human health impacts alongside safety actions, noting the importance of nighttime risk-reduction strategies for higher risk populations without cooling-off opportunities (Focus Group A, E).
- Infographics effectively convey safety information (Focus Group E).
- Providing actionable steps during extreme heat events is crucial, with suggestions that included carrying an umbrella, instructing workers on their rights, and lodging complaints against employers (Focus Group A, F).
- Considering other climate, safety or public health concerns that may intersect with extreme heat, an intersectional approach is recommended, along with instructions on accessing resources for such intersections (Focus Groups A & E).
- Promoting personal responsibility for learning about heat impacts is essential, focusing on making internet and social media messaging accessible (including Section 508 compliance, multiple languages, depicting culturally relevant actions, etc.), engaging local stakeholders, and considering multilingual communication for broader reach (Focus Groups C, F).

4.3.3. Apply multiple methods to tackle messaging challenges in underserved communities

Diverse strategies are necessary to overcome access challenges, including working with numerous partners, using various communication channels, and distributing information through volunteers and such organizations as faith-based groups (Focus Group A, D, E). Acknowledging limitations of internet connectivity in higher risk communities, the research advises against relying solely on online communication. It suggests distributing Portable Document Formats (PDFs) in public spaces through volunteers and such organizations as faith-based groups (Focus Group D, E). Creating content suitable for different platforms such as WhatsApp, Facebook, and Snapchat are recommended to enhance accessibility (Focus Group C). Content needs to cover required conditions such as waiting for the bus, walking to school, elderly getting groceries in addition to optional outdoor recreation (Focus Group B).

Effective messaging involves incorporating local context, collaborating with local partners, providing cultural competence, addressing language barriers, and accommodating diverse needs (Focus Group A, F). To enhance effectiveness, according to the research, consider alternative audiences and formats and leveraging trusted intermediaries with cultural competency, emphasizing their role as "force multipliers" for reaching underserved communities (Focus Group A, D). Specific attention should be paid to providing explicit instructions for populations that may not perceive themselves as at greater risk for negative heat impacts, such as older adults. The research also underscores the potential for message fatigue when forecasts become repetitive (including those related to forecast temperature or the heat index). This can be addressed through a focus on the risks and actions to mitigate the harmful effects of the temperature or heat index (Focus Group E, B). Overall, the findings emphasize the need to proactively address heat impacts plus urging a shift from reactionary measures to sustained efforts in urban design, canopy choices, and energy-related decisions to make cities cooler in the future (Focus Group E).

4.3.4. Employ effective communication methods, community partnerships, and related messaging mechanisms

Easy-to-understand content using graphics and brief messages on heat impacts and instructions on what to do is crucial (Focus Group A, F). The research emphasizes the importance of hyperlocal communication, cartoons, one-page flyers and short videos, and editable content (for written text with regard to city or neighborhood names, the type of outdoor or indoor work depicted, and for graphic elements that apply to how to dress, including head covering, and skin tone) for local partners (Focus Group A, F). Employing existing communication sources, putting cooling centers on Google Maps, and using text-based alerts on weather are practical measures to enhance messaging reach (Focus Group F, E). Canvassing to gather information about messaging and heat-related needs is highlighted, which emphasizes the value of direct outreach to higher risk populations and door-to-door checks (Focus Group A, F). The research suggests the use of phone alerts for localized messages, the development of messaging campaigns for use as heat seasons commence, and the addition of diverse strategies such as video public service announcements, bus stop signs, and municipal-level initiatives (Focus Group B, D, F).

Combining equity-related strategies while providing heat information is recommended, including emphasis on messages that address both equity and vulnerability without focusing solely on heat measurements (Focus Group D). For instance, the message could be not just "it's dangerously hot," but "this heat is particularly dangerous for people who are obese." The research encourages supporting training for local/community leaders, such as summer camp providers and cooling center workers, to enhance their understanding of risks and appropriate responses (Focus Group B). Focus group participants suggested bundling policy rules meant to protect people from extreme heat with messaging about what they can do to avoid risks. For instance, these could include that park rangers at trails closed due to heat may suggest other activities that visitors can do, including other less-exposed trails that may be open. It also encourages collaboration with utilities and private employers to reach a variety of residents and workers through, for instance, monthly utility bills or communication to the workforce (Focus Group C, D, F).

4.3.5. Partner with additional organizations and stakeholder groups to address heat

Trusted intermediaries are highlighted for their role in disseminating heat-related information (Focus Group A, B, F). Specific attention is drawn to health-care providers, emphasizing the need for hospitals to improve admissions processes to record heat-related admissions systematically and encouraging health-care providers to inquire about vulnerabilities, ensure released patients have cooling opportunities as they recover and pass on cooling tactics (Focus Group B, F). Engaging employers and corporations, particularly those employing outdoor workers, is heavily favored, with suggestions to reach out to construction and agriculture companies specifically and to leverage such programs as the Weather-Ready Nation Ambassador Program (Focus Group B).

The focus group findings underscore the importance of involving popular social media leaders, local influencers, celebrities, and creative mediums such as comic strips and videos to make heat information accessible to diverse populations (Focus Group A, B). Young people may be potential knowledge brokers in rural or immigrant communities because they often use social media extensively (Focus Group A). Moreover, engaging landlords for renter safety and reaching out to visitor populations who may not be knowledgeable about local heat levels are identified as essential components of effective heat-related communication strategies (Focus Group F, B).

4.3.6. Identify locally relevant populations of concern, including historically underserved communities

The Focus Group findings identify these populations of concern with regard to extreme heat:

- Air-condition-insecure (who live indoors)
- Athletes
- BIPOC and low-income communities
- Children
- Older adults
- Fiercely independent, socially isolated individuals
- Immigrant communities
- Those at risk of dying indirectly (e.g., from drowning when seeking cool in water bodies, foodborne illness when eating food spoiled due to exposure to heat)
- Low-income community members
- Migrants to new areas
- Outdoor workers, day laborers

- People with limited English proficiency
- People with pre-existing conditions and/or substance use disorders that decrease the body's ability to tolerate heat
- Pregnant women
- Prison populations
- Restaurant workers
- Rural populations
- Members of Tribal nations
- Those experiencing homelessness including those living in cars
- Manufactured/mobile home residents
- Visitors to hotter areas
- Pets

5. CONCLUSIONS

5.1. Application of Knowledge

Drawing on the survey and focus group quantitative and qualitative data assessment, the findings are organized into an actionable checklist on what, to whom, when, and how NWS could apply this study's knowledge to communicate heat behavioral health messages.

These recommendations strive to support best practices that prompt the general public and, in particular, at-risk populations to take appropriate action to prepare and protect against heat impacts.

Applying knowledge recommendations outlined here provides a framework to help NWS enhance extreme-heat behavioral health communication. Executing these recommendations would enhance significantly NWS's ability to communicate effectively during extreme heat events. Continual evaluation and adaptation will prove crucial in refining these strategies and, ultimately, saving lives within underserved communities. Through these efforts, the NWS can forge stronger connections with communities, thus saving lives and fostering a culture of proactive preparedness.

5.2. Recommendations on typical NWS extreme heat messaging

The focus on clear, tailored, culturally competent, and timely messaging, along with collaboration with trusted intermediaries, ensures a more effective approach to addressing the diverse challenges posed by extreme heat events.

5.2.1. Clear language and visuals

- Leverage plain, clear language and visuals inspired by successful examples such as the Pacific Northwest Agricultural Safety and Health CenterHeat Toolkit.
- Emphasize the visual representation of impacts by using examples.
- Develop a publicly available glossary of common terms that weather offices and media can use across the country.
- Create more comic books, working through intermediaries with local artists and employing a multitude of languages, focused on varied sectors, activities and demographics, such as the King County Hot Weather Preparedness webpage (lower right of the webpage).
- Create cartoons that depict different types of people doing different tasks and creating cooling or responding to heat stress in various ways. Make the cartoons editable so that intermediaries can make them specific to a place, can use non-English text and can mix the people and response types.
- Include long-term solutions in communication materials, such as the installation of air conditioning and short-term solutions such as hydration, electrolytes, ice, wet clothing, shade, and rest breaks. Create mini-stories such as someone with air conditioning and feeling comfortable or drinking electrolytes and being able to think clearly.

- Create audio or written communications that depict people talking to others about what human body heat stress signals to look for and actions to take, and that depict older people talking about how summer heat differs from what it was when they were young and what they do about it.

5.2.2. Interventions focus

- Shift focus from mortality and morbidity to actionable interventions for the general public, private sector, and government.
- To attract attention, encourage intermediaries to highlight intersections with other risks, such as crime, air quality, and housing. For instance, identify for intermediaries the connection between hotter temperature and violence. Reference the "Connect heat messaging to broader issues and inequities" in item number six below.

5.2.3. Universal geofencing

- To allow intermediaries to identify heat specific to the communities they serve and to compare with other sites familiar to their stakeholders, implement geofencing – a virtual perimeter for a real-world geographic area – for heat forecasts, warnings and/or messaging universally and make it publicly available.
- Enhance local monitoring of heat weather observations and deliver targeted messages specific to neighborhood-level heat risks.

5.2.4. Personalized messages

- Allow messages to be personalized and tailored for increased accountability and the likelihood of audience action.
- Include solutions for keeping cool at home, addressing known messaging barriers for specific populations such as the elderly.

5.2.5. Message contextualization

- In places with prolonged extreme heat, develop a heat-and-health categorization system that describes what is happening and how to make it better in the long term as well as actions to keep cool short term.
- Indicate increasing danger by describing the increase in hazardous high heat days along with the increase in vulnerability and exposure due to increasing numbers of people experiencing homelessness or other locality-specific populations of concern.
- NWS should conduct research on effective messaging for long running extreme heat events and work with partners to develop communication plans for long-running heat emergencies to prevent message fatigue.
- Craft appropriate messaging when a particular heat event differs from previous events (e.g., length, temperature, frequency, time of year).

5.2.6. Holistic heat messaging

- Connect heat messaging to broader issues and inequities or risk factors including limited English proficiency, racial or ethnic minorities, those living alone, those without a vehicle, and those with lower incomes.
- Work with partners to identify messaging needs when more than one weather event or issue occurs at once or in close succession.
- Message to corporate, government, and nonprofit leaders, emphasizing interventions they can take to support individual actions.

5.3. Recommendations on audiences NWS should focus extreme heat messages

Focus group participants described the need for policy change to protect worker and family health by influencing employers, municipal land use officials, affordable housing officials and social service practitioners, among others. To integrate the use of NWS products and services appropriately and influence public risk perception and extreme heat protective actions, NWS and its NIHHIS partners can tailor messages to intermediaries with the power to address various institutional barriers. For instance, these intermediaries can tailor messages for those experiencing homelessness and their caretakers, for low-income tenants and their landlords, for outdoor workers and the companies that employ them, and for utility and local government service providers.

5.3.1. Messages tailored for intermediaries

- Tailor messages for trusted intermediaries that consider their unique contexts, cultural competency, and community roles.
- Encourage media and intermediaries to adapt messages for diverse contexts.

5.3.2. Messages for various populations in partnership with other agencies

- Develop and promote tailored messages for diverse populations, including labor, school, sports, landlords, case workers, clinicians, and utilities.
- Emphasize messages to entities with the power to protect people from heat.
- Tailor relatable messages for decision-makers and their staff who already may have cooling solutions in place or be in air conditioning much of the time.
- In addition to being given extreme heat warnings, workers might lack agency and may need instructions on their rights (especially regarding heat safety measures), how to lodge a complaint against their employer, and what resources might be available for them against employer retaliation.

5.3.3. Multilingual and cultural messages

- Create messages in various languages (e.g., not just general Spanish, but also Spanish dialects and Indigenous languages found throughout the Americas) as well as cultural contexts to ensure broader accessibility.

- Avoid messages that are just scientific heat measurements on their own; include information about specific vulnerabilities (e.g., particular health issues) and exposures (e.g., type of work.)

5.4.   Recommendations on when NWS should deliver extreme heat messages

Focus group participants suggested that messages should help people prepare for heat waves by disseminating awareness messages before a region starts to get hot (e.g., before late spring), and then days in advance, emphasizing the impact of heat on the body and specific protective actions, coordinating extreme heat warnings tailored to different sectors, and encouraging the creation of comprehensive extreme heat event plans. They also recommended utilizing various communication channels such as bus wraps and staggered warning levels to avoid message fatigue while ensuring timely dissemination of critical information.

5.4.1. Before heat season preparation

- Disseminate messages days before a heat wave to allow ample time to prepare.
- Emphasize awareness, especially of heat's impact on the body and specific actions to protect the body.
- Have specific sectors (e.g., hospitals vs. utilities vs. outdoor workplaces) agree on locality-specific extreme heat warnings that trigger temperatures far ahead of emergencies.
- Use this as an opportunity to convey that waiting until indoor temperatures become unbearable is too late.
- Encourage the creation of plans and back-up plans for heat events, especially in the context of cascading emergency events.

5.4.2. Start of heat season messaging

- Use bus wraps and other channels to communicate heat-related information about actions to take at home, at work and on commute throughout the heat season.

5.4.3. Avoid message fatigue through strategic messaging

- Consider different warning timing including (e.g., in the evening about extreme heat recovery or on the weekends about modifying recreation.)
- Reserve phone alerts by Intermediaries to their stakeholders for the most serious levels of extreme heat warnings.

5.5.   Recommendations on how NWS should deliver extreme heat messages

Focus group findings suggest that NWS should collaborate with NIHHIS partners to advocate for proactive measures in underserved communities, engage in community networks to distribute critical information through text networks and radio stations, integrate cooling center layers into existing online mapping services, tailor messages to different populations and sectors, and work with various messengers including media, landlords, and healthcare providers to address heat impacts effectively.

5.5.1. Engagement with Intermediaries

- Work with NIHHIS partners to advocate for more proactive action to mitigate heat impacts in underserved communities that may lack historical investment in cooling solutions.
- Partner with NIHHIS agencies to co-host heat message challenges/competitions for different populations.
- Create modifiable content, offering stipends to intermediaries to adapt messages to local contexts. See "Personalized Messages" above.

5.5.2. Community networks

- Work with NIHHIS partners to establish community cell phone text networks with nonprofits to distribute critical information.
- Collaborate with farm and industry worker radio stations for broader dissemination.
- Emphasize that checking on neighbors is vital and should include helping neighbors to stay hydrated and cool and to move to safer spaces.

5.5.3. Technology collaboration

- Collaborate with Google and other general online mapping resources to integrate a "cooling center" layer into existing mapping services (instead of creating a new app) and to continue and expand the new layer that indicates heat alerts in map searches for areas experiencing impacts.
- Analyze social media in real time and post event to gather information on national and local discourse about heat impacts, reactions and outcomes.
- Collaborate with local intermediaries to use phone alerts to send localized messages during heat emergencies.
- Support hyperlocal weather information through geofencing and modifiable visual and written messages.

5.5.4. Segmented messaging

- Partner with NIHHIS members to work with intermediaries to canvas underserved populations, asking what, when and how messages could best help them.
- Segment messages to tailor to different populations, areas, and sectors. Examples appear in the box.

Example Segmentation Opportunities for Selected Audiences

High school students including athletes: Create materials that focus on heat impact awareness, preparedness, and response. By communicating good heat habits in high schools, youth can become advocates within their teams, families, and communities, including as they bring this heat knowledge to the workplace as adults. Raise awareness of the issue and suggest practical solutions for staying safe during extreme heat events.

People experiencing homelessness and/or people with substance use disorders: Addressing the unique challenges faced by the unhoused and/or substance user populations requires a multifaceted approach. By leveraging the "homeless grapevine" to reach leaders within unhoused communities to share messages about signs of heat stress and actionable steps to take, more people can receive and act on heat messages to protect themselves and their community. The unhoused population confronts complex issues related to seeking cool conditions and their barriers to sleep, substance use, personal effects storage, pets, and pre-existing mental and physical health challenges. Collaboration with case workers, mental health support groups, and various community agencies can help create and distribute tailored communication materials. NWS could establish a heat survival task force for those experiencing homelessness that collaborates with case workers, advocates, and experts.

Visitors: Recognizing the transient nature of tourists to hot locations, proactive communications may increase the potential that individuals unfamiliar with the local climate become well-informed about the risks and measures to stay safe during their visit. Partnering with such tourism apps as Airbnb and Travelocity or creating public service announcements for airports plus alerting relevant professional associations could facilitate the dissemination of information about extreme heat to visitors.

Older adults and retirees: These groups may rely on conventional media to a greater extent than do younger audiences, primarily TV. Therefore, more targeted messages about particular risks to this group may be effective.

Community members with lower incomes: While access to cool spaces including cooling centers is best, convey "no-cost" measures that can provide some heat relief.

5.5.5. Collaboration with Other Messengers

By working with NIHHIS federal partners and collaborating with message intermediaries and local government, case workers, workforce and housing leaders, NWS can tailor its approach to different populations.

- Work with NIHHIS partners to engage various messengers, including media, landlords, labor organizations, local government, and healthcare providers, recognizing their distinct influence within different sectors of society. Examples appear in the box.

Example Engagement Opportunities for Selected Messengers

Media messengers: Engage a celebrity impacted by heat-related incidents. For example, Taylor Swift could be asked to deliver ad council messages, given the 2023 heat mortality incident in Brazil that caused her to cancel a concert. Trusted media figures can amplify the importance of heat preparedness to a broader audience.

Landlord messengers: Collaborate with organizations such as the Department of Housing and Urban Development to inform affordable housing managers about building improvements that mitigate heat and to create visual flyers for common spaces that inform tenants about extreme heat. Disseminate these materials annually via hard copy mail, encouraging distribution and posting in housing developments. Learn from successful campaigns related to COVID and wildfires.

Labor messengers: Work closely with Occupational Safety and Health Administration and private sector leaders to create materials for outdoor and agricultural labor. Occupational Safety and Health Administration should establish clear standards for employers to ensure they provide essential protections such as water, rest breaks, and meals, which can be messaged across NIHHIS agencies. Provide information about workers' rights and advance worker knowledge about these rights to enhance self-protection.

Local government messengers:
- Provide materials to local governments to encourage creation of community heat relief plans.
- Collaborate on initiatives that allow NWS messages to align with tangible tools to prepare for extreme heat.
- Focus on the built environment – heat islands, construction sites, transit stops – that local governments can change through investment and regulation.
- Besides public health impacts, recognize loss of tourism revenue and small-business hardship due to people staying indoors, etc.
- Consider rebranding climate change issues around heat to depoliticize the discourse.
- Where possible, bundle messages with policy rules, such as working with or encouraging park agencies to close gates to hiking trails to prevent people from using them when heat alerts discourage hiking because of dangerously hot weather.

Health-care messengers: Collaborate with health-care professionals to identify medications that can increase susceptibility to heat. Create fact sheets for clinicians, providing information on vulnerable patient types (renal, pulmonary, behavioral, cardiac, pregnancy, drug) and offering short-term and long-term solutions. Use personal health-care providers and other health-care professionals often more trusted than other public officials as messengers.

6. FUTURE RESEARCH OPPORTUNITIES

The consultant team learned several lessons during this project that might inform the process of other related research.

1. Except for occasional specificity from focus group participants who were part of local Integrated Warning Teams, focus group discussions did not clearly articulate if they were referring to NWS extreme heat forecasts, watches, warnings, or indices when discussing extreme heat messaging. A future study could ask focus group or survey participants questions about each of these message types.

2. Identify routine, systematic means to analyze web content and social media data for extreme heat events. Such efforts in real time and following events would unpack heat-related public discourse on heat, the reach and utility of NWS messages, and opportunities for further improvement in NWS' messaging.

3. Through all three methods of this study, evidence points to message fatigue as a concern for spurring appropriate actions during heat events. Based on the message testing conducted in the survey and the potential for message fatigue after just two messages, NWS might apply such a design in future survey methods to further understand message fatigue.

4. The survey portion of this study did not test participants' perceptions of NWS warning language (e.g., "watch," "warning.") A future survey could further explore how such language influences perceptions of event severity and messaging fatigue.

5. Definitions of what constitutes extreme heat vary regionally in the survey. Future work could begin to unpack these regional variations to further tailor and streamline messaging by having participants respond to messages that include specific temperature thresholds versus general severity language.

6. Survey results for older adults, retirees, and households with older members seemed to indicate they self-identify as very prepared and with few potential risks from heat events and as being low risk for heat impacts on health. These results may warrant further research to help tailor future extreme heat messaging, as those over age 65 are typically in a higher risk category for negative heat health outcomes.

7. Survey results seemed to indicate that lower income participants were less likely to adopt seemingly "no cost" protective actions (e.g., avoid time outdoors, seek shade, limit strenuous activity, wear lightweight clothing). These results may warrant further research to investigate if they do not have the flexibility to take such actions (e.g., if they are outdoor workers), or if other reasons exist why this group seemed somewhat less likely to adopt such measures, to help tailor future extreme heat messaging to this group.

8. Survey results seemed to indicate that residents in manufactured housing were more likely to have contingency plans in place for heat events (i.e., a power outage during a heat event), than their counterparts living in other types of residences. To help tailor future extreme heat messaging to these residents, future research might seek to identify if these residents perceive greater risks and, therefore, already have contingency plans in place.

APPENDIX A. LITERATURE REVIEW SUPPORTING MATERIALS

Bibliography

This study's first research method was a comprehensive literature review, which informed subsequent focus group and survey research, as well as this report. The bibliography is contained in these related resources:

Summary of NWS Extreme Heat Behavior Science Literature Review

NWS Extreme Heat Messaging Literature Review

APPENDIX B.   SURVEY SUPPORTING MATERIALS

Survey Results Memorandum

Survey Cognitive Testing Results

Survey Instrument: NWS Extreme Heat Survey

1) Intro/welcome

Thank you for taking the time to complete this survey. Your feedback is important to the National Weather Service and will be used to better understand: the public's experiences with extreme heat, the public's readiness for future heat waves, and opportunities for the National Weather Service to share information. The survey should take you about 15 minutes to complete.

2) Question module: Self-identifying information

First, we have some questions about your household. Please think about your primary residence where you live most of the time.

2.1   To make sure we understand which general area you live in, please provide the zip code where you live most of the time.
ENTER 5-DIGIT ZIP CODE: _____ [REQUIRE 5-DIGIT NUMBER]
[DISPLAY IF SKIP WITHOUT RESPONSE]
99999 - Not sure/Rather not say

2.2   [ONLY ASK IF RESPONDENT REFUSED TO PROVIDE ZIP CODE ABOVE – EITHER 'Not sure/Rather not say' OR SKIP WITH NO RESPONSE]: Using the dropdown list, please select the state where you live most of the time. [STATE DROPDOWN LIST]

2.3   Approximately how long have you lived there?
1 – Less than 1 year
2 – 1 to 2 years
3 – 3 to 5 years
4 – 6 to 10 years
5 – More than 10 years

2.4   What type of home is your primary residence?
1 – Apartment or condo
2 – Single family home
3 – Duplex or townhouse
4 – Mobile home / manufactured home
5 – I do not have stable housing
6 – Other (please specify)

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2.5   How many people, including yourself, live in your household?
ENTER NUMBER: ___ [ALLOW RANGE OF 1-20]

2.6   Is there at least one person in your household who is…?
(Please select all that apply)
1 – [ONLY ASK IF 2.5=>2] Age 4 or younger
2 – Age 65 or older
3 – Lower income (for example, needing or receiving government income, food, or healthcare assistance)
4 – A non-English speaker / limited English proficiency
5 – A person with a physical disability (for example, uses a wheelchair or mobility device)
6 – Pregnant
7 – A person with a medical condition (such as obesity, heart disease, or mental illness)
8 – Without stable housing
9 – Without a vehicle
10 – An outdoor worker
11 – An indoor worker without adequate cooling
12 – A person who regularly participates in indoor/outdoor exercise or athletics
13 – None of the above

2.7   Are you currently…?
(Please select only one)
1 – Employed for wages
2 – Self-employed
3 – Out of work for 1 year or more
4 – Out of work for less than 1 year
5 – A homemaker
6 – A student
7 – Retired
8 – Unable to work and/or receiving disability

2.8   How would you describe a heat wave?
[PROVIDE A TEXT BOX]

2.9   Have you ever experienced a heat wave, in other words, a period of unusually hot days?
1 – Yes
2 – No
3 – Not sure

2.10   [ONLY ASK IF 2.9 = YES]: How long ago did you experience the most recent heat wave?
(Please select only one)
1 – Less than 1 year
2 – 1 to 2 years
3 – 3 to 5 years

4 – 6 to 10 years
5 – More than 10 years

3) Question module: Personal risk perception
Next we have some questions about how your household may or may not be at-risk from heat.

3.1   Do you believe [IF 2.5=1 USE: you are / IF 2.5=2-20 USE: anyone in your household is] at-risk for any of the following impacts from a heat wave?
        (Please select all that apply)
        [ANSWER LIST TO BE RANDOMIZED]
        1 – Extreme discomfort
        2 – Difficulty doing normal daily activities (such as sleeping, working, studying)
        3 – Irritability
            4 – Harmful health symptoms (such as breathing issues, muscle cramps, overheating, or dizziness/fainting)
        5 – Death
        6 – Difficulty commuting
        7 – None of the above
        8 – Not sure

3.2   How much health risk, if any, do you think the following groups would experience during a heat wave?
        [LIST OF SUB-ITEMS TO BE RANDOMIZED]
                A. Ages 4 or younger
        B. Ages 65 or older
        C. Racial or ethnic minorities
        D. Lower income (for example, needing or receiving government income, food, or healthcare assistance)
        E. Non-English speakers / limited English proficiency
        F. With a physical disability (for example, using a wheelchair or mobility device)
        G. Pregnant
        H. With a medical condition (such as obesity, heart disease, or mental illness
        I. Without stable housing
        J. Without a vehicle
        K. Outdoor workers
        L. Indoor workers without adequate cooling
        M. Regularly participates in indoor/outdoor exercise or athletics
        N. Living alone
        EACH OF THE ABOVE SUB-ITEMS WILL HAVE THE FOLLOWING ANSWER OPTIONS:
                        1 – No risk
                        2 – Low risk
                        3 – Medium risk
                        4 – High risk
                        5 – Not sure

4) Question module: Communication methods
Now we have some questions about how [IF 2.5=1 USE: you get / IF 2.5=2-20 USE: your household gets] information about heat. First, we will ask what <u>platforms</u> you use to get the information. Then we will ask for <u>the source</u> of the information.

4.1 Think about what <u>platforms</u> you use to get information about major weather events, such as a heat wave, blizzard, or hurricane. How often, if at all, do you use these <u>platforms</u> to get the information?
[PLATFORMS TO BE RANDOMIZED]
      A. Television
      B. Websites, including news and weather sites
      C. Social media sites
      D. Apps on your phone or tablet
      E. Phone notifications (that is, alerts popping up on your phone)
      F. Print news
      G. Radio
      H.   Word of mouth (for example relatives, friends, or co-workers)
      EACH OF THE ABOVE SUB-ITEMS WILL HAVE THE FOLLOWING ANSWER OPTIONS:
            1 – Often
            2 – Sometimes
            3 – Hardly ever
            4 – Never

4.2   Think about <u>who is the source</u> of information you get about major weather events, such as a heat wave, blizzard, or hurricane. How often, if at all, do you use these <u>sources</u> to get the information?
      (Hover over a source for additional information)
      [SOURCES TO BE RANDOMIZED. EACH SOURCE WILL HAVE A MORE DETAILED EXPLANATION AFTER IT THAT ONLY APPEARS IF THE RESPONDENT HOVERS OVER THE SOURCE]
          A. Local news
            ▪ *Local, state, or regional news media such as a local newspaper or television station*
          B. Local government
            ▪ *Local, state, or regional government agencies such as an elected official, health department, or emergency management/law enforcement*
          C. National news
            ▪ *National news media such as major national television networks or cable stations*
          D. National government
            ▪ *Federal government agencies (such as the National Weather Service, Centers for Disease Control and Prevention, or the Federal Emergency Management Agency)*
          E. Other weather providers
            ▪ *Other weather or news providers (such as national weather applications or websites)*
          F. Medical professionals
            ▪ *Medical professionals such as a primary care doctor*
          G. Utility company
            ▪ *Utility companies such as electric, gas, or water*
          H. Community leaders

▪ *Community-leaders from businesses, religious organizations, or not-for-profit organizations*

I. [ONLY ASK IF 2.7=1]: Employer

J. Word of mouth

▪ *People I know, such as relatives, friends, neighbors, or co-workers*

EACH OF THE ABOVE SUB-ITEMS WILL HAVE THE FOLLOWING ANSWER OPTIONS:

1 – Often

2 – Sometimes

3 – Hardly ever

4 – Never

5) Question module: Communication framing

In this section, we are going to present you with two different heat messages. After each message, we are going to ask how you would feel about seeing it in your local weather report.

HERE WE WILL PRESENT THE 2 RANDOMLY ASSIGNED VERSIONS OF HEAT MESSAGES. EACH MESSAGE WILL HAVE 3 MESSAGE CHARACTERISTICS RANDOMLY ASSIGNED:

1. SEVERITY

2. HEALTH IMPACT

3. ORDER OF INFORMATION

Here is the first message:

[DISPLAY MESSAGE TEXT ON SEPARATE LINE, BOLD TEXT, CENTERED AND INDENTED ON ALL SCREENS WHERE MESSAGE IS DISPLAYED]

Message w/ Order 1

[HEALTH IMPACT]. [SEVERITY] will occur tomorrow. Watch for symptoms of heat illness. Stay healthy by drinking plenty of water and taking breaks in cool areas.

Now, here is the second message:

Message w/ Order 2

[SEVERITY] will occur tomorrow. [HEALTH IMPACT]. Watch for symptoms of heat illness. Stay healthy by drinking plenty of water and taking breaks in cool areas.

Option	HEALTH IMPACT	SEVERITY
1	Many people are at risk for heat illness	Potentially dangerous temperatures
2	You may be at risk for heat illness	Potentially deadly temperatures

ASK FOR EACH: 5.1 On a scale of 1-10, where 1 is not at all serious and 10 is profoundly serious, how serious or not would you rate this message?

AND ASK FOR EACH: 5.2 Seeing this message in my local weather report…

(Please select all that apply)

[ANSWER LIST TO BE RANDOMIZED]

1 – Makes me want to track the situation

2 – Indicates an immediate threat to me

3 – Scares me

4 – Makes me want to prepare

5 – Makes me want to get more information

6 – Does not make me want to take action

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7 – None of the above

5.3   Thinking of the usual news reports and messages your household gets about heat waves, which of the following types of information, if any, would you want to have more of? Please select up to 3 of your top choices:

[ANSWER LIST TO BE RANDOMIZED]
1 – Advanced notice
2 – Information on who is at risk
3 – Details on how hot it will be
4 – Details on exactly where it will be hot
5 – Information on what my household can do to prepare
6 – Specific precautions or preparations that those at greatest-risk should take
7 – Information on where to get help
8 – Information on what my workplace is doing to protect us
9 – Information on what my city is doing to protect us
10 – Information on what I can do to help others protect themselves
11 – Other (please specify)
12 – None of the above

6) Question module: Personal action
Next we ask what your household does about heat.

6.1   How much time [IF 2.5=1 USE: do you / IF 2.5=2-20 USE: does your household] need to prepare for a heat wave?
1 – None
2 – Very little time (a few hours)
3 – Some time (up to 24 hours)
4 – More time (more than 24 hours)
5 – Not sure

6.2   If a heat wave occurred, could [IF 2.5=1 USE: you / IF 2.5=2-20 USE: your household]…?
1 – Easily protect [yourself/yourselves]
2 – Somewhat easily protect [yourself/yourselves]
3 – Not easily protect [yourself/yourselves]
4 – Not protect [yourself/yourselves] at all
5 – Not sure

6.3   What actions, if any, [IF 2.5=1 USE: do you take to protect yourself / IF 2.5=2-20 USE: does your household take to protect yourselves] in a heat wave?
(Please select all that apply)
[ANSWER LIST TO BE RANDOMIZED]
1 – Use air conditioning
2 – Use fans
3 – Open windows
4 – Close window shades or blinds

5 – Take cool baths or showers
6 – Wear lightweight clothing
7 – Avoid time outdoors
8 - Seek shade when outdoors
9 – Take rest breaks
10 - Limit or reschedule exercise / strenuous activity
11 – Stock up and/or drink plenty of water
12 – Eat light meals
13 – Visit air-conditioned places (for example a shopping center, library, or cooling center)
14 – Move to a cooler part of my home (for example a basement)
15 – Check on at-risk family, friends, and neighbors
16 - Other (specify)
17 – None of the above

6.4   How prepared or not [IF 2.5=1 USE: are you / IF 2.5=2-20 USE: is your household] for a heat wave?
1 – Very prepared
2 – Somewhat prepared
3 – Somewhat unprepared
4 – Very unprepared
5 – Not sure

6.5   If your usual plan to protect [IF 2.5=1 USE: yourself / IF 2.5=2-20 USE: yourselves] during a heat wave wasn't possible anymore (for example, if a power outage limited use of fans or air conditioning, or there was limited bus service on a holiday), could [IF 2.5=1 USE: you / IF 2.5=2-20 USE: your household]:
1 – Easily protect [yourself/yourselves]
2 – Somewhat easily protect [yourself/yourselves]
3 – Not easily protect [yourself/yourselves]
4 – Not protect [yourself/yourselves] at all
5 – Not sure

6.6   Which of the following, if any, [IF 2.5=1 USE: do you / IF 2.5=2-20 USE: does your household] not have enough of to protect [IF 2.5=1 USE: yourself / IF 2.5=2-20 USE: yourselves] during a heat wave?
(Please select all that apply)
[ANSWER LIST TO BE RANDOMIZED]
1 – Air conditioning
2 – Transportation
3 – Money to spend on protecting [yourself/yourselves]
4 – Information on how to protect [yourself/yourselves]
5 – Work flexibility (such as working from a different location or at different times)
6 – Sports flexibility (such as adjusting the intensity, timing, or location of training)
7 – Shade
8 – Drinkable water
9 – None of the above
10 – Other (specify)

6.7   If given enough advance notice of a heat wave, when would [IF 2.5=1 USE: you / IF 2.5=2-20 USE: your household] most likely begin to prepare?
        1 – Ahead of the heat wave
        2 – As the heat wave starts
        3 – Only when it gets hot indoors
        4 – Only if someone gets sick
        5 – [You/Your household] would not prepare
        6 – [You are/Your household is] already prepared

6.8   How likely is it that the following results could happen to [IF 2.5=1 USE: you / IF 2.5=2-20 USE: someone in your household] in a heat wave?
        [LIST OF SUB-ITEMS TO BE RANDOMIZED]
           A. May need to change typical daily activities
           B. May need to move to a cooler part of the home or workplace
           C. May need help moving to a cooler location (such as a different building)
           D. May need to miss work
           E. May need to seek a doctor's care
           F. May need to call 911
           G. May die
EACH OF THE ABOVE SUB-ITEMS WILL HAVE THE FOLLOWING ANSWER OPTIONS:
                    1 – Very likely
                    2 – Somewhat likely
                    3 – Not very likely
                    4 – Not at all likely

6.9   Do you think that the nature of heat waves is changing (for example, in length, temperature, frequency, or time of year)?
        1 – Yes
        2 – No
        3 – Not sure

 7) Demographics
 Now, I would like to ask a few final questions about your background.

7.1 What is your age?
        ENTER YEARS: _____ [ALLOW RANGE OF 18-99]
        [DISPLAY IF SKIP WITHOUT RESPONSE]
        00 - Not sure/Rather not say

7.2 Are you of Hispanic, Latino/a, or Spanish origin?
            1 – Yes
            2 – No
        [DISPLAY IF SKIP WITHOUT RESPONSE]
            9 - Not sure/Rather not say

7.3 Which one or more of the following would you say is your race?

(Please select all that apply)

1 – White

2 – Black or African American

3 – Asian

4 – Native Hawaiian or Pacific Islander

5 – American Indian or Alaska Native

[DISPLAY IF SKIP WITHOUT RESPONSE]

9 - Not sure/Rather not say

7.4 What is the highest level of education you completed?

1 – Less than a High School Diploma/GED

2 – High School Diploma/GED

3 – Vocational or Technical Diploma after high school

4 – Some college but no degree

5 – Associate Degree

6 – Bachelor's Degree

7 – Graduate or Professional School but no degree

8 – Master's Degree

9 – Doctorate

10 – Other

[DISPLAY IF SKIP WITHOUT RESPONSE]

99 - Not sure/Rather not say

7.5 Which of the following categories best describes your total annual <u>household</u> income before taxes, from all sources?

1 – Under $20,000

2 – $20,000 to under $35,000

3 – $35,000 to under $50,000

4 – $50,000 to under $75,000

5 – $75,000 to under $100,000

6 – $100,000 or more

[DISPLAY IF SKIP WITHOUT RESPONSE]

9 - Not sure/Rather not say

7.6 Are you…?

(Please select all that apply)

1 – Female

2 – Male

3 – Transgender, non-binary, or another gender

[DISPLAY IF SKIP WITHOUT RESPONSE]

9 - Not sure/Rather not say

7.7 Is English the main language you speak at home?

     1 – Yes

     2 – No

     [DISPLAY IF SKIP WITHOUT RESPONSE]

     9 - Not sure/Rather not say

Those are all our questions. Thank you for completing our survey!

APPENDIX C. FOCUS GROUP SUPPORTING MATERIALS

This study included focus groups, and data from these moderated discussions are summarized in these related resources:

NWS Focus Group Themes and Key Highlights

NWS Extreme Heat Messaging Focus Group Assessment Matrix

Focus Group Question Guide

The focus group questions center on the research questions outlined by NWS. They were further reviewed and revised based on input from expert advisors. This introduction and question text was used for each of the six focus groups.

Moderator Introduction (2 min)

The moderator will put this in the chat at the start of the session: From Executive Order 13985: The term "underserved communities" refers to populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life, as exemplified by the list in the preceding definition of "equity."

Hello, my name is X, and I will be moderating our discussion today. We are interested in your expertise communicating with underserved populations about extreme heat.

NWS mission: The National Weather Service or "NWS" is an agency of the United States federal government that is tasked with providing weather forecasts, warnings of hazardous weather, and other weather-related products to organizations and the public for the purposes of protection of life and property and the enhancement of the national economy.

The **NWS Extreme Heat Social and Behavioral Science Research Project** includes focus groups, a larger scale public survey, and a literature review. The project scope is to expand NWS knowledge of public perception and understanding of heat to inform and improve NWS' national and local level heat communication and messaging.

Project team:

- **Climate Resilience Consulting** is a social enterprise working with nonprofits, corporates, and governments on climate resilience strategy.
- **Abt Global** is a global consulting and research firm that strives to improve the quality of people's lives. We partner with clients and communities to advance equity and innovation—from combating infectious disease, mitigating climate change, to evaluating programs for measurable social impact.

<u>Focus Group (FG) Questions</u>

As people are entering the web conference room, invite to use the chat feature at any time during the discussion.

FG Questions

Introductory Questions, interview style

1) What is your title or a short description of your position?
2) In one sentence, what role does your organization play in extreme heat, behavior change, and/or public communication and messaging?
3) In your community or role, what groups are of greatest concern/risk from extreme heat exposure?

Now we would like to learn more about how you and your organization research or work with historically underserved groups in your community to communicate about extreme heat. The next series of questions focuses on messaging to reach those communities. This focus group is a diverse group of participants. In answering these questions, please respond from your point of view and perspective. We look forward to a discussion among all participants as you answer these questions.

Open Ended Questions, discussion style

A. How are you using hot weather forecasts and information to support your decision making?

Probes:
- What is particularly useful or actionable in your decision making and/or for your community or stakeholders?
- What further weather/forecast information (that you don't currently have) would support your decision making?
- How can NWS support your or others' messaging?

Academic/Think Tank probing question: How are you using weather forecasts and information? Clarifying question: On what timescales? What is particularly useful? What further information (that you don't currently have) would support your research?

B. What are some of the heat messaging challenges you face as you support underserved communities? [For those who do not support directly: What barriers exist in the day-to-day practices of those who support the heat-health of underserved communities?]

Academic/Think Tank probing question: What heat findings exist regarding messaging challenges and barriers in underserved communities?

C. What communication methods, community partnerships, and other mechanisms enable effective heat messaging?

Academic/Think Tank probing question: Same as above.

D. **How have you or how would you like to tailor messaging for the underserved groups you serve (indicate which underserved group(s) you are referring to in response to this question)?**

Probe:
- Are there innovative techniques you've explored to supplement your more traditional messaging strategies?

Academic/Think Tank probing question: In your research, what have you discovered about tailoring messaging to underserved groups? (Indicate which underserved group(s) you are referring to in response to this question)? Have you found innovative techniques that supplement more "traditional" messaging strategies?

E. **In your research or experience, why do (or do not) underserved community members undertake safety measures to protect themselves from heat?**

Probes:
- What actions do they take?
- What barriers to action have you seen?
- What actions would you like to see them take?

Academic/Think Tank probing question: Same as above.

F. **Who should we involve as a society to better address heat concerns?**

Probe:
- Which other groups have we not mentioned so far that we might involve or consider as a heat messaging audience?

Academic/Think Tank probing questions:

- What should we be doing to better address heat concerns?

If focus group participants start talking about a whole-of-government or generalized action, ask them to specify the agency and kind of expertise they seek.

Moderator close: We will email you when the final report is posted on the NWS site in 2024. If there is something else you would like from us or to share with us, please email [consultant email].