

Communicating Extreme Heat to At Risk Publics: A content analytic study of Tweets from 2021

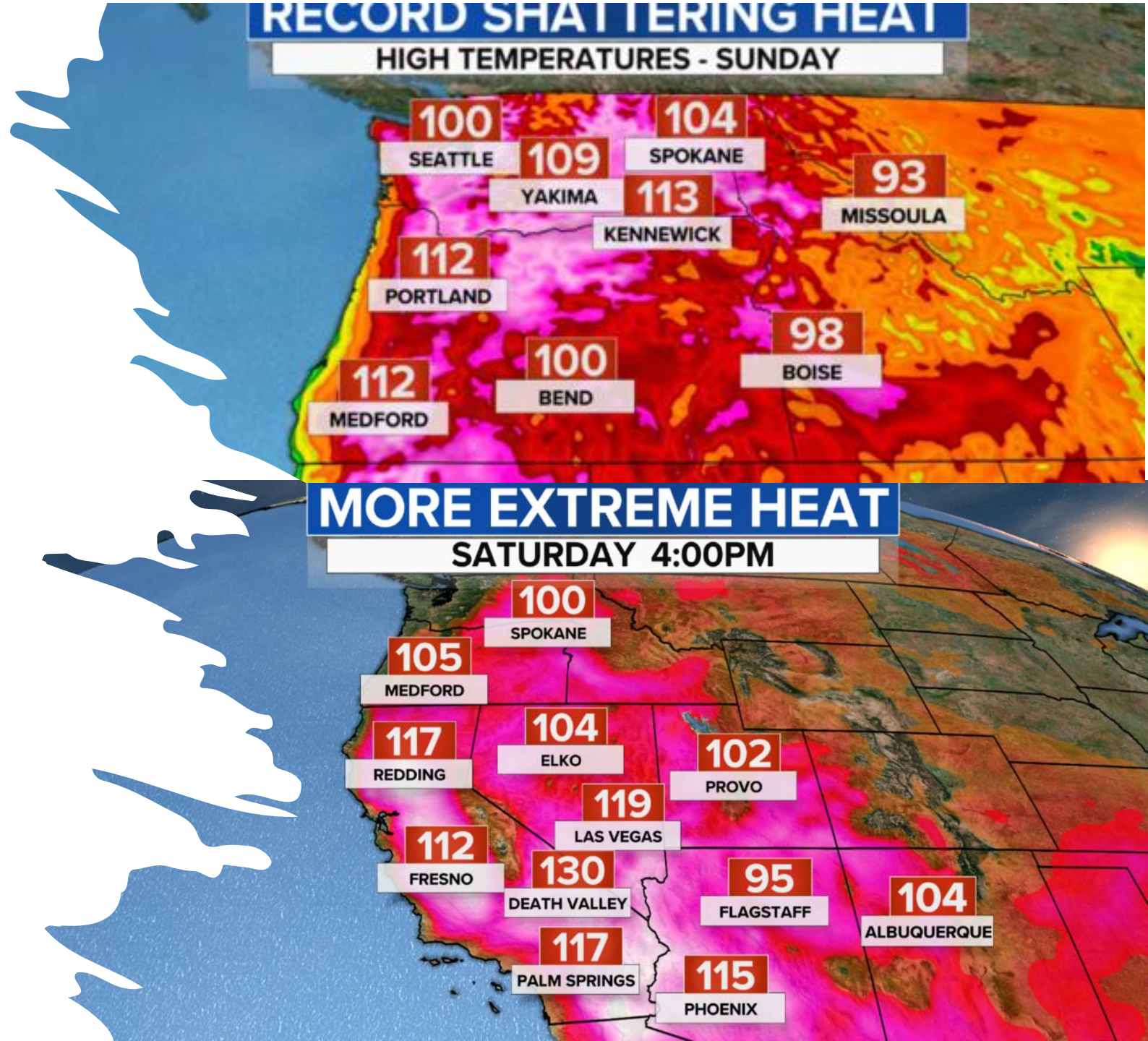
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With funding from NOAA: NA21OAR4590360



2021 Heat Dome

- In late June and early July, 2021 over 1,000 deaths across the Western United States & Canada
- Surge in 911 calls, hospitalizations, heat-related emergency departments,
- Many homes where deaths occurred had no air conditioning;
- Persons at greater risk lack access to resources; have pre-existing medical conditions; young & old.
- *Was this a harbinger of things to come?*



Motivating question: how is extreme heat communicated to at risk publics?

- Twitter represents one of the few mechanisms that NOAA has to communicate directly with the public
- While the most vulnerable people in society are least likely to use social media (children and persons over age of 65), Twitter provides a snapshot into communication practices
- *What contents have been included in extreme heat messages and how can Tweets be improved in the future?*

Socio-Behavioral Response to a Warning Message



Shift from perception of safety
to perception of risk



Hazard/Impact
Location/Population
Guidance
Source
Time

Message Perceptions

Understanding
Believing
Personalizing
Deciding

Message Confirmation

Milling

*The **words** you choose for a message are one of the few factors you can affect in the warning response process.*

From Mileti & Sorensen, 1990

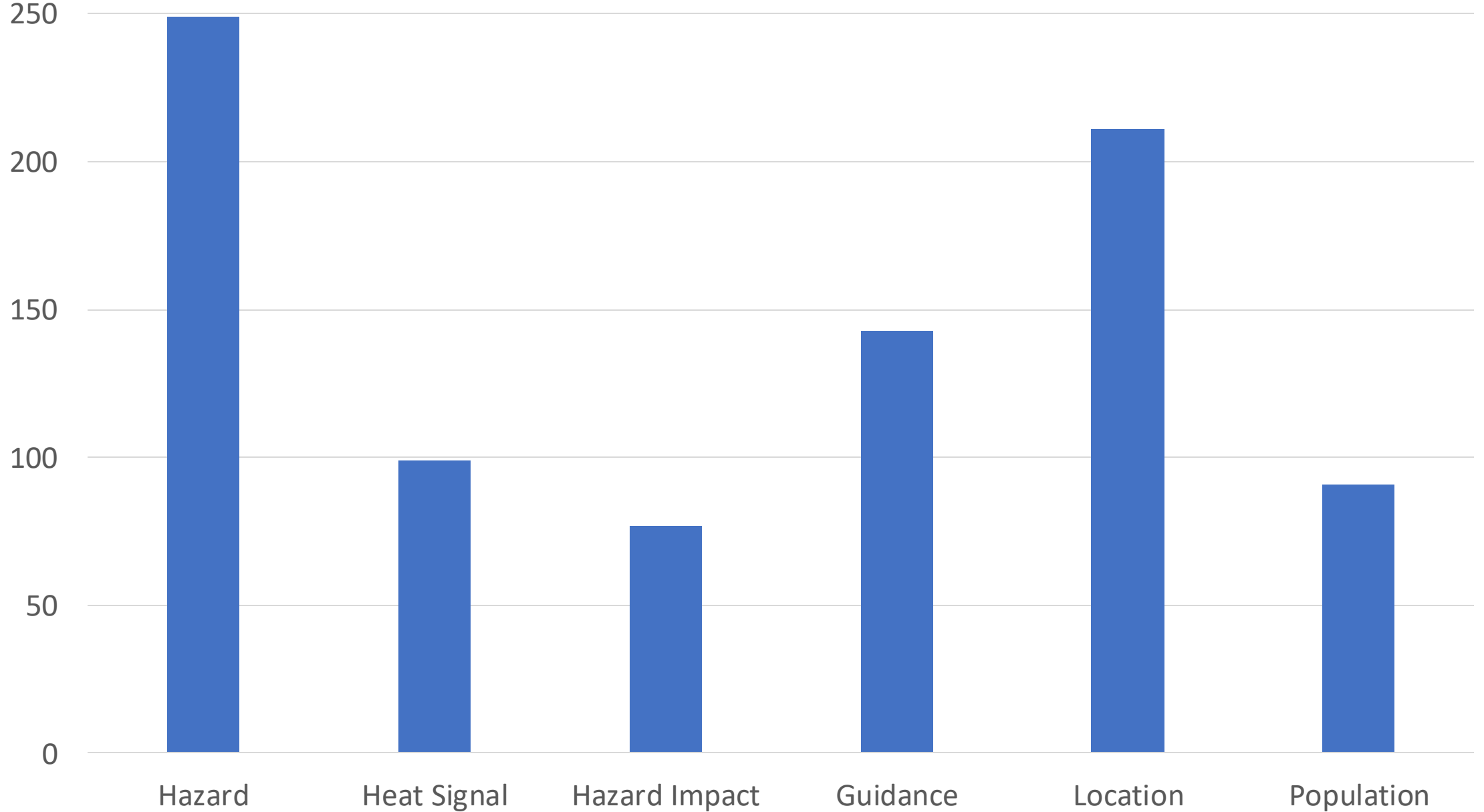
Data (n = 250) were collected from 7 WFOs that experienced excessive heat events in 2021

City, State	Dates (2021)	Number of Tweets
Albany, NY	June 2 nd – June 7 th ; June 25 th – June 30 th	34
Huntsville, AL	July 20 th – August 1 st	32
New Orleans, LA	July 17 th – July 31 st	47
New York City, NY	June 2 nd – June 8 th June 21 st – June 30 th	20
Portland, OR	June 20 th – July 2 nd	33
Raleigh, NC	July 24 th – July 30 th	13
Seattle, WA	June 22 nd – June 29 th	71

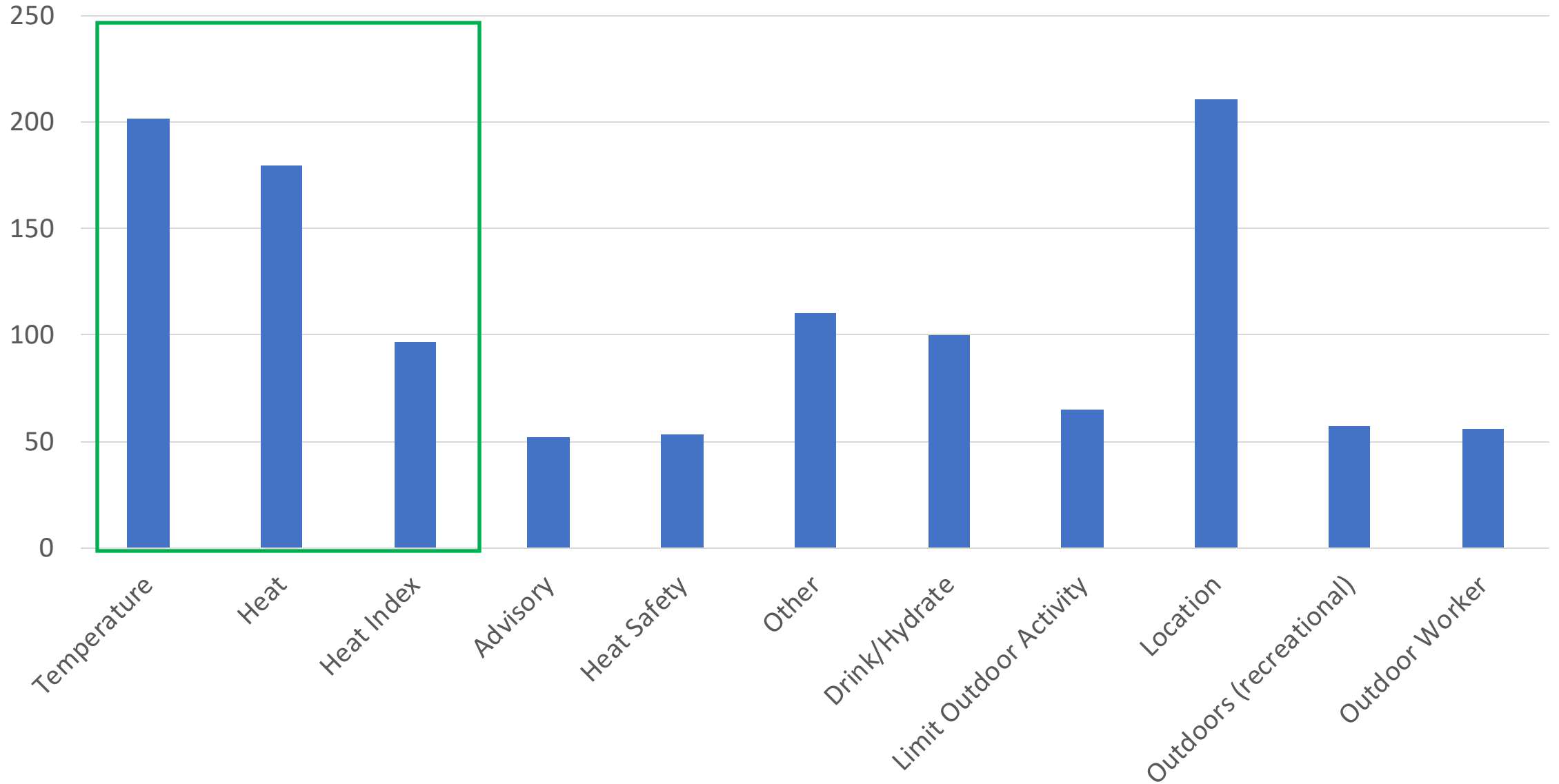
Written/verbal content contained in the text and the image of each message were manually coded

Code	Definition	Example
Hazard	The thing/threat that will affect people/pets	Temperature, locking pets in cars, heat index
<i>Signal Words</i>	<i>Words that identify threat level</i>	<i>Advisory, warning</i>
<i>Hazard Impact</i>	<i>What can happen to people/pets affected by the hazard</i>	<i>Heat stroke, death, sunburn</i>
Guidance	What people are being told to do	Take breaks, drink/hydrate
Location	Whether a map or specific location(s) are mentioned	Eastern New York, coastal Mississippi
Population	Who is at risk (populations or people identified)	Outdoor workers, pregnant women

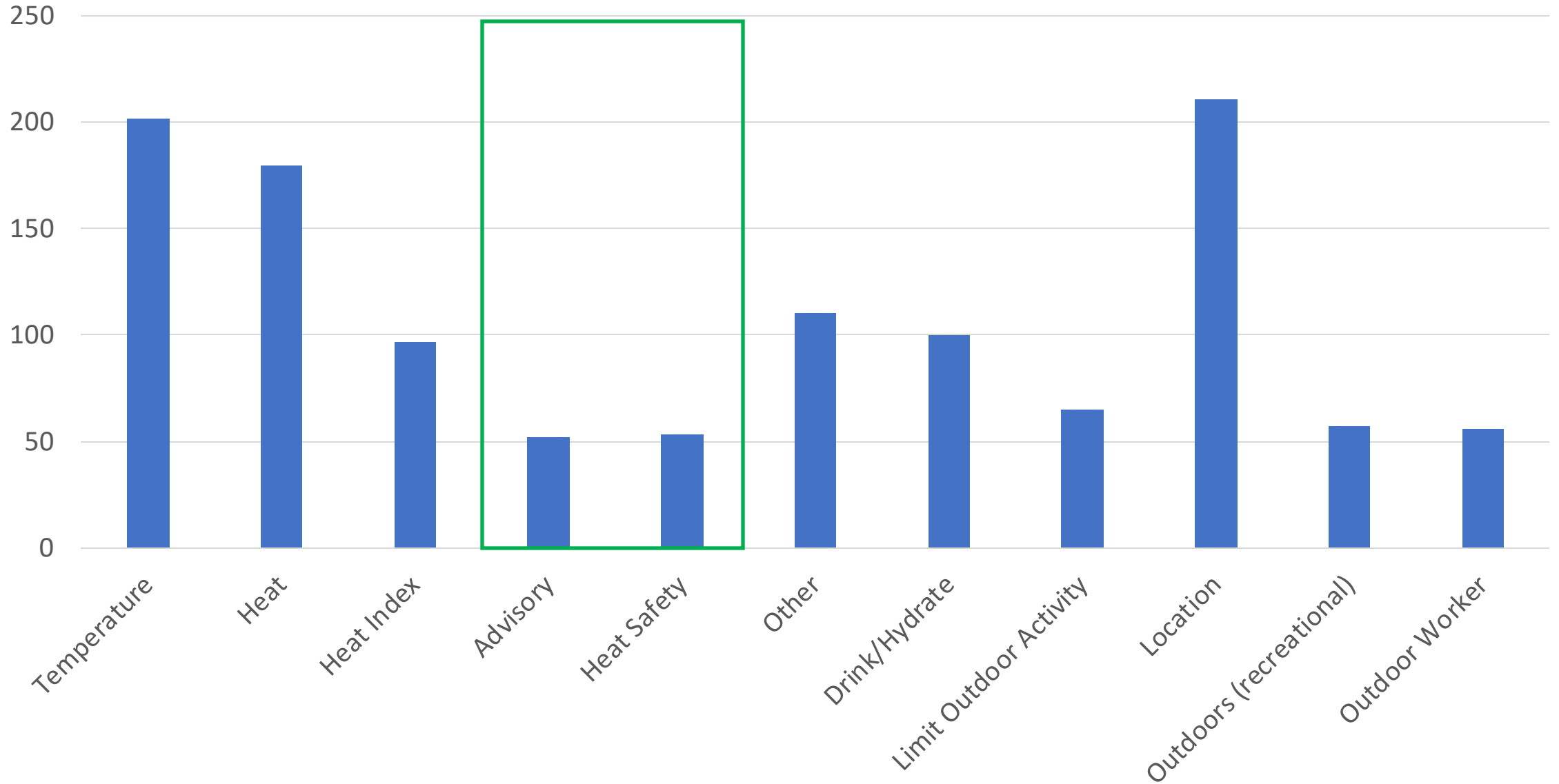
Content Types by Tweet



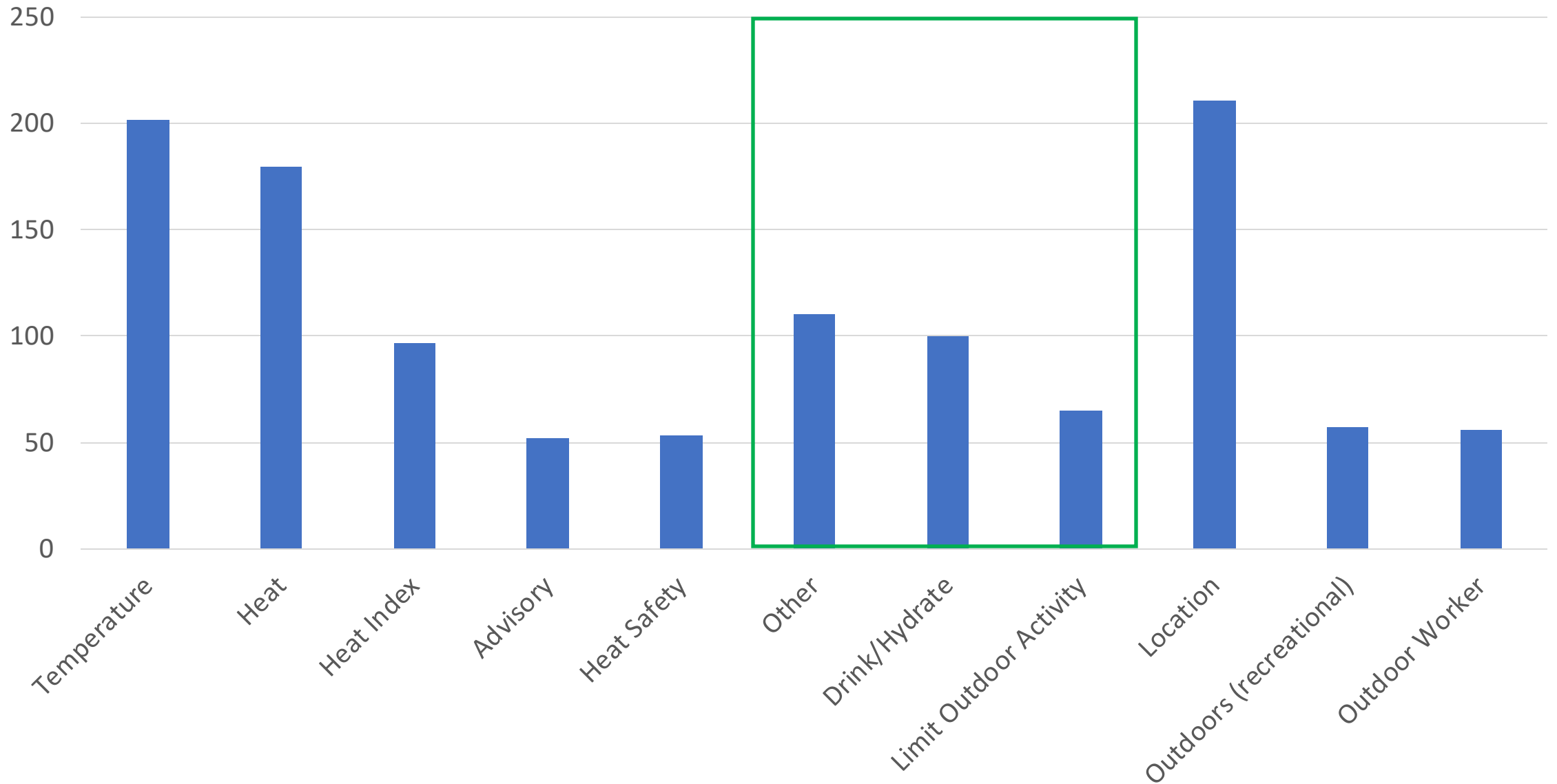
Most Frequent Contents: Hazard



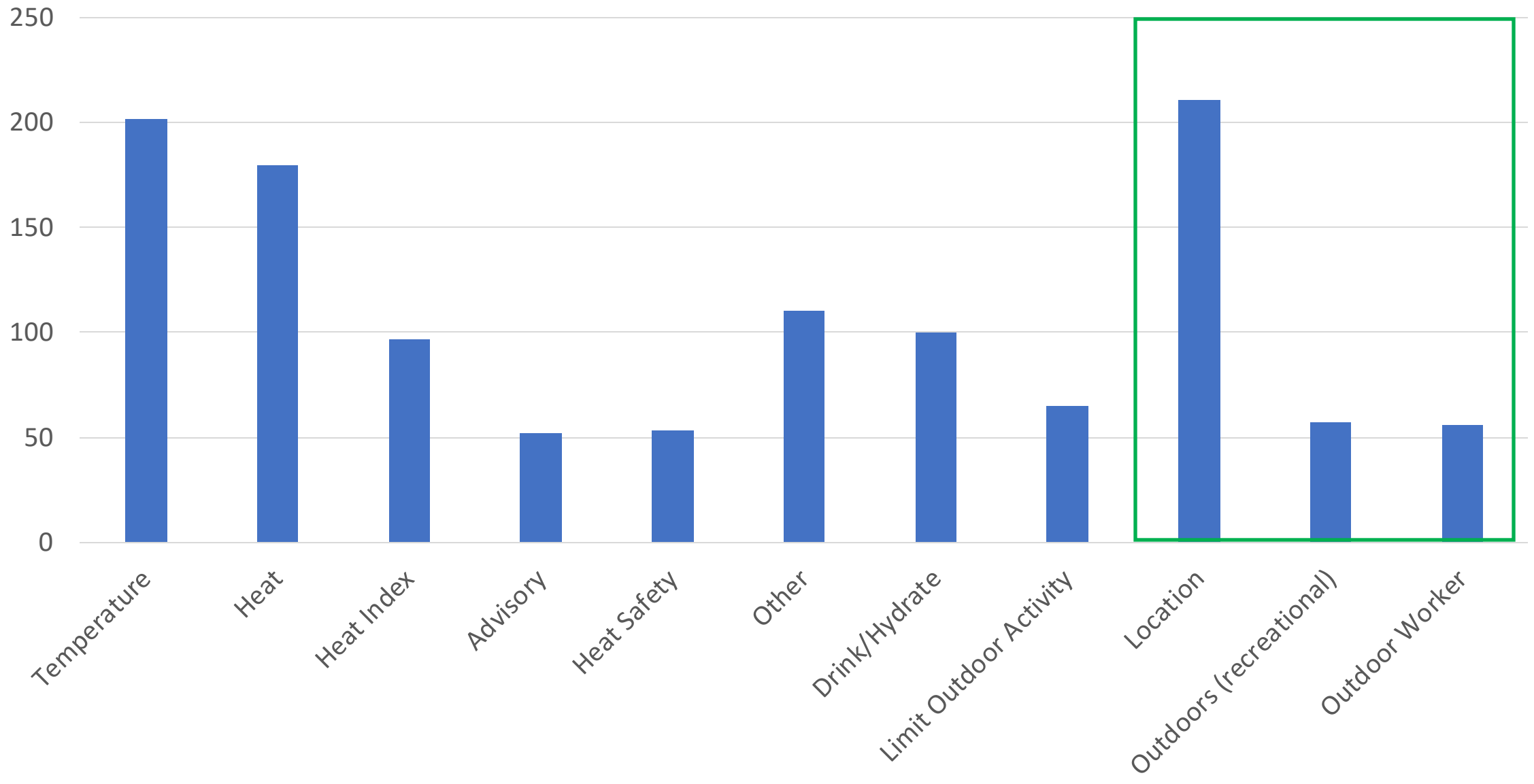
Most Frequent Contents: Signal



Most Frequent Contents: Guidance



Most Frequent Contents: Location/Population



Assumptions about how are vulnerable groups identified and reached using heat health interventions?

- (1) Informing people about heat and heat dangers will lead to behavioral change
- (2) At-risk individuals will recognize their own vulnerability which will lead to concern and awareness
- (3) Benefits of heat advice are commonly understood [by target population] and taken seriously
- (4) Caretakers of vulnerable groups have the capacity and training to engage in heat reduction measures

Mayrhuber, Elisabeth Anne-Sophie, Michel LA Dückers, Peter Wallner, Arne Arnberger, Brigitte Allex, Laura Wiesböck, Anna Wanka et al. "Vulnerability to heatwaves and implications for public health interventions—A scoping review." *Environmental Research* 166 (2018): 42-54.

Assumption 1: informing people about the danger of heat and particular risks will make them aware and adapt their behavior according to advice

DANGER

Heat “signal words” (n = 99; 40%)

- Advisory*, watch, warning, safety

Hazard (n = 249; 99%)

- Temperature*, heat index*, heat wave, excessive heat, extreme heat, dangerous heat, heat index, humidity, severe weather (non-heat), temperature [locked car, working outside, other]

RISKS

Hazard Impacts (n = 77; 31%)

- Heat illness*, heat stroke, heat exhaustion, dehydration, sunburn, death, other

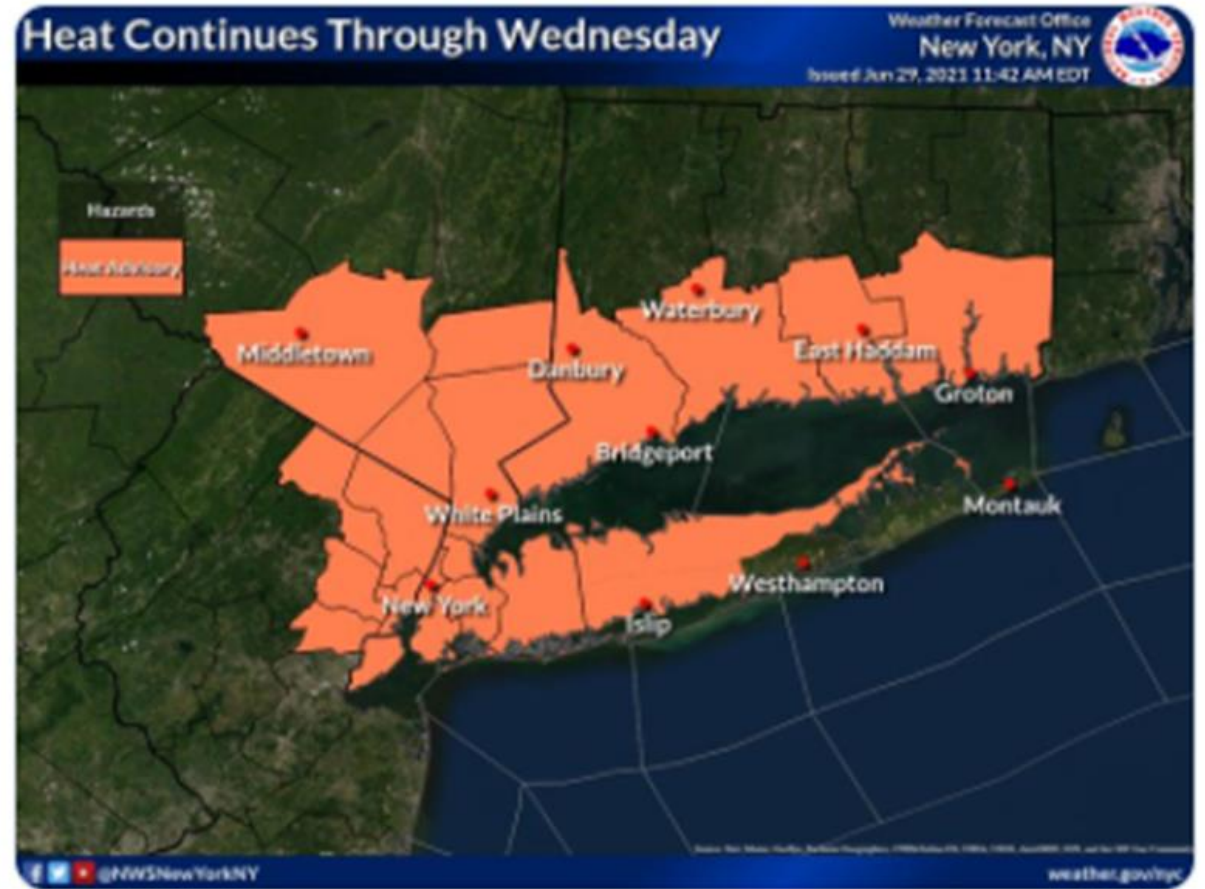
Many messages make use of “**signal words**” (advisory, watch, warning) absent any definition of how it is measured, what it means, and what people should expect or do in response.



NWS New York NY
@NWSNewYorkNY



The Heat Advisory has been expanded to include southwest Suffolk County. #NYwx



12:26 PM - Jun 29, 2021 - Twitter Web App

18 Retweets 1 Quote Tweet 36 Likes

In many cases, the **signal word** is defined by the use of heat indices and other measurements

Note the lack of definition for heat index and the connection of heat advisory is implied.



NWS Huntsville
@NWSHuntsville

...

550 AM - A Heat Advisory will be in effect for much of the area, from 10 AM to 7 PM CDT. Heat indices ranging from 105 to 107 degrees are forecast within the advisory area. Please limit time outdoors, drink plenty of water, stay in air conditioned areas if possible. #HUNwx

!! Dangerous Heat Today !!

Heat Advisory	Heat Index	Heat Safety Tips
	<p>When: 10 AM to 7 PM CDT</p> <p>Heat Index values from 105-107° range in the Advisory area</p> <p>In the mid 90s to 104° degrees elsewhere</p>	<ul style="list-style-type: none"> Dress in light colored, loose fitting clothing Drink plenty of water Do not leave kids or pets in vehicles Avoid strenuous activity during hottest part of day

weather.gov/hunts @NWSHuntsville Issued 7/29/21 6:26 AM

6:50 AM - Jul 29, 2021 - Hootsuite Inc.

11 Retweets 5 Quote Tweets 11 Likes

Infrequently, the signal word **heat advisory** is explained by including heat index, heat index temperatures, or heat index values.

Here, heat index is implied by pointing to a chart on how heat index is measured.



NWS New York NY
@NWSNewYorkNY

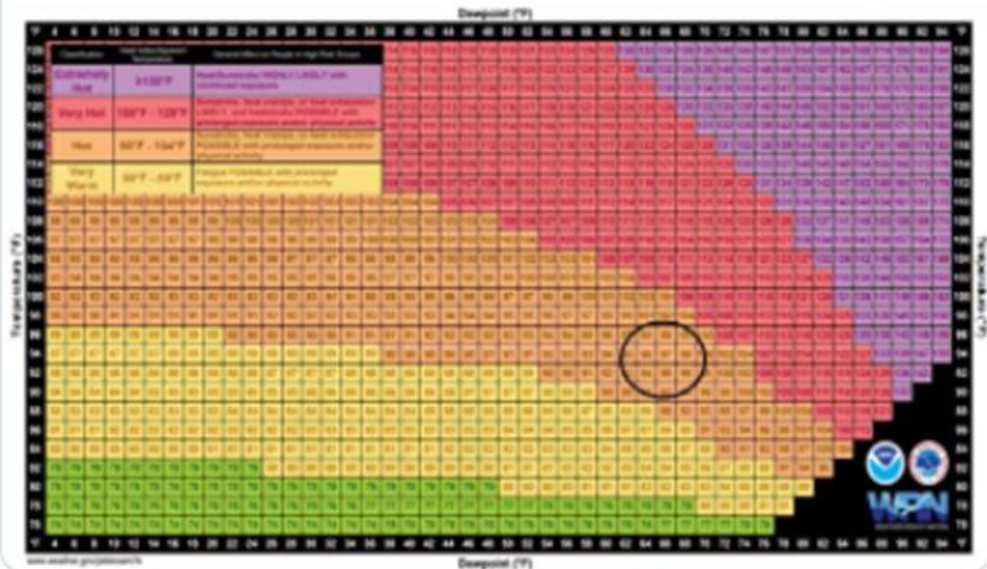
A Heat Advisory is in effect until 8 PM Tuesday evening for northeastern NJ. Heat index values up to 96 degrees are expected and can cause heat illnesses to occur.

Check out this tweet from @NWS_MountHolly that shows how the heat index is calculated. #NJwx



NWS Mount Holly @NWS_MountHolly - Jun 6

Sometimes you'll hear us reference the dew point when talking about the heat index or humidity. Here's a useful chart on how the heat index varies with temperature and dew point. The circled area is where we are/will be the next couple days! #NJwx #PAwx #DEwx #MDwx



9:01 PM - Jun 7, 2021 - Twitter Web App

3 Retweets 1 Quote Tweet 10 Likes

Less frequently, the **hazard** (temp and humidity) is explained as the cause for heat index values.



NWS Huntsville
@NWSHuntsville

If we say "Spring has Sprung" then I think it's safe to say this weekend and next week that "Summer has Belly-flopped" its way into the TN Valley. Highs in the 90s and humid air will cause heat index values to peak near 100-105 each afternoon. Take time now to review heat safety!



NWS Seattle
@NWSSeattle

It's rarely a factor for Western WA, but it is today. With dew points well into the 60s, it makes the temperature feel warmer than it is. This is called the "heat index". Several locations already have heat indices above 90 degrees this A.M. Be careful outdoors. Stay hydrated.

2:29 PM - Jun 26, 2021 - Twitter Web App

92 Retweets 24 Quote Tweets 383 Likes

Contents about **hazard**
Impacts are included
in 31% of tweets

Most frequently, impacts
include death (the most
severe impact) and heat
illness (an undefined impact)

**Practice HEAT SAFETY
Wherever You Are**

Heat related deaths are preventable. Protect yourself and others from the impacts of heat waves.

- Job Sites**
Stay hydrated and take breaks in the shade as often as possible
- Indoors**
Check up on the elderly, sick and those without AC
- Vehicles**
Never leave kids or pets unattended - LOOK before you LOCK
- Outdoors**
Limit strenuous outdoor activities, find shade, and stay hydrated

weather.gov/heat

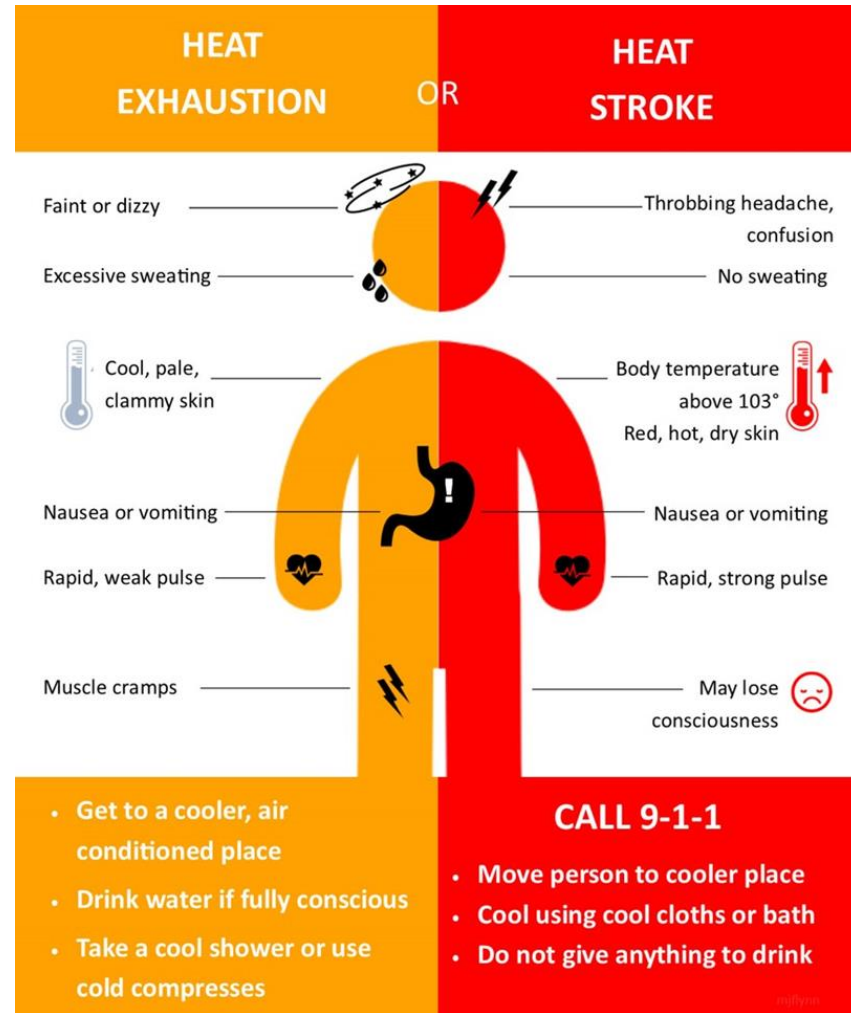
**Heat Related Deaths
ARE Preventable
LOOK BEFORE YOU LOCK**

The temperature in your car can quickly become deadly!

Outside Temperature	80°
Inside 99°	Time Elapsed: 10 Minutes
Inside 109°	Time Elapsed: 20 Minutes
Inside 114°	Time Elapsed: 30 Minutes
Inside 123°	Time Elapsed: 60 Minutes

weather.gov/heat nhtsa.gov

Some of the 250 messages included graphics that describe **hazard impacts** and the associated protective action guidance.



N=9

HEAT-RELATED ILLNESSES

WHAT TO LOOK FOR	WHAT TO DO
HEAT STROKE	
<ul style="list-style-type: none"> • High body temperature (103°F or higher) • Hot, red, dry, or damp skin • Fast, strong pulse • Headache • Dizziness • Nausea • Confusion • Losing consciousness (passing out) 	<ul style="list-style-type: none"> • Call 911 right away-heat stroke is a medical emergency • Move the person to a cooler place • Help lower the person's temperature with cool cloths or a cool bath • Do not give the person anything to drink
HEAT EXHAUSTION	
<ul style="list-style-type: none"> • Heavy sweating • Cold, pale, and clammy skin • Fast, weak pulse • Nausea or vomiting • Muscle cramps • Tiredness or weakness • Dizziness • Headache • Fainting (passing out) 	<ul style="list-style-type: none"> • Move to a cool place • Loosen your clothes • Put cool, wet cloths on your body or take a cool bath • Sip water <p>Get medical help right away if:</p> <ul style="list-style-type: none"> • You are throwing up • Your symptoms get worse • Your symptoms last longer than 1 hour
HEAT CRAMPS	
<ul style="list-style-type: none"> • Heavy sweating during intense exercise • Muscle pain or spasms 	<ul style="list-style-type: none"> • Stop physical activity and move to a cool place • Drink water or a sports drink • Wait for cramps to go away before you do any more physical activity <p>Get medical help right away if:</p> <ul style="list-style-type: none"> • Cramps last longer than 1 hour • You're on a low-sodium diet • You have heart problems
SUNBURN	
<ul style="list-style-type: none"> • Painful, red, and warm skin • Blisters on the skin 	<ul style="list-style-type: none"> • Stay out of the sun until your sunburn heals • Put cool cloths on sunburned areas or take a cool bath • Put moisturizing lotion on sunburned areas • Do not break blisters
HEAT RASH	
<ul style="list-style-type: none"> • Red clusters of small blisters that look like pimples on the skin (usually on the neck, chest, groin, or in elbow creases) 	<ul style="list-style-type: none"> • Stay in a cool, dry place • Keep the rash dry • Use powder (like baby powder) to soothe the rash

N=1

Assumption 2: At-risk individuals recognize their own vulnerability and therefore will feel concerned by heat alerts and heat messaging

AT RISK INDIVIDUALS

- N = 91 (36%) of tweets include information about at-risk individuals.
 - Outdoor workers*, outdoor (recreational), pets, children, aging/elderly, those with chronic illness, and A&FN



NWS Portland
@NWSPortland

At this point in our ongoing heat wave, heat exhaustion & heat stroke are becoming even more of a threat for people without access to an indoor area with air conditioning, especially for those who are over age 65 and infants/children up to age 4. Make sure you know the symptoms!

HEAT EXHAUSTION OR HEAT STROKE		AGOTAMIENTO DEBIDO AL CALOR O INSOLACIÓN	
<p>Head or face: Sweating/flushing</p> <p>Excessive sweating: No sweating</p> <p>Cool, pale, clammy skin: Body temperature above 103°F, hot, red, dry skin</p> <p>Nausea or vomiting: Nausea or vomiting</p> <p>Rapid weak pulse: Rapid strong pulse</p> <p>Muscle cramps: May lose consciousness</p>	<p>Head or face: Dolor de cabeza</p> <p>Excessive sweating: No sweating</p> <p>Cool, pale, clammy skin: Temperatura corporal por encima de 103°F, piel roja, seca, y caliente</p> <p>Nausea or vomiting: Náuseas y vómitos</p> <p>Rapid weak pulse: Latidos del corazón rápidos y débiles</p> <p>Muscle cramps: Debilidad del movimiento</p>		
<ul style="list-style-type: none"> Get to a cooling air conditioned place Drink water if fully conscious Take a cool shower or use cold compresses 	<p>CALL 9-1-1</p> <ul style="list-style-type: none"> Take immediate action to cool the person until help arrives 	<ul style="list-style-type: none"> Descansa en un lugar fresco y ventilado Tomar mucha agua y otros líquidos Siempre usar agua fría o otros compresores fríos 	<p>Llame al 9-1-1</p> <ul style="list-style-type: none"> Seve acción inmediatamente para enfriar su temperatura corporal hasta que llegue la ayuda necesaria

1:07 PM - Jun 28, 2021 - TweetDeck

324 Retweets 15 Quote Tweets 370 Likes

Heat Impacts: Vulnerable Populations

PREGNANT

Extreme heat events have been associated with adverse birth outcomes such as low birth weight, preterm birth, infant mortality, and congenital cataracts.

NEWBORNS

Newborns are extra sensitive to heat because their ability to regulate body temperature is limited.

CHILDREN

Young children and infants are particularly vulnerable to heat, as their bodies are less able to adapt to heat than adults. Those under four are especially vulnerable.

ELDERLY

Older adults, especially those who have preexisting diseases, live alone or have limited mobility are at higher risk for heat illness.

CHRONIC ILLNESS

People with chronic health conditions are more likely to...

Source: The Impacts of Climate Change on Human Health in the United States, A Scientific Assessment (U.S. Global Changes Research Program)

Protect Your Pets In the Heat

- Limit exposure to concrete and asphalt surfaces.
- Keep pets hydrated with plenty of fresh water.
- Take walks in the morning or evening.
- NEVER leave pets in the car.



Practice HEAT SAFETY Wherever You Are

Heat related deaths are preventable. Protect yourself and others from the impacts of heat waves.

Job Sites
Stay hydrated and take breaks in the shade as often as possible

Indoors
Check up on the elderly, sick and those without AC

Vehicles
Never leave kids or pets unattended - LOOK before you LOCK

Outdoors
Limit strenuous outdoor activities, find shade, and stay hydrated

NWS Spokane, WA

weather.gov/heat

Assumption 3: Benefits of visiting cooling centers and other heat advice behavior are commonly understood and taken seriously

HEAT ADVICE

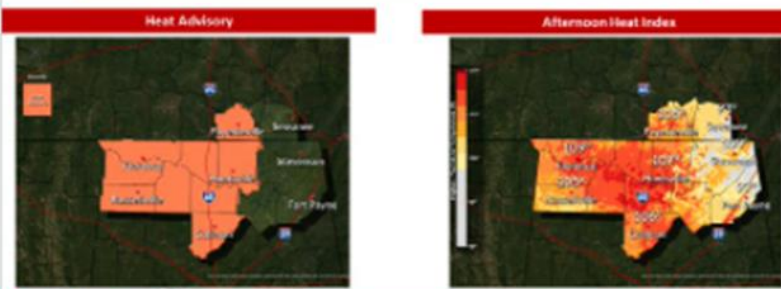
N = 143 (57%) of tweets included heat advice/protective actions

- Drink/Hydrate*, limit outdoor activity, wear loose fitting clothing, take breaks
- *Cooling center is included five (n = 5) times.*

Generally, *benefits* of heat advice (guidance) are not included in instructional messages.

NWS Huntsville @NWSHuntsville
[8:41 PM]: A HEAT ADVISORY will be in effect from 10 AM to 7 PM CDT. Heat Index readings from 105 to 109 degrees are expected in the heat advisory area. Use caution, limit time outdoors, drink plenty of water, and stay in air conditioned areas. #HUNwx

Heat Advisory: Friday 10 AM CDT until 7 PM CDT



Heat Safety Tips

- Don't leave kids or pets in vehicles
- Drink plenty of water
- Dress in light colored, loose fitting clothing
- Avoid strenuous activity during hottest part of day

weather.gov/hun @NWSHuntsville

9:43 PM · Jul 29, 2021 · Hootsuite Inc.

6 Retweets 6 Likes

In some cases, benefits of heat advice (guidance) are presented as educational/awareness.

NWS Albany @NWSAlbany

The return of summer weather! Heat is the leading cause of weather-related deaths most years. You are generally safe indoors with the AC on, while staying hydrated. If you can't easily get indoors, stay in the shade. Stay #WeatherReady with heat safety:

weather.gov/safety/heat

Practice HEAT SAFETY Wherever You Are



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Job Sites
Stay hydrated and take breaks in the shade as often as possible

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Outdoors
Limit strenuous outdoor activities, find shade, and stay hydrated

weather.gov/heat

7:00 AM · Jun 5, 2021 · Hootsuite Inc.

14 Retweets 1 Quote Tweet 24 Likes

Assumption 4: Care-takers of vulnerable groups possess the capacity to intensify care provision during heatwaves and are sufficiently trained in thermoregulation and possible heat reduction measures.

CARETAKER – CARE PROVISION

- Recommendation to “check on others” included in 20 Tweets (5%)

Few messages include instruction to check on others; none include the mechanisms of how to change behavior or what to look for.



Here is an image of the current weather & temperatures at local airports. The majority of these airports are into the mid & upper 90s, while temperatures along the coast are in the mid 60s to mid 70s. Remember to stay hydrated & check on those who are sensitive to extreme heat.

Site	Time (Z)	Wind (KT)	Gust	Peak	Vis	Wx	Sky	T (F)	D (F)	WB	RH	Ap. T	Pressure	3dP	P1
KHQM	1955	250054	---	---	59.0	---	CLR	72.8	44.0	66.7	76	72.8	1015.6	0.3	---
KAST	1955	240054	---	---	59.0	---	CLR	75.9	42.1	66.9	62	75.9	1015.3	-0.3	---
KTMK	2015	310056	---	---	59.0	---	CLR	80.0	47.0	71.0	61.5	80.0	---	---	---
KOPF	2015	270052	---	---	59.0	---	SKNSLS	60.8	55.4	W	82	---	---	---	---

**Practice HEAT SAFETY
Wherever You Are**

Heat related deaths are preventable. Protect yourself and others from the impacts of heat waves.

- Job Sites**
Stay hydrated and take breaks in the shade as often as possible
- Indoors**
Check up on the elderly, sick and those without AC
- Vehicles**
Never leave kids or pets unattended - LOOK before you LOCK
- Outdoors**
Limit strenuous outdoor activities, find shade, and stay hydrated

weather.gov/heat

What would we recommend in place of these messages?

Do not rely on heat advisory, heat watch, or heat warning to convey the dangers of heat.

Do not expect people to understand the meaning of heat index temperatures or heat index values.

Use **plain, clear and actionable language**,

Identify vulnerable populations, **explain** why they are vulnerable, provide **instruction** about actions and **justify** why they should be taken.



Example of “better” tweet b/c includes hazard (w/o jargon like heat index), location, population, guidance, impact

Limitations & Next Steps

- We only looked at seven Weather Forecast Offices
- We do not know how receivers interacted with this content
- We do not know if the content was even viewed by vulnerable populations

- Conduct research on hazard literacy –
 - Knowledge of words like “heat index,” “heat illness”
 - Importance of understanding words that convey specific and scientific concepts?
- Communicating to vulnerable populations –
 - Especially those who are “aging into” vulnerability

QUESTIONS?

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