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## Heat Wave- Define

World Meteorological Organization defines a heat wave as five or more consecutive days during which the daily maximum temperature exceeds the average maximum temperature by five degrees Celsius. If the maximum temperature of any place continues to be more than 45°C consecutively for two days, it is called a heat wave condition.

There will be no harm to the human body if the environmental temperature remains at 37°C. Whenever the environmental temperature increases above 37°C, the human body starts gaining heat from the atmosphere. If humidity is high, a person can suffer from heat stress disorders even with the temperature at 37°C or 38°C.

WHEN SHOULD A HEAT WAVE BE DECLARED	
Recorded maximum temperature	
At or above	At or above
<b>45°C</b> for all locations	<b>40°C</b> for coastal locations

source [www.nidm.gov.in](http://www.nidm.gov.in)

To calculate the effect of humidity we can use Heat Index Values. The Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature. As an example, if the air temperature is 34°C and the relative humidity is 75%, the heat index -- how hot it feels -- is 49°C. The same effect is reached at just 31°C when the relative humidity is 100 %.<sup>1</sup>

This Heat Index value can be calculated by using the formula as follows:

$$Hi = -42.379 + 2.049(1.8C + 32) + 10.14R - 0.224(1.8C + 32) R - 6.83 \times 10^{-3} (1.8C + 32)^2 - 5.48 \times 10^{-2} R^2 + 1.22 \times 10^{-3} (1.8C + 32)2R + 8.52 \times 10^{-4} (1.8C + 32) R^2 - 1.99 \times 10^{-6} (1.8C + 32)2R^2$$

by Rothfusz.

The temperature vs humidity chart is placed, and the temperature actually felt is placed below: <sup>2</sup>

<sup>1</sup> <http://vikaspedia.in/social-welfare/disaster-management-1/guidelines-on-disaster-management/guidelines-on-management-of-heat-wave>

<sup>2</sup> <https://ndma.gov.in/images/guidelines/guidelines-heat-wave.pdf>

Relative Humidity %	Temperature °C																
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
40	27	28	29	30	31	32	34	35	37	39	41	43	46	48	51	54	57
45	27	28	29	30	32	33	35	37	39	41	43	46	49	51	54	57	
50	27	28	30	31	33	35	36	38	41	43	46	49	52	55	58		
55	28	29	30	32	34	36	38	40	43	46	48	52	54	58			
60	28	29	31	33	35	37	40	42	45	48	51	55	59				
65	28	30	32	34	36	39	41	44	48	51	55	59					
70	29	31	33	35	38	40	43	47	50	54	58						
75	29	31	34	36	39	42	46	49	53	58							
80	30	32	35	38	41	44	48	52	57								
85	30	33	36	39	43	47	51	55									
90	31	34	37	41	45	49	54										
95	31	35	38	42	47	51	57										
100	32	36	40	44	49	56											

Caution	Extreme Caution	Danger	Extreme Danger
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Source: Calculated °F to °C from NOAA’s National Weather Service

Temperature/ Humidity Index

## History of Heat Waves

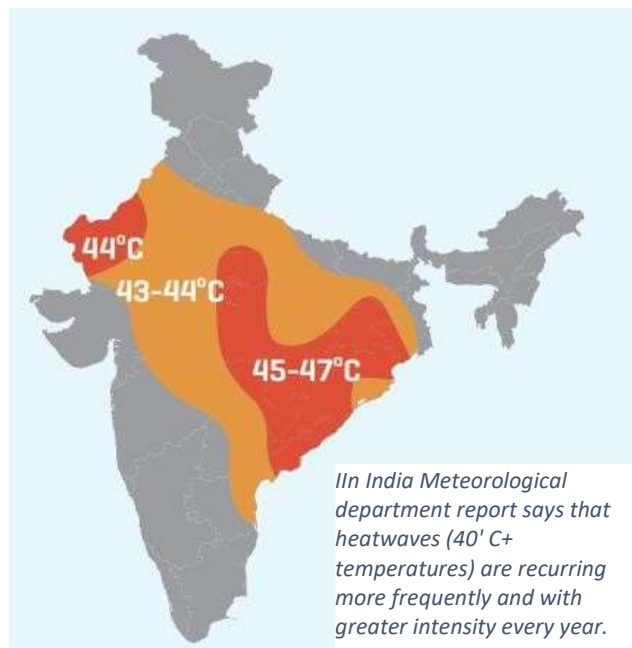
State	Month	*Mean Daily Maximum Temperature (°C)	**Recorded Maximum Temperature (°C)
1	2	3	4
Andhra Pradesh	15 April to 30 May 15 Hyderabad,	39.9	46
Telangana	15 April to 30 May 15 Khammam	40.0	48
Odisha	21 May 15 Jharsuguda,	41.4	45.4
	10 June 15 Bhubaneswa,	37.2	44
Uttar Pradesh	24 May 15 Allahabad	41.8	47.7
	8 June 15 Allahabad,	39.8	47.8
Delhi	25 May 15 Delhi	40.5	46.4
Chattisgarh	25 May 15 Jashpur	41.9	44.5
West Bengal	28 May 15 Kolkata	35.5	44.5
Gujarat	29 May 15 Ahmadabad	41.4	43.2
Madhya Pradesh	29 May 15 Harda	39.7	43.5

Heat wave: April to May 2015, Source [www.ndma.gov.in/images](http://www.ndma.gov.in/images)

Globally, 2015 was the hottest year on record, beating the record set in 2014 and making it the fourth time this century that a new high temperature record was set. The situation in India is also worsening. In 2015, more than 2,300 people died, making it the 5th highest in world history in terms of mortality due to heatwave. Most of the deaths are concentrated in Andhra Pradesh, Telangana, Punjab, Odisha and Bihar. In 2016, the month of April 2016, has seen the highest recorded average global temperature ever. The Intergovernmental Panel on Climate Change (IPCC) has also brought out that climate change has played a key role in intensifying and triggering extreme heat events and is likely to increase.

## Impacts of Heat wave

Heatwaves have serious health impacts, exacerbated further by increase in humidity. Population groups such as the



elderly, very young, people with pre-existing health problems, housing issues and those who are economically challenged are most vulnerable and their vulnerability depends on the degree of exposure. Heat impacts are more in urban areas due to Urban Heat Island (UHI). Factors such as pollution, changing climate, sprawl, lifestyle and city geography as well as geometry increase UHI intensity. Impact of heat is increasing. Apart from vulnerable groups in cities and villages, workers working both outdoor (traffic police, street vendors) and in closed environment (miners, industrial workers) face considerable occupational risk to heat stress during extreme heat days<sup>3</sup>

Heatwaves typically occur between March to June, and in some rare cases even extend till July. Heat waves are more frequent over the Indo-Gangetic plains of India. On an average, 5-6 heat wave events occur every year over the northern parts of the country. The most notable amongst the

recent ones are Hyderabad (Andhra Pradesh) 46 °C, Khammam 48 °C , Jharsuguda (Odisha) 45.4°C, Bhubaneswar (Odisha) 44°C, Allahabad (Uttar Pradesh) 47.8°C , Delhi 46.4°C, Jashpur (Chhattisgarh) 44.5°C, Kolkata (West Bengal) 44.5°C, Gaya (Bihar) 46.3°C, Nagpur (Vidarbha region in Maharashtra) 47.1°C, Kalburgi (Karnataka) 44.1°C and Churu (Rajasthan) 48.0°C in 2015. This unusual and uncomfortable hot weather can impact human and animal health and also cause major disruption in community infrastructure such as power supply, public transport and other essential services. Heat wave is also called a “silent disaster” as it develops slowly and kills and injures humans and animals nationwide. Importantly, the adverse impact of heat wave is preventable by educating the public on the preventive actions, following the Do’s and Don’ts reporting early to health facilities and timely diagnosis and treatment.<sup>4</sup>

## Need for a Heat Action Plan Roadmap

There is the need for systematic and comprehensive planning to prepare for future heat events in the country. This Roadmap identifies the potential goal, objectives; intervention framework and priority areas for reflection during such action planning. It will also guide sub-national planning efforts.

### Experience on Heat-wave plan implementation

Ahmedabad was among the first city to prepare a Heat wave Action Plan in 2015. This plan provides a framework for other Indian cities to emulate and help protect their citizens from the extreme heat. The Heat Wave Action Plan of Ahmedabad concluded that Smart Cities are Heat wave Safe Cities. The following are key lesson learnt from Ahmedabad Heat Wave Action Plan:

1. Recognize Heat Wave as a major Health Risk.
2. Map out the 'High Risk' Communities.
3. Setting up of 'Public Cooling Places'.
4. Issue Heat wave alerts through different media.
5. Key strategies

The heat-wave action plan is intended to mobilize individuals and communities to help protect their neighbours, friends, relatives, and themselves against avoidable health problems disruption to general, social and economic

<sup>3</sup> [https://www.preventionweb.net/files/50954\\_50954roadmapforurbanheatwavewarning.pdf](https://www.preventionweb.net/files/50954_50954roadmapforurbanheatwavewarning.pdf)

<sup>4</sup> <https://ndma.gov.in/images/guidelines/guidelines-heat-wave.pdf>

services. For this reason, Government agencies will have a critical role to play in preparing and responding to heatwaves.

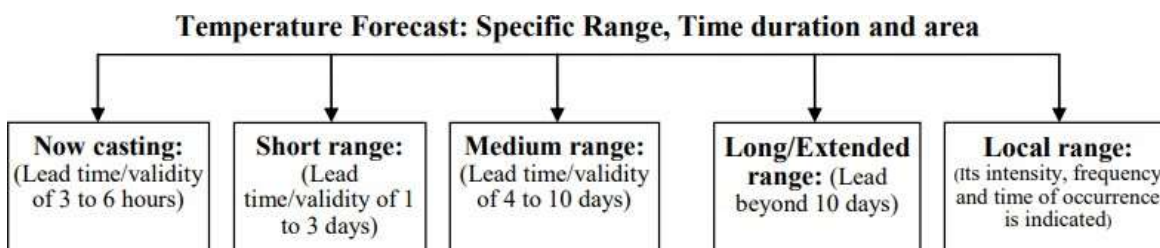
1. Establish Early Warning System and Inter-Agency Coordination to alert residents on predicted high and extreme temperatures.
2. Capacity building / training programme for health care professionals at local level to recognize and respond to heat-related illnesses, particularly during extreme heat events.
3. Public Awareness and community outreach, disseminating public awareness messages on how to protect against the extreme heat-wave through print, electronic and social media and Information, Education and Communication (IEC) materials such as pamphlets, posters and advertisements and Television Commercials (TVCs) on Do's and Don'ts and treatment measures for heat related illnesses.
4. Collaboration with non-governmental organizations and civil society organizations to improve bus stands, building temporary shelters, wherever necessary, improved water delivery systems in public areas and other innovative measures to tackle Heat wave conditions.
5. Purpose of Heat-wave Action Plan
6. The Heat-Wave Action plan aims to provide a framework for implementation, coordination and evaluation of extreme heat response activities in cities/town in India that reduces the negative impact of extreme heat. The Plan's primary objective is to alert those populations at risk of heat-related illness in places where extreme heat conditions either exist or are imminent, and to take appropriate precautions, which are at high risk.
7. Drawn by the Ahmedabad Municipal Corporation (AMC) in collaboration with the US' Georgia Institute of Technology, the action plan is a response to the deadly heat wave in May 2010 when the city's temperature spiked to 46.8°C and killed hundreds of people.
8. "The Georgia University has used historical data to develop a model for Ahmedabad. We can get reliable predictions in advance and also have enough time to prepare and communicate to other departments and stakeholders."
9. AMC also plans to install thermometers at various spots and use pamphlets and other mass awareness tools such as billboards to raise awareness of the dangers of extreme heat among children, people who work outdoors and other vulnerable people, especially those who live in the slums. In Gandhinagar it was found that 10 per cent of the construction workers in the city were hospitalised at least once during summer for heat-related sickness. Slum residents suffer the most because their localities are congested and their roofing material does not provide enough protection from the heat.

## Early Warning & Communications

Early warning systems can enhance the preparedness of decision-makers and their readiness to harness favourable weather conditions. Early warning systems for natural hazards is based both on sound, scientific and technical knowledge. Heat-wave early warnings are designed to reduce the avoidable human health consequences from heatwaves through timely notification of prevention measures to vulnerable populations.

Forecast and Issuance of Heat Alert or Heat Warning India Meteorological Department (IMD):

The IMD is mandated to meteorological observations and provides current and forecast meteorological information. It provides warning against severe weather phenomena, real time data and weather prediction of maximum temperature, Heat-wave warning.



<b>Red Alert (Severe Condition)</b>	<b>Extreme Heat Alert for the Day</b>	<b>Normal Maximum Temp increase 6° C to more</b>
<b>Orange Alert (Moderate Condition)</b>	<b>Heat Alert Day</b>	<b>Normal Maximum Temp increase 4° C to 5° C</b>
<b>Yellow Alert (Heat-wave Warning)</b>	<b>Hot Day</b>	<b>Nearby Normal Maximum Temp.</b>
<b>White (Normal)</b>	<b>Normal Day</b>	<b>Below Normal Maximum Temp.</b>

Colour signals for Heat wave, Source [www.ndma.gov.in/pdf](http://www.ndma.gov.in/pdf)

## Heat Wave management planning- Ahmedabad

In India, the first systematic attempt at heatwave management planning has happened with Ahmedabad Heat Action Plan (AHAP), launched in 2013. It was developed by Ahmedabad Municipal Corporation (AMC) in partnership with domestic and international experts focusing on four key strategies;

1. Building public awareness on risk of heatwaves through mass outreach.
2. Implementing response system to prevent heat-related death and illness at the onset
3. Initiating inter-agency collaboration framework to alert citizens
4. Capacity building among city officials and healthcare professionals

Additionally, identification of adaptive measures such as mapping high-risk areas and cooling spaces during extreme heat days and coordinating utility services such as water and electricity to support life. This model has been applied regionally at Maharashtra and Odisha. Other notable initiatives include the National Knowledge Network Programme on Climate Change and Human Health, launched in 2011 by the Department of Science and Technology. These consist of several studies including those related to impacts of heat stress on health, especially in relation to occupation.<sup>5</sup>

## Symptoms and First Aid for various Heat Disorders<sup>6</sup>

Heat Disorder	Symptoms	First Aid
<b>Sunburn</b>	Skin redness and pain, possible swelling, blisters, fever, headaches.	Take a shower, using soap, to remove oils that may block pores preventing the body from cooling naturally. If blisters occur, apply dry, sterile dressings and get medical attention.
<b>Heat Cramps</b>	Painful spasms usually in leg and abdominal muscles or extremities. Heavy sweating	Move to cool or shaded place. Apply firm pressure on cramping muscles or gentle massage to relieve spasm. Give sips of water. If nausea occurs, discontinue.
<b>Heat Exhaustion</b>	Heavy sweating, weakness, skin cold, pale, headache and clammy. Weak pulse. Normal temperature possible. Fainting, vomiting	Get victim to lie down in a cool place. Loosen clothing. Apply cool, wet cloth. Fan or move victim to air-conditioned place. Give sips of water slowly and if nausea occurs, discontinue. If vomiting occurs, seek immediate medical attention. Or call 108 and 102 for Ambulance.
<b>Heat Stroke (Sun Stroke)</b>	High body temperature (106°F). Hot, dry skin. Rapid, strong pulse.	Heat stroke is a severe medical emergency. Call 108 and 102 for Ambulance for emergency medical

<sup>5</sup> [https://www.preventionweb.net/files/50954\\_50954roadmapforurbanheatwavewarning.pdf](https://www.preventionweb.net/files/50954_50954roadmapforurbanheatwavewarning.pdf)

<sup>6</sup> <https://ndma.gov.in/images/guidelines/guidelines-heat-wave.pdf>

Possible unconsciousness. Victim will likely not sweat.

services or take the victim to a hospital immediately. Delay can be fatal. Move victim to a cooler environment. Try a cool bath or sponging to reduce body temperature. Use extreme caution. Remove clothing. Use fans and/or air conditioners. **DO NOT GIVE FLUIDS.**

## Heat impacts in urban areas

Heat health impacts are more severe in urban areas where residents are exposed to higher and nocturnally



sustained temperatures compared to surrounding areas due to a phenomenon called the Urban Heat Island (UHI). UHIs, caused by a combination of more heat absorbing surfaces (rooftops, buildings and paved surfaces), the trapping of hot air between buildings, limited tree cover and other heat trapping and heat inducing factors such as fuel combustion and air conditioning, can result in average annual temperatures in urban areas being 1-30°C hotter than surrounding areas. Factors such as pollution, climate change, sprawl, lifestyle and urban design increase UHI intensity. Higher urban temperatures mean greater energy use during the summer, Increased air pollution and

*causes of urban head land*

greenhouse gas emissions. In addition to cities and villages, specific industries (e.g., mining) emit as well as absorb considerable heat. This increases risks to a large workforce in these occupational settings. With the majority of workplace settings in developing countries being heavily influenced by outdoor temperatures, it can be expected that both indoor and outdoor workers will experience increased heat stress due to climate change and other factors. However, the most severe impact of heat is felt on water resources which evaporates fast during heatwave conditions, thereby increasing the vulnerability of humans, natural habitat and economic activity including agriculture (crops and livestock).<sup>7</sup>

## Do's and Dont's

Heat Wave conditions can result in physiological strain, which could even result in death. To minimise the impact during the heat wave and to prevent serious ailment or death because of heat stroke, you can take the following measures:

1. Avoid going out in the sun, especially between 12.00 noon and 3.00 p.m.
2. Drink sufficient water and as often as possible, even if not thirsty
3. Wear lightweight, light-coloured, loose, and porous cotton clothes. Use protective goggles, umbrella/hat, shoes or chappals while going out in sun.
4. Avoid strenuous activities when the outside temperature is high. Avoid working outside between 12 noon and 3 p.m.
5. While travelling, carry water with you.
6. Avoid alcohol, tea, coffee and carbonated soft drinks, which dehydrates the body.
7. Avoid high-protein food and do not eat stale food.
8. If you work outside, use a hat or an umbrella and also use a damp cloth on your head, neck, face and limbs

<sup>7</sup> [https://www.preventionweb.net/files/50954\\_50954roadmapforurbanheatwavewarning.pdf](https://www.preventionweb.net/files/50954_50954roadmapforurbanheatwavewarning.pdf)

9. Do not leave children or pets in parked vehicles
10. If you feel faint or ill, see a doctor immediately.
11. Use ORS, homemade drinks like lassi, torani (rice water), lemon water, buttermilk, etc. which helps to rehydrate the body.
12. Keep animals in shade and give them plenty of water to drink.
13. Keep your home cool, use curtains, shutters or sunshade and open windows at night.
14. Use fans, damp clothing and take bath in cold water frequently.

### Tips for treatment of a person affected by a sunstroke:

1. Lay the person in a cool place, under a shade. Wipe her/him with a wet cloth/wash the body frequently. Pour normal temperature water on the head. The main thing is to bring down the body temperature.
2. Give the person ORS to drink or lemon sarbat/torani or whatever is useful to rehydrate the body.
3. Take the person immediately to the nearest health centre. The patient needs immediate hospitalisation, as heat strokes could be fatal.

### Recent Heat wave in Surat (Gujarat):

Following the sudden spurt in heat across Gujarat in April 2019, the state health department has issued an "Orange Alert" for two-days as the temperatures are likely to touch 44 degrees. All the bus stands have ORS packets, municipal corporation has made arrangements for water at multiple points. Meteorological Centre (MC) Ahmedabad released a warning on Saturday for heatwave in multiple regions of Gujarat for the next 48 hours.

"Heatwave conditions very likely to prevail at a few places in the districts of Gujarat region namely Ahmedabad, Gandhinagar, Banaskantha, Sabarkantha, Surat; in the districts of Saurashtra-Kutch namely Bhavnagar, Veraval, Porbandar, Rajkot, Amreli, Surendranagar, Kutch and Diu during next 48 hours commencing from 0830 hours IST of today.<sup>8</sup>

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<sup>8</sup> <https://www.ndtv.com/india-news/heatwave-conditions-in-gujarat-authorities-issue-orange-alert-2029685>