NATIONAL GUIDELINES FOR PREPARATION OF ACTION PLAN – PREVENTION AND MANAGEMENT OF HEAT WAVE

October 2019

NATIONAL DISASTER MANAGEMENT AUTHORITY
MINISTRY OF HOME AFFAIRS
GOVERNMENT OF INDIA

National Guidelines for Preparation of Action Plan – Prevention and Management of Heat wave

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सत्यमेव जयते

प्रधान मंत्री

Prime Minister

MESSAGE

I am happy to learn that the National Disaster Management Authority has revised the Guidelines for Prevention and Management of Heat Wave.

Climate Change needs Climate Action, as heat waves are becoming more intense and frequent across the country. Our continuous efforts are towards devising and improving strategies to mitigate the adverse impacts of heat waves, particularly upon the poor and disadvantaged sections of the society.

These guidelines have been revised after a series of consultations with experts and are aligned with local needs and international trends. The key to minimise the damage is in better and increased awareness.

I am sure that these guidelines will go a long way in improving and strengthening our preparedness and response to heat waves in the short-term and mitigate the adverse impact of heat wave in the long-term.

I congratulate the NDMA on this initiative and wish them the very best for their endeavours.

(Narendra Modi)

New Delhi
अश्विन 12, शक संवत् 1941
4th October, 2019

अमित शाह
AMIT SHAH

सत्यमेव जयते

गृह मंत्री
भारत
HOME MINISTER
INDIA

MESSAGE

It is heartening to note that National Disaster Management Authority has brought out the revised Guidelines for Prevention and Management of Heat Wave.

Over the years, heat waves have become fatally catastrophic. We need to continuously upgrade our mechanisms to address emerging neat-related threats, reflect best practices and draw lessons from past experiences. I am sure: these guidelines prescribe short-term relief and response measures as well as long-term heat risk reduction strategies. I am also confident that these guidelines will go a long way in creating awareness and with better coordination among the stakeholders; it would be possible to take concrete measures, to save lives.

I congratulate the NDMA for bringing out these guidelines and wish them success in ail their endeavours.

(Amit Shah)

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Foreword

The World Meteorological Organization statement on the State of the Global Climate in 2018 indicates that the global temperatures continue to increase; and 2015-2018 have been the four warmest years on record. The year 2018 was the fourth warmest year on record with the average global temperature reaching approximately 1° C above pre-industrial levels. Heat waves are projected to increase in frequency, intensity and duration over most of the land area in the 21st century.

Over the past several years, India too has witnessed an increasing trend of heat waves that severely affect several States. During March-June every year, many places record high temperatures and humidity conditions that result in moderate to severe heat wave conditions that prevail for several days. Heat wave caused 24,223 deaths from 1992 to 2015 across the country. Noticing this severity, NDMA started working on heat risk reduction and came out with first-ever National Guidelines in 2016. To evaluate the impacts of heat waves, plan adaptation and mitigation strategies and assess the implementation of the Guidelines, NDMA has been organizing national-level annual workshops with all the stakeholders since 2017.

In 2019, NDMA in collaboration with Government of Maharashtra organized the workshop at Nagpur on 27-28th February. Its broad objectives included sharing of experiences, lessons learnt, long-term mitigation measures and future course of action on heat wave action planning. Several recommendations made at the workshop have been incorporated in these guidelines.

The Expert Group on Heat Wave, through successive deliberations, has helped update the guidelines to include specific actions based on the scientific outlook from various research papers, reports, best practices in heat wave assessment and mapping techniques.

Unplanned urban growth and development, changes in land use and land cover, densely populated areas and increasing urban sprawl are exacerbating the impact of heat waves. Built environment profoundly affects and plays a critical role in maintaining the urban ecosystem, and the hydrological and energy cycles. A new section on 'Built Environment' has been added in these guidelines to address this aspect.

These guidelines urge stakeholders to learn from past experiences, improve inter-agency coordination and ensure the participation of all. One key aspect that has been highlighted is information/knowledge dissemination through collaboration with academia. Research and development have also been encouraged to focus on detailed assessment of heat wave risk and vulnerability. Studies assessing the local thresholds of temperature and humidity have been identified as an important activity to help improve India Meteorological Department's forecast on heat waves. Identifying new techniques and coming up with smart solutions is a priority.

These guidelines aim to facilitate the stakeholders to prepare/revise/update their Heat Action Plans by providing insights into various aspects related to heat risk reduction. It will also help in the mobilization of stakeholders and coordination among various ministries/ departments, individuals and communities for mitigating the impacts of heat waves, protecting lives and preventing illnesses.

Shri Kamal Kishore	Dr. D. N. Sharma	Lt.Gen. N.C.Marwah (Rtd.)	Shri G.V.Venugopal Sarma
Member,	Member	Member	Member Secretary

ACKNOWLEDGEMENTS

Heat Waves affect various parts of our country and its prevention and management requires pro-active participation from a plethora of stakeholders extending beyond those working only on disaster risk management. The challenging task of preparing these National Guidelines has been accomplished with the support of many such individuals and institutions. We gratefully acknowledge the support of each one of them.

Shri Kamal Kishore, Member, NDMA, chaired the Expert Committee and guided the review process towards the preparation of these guidelines. Other Members - Lt. Gen. N. C. Marwah (Retd.) and Dr. D. N. Sharma - actively participated in all the meetings and provided valuable inputs and suggestions. Members Secretary Shri G.V.Venugopal Sarma provided inputs in the final draft. Several rounds of consultations were held, inputs sought and drafts prepared before these guidelines were finalized.

Dr. V. Thiruppugazh, Joint Secretary (Policy and Plan), NDMA, led the efforts towards the preparation of first National Guidelines on Heat Wave and its subsequent revision in 2017. Under his guidance, the Guidelines have once again been thoroughly revised to incorporate latest research and developments with a view to respond to and mitigate long-term risk. The writing of this document was done by Shri Anup Kumar Srivastava, (Sr. Consultant, Drought, Heat wave, Thunderstorm, Cold Wave & Food Security), who coordinated inputs from a range of institutions, experts and individuals. Shri Anuj Tiwari (Sr. Consultant, Policy, Plan & Mainstreaming), Dr. Swati Sulagna (Sr. Consultant, Climate Change), Ms. Anshupriya (Consultant – Media), Shri Nawal Prakash (Senior Research Officer) and Shri Pankaj Kumar (Under Secretary) provided technical and administrative support.

Significant contributions were made by the Members of the Expert Committee, Ministry of Home Affairs (MHA), Ministry of Health and Family Welfare (MoH&FW), Ministry of Earth Sciences (MoES), Indian Meteorological Department (IMD) and representatives of Andhra Pradesh, Bihar, Odisha, Gujarat, Karnataka, Maharashtra, Rajasthan and Telangana. Various scientific and technical institutions, eminent professionals and non-governmental organisations (NGOs) also gave useful feedback and suggestions on different sections of the guidelines.

ABBREVIATIONS

The following abbreviations and acronyms appear in the text:

AICTE	All India Council of Technical Education
AIR	All India Radio
ATIs	Administrative Training Institutes
CBOs	Community-Based Organisations
cCASHh	Climate Change and Adaptation Strategies for Human Health
CHC	Community Health Centre
COR	Relief Commissioner
DDMA	District Disaster Management Authority
DRR	Disaster Risk Reduction
DST	Department of Science and Technology
EuroHEAT	World Health Organisation project for improve public-health responses to weather extremes
HAP	Heat Action Plan
HI	Heat Index
IDSP	Integrated Disease Surveillance Program
IEC	Information, education and communication
IIPH	Indian Institute of Public Health
IIT	Indian Institute of Technology
IITM	Indian Institute of Tropical Meteorology, Pune
IMA	India Medical Association
IMD	India Meteorological Department, New Delhi
IPCC	Intergovernmental Panel on Climate Change
IV fluid	intravenous fluid drip
LED	Light Emitting Diodes
MC	Municipal Corporation
MHA	Ministry of Home Affairs
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Scheme
MoA&FW	Ministry of Agriculture and Farmers' Welfare
MoAH&D	Ministry of Animal Husbandry and Dairying
MoEF&CC	Ministry of Environment Forest and Climate Change
MoES	Ministry of Earth Sciences
MoHFW	Ministry of Health and Family Welfare
MoHRD	Ministry of Human Resource Development
MoHUA	Ministry of Housing and Urban Affiars
MoJS	Ministry of Jal Shakti
MoL&E	Ministry of Labour and Employment
MoP	Ministry of Power
MoPR	Ministry of Panchayati Raj

MoR	Ministry of Railways
MoRD	Ministry of Rural Development
MoRT&H	Ministry of Road Transport and Highways
MoWR,RD&GR	Ministry of Water Resources, River Development and Ganga Rejuvenation
NCDC	National Centre for Disease Control
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NGO	Non Governmental Organisation
NIDM	National Institute of Disaster Management
NOAA	National Oceanic and Atmospheric Administration, USA
NRDC	Natural Resource Defence Council
OPD	Out Patient Department
ORS	Oral Rehydration Salts
PHC	Primary Health Centre
PHED	Public Health Engineering Department
PHEWE	Assessment and Prevention of Acute Health Effects and Weather Conditions in Europe
RH	Relative Humidity
RRT	Rapid Response Team
SDMA	State Disaster Management Authority
SDRF	State Disaster Response Force
SEOC	State Emergency Operation Centre
SMS	Short Message Services
SoP	Standard Operating Procedure
T_{max}	Maximum Temperature
T_{min}	Minimum Temperature
UGC	University Grants Commission
UHI	Urban Heat Island
USA	United State of America
WMO	World Meteorological Organisation

Executive Summary

Heat wave has emerged as one of the major weather hazards in India. Heat wave is a period of abnormally high temperatures, more than the normal maximum temperature that occurs during the pre-monsoon summer season. Heat wave season typically occurs from March to June and in some cases, even extends up to July. On an average, five-six heat wave events occur every year over the northern parts and eight to ten heat wave event in southern parts of the country.

In 2015, nine states were affected due to heat waves. IMD data shows that 13 states recorded temperature beyond the threshold in 2016. Subsequently, 17 states in 2017 and 19 States (including some parts of J&K and Himachal Pradesh) in the year 2018, recorded high temperature leading to heat-wave conditions. There has been an increasing trend of heat wave phenomenon in India over the past several years whereby several States/district/cities/towns in India have been severely affected.

Consequently, there is an urgent need to evaluate impacts of the heat wave and plan adaptation and mitigation strategies for prevention, preparedness and community outreach to safeguard human lives, livestock and wild life.

Genesis:

Climate change is driving temperatures higher as well as increasing the frequency and severity of heat waves in India. In the past few years, India too is experiencing the impact of climate change in terms of increased instances of heat wave every year. According to the special report released by the Inter-governmental Panel on Climate Change (IPCC) (October 2018), global warming of 1.5ºC-2°C will worsen the situation in the cities where conditions comparable to the deadly 2015 heat wave are expected, along with unavoidable poverty and health risks that come with global warming. Deforestation and increasing constructed area are also adding to environmental instability and contributing to global warming and climate change.

NDMA realized from past experiences that there is a need to revise the “National Guidelines for preparation of Action Plan – Prevention and Management of Heat wave" for improving the capacity of the States to deal with heat wave management in a planned manner. The Guidelines will help develop measures and strategies for assessment, forecast, preparedness and mitigation through coordinated efforts with multiple agencies and undertake long term mitigation measures for addressing the issues at a broader level by states/local authorities in their respective areas to reduce the negative impacts of extreme heat-wave conditions.

NDMA constituted an expert group, comprising representatives of various Ministries/ Departments, States representatives, Academic & Research Institutions, and experts along with other stakeholders, to build consensus on the content of the guidelines. The Expert Group, through successive deliberations, updated the guidelines with more specific actions based on scientific outlook from various research papers, reports, best practices in heat wave assessment and mapping techniques. Based on the discussions, a new section ‘Built Environment’ has been added in the revised guidelines.

Objective:

The Heat Wave Guidelines aims to provide a framework for developing Heat Action Plans for implementation, inter-agency coordination and impact evaluation of heat wave response activities in cities/towns.

Structure of the Guidelines

Sharing of past learning and experiences, academic and institutional research action taken by States and historical data helped in preparing these guidelines. It has five chapters and formats for recording data and documentation:

Chapter 1 - Background and Introduction: This chapter examines cause of extreme temperatures combined with high humidity and associated atmospheric conditions that adversely affect many countries and millions of people leading to physiological stress, loss of productivity, illness and sometimes even deaths.

Chapter 2 - Preparation of Action Plan: This chapter explains the rationale behind the guidelines, vulnerability assessment, built environment, short-term, medium term & long term goals and lists major objectives. It also lists the key strategies required to prepare for and respond to this extreme weather event at the local level besides the steps involved in developing an Action Plan.

Chapter 3 - Early Warning and Communication: This chapter explains the entire system of issuing weather forecast and early warning. Short to medium range forecast indicates the potential areas at risk with the probability of occurrence of the phenomena. Nowcasting provides specific information about the place and time of heat wave occurrence. The chapter also draws early warning/alerts communication and dissemination strategies and public awareness, community outreach and plans at various levels so that timely information reaches officials as well as the general public.

Chapter 4 – Dealing with Heat Related Illnesses, Mitigation and Preparedness Measures: This chapter deals with the concept of prevention of Heat related illness and symptoms and first aid for various heat wave related disorders. Heat wave prevention covers measures aimed at the hospital preparedness for managing heat related illnesses and/or preventing communities from getting affected. Setting affected Justification with identification for heat related illnesses and recording of casualties has also been covered in the chapter.

Chapter 5 - Roles & Responsibilities and Implementation Plan: This chapter clearly lays down the roles/responsibilities of all stakeholders in a matrix format. It also provides a brief insight into how an SEOC, its system and procedures should be designed for rapid dissemination of information to all stakeholders to enable effective decision-making and quick response during heat wave season.

Format for Record of Data and Documentation: The chapter underlines the need and importance of data collection and validation at the district level and compilation at the State and Central level, which in turn would feed into the national-level disaster database and enable policy decisions.

Checklist for States to Develop Heat Action Plan

Step 1: Government Engagement

Setting up a Heat Action Plan requires participation from State and district government leaders, municipal health agencies, disaster management authorities and local partners. For example, Odisha has a dedicated heat wave committee chaired by the Odisha State Disaster Management Authority and has representatives from all other relevant departments such as water and sanitation, animal husbandry etc.

Step 2: Appointing a State Nodal Agency and Officer

The State should appoint a head/nodal officer at the State or district levels, and depute an agency to oversee the Heat Action Plan. It should also build the capacity of key officials and agencies to recognize their roles in the State Heat Action Plan. The State Nodal Agency and Officer can then conduct table-top exercises, simulations, and drills before the heat season as well as identify and resolve communication gaps between participating departments, partners and the public.

Step 3: Vulnerability Assessment and Establishing Heat-Health Threshold Temperatures

It is important to identify vulnerable areas and populations in order to establish priorities and minimum thresholds for heat alerts and activities. Threshold temperatures can be determined by several methods: percentile approach and specific approach, as well using combined temperature metrics or a departure-from-normal approach. The state should coordinate with the Indian Meteorological Department (IMD) to develop thresholds as well. Identifying local academic/research institutes like medical colleges can provide additional useful partners for coordination.

Step 4: Drafting and Developing the Heat Action Plan

The State Nodal Officer and Agency can then coordinate with the local IMD office to start receiving summer season forecasts annually from March to June and set up the early warning and daily alert system with colour codes based on predicted peak daily temperatures relative to different local threshold temperatures.

Step 5: Team Preparation and Coordination

Governments should ensure that State officials and agencies are well prepared for the heat season, key officials are well-trained and have information regarding pre, during and post heat season activities. Team members then develop a clearly defined interagency emergency response plan with roles and information flows clearly marked out.

Step 6: Implementation and Monitoring

While the government departments (and partners) are responsible for implementing many components of a heat action plan concerned, the public should be made aware of how to prepare and respond to extreme heat. Information, education and communication (IEC) plays an important role in widely disseminating key messages to communities in advance. Specific messages should be developed to cater to vulnerable groups such as elderly, young children, outdoor workers and slum residents. "Do's-and-Don'ts" during a heat wave should be available in local languages and disseminated through media, including social media such as SMS that is easily accessible by vulnerable sections of the population.

Step 7: Evaluating and Updating the Plan

The approach towards extreme heat must be flexible and frequently updated to deal with unintended consequences. The process should determine if the strategies to deal with heat are effective, such as traditional remedies for mitigating heat that includes eating onions and drinking beverages like raw mango juice that cool the body. After every heat season, the city or State must assess the efficacy of the heat action plan, including the processes, outcomes, and impacts. Stakeholders should then identify changes and improvements for the next heat season. The plan should be revised and updated as required. The changes carried out should be brought to notice of key officials and other stakeholders.

Step 8: Strategies for Reducing Extreme Heat Exposures and Adapting to Climate Change (Long term plans)

States should consider mitigation strategies to reduce the impact of extreme heat, such as increasing the green cover in a city to reduce the urban heat island effect, or implementing cool roofs to provide comfort as well as reduce the impact of increased urbanization. Vulnerability assessment should also consider climate change scenarios wherever possible.

1. Background & Status

1.1 Introduction

India, with approximately 1.35 billion people (as on 2018), is the second most populous country in the world with considerably high levels of builtup area and population density. It is also among the highly disaster-prone countries of the world with almost all regions being vulnerable to extreme events. The trend shows that the number of persons living in urban areas (33.6% of the population is urban) will continue to grow at a faster rate than the population in the rural areas due to migration. Increasing urbanization and unique challenges associated with it such as Urban Heat Island (UHI) effect in cities will further exacerbate the problem of heat wave in many parts of our country.

In Indian scenario, vulnerability pattern is unequally distributed within the cities because of socio-spatial segregation, income levels and type of occupations (Dupont, 2004)(Singh & Vithayathil, 2012) linked to the availability of amenities like water supply (Sidhwani,2015). Due to this socio-economic segregation, phenomenon like development of slums and squatters took place in hazard prone areas where dwelling conditions are not enough to cope with the increasing impact of climate change (World Health Organization, 2010). Extreme events such as heat waves can affect communities by increasing summer time peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, and degrade water quality, and they impose negative effects on local and global public health causing heat-related illness and mortality poor quality of life, and environmental imbalance. Recurrent heat waves, already a concern in rapidly growing and urbanizing India, will very likely to further worsen in a warming world. The highest ever recorded temperature at different stations across the country is shown in Figure 1.

The latest World Meteorological Organization statement on global climate during 2018 (https://public.wmo.int/en/media/press-release/wmo-confirms-past-4-years-were-warmest-record published 06 February, 2019) indicates that the global temperatures continue to increase; and 2015, 2016, 2017 and 2018 have been confirmed as the four warmest years on record. The extreme weather and climate conditions have continued into 2018. Extreme and high impact weather events affected many countries and millions of people, with devastating repercussions for economies and ecosystems in 2018. Globally, 2018 was the fourth warmest year on record (approximately 1.0°C above pre-industrial levels). Heat waves are projected to increase in number, intensity and duration over most of the land area in the 21st century. In India the impact of increased temperatures is already being observed.

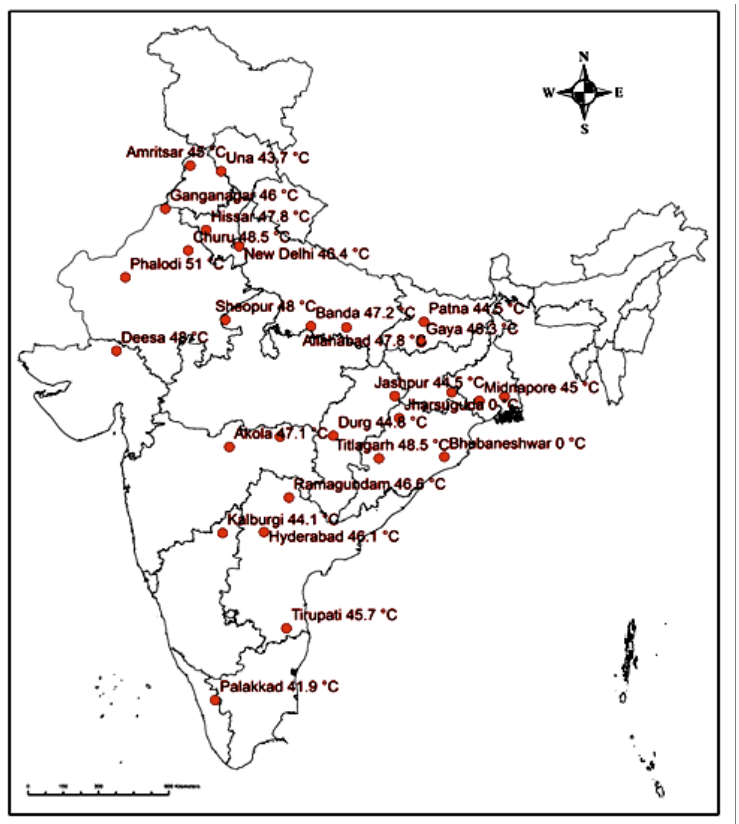


Figure 1: Higest ever recorded temperature at some station in the country

According to the India Meteorological Department (IMD), the 2018 annual mean land surface air temperature for the country was +0.41^{0}C above the 1981-2010 average, thus making the year 2018 as the sixth warmest year on record since 1901 (Fig. 2)). The five warmest years on record in order were: 2016 (+0.72^{0}C), 2009 (+0.56^{0}C), 2017 (+0.55^{0}C), 2010 (+0.54^{0}C), 2015 (+0.42^{0}C). It may be mentioned that 11 out of 15 warmest years were during the recent past fifteen years (2004-2018). Past decade (2001-2010/ 2009-2018) was also the warmest decade on record with anomalies of 0.23^{0}C /0.37^{0}C. The annual mean temperature during 1901-2018 showed an increasing trend of 0.6^{0}C/100 years (Fig.2) with significant increasing trend in maximum temperature (1.0^{0}C/100 years).The country averaged season mean temperatures were also above the average during all the four seasons with the winter season (January- February, +0.59^{0}C) being the 5th warmest since 1901 and the pre- monsoon season (March-May, with anomaly +0.55^{0}C above average) being the 7th warmest ever since 1901. The country averaged mean monthly temperatures were warmer than the normal during all the months of the year (except December) with mean temperatures exceeding the normal by around 1^{0}C during the two months (February (0.93^{0}C) and March (0.96^{0}C)). **This is directly affecting the communities, undermining their livelihoods through gradual, insidious changes in temperature and rainfall patterns, and resulting in an increased frequency and intensity of hazards such as floods, cyclones, droughts, unseasonal rains and hailstorms, etc., causing extensive damage to crops, fisheries and agro-rural economy.**

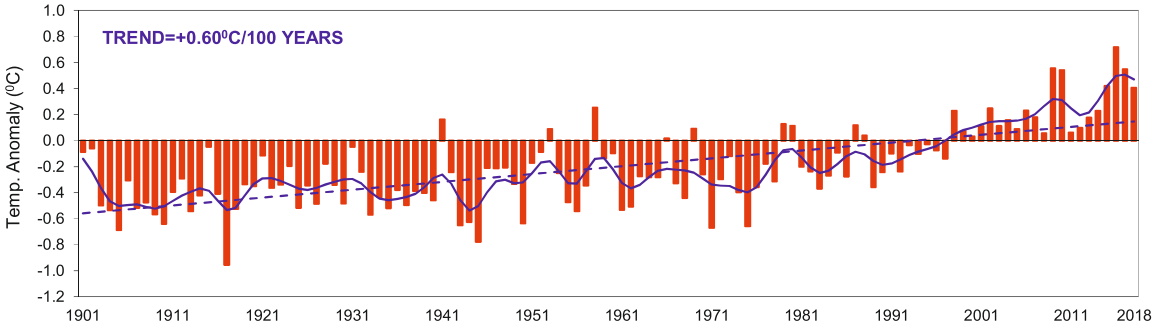


Fig.2: Annual mean land surface air temperatures anomalies averaged over India for the period 1901-2018. The anomalies were computed with respect to base period of 1981-2010. The dotted line indicates the linear trend in the time series. The solid blue curve represents the sub-decadal time scale variation smoothed with a binomial filter.

Source: IMD, Pune

Heat wave is a period of abnormally high temperatures, more than the normal maximum temperature that occurs during the pre-monsoon (April-June) summer season. Heat waves season typically occurs from March to June, and in some rare cases, even extend up to July. On an average, five-six heat wave events occur every year over the northern parts of the country. **In 2018,** severe heat wave conditions affected Saurashtra & Kutch on 2 days in April and 1 to 3 days in May over West Rajasthan, Vidarbha & Madhya Pradesh. Heat wave conditions prevailed for about 3-6 days over eastern India (West Bengal, Odisha, Jharkhand and Bihar), Gujarat, Haryana, Chandigarh & Delhi. It was most frequent with higher duration over Western Rajasthan followed by eastern Rajasthan, Vidarbha, Uttar Pradesh and Madhya Pradesh. Severe heat wave conditions affected Andhra Pradesh, Telangana, Northern parts of Karnataka and Tamil Nadu on 1-2 days in March, 3-4 days in April and May. Details of the heat wave conditions in 2018 are given in Table 1.

The most notable temperatures have been over Phalodi (West Rajasthan): 47.0°C on 1st May, Brmapuri (Vidarbha): 46.4°C on 9th May, Chandrapur (Vidarbha): 47.8°C on 19th May, Ganganagar (Rajasthan): 48.7°C on 29th May and Churu (Rajasthan): 49.7°C on 1st June **in 2018.** The highest-ever recorded maximum temperatures at some of the places in the country are given in **Table 1 below**. It shows that temperatures in excess of 46°C have been recorded in many parts of the country.

Table 1: Heat Wave Reported during April – June 2018

State	Heat wave spell	Place	Recorded Max. Temp in 2018			
			March	April	May	June
Andhra Pradesh	19-20, April; 1-2, 10-12, 24-26 May	Guntur	42.0	43.6	44.2	41.8
		Nellore	-	41.0	42.6	41.3
		Kurnool	41.2	43.3	43.3	39.1
Telangana	19-20, April; 1-2, 10-12, 26-28 May	Hyderabad	40.1	42.0	42.5	39.2
		Khammam	-	41.0	43.8	41.6
		Ramgundam	41.0	43.0	44.4	42.2
Odisha	16-20 June	Titlagarh	41.5	43.0	44.0	42.2
		Jharsuguda	41.0	43.2	44.4	40.1
Jharkhand	16-20 June	Daltonganj	41.4	43.6	44.6	42.8
		Jamshedpur	40.5	41.0	40.8	42.1
Bihar	16-22 June	Gaya	40.5	42.7	44.6	43.5
		Patna	38.0	40.3	41.5	43.0
Uttar Pradesh (West)	23-29 May, 22-25 June	Agra	-	-	45.9	-
		Aligarh	37.8	41.8	43.2	43.6
		Jhansi	40.6	44.1	46.6	45.7
Uttar Pradesh (East)	23,24, 27 to 29 May, 21-25 June	Varanasi	41.0	43.0	44.6	43.4
		Lucknow	38.5	40.7	44.8	42.7
Punjab	24-29 May	Amritsar		42.1	44.2	44.4
		Patiala	35.4	41.6	45.0	46.2
Jammu AP	24-29 May	Jammu	35.8	40.0	43.5	43.3
Haryana,	24-29 May	Hissar	39.1	43.9	46.6	46.0
Chandigarh	24-29 May	Chandigarh	34.5	40.4	43.8	42.7
Delhi	24-29 May	New Delhi	38.6	42.0	45.0	42.7
Rajasthan (West)	1-4 April, 29-30 April, 1-2, 22-31 May, 1-5 June, 7-8, 23 June	Barmer	43.2	45.4	46.9	45.6
		Bikaner	42.1	45.2	46.8	47.7
		Falodi	43.2	46.0	47.0	48.0
Rajasthan (East)	29-30 April, 22-29 May, 8, 23 June	Ajmer	40.4	43.2	44.4	44.7
		Kota	41.9	45.6	46.5	45.5
Madhya Pradesh (West)	13, 21-29 May,	Gwalior	39.8	43.5	46.6	45.4
		Khandwa	40.1	43.5	45.5	42.1
		Ratlam	40.6	42.8	46.0	42.6
Madhya Pradesh (East)	22-29 May,	Jabalpur	40.3	42.8	45.3	42.8
		Bhopal	39.6	42.8	45.3	42.8
		Umaria	40.4	43.0	45.6	44.6
Gujarat	18-19 April, 23, 27 May	Ahmadabad	41.4	43.1	44.8	42.3
		Bhuj	41.6	42.0	44.2	40.2
Maharashtra	19-20, 27-30 April; 1-2, 6-12, 17-22, 24-30 May	Chandrapur	42.8	46.8	47.9	43.0
		Akola	42.5	45.0	46.9	43.8
		Nagpur	41.6	45.6	46.7	42.4
		Jalgaon	41.8	44.4	45.0	42.0
Karnataka	16 and 22-24 May	Gulbarga	42.2	43.2	43.4	38.8
		Raichur	40.0	42.3	42.0	38.5
West Bengal	16-19 June	Bankura				42.6
Tamil Nadu	5-6, 9, 18, and 24 May	Tiruchirapalli	40.1	41.1	41.3	39.4
		Chennai	37.6	39.2	40.8	40.1

Source: IMD, New Delhi,

International experiences: Special Report of the Intergovernmental Panel on Climate Change (IPCC-SREX) mapped the global warm days, warm nights, and number of days with maximal temperature larger than 30°C (IPCC 2012). IPCC's Fifth Assessment Report pointed out that it was very likely that the number of warm days and nights had increased on the global scale between 1951 and 2010; globally, there was medium confidence that the length and frequency of warm spells, including heat waves, have increased. After a major heat wave in Europe resulted in around 70,000 deaths in 2003, many research projects were carried out to assess the impact of heat and cold waves. For Russia as a whole, the death toll of 2010 summer heat wave totalled 55,000 people (Swiss Re 2011). With global warming, the frequency and intensity of heat waves have been expected to increase (Meehl and Tebaldi 2004). Heat wave has become one of the most serious climate events in the world. This led to impact and adaptation assessments for a selection of climate-related health outcomes, especially for heat waves. EuroHEAT (A project run by World Health Organisation) aimed to improve public-health responses to weather extremes, particularly to heat waves. Major findings from the EuroHEAT project were: adverse health effects of heatwaves are largely preventable; this requires a range of actions at different levels from health-system preparedness coordinated with meteorological early warning systems to timely public and medical advice and improvements to housing and urban planning.

Assessment and Prevention of Acute Health Effects and Weather Conditions in Europe (PHEWE) is a project set to investigate the association between meteorological variables during the warm season and acute health effects (mortality, hospital admissions) in 17 large European cities, and using this understanding to develop preventive strategies. Specific issues investigated included health-related threshold levels of a range of weather variables, form of the weather dose-health response curve, latency time between weather exposure and effect, specific air masses associated with health effects.

Climate Change and Adaptation Strategies for Human Health (cCASHh) is a similar project and it suggested that any comprehensive long-term strategy for minimizing the risks associated with global climate change requires the combination of planned adaptation (now and how) and mitigation. Apart from these plans in Europe, US has also developed city level plans for several cities (New York, Chicago and California, to name a few). These plans suggest best practices during the heat wave periods and resilience strategies to combat heat waves. Globally, many action plans were developed, tested and the results assessed based on the preparedness level, mitigation strategies and the impact it had on human health. We can learn from these plans and then adapt them to situation in India. This has been done in the Ahmedabad.

States in India experience a severe heat wave year after year. In 1998, heat wave in Odisha resulted in the loss of 2,042 lives. Between April to May 2015, a heat wave conditions reoccurred in India, killing more than 2000 people in country's different geographical regions. Daytime temperatures hovered between 45 and 47°C (113–116 F) in parts of two states (Maharashtra and Rajasthan), 3–7 °C above normal. The recent expansion of heat wave conditions to newer areas made people even more vulnerable, as communities were caught unawares.

In 2019, many cities recorded all-time high temperatures, with temperatures rising about 40 degrees Celsius in most cities, and exceeding 45 degrees Celsius in some of the worst-affected states. Rajasthan, Madhya Pradesh and Maharashtra are among some of the worst-affected states from the extreme heat, having experienced the longest spells of dry weather this year. These three states were found facing "extreme" heat conditions. Other states, like parts of Telangana, Andhra Pradesh, Vidarbha region of Maharashtra, Bihar, Delhi, Jharkhand, Uttar Pradesh, Gujarat, Punjab

and Haryana, Jammu & Kashmir, Himachal Pradesh and Uttarakhand experienced "severe" heatwave conditions. In West Rajasthan, Churu experienced 50.8 degree Celsius and Sri Ganganagar wasn't far behind at 49.6 degrees Celsius and Bihar Gaya and Patna experience 45.8 degree Celsius for several days in the month of June 2019. Similarly, Chandrapur 48^0 C, Brhapur 47.5^0C, and Una(Himachal Pradesh) 44.9^0C in the month of May.

While surface temperatures around the world have escalated by 0.6 degrees Celsius, but India's average surface temperature has risen by 0.8 degrees Celsius from 1880 to 2018, according to a report by El Dorado Weather. According to reports, there have been 32 heatwaves this year in India, the second-longest spell of high temperatures in the country's recorded history. The delayed arrival of the southwest monsoon delayed respite from heatwave conditions in almost two-thirds of the country.

Heat vulnerability is linked to characteristics of individuals, buildings and urban structures. Heat stress becomes aggravated due to reduced levels of evapotranspiration that occurs in high-density industrial parks and in central zones, thus affecting public health. The recent trends in the increase of temperatures throughout South Asia has led to take a relook at the planning policies and interventions keeping in mind the environmental aspects and vulnerable and underprivileged population. Factors that influence heat vulnerability include the quality of housing and built environment, local urban geographies, resident lifestyles, income levels, employment trends, tenure patterns, social networks and self-perceptions of risk (Inostroza L, Palme M; 2016 DOI: 10.1371/journal.pone.0162464).

In 2013, Ahmadabad in Gujarat was the first city to develop a Heat Action Plan. Followed by this, States like Bihar, Telangana, Odisha and Maharashtra also developed their State-specific heat wave action plans.

Scientific studies have been undertaken in Ahmadabad, Nagpur and Bhubaneswar to identify threshold temperatures. Vulnerability assessment in two cities of states of Odisha and Gujarat have been completed. Such studies are needed in other states in order to develop contextualized action plans.

Lessons learnt from other States and countries can be implemented in order to protect vulnerable groups of population in the country. The recommended action plan for each State can be divided into short term and long term measures based on its socio-cultural context. Short term interventions like development of protocols and standard operating procedures for each department, improving communication activities, water crisis management, making all work places safe, and provision of medical treatment, drinking water facilities and wash rooms at work place and other strategic interventions can save many lives. Long term strategies like urban planning, specific budget allocation towards heat risk reduction in each department, increasing forest coverage, pollution control, promoting the use of public transport, encouraging green buildings and promoting sustainable growth in the cities can save lives.

Extreme temperatures combined with high humidity and associated atmospheric conditions adversely affect people leading to physiological stress, loss of productivity, illness and sometimes-even death. Heat wave can affect 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. India too is feeling the impact of climate change in terms of increased

instances of heat wave with each passing year. The adverse impacts of heat wave can be significantly reduced by educating people on the DO's and Don'ts of Heat Wave (Annexure 4) and developing a culture of reporting health issues pertaining heat wave to medical facilities in time thereby ensuring timely diagnosis and treatment.

1.2 Definition

Heat wave: Heat wave is a condition of atmospheric temperature that leads to physiological stress, which sometimes may cause death. The 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. Different countries define heat wave differently in context of their local conditions. In India, heat wave conditions are considered if maximum temperature of a station reaches at least 40°C or more for plains, 37°C or more for coastal areas and at least 30°C or more for hilly regions. Following criteria is used to declare a heat wave conditions prevailing:

a) Based on Departure from Normal

- *Heat Wave:* Departure from normal is 4.5°C to 6.4°C
- *Severe Heat Wave:* Departure from normal is >6.4°C

b) Based on Actual Maximum Temperature (for plains only)

- *Heat Wave:* When actual maximum temperature ≥ 45°C
- *Severe Heat Wave:* When actual maximum temperature ≥47°C

To declare a heat wave, the above criteria should be met for at least at two stations in a Meteorological sub-division for at least two consecutive days. A heat wave will be declared on the second day.

As per the annual climate summary report of the IMD, the mean temperature over India has increased at a rate of 0.63°C/100 years since the beginning of the 20th century with large positive anomalies in the last couple of decades. The increase of mean temperature during summer season (March-May) in the same period has been at a rate of 0.56°C/100 years. On an average, more than eight heat wave days and one to three severe heat wave days are experienced during the summer season from March to July over north and central parts of the country. Also, many of the stations in northwest India, Gangetic plains, Central India and east coast India have experienced continued heat wave spell of more than 10 days, mostly during May and June. There has been an increasing tendency of extreme summer temperatures over most parts of the country in last five decades. Hence, the impact of extreme temperatures is higher along the west coast of India.

Temperature / Humidity Index:

The level of heat discomfort is determined by a combination of meteorological (temp, RH, wind, direct sunshine), social/cultural (clothing, occupation, accommodation) and physiological (health, fitness, age, level of acclimatization) factors. 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 as high humidity does not permit loss of heat from human body through perspiration. To calculate

the effect of humidity, Heat Index Values are used in some countries. The Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature. Heat index chart used by the National Weather Service of the USA given below shows that if the air temperature is 34°C and the relative humidity is 75per cent, the heat index - how hot it feels - is 49°C. The same effect is reached at just 31°C when the relative humidity is 100per cent.

This chart, however, is developed for heat wave conditions prevailing and acclimatization of people in colder countries; and is not directly applicable in India. The US National Weather Service states that the Heat Index calculation using this chart may produce meaningless results for temperatures and relative humidity outside of the range depicted on the chart. As temperature and humidity outside range of this chart are not uncommon in many parts of India, it cannot be directly used. The notion of looking at temperature and humidity in combination is good; however, in order to develop a usable matrix in the Indian context, more research needs to be done.

Temperature / Humidity Index by NOAA, for USA

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											

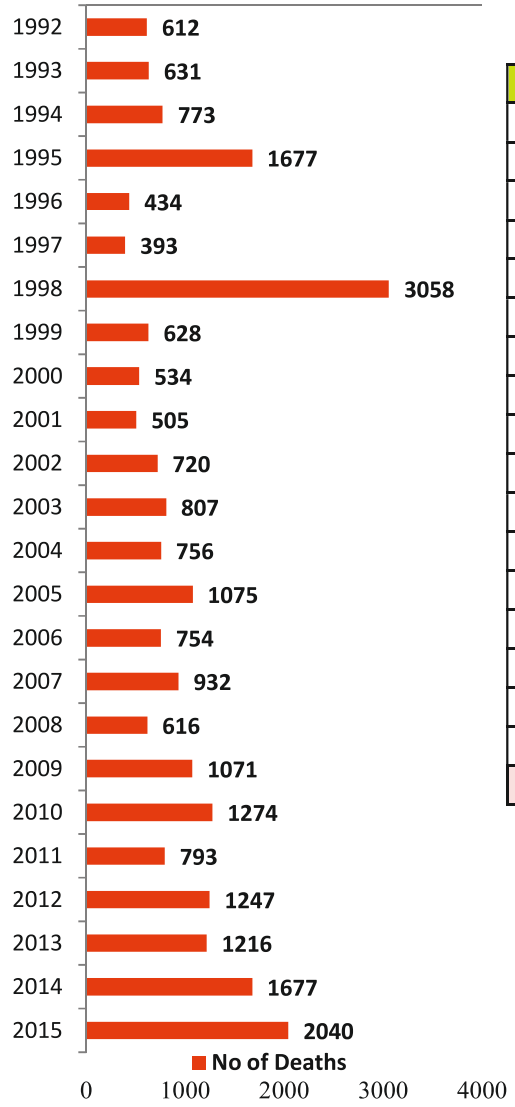
Caution | Extreme Caution | Danger | Extreme Danger

The US National Weather Service Heat Index Chart (http://www.nws.noaa.gov/os/heat/heat_index.shtml)

1.3 Heat Waves Impacts in India

Extreme positive (warmer) departures from the normal maximum temperature result in a heat wave during the summer season. The rising maximum temperature during the pre-monsoon months continues till June, and in some cases till July, when the onset of southwest monsoon occurs over some parts of the country. In recent years, heat wave casualties have increased. Abnormally high temperatures were observed during April–June during 2010 to 2016 across the country. In India, heat wave caused 24,223 deaths from 1992 to 2015 across various states (Fig.3). Intense and sustained efforts by all stakeholders' significance reduction in mortality due to heat wave from 2040 in 2015 to 1111 in 2016. Mortality due to heat wave further reduced to 384 in 2017 and 25 in 2018. (See **Table** 2). Heat wave also caused the death of wildlife, birds, poultry, etc. across the country.

Fig.3: Deaths recorded due to Heat Wave in India



Source: compiled data from different sources,

2. Media News published in the Hindu, 7th June 2015: http://www.thehindu.com/sunday-anchor/summer-of-2015-heat-wave-and-deaths/article7289830.ece
3. Revenue and Disaster Management Division of respective State Government
4. IMD report

Table 2

No of Deaths due to Heat wave

(Information received by NDMA From respective States Government)

SN	State	2015	2016	2017*	2018
1	Andhra Pradesh	1422	723	236	8
2	Bihar	-	Nil		2
3	Chhattisgarh	-	1		
4	Delhi-NCR	-	-		
5	Gujarat	17	7		3
6	Haryana				
7	Jharakhand	-	4		
8	Karnataka	-	Nil	2	
9	Maharashtra	-	7	9	2
10	Madhya Pradesh	-	Nil	3	1
11	Odisha	60	36	17	7
12	Punjab				
13	Rajasthan	-	9	9	1
14	Telangana	541	324	108	
15	Tamil Nadu				
16	Uttar Pradesh	-	Nil		
17	West Bengal	-	Nil		1
	Total	**2040**	**1111**	**384**	**25**

Source: IDSP, Ministry of Health & Family Welfare report confirmed by Revenue and Disaster Management Division of respective State Governments

*Reported up to 31 July 2018

1.4 Past experience on Heat-wave plan implementations

In 2013, the Ahmadabad Heat Action Plan was developed, which outlined several interventions such as public awareness and community outreach, building capacity of medical community, reducing heat exposure and promoting adaptive measures, and finally, developing an early warning system along with an inter-agency response plan. The key lessons on developing a heat action plan at the local level were: involving local city/district administration, using local IMD and health data (death registration, OPD, Indoor admission, ambulance calls)discussing issues with local and national institutions / experts, adapting HAPs developed in other countries / cities, monitoring and evaluating implementation and impact on mortality and morbidity.

Ahmadabad Heat wave Action provides these following key lessons for other cities like accepting Heat Wave as a hazard, identify the high risk communities and stakeholders, create public infrastructure for cooling and combine different medium of communication to help change in public behavior towards heat wave.

Odisha State Disaster Management Authority has taken the following steps to tackle heat wave:

- **Early warning systems:** Temperature and humidity levels, considered together, will determine the threshold for early warning heat wave alerts. Bhubaneswar experiences up to 85 percent humidity in the summers, with Odisha's coastal regions facing even higher humidity.
- **Public outreach:** Temperature forecasts and heat alerts will be sent as bulk messages on mobile phones, including to the media for wider broadcast. Electronic screens at busy traffic intersections and market places will also display the information. The State has also developed a website and a mobile phone app that would not only provide heat alerts but also help users identify, via maps, heat shelters and drinking water sources along highways throughout the State.
- **Medical up-gradation and administrative measures:** Dedicated sections in hospitals to provide treatment for heat wave related health conditions have been planned and heat alerts would trigger early morning shifts for schools and offices.

2. Preparing a Heat Wave Plan

2.1 Heat wave and Disaster Management

"Disaster" is defined under section 2(d) of the Disaster Management Act, 2005 as a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, and is of such a nature or magnitude as to be beyond the coping capacity of the affected area. Heat wave has not been notified as a disaster by the Government of India yet. It is not in the list of twelve disasters eligible for relief under National/ State Disaster Response Fund norms. However, a State Government may use up to 10 per cent of the funds available under the SDRF for providing immediate relief to the victims of natural disasters that they consider to be disasters "within the local context in the State and which are not included in the notified list of disasters of the Ministry of Home Affairs subject to the condition that the State Government has listed the State specific natural disasters and notified clear and transparent norms and guidelines for such disasters with the approval of the State Authority."

2.2 Rationale for Heat wave Action Plan (HAP)

Firstly many States are affected during the heat wave season, such as Andhra Pradesh, Telangana, Odisha, Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Bihar, Jharkhand, West Bengal, Haryana, Punjab and Delhi. Secondly, the actual numbers of deaths resulting from heat wave are higher than the reported numbers. Mostly the deaths in rural areas due to heat wave are often not reported. Thirdly, the booming service sector with large number of vegetable vendors, auto repair mechanics, cab drivers, construction workers, road side kiosk operators etc particularly vulnerable to the heat wave conditions. Fourthly, though the richer sections of India have ability to cope with higher temperatures by investing air conditioners and coolers, the poorer population remain vulnerable to the higher temperatures. Therefore, it is not surprising that these workers, homeless people and the elderly constitute the majority of heat wave casualties in India. Fifthly, these heat wave related deaths can be prevented with an evidence based plan, effective implementation and frequent updating in line with recent scientific development.

Hence, a national level strategy and plan to combat heat wave should be developed. . A comprehensive heat preparedness and response requires involvement from government authorities, non-governmental organizations and civil society.

2.3 Vulnerability Assessment

Identifying the vulnerable population helps in designing appropriate strategies and intervention at community level. Physical vulnerability could be due to age, pregnancy, chronic disease, type of housing, occupation etc. Each city or town should carry out an assessment using available resources and robust scientific methods. One of the methods could be a case control study in a community or at a workplace to identify the most vulnerable population and the risk factors of being vulnerable. The first phase would be a household survey gathering information on socio-demographic data, medical conditions, medication use, adaptive practices during summer, community strategies and challenges faced during summers. A qualitative technique should be used to explore the opportunities, challenges and innovations during summers. The list of possible vulnerable population can be but not limited to pregnant/lactating women, elder (>=60 yr), children (<5 yr), persons with disabilities (physical or mental), persons with chronic diseases, persons suffering from immune compromised diseases, and/or persons with debilitating conditions patients taking certain medications (anti-cholinergic).

The vulnerability assessment done in Bhubaneswar identified that people with chronic disease(s) and poor housing conditions are more vulnerable to heat wave. Also, those who use firewood/coal for cooking and those who travel long distance during summer months is more susceptible to heat related illnesses. Besides Bhubaneswar, Ahmedabad has also done a survey on vulnerability assessment for traffic police. Similar exercises should be done in other cities/towns to identify the vulnerable populations.

Similar surveys can be done among different occupational groups to understand their challenges, practices and vulnerability risk at workplace/ working conditions.

2.4 Built Environment

According to experts, there is a significant role of urban areas in tending to climate change. They point out that within urban areas, construction of roads, buildings, and other structures replace the naturally vegetated landscape, leading to changes within the microclimate. As a result, various urban and pre-urban or rural landscapes observe different temperature, which leads to development of urban heat island (UHI) phenomenon. The impact of heat wave and UHI altogether affects the human health, energy consumption and environment. Local warming from the UHI intensifies the discomfort of urban residents and increases their vulnerability to heat stress. Urban areas experience different UHI intensities as a result of different physical and built characteristic properties. Building material, building height and density, population density, and percentage of green cover are few of the factors that affect the magnitude of UHIs between different cities.

Examining the local cause of disproportionate increase in temperature assists in identifying vulnerable hot spots for developing various mitigation measures. Each city should carry an assessment of its built environment and identify major factors contributing/controlling the UHI magnitude. The assessment could be carried out and evaluated from local or regional research groups or institutions. Based on the assessment results, critical urban areas should be mapped and assigned priority of action accordingly. In long term measures, these factors should be incorporated in urban planning and design policies or proposal to minimize the heat stress risk.

City-level medium/long term measures

- Identification and evaluation of factors leading to disproportionate increase in temperature within the city.
- Generating a heat wave risk and vulnerability map for developing a strategic mitigation action plan.
- Mapping hot-spots within the city and integrating them in vulnerability assessment.
- Measures to reduce temperature in these hot spots by developing vertical gardens, small parks with a water fountain etc must be developed.
- Co-ordination with different research and educational institution for built environment assessment.
- Allocate part of research and development in the financial budget approvals for heat wave action planning.
- Curbing future UHI manifestation by incorporating findings from the built environment assessment into urban planning and design policies or byelaws.
- Integrating heat action plan with development plan. Development plans should be should focus on reducing heat stress and water stress in the city.
- Adhering to building codes in the city

2.5 GOALS

Recurring /regular activities

- Putting up display boards for colour coded heat wave alerts and Do's and Don'ts in public places such as parks, hospitals, etc.
- Multiple medium of communication (preferably in local languages) like TV, Radio and newspaper for awareness.
- Identify and reduce awareness gap through disseminating of information using pamphlets, hoardings, LED display on advertisement boards.
- Change in timings of schools, colleges, offices, markets, etc.

Short-Term:

- Installing temporary kiosks for shelter, and distribution of water, medicines, etc.
- Developing mobile applications for spreading awareness on heat-related issues and locating shelters, drinking water kiosks, etc.
- Issuing advisories for tourists.
- Setting up special cool shelters for "Wage Employment programmes" such as Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGA).
- Providing shade and drinking water for on-duty traffic personnel.

Medium Term:

- LED Display boards installed at District Headquarters displaying the real-time weather data pertaining to Rainfall, Temperature, Humidity and Wind Speed should be incorporated into precautionary measures for Disaster Management.
- Involving Forest department for collating local coping and adaptation strategies, indigenous technologies such as vernacular building materials, construction of green building, Energy Conservation Building Code (ECBC) etc. related to heat wave risk mitigation.
- New heat wave criteria must be evolved based on gridded data with maximum and minimum temperature, to develop a scientific model to determine all cause mortality.
- Zonal/regional HAP for megacities like Delhi, Mumbai etc should be develop for its effective implementation.
- Identify "heat hot-spots" in India through appropriate tracking and modelling of meteorological data, and promote the timely development and implementation of local Heat Action Plans with strategic inter-agency co-ordination, and a response which targets the most vulnerable groups.

Long Term:

- Focused capacity building- Heat wave mitigation management should be added in school curriculum to sensitize school children and local people. Training programmes in local level/community level for awareness among people.
- Integrate climate variability mitigation and adaptation efforts in HAP.
- Yearly improvisation of heat wave plan through response and feedback data collection.
- Operational forecast of maximum temperature over India in short, medium and extended range timescale is very useful in giving Heat Wave outlook.
- Up gradation of forecast system & associated equipments to provide heat wave alerts

minimum of 2 to 3 weeks prior to the event.

- Health-harming air pollution apportionment studies, emission inventories, and health impact assessments of ambient and household air pollution through State-wise Clean Air Action Plans, and use these findings to inform policies targeted at reducing the main sources of pollution via an inter-ministerial approach.
- Evaluation of cascading effects of heat waves over flood, drought and hydrological models.
- Involvement of academia along with collaboration and more participation from higher educational institutes may be developed. The centres for excellence and dedicated research centres may have a pivotal role to play.

2.6 Objective of Heat wave Action Plan

The Heat Wave Action plan aims to provide a framework for developing plans for implementation, inter-agency coordination and impact evaluation of heat wave response activities in cities/town that reduce the negative impact of extreme heat. The Plan's primary objective is to alert those at high risk of heat-related illness in places where extreme heat conditions either exist or are imminent, and to take appropriate precautions. The Plan also calls for preparedness measures to protect livestock/animals as extreme heat causes significant stress to them as well. The heat wave action plan intends to mobilize departments and communities to help protect communities, neighbors, friends, relatives, and themselves against avoidable health problems during spells of very hot weather. The Plan also intends to help early warning agencies as well as the media to be proactive on steps taken to negate heat wave impacts. The administrative/preventive actions that need to be taken by multiple agencies/ministries/departments are enumerated in Table 5. All States/district/cities/town can learn from their/others' experiences and develop a plan to deal with heat wave effectively.

2.7 Key strategies

Severe and extended heat waves can also cause disruption to general, social and economic services. Government agencies will have a critical role to play in preparing and responding to heat waves at the local level, working closely with health and other related departments on a long-term strategic plan.

- Establish Early Warning System and communication systems
- Developing inter-agency response plan and coordination in field
- Preparedness at the local level for health eventualities
- Health care system capacity building
- Public awareness and community outreach
- Collaboration with private, non-government and civil society
- Assessing the impact – feedback for reviewing and updating the plan

3. Early Warning and Communications

3.1 Forecast and Issuance of Heat Alert or Heat Warning

India Meteorological Department (IMD), Ministry of Earth Sciences, is the nodal agency for providing current and forecast weather information, including warnings for all weather related hazards for optimum operation of weather-sensitive activities. It provides warning against severe weather phenomena like tropical cyclones, squally winds, heavy rainfall/snow, thunder-squall, hailstorm, dust storms, heat wave, warm night, fog, cold wave, cold night, ground frost, etc. It also provides real time data and weather prediction of maximum temperature, heat wave warning, extreme temperatures, and heat alerts for vulnerable cities/rural areas.

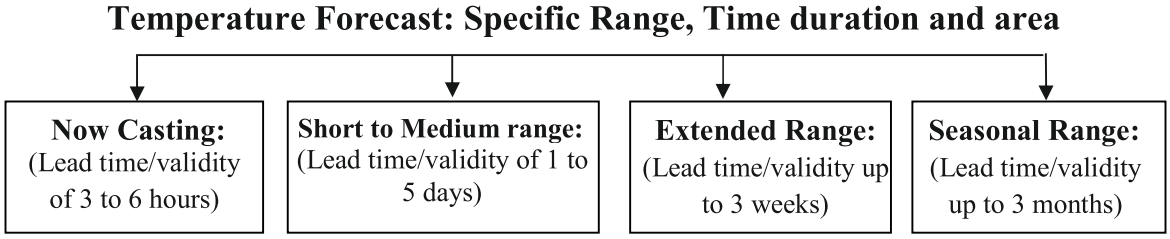
IMD issues forecasts and warnings for all weather related hazards in short to medium range (valid for the next five days) every day as a part of its multi-hazard early warning system. These warnings, updated four times a day, are available at http://www.imd.gov.in/pages/allindiawxfcbulletin.php.

A new system of exclusively heat-related warnings has been introduced with effect from 03 April, 2017. These warnings, valid for the next four days, are issued around 1600 hours IST daily and are provided to all concerned authorities (Departments of health, disaster management, Indian Red Cross and Indian Medical Association, NDMA etc.) for taking suitable action at their end. A bulletin in extended range with outlook for the next two weeks (for all hazards including heat wave) is issued every Thursday (available at http://www.imd.gov.in/pages/extended.php).

In addition to the above, Climate Forecast System based forecasts maps of daily maximum temperatures and their departures from normal for the next 21 days (issued every Thursday) are also available on IMD website (http://nwp.imd.gov.in/cfs_all.php?param=tmax and http://nwp.imd.gov.in/cfs_all.php?param=tmaxa, respectively).

From 2016, IMD has introduced a system of issuing seasonal temperature outlooks for the next three months. For 2017, the first outlook valid for March to May was issued on 28 February, 2017; and the second one valid for April to June was issued on 02 April, 2017. These seasonal outlooks are issued in the form of a press release on the IMD website, and through electronic and print media. These are also provided to all concerned Chief Secretaries, Disaster Managers and to the health sector through the India Medical Association (IMA).

The operational system of weather forecasts and warnings is summarized in the chart below:



3.2 Identification of Colour Signals for Heat Alert

IMD currently follows a single system of issuing warnings for the entire country through a colour coded system as given below. This system advises on the severity of an expected heat hazard. However, threshold assessments carried out in different parts of the country tells us that there are different cut-off points that determine the warning signals appropriate for a specific state/region. The States, districts and cities should, therefore, carry out their respective threshold assessments for mortality and provide the information to IMD so that it can provide specific warning alerts to those States.

Colour Code Signals for Heat Alert and Suggested Actions

Colour Code	Alert	Warning	Impact	Suggested Actions
Green (No action)	Normal Day	Maximum temperatures are near normal	Comfortable temperature. No cautionary action required.	Normal activity
Yellow Alert (Be updated)	Heat Alert	Heat wave conditions at isolated pockets persists for 2 days	Moderate temperature. Heat is tolerable for general public but moderate health concern for vulnerable people e.g. infants, elderly, people with chronic diseases	(a) Avoid heat exposure. (b) Wear lightweight, light-coloured, loose, cotton clothes. (c) Cover your head
Orange Alert (Be prepared)	Severe Heat Alert for the day	(i) Severe heat wave conditions persists for 2 days (ii) Through not severe, but heat wave persists for 4 days or more	High temperature. Increased likelihood of heat illness symptoms in people who are either exposed to sun for a prolonged period or doing heavy work. High health concern for vulnerable people e.g. infants, elderly, people with chronic diseases.	(a) Avoid heat exposure– keep cool. Avoid dehydration (b) Wear lightweight, light-coloured, loose, cotton clothes (c) Cover your head (d) Drink sufficient water- even if not thirsty (e) Use ORS, homemade drinks like lassi, torani (rice water), lemon water, buttermilk, etc. to keep yourself hydrated (f) Avoid alcohol, tea, coffee and carbonated soft drinks, which dehydrates the body (g) Take bath in cold water frequently. In case of SUNSTROKE: 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. Consult a Doctor immediately.
Red Alert (Take Action)	Extreme Heat Alert for the day	(i) Severe heat wave persists for more than 2 days. (ii) Total number of heat/severe heat wave days exceeding 6 days.	Very high likelihood of developing heat illness and heat stroke in all ages.	Along with suggested action for Orange Alert, Extreme care needed for vulnerable people.

4. Dealing with Heat Related Illness

4.1 Prevention of Heat Related Illness:

Heat waves characterized by long duration and high intensity have the highest impact on morbidity and mortality. The impact of extreme summer heat on human health may be exacerbated by an increase in humidity. There is growing evidence that the effect of heat wave on mortality is greater on days with high levels of ozone and fine particulate matter. Global climate change is projected to further increase the frequency, intensity and duration of heat waves and attributable death (WHO).

Heat related illness is avoidable. It can be best prevented if the vulnerable populations/communities are made aware of prevention tips, basic Do's and Don'ts through effective use of various media. Knowledge of effective prevention and first-aid treatment, besides an awareness of potential side-effects of prescription drugs during hot weather, is crucial for physicians and pharmacists to best mitigate the effects of heat illnesses. The details of case definitions are mentioned in annexure 2.

Table 4: Symptoms and First Aid for various Heat Disorders

Heat Disorder	Symptoms	First Aid
Heat rash	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 seek medical attention.
Heat Cramps	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 gently massage to relieve spasm. Give sips of water. If nausea occurs, discontinue.
Heat Exhaustion	Heavy sweating, weakness, Skin cold, pale, headache and clammy extremities. 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, call 108 and 102 for ambulance.
Heat Stroke (Sun Stroke)	High body temperature. Hot, dry skin. Rapid, strong pulse. Possible unconsciousness or altered mental status. Victim will likely not sweat.	Heat stroke is a severe medical emergency. Call 108 and 102 for ambulance for emergency medical services or take the victim to a hospital immediately. Delay can be fatal. Move victim to a cooler environment. Try spraying water, cold water on body & fan the wet body. If possible sponging or cool bath sponging to reduce body temperature. Use extreme caution. Remove clothing. Use fans and/or air conditioners. **DO NOT GIVE FLUIDS ORALLY if the person is not conscious.**

4.2 Hospital Preparedness Measures for Managing Heat related Illness:

Director/In-charge of Hospitals CHCS and PHCS in all States/Districts should ensure that the following measures are in place:

- A detailed action plan to tackle heat-related illnesses well in advance of hotter months.
- Operational framework - preparing specific health adaptation plan, development of guidelines and response plan for climate sensitive diseases (CSD).
- Need for updating heat health action plan, and issuing advisories for hospital preparedness, surveillance and weekly monitoring, including capacity building.
- Promoting strategic media coverage of climate and health linkages at the State level in regional languages to increase support for climate mitigation and adaptation responses.
- Long-term measures such as adopting cool roofs, improving green/forest coverage and analysing health impacts in urban planning.
- Standard Operating procedures to tackle all levels of heat-related illnesses. Capacity building measures for doctors, nurses and others staff should be undertaken.
- Cases with suspected heat stroke should be rapidly assessed using standard Treatment Protocols.
- Identify surge capacities and mark the beds dedicated to treat heat stroke victims and enhance emergency department preparedness to handle more patients.
- Identify RRT (Rapid Response Teams) to respond to any exigency call outside the hospitals.
- Ensure adequate arrangements of Staff, Beds, IV fluids, ORS, essential medicines and equipment to cater to management of volume depletion and electrolyte imbalance.
- May try to establish outreach clinics at various locations easily accessible to the vulnerable population to reduce the number of cases affected. Health Centers must undertake awareness campaigns for neighbourhood communities using different means of information dissemination.
- Primary health centres must refer the patients to the higher facility only after ensuring adequate stabilization and basic definitive care (cooling and hydration).
- Hospitals must ensure proper networking with nearby facilities and medical centres to share the patient load which exceeds their surge capacities.
- All cases of heat-related illnesses (suspected or confirmed) should be reported to IDSP (Integrated Disease Surveillance Programme) unit of the district.

4.3 Acclimatization:

Those who come from a cooler climate to a hotter climate, especially during the heat wave season, are at risk. They should be advised not to move out in open for a period of one week. This helps the body get acclimatized to heat. They should also be advised to drink plenty of water. Acclimatization is achieved by gradual exposure to the hot environment during a heat wave season.

4.4 Identification for Heat Wave related illnesses and recordings of casualties:

It is important to undertake an objective identification of heat wave illnesses and systematically record causalities resulting from heat wave. States may form committees at the district level with members not below the rank of Assistant Civil Surgeon, Tahsildar, and Inspector of Police to enquire into the deaths due to heat strokes / heat waves for correct reporting. In order to do so, the following four factors need to be taken into account:

- Recorded maximum temperature during the particular time period and place.
- Recording incidents, *panchnama* or others witnesses, evidence or verbal – autopsy.
- Postmortem/medical checkup report with causes.
- Local authority or Local body enquiry/verification report.
- Cases of heat exhaustion and heat stroke should be reported.

5. Roles and Responsibilities for Managing Heat Wave

5.1 Need for Data and Analysis

As heat wave is not a notified disaster at the national level, accurate information and data related to heat wave deaths and illnesses are not available. In order to prepare for and take necessary mitigative action against heat wave, we need data on age group, sex and occupation of those who die of heat wave. We also need to collect data on whether the deaths occurred indoors or outdoors. Similarly, data on the economic status of the people who died also needs to be collected. A format for collecting this data is provided at Annexure 2, which should be used by the DDMAs and SDMAs.

Data from various domains are very much needed to have a sound evidence-based policy and its proper strategization Valid and reliable data is needed for mortality as well as morbidity – the health outcomes directly as well as indirectly related to heat. Most of the recent work exploring the effects of ambient temperature on human health has not considered the direct heat-related health events such as heat strokes, heat exhaustion and fatigues. However, counter-intuitive it might seem, these direct health outcomes are often not preferred by the research community. This is because their definitions are not always standardized and the application of these definitions often may not be clinically feasible, especially in low and middle income country settings, with sub-optimal health system, such as India, leading to differential underestimation of such events. Moreover, these direct heat outcomes are often biased by other factors the affected area, thus compromising their validity. Instead, the research community has frequently examined the effects of heat on general health indicators that include all-cause mortality, disease-specific mortality and morbidity – cardiovascular and respiratory events being prominent among them, visits to emergency departments of health facilities, demand for ambulance services and others - which might be causally associated to soaring temperatures. Hence, availability of such data from vital registration systems of local and district bodies, various tiers of health facilities and health departments are essential to carry out meaningful analysis of heat-related health events.

Reliable meteorological data, which constitute the exposure variables, are also necessary for robust evidence generation in this field- this includes data regarding various dimensions of ambient atmospheric temperature, relative humidity, rainfall and wind flow. Standardized atmospheric pollution data are often used to control their variations in these health prediction models, which can refine the dependency estimates of health outcomes on atmospheric heat.

Mortality data must be acquired from Registrar of Birth/Deaths at different levels. The determination of threshold values and characterizing the temperature-mortality relationship and vulnerability assessment. It would help in preparation of heat action plan.

All these data are needed in a time-series format - collected at the same time intervals, at the same locations and for a considerable period of time, so that studies can identify even the smaller but critical effects of heat on the affected population can be based on statistical data. Along with strengthening the vital registration systems, a proper data sharing strategy among all stakeholders should be developed. Each death should be registered at the respective municipality and/or block and the concerned medical officer should provide a medical certificate for the same. The format given at the end of this chapter, has been adopted from the Department of Health and Family Welfare, Government of Odisha, can be used for collecting data on heat wave related deaths.

5.2 Prevention, Preparedness and Mitigation Measures:

Cool Roofs to Provide Affordable Thermal Comfort: Urban residents living in slums have fewer options available to adapt to rising temperatures. This increases their vulnerability to heat and results in greater adverse impacts of extreme heat on these communities. In their issue brief "Rising Temperatures, Deadly Threat", the NRDC and IIPH Gandhinagar identified several specific factors that increase the vulnerability of slum residents to extreme heat:

- **Higher Exposure to Extreme Heat:** Slum residents are more likely to be exposed to heat since they work primarily outside or in unventilated conditions, they live in homes constructed of heat-trapping materials with tin or tarpaulin roofs, and their communities lack trees and shade.

- **Greater Susceptibility to Health Effects of Extreme Heat:** Lack of access to clean water, poor sanitation, over-crowding, malnutrition, and a high prevalence of undiagnosed/untreated chronic medical conditions due to poor access to healthcare heighten slum community members' susceptibility to extreme heat's effects on health.

- **Fewer Adaptation Options Available:** Slum residents lack control over their home and work environments, with limited access to (and inability to afford) reliable electricity and cooling methods like fans, air coolers and air conditioning, insufficient access to cooling spaces, and a dearth of health information on which to act. All these factors reduce slum residents' opportunities to adapt to increasing temperatures.

An affordable solution is cool roofs. A cool roof is a white reflective roof that stays cool in the sun by minimizing heat absorption and reflecting thermal radiation to help dissipate the solar heat gain. Studies have shown that cool roofs can be up to 30°C cooler than conventional roofs, and can bring the indoor temperatures down by 3-5° C. When implemented on a large scale, cool roofs can reduce the urban heat island effect in a city.[1,2] Cool roofs include coatings and treatments such as lime-based whitewash, white tarp, white china mosaic tiles and acrylic resin coating, and provide an affordable solution for providing thermal comfort.

Livestock preparedness during hot weather: Extreme heat causes significant stress to livestock. There is a need to plan well for reducing the impacts of high temperatures on livestock. Keeping an eye on the weather forecasts, and developing a mitigation plan for high to extreme temperature can be effective in ensuring that the livestock has sufficient shade and water on hot days.

Prevention, preparedness and mitigation measures for various stakeholders are enumerated in the following Table No.5:

[1]Natural Resources Defense Council, "Looking Up: How Green Roofs and Cool Roofs Can Reduce Energy Use, Address Climate Change, and Protect Water Resources in Southern California", June 2012, https://www.nrdc.org/sites/default/files/GreenRoofsReport.pdf (last accessed on April 5, 2017)
[2]Vishal Garg, Cool Roofs Toolkit, "Cool Roof Activities in India", http://www.coolrooftoolkit.org/wp-content/uploads/2012/04/Vishal-Presentation.pdf (last accessed on April 5, 2017)

4.3 Table 5: Roles and Responsibilities for Managing Heat Wave

SN	Key Strategy	Task / Activities	Centre / State Agencies & their Responsibilities			
			Centre	Responsibility	State	Responsibility
Understanding Risk						
1.	Formulation of Policy, plan and guideline	Preparation of Heat Action Plan in coordination with all stakeholders	NDMA	Revision of National Guidelines for Preparation of Action Plan – Prevention and Management of Heat wave	[3]State Govt./ Dept.of DM / COR/ SDMAs/DDMAs ULBs/PRIs	• Preparation/revision of Heat Action Plan based on NDMA revised Guidelines and local experiences
Interagency Coordination						
2.	Early warning & Coordination	Establish Early Warning System	IMD with DST,	• Strengthening of early warning system- with accurate and timely alert systems • Issue Heat wave alerts, warnings and weather forecasts of Short / Medium / Long range duration • Coordination with state agencies	State Government /CORs/ District Admin./DDMAs	• Real-time surveillance and evaluation of weather station. • To disseminate the information received from IMD to the public at large • Disseminate the heat–health warning, determine the threshold for action and communicate the risks
			IITM	Extended range of forecast and Numerical Weather Prediction on heat wave	State Government /CORs/ District Admin./DDMAs	Prepare SoP for heat wave response based on Extended range of forecast and Numerical Weather Prediction
		Response & Relief	Ministries/ Departments concerned with heat wave (List Annexed -5)	• Take necessary measures, wherever applicable • Flexible timing of market and offices • Provide occupational support and advisories	CORs / SDMAs/ DDMAs / ULBs/PRIs	• Coordination among all stakeholder with clearly defined roles and responsibilities • Flexible timing of market and offices • Take necessary measures, wherever applicable • Collaboration with non government and civil society

[3] The administrative set up for disaster management differs across states in one state government where the set up differ from the on department mentioned in the matrix, the responsibility will be with the department dealing with disaster management.

						• Provide occupational support and advisories • Special care for vulnerable groups - children, disabled, women and old aged.
		Monitoring of medical preparedness	MoH&FW	• Develop a monitoring mechanism • Provision of funds for heat action mitigation plans. • Surveillance of heat wave impact • Deployment of Medical Teams	State government CORs /SDMAs/DDMAs / Health Dept.	• Develop monitoring mechanism for implementation of heat action plan • Provision of funds for heat action mitigation plans. • Deployment of rapid medical response teams
Investing in DRR – Non-structural measures						
3.	Preparedness and Mitigation Measure	Preparedness Measure	Ministries/ Departments concerned with heat wave (List Annexed -5)	• Appointment of Nodal officer at each Ministry/Department • Develop strategy for preparedness measures • Issue necessary directions for preparedness	State Government /CORs/ District Admin./DDMAs / ULBs/PRIs	• Appointment of Nodal officer at each level (state, districts, tehsil and block, department etc) • Implementation of Heat Action Plan • Issue necessary directions for preparedness
			MHA	• Issue directives to state police department for distributions of Cool jacket for traffic police personnel	State Government/ Dept. of Home	• Ensure shade for on duty traffic police, as they are more exposed to heat wave and distribution of Cool jacket for traffic police personnel
			NDMA	• Review preparedness & mitigation measures in heat prone states. • Inter-ministerial coordination for preparedness activities	CORs/SDMAs/ DDMAs / District Admin./ ULBs/PRIs	• Heat wave should be included in annual disaster event/ calendar. • Interstate collaboration for sharing experiences and data • Reviewing preparedness & mitigation measures
		Short and Medium term mitigation measures	MoH&FW	• Issue directives for hospital preparedness & mitigation measures to states • Formulation of Schemes and program for heat-health safety • Ensure monitoring	State govt./Dept. of Health	• Prepare hospital preparedness plans • Preparedness of the heat health and social care system • Ensuring 24X7 heat health facilities with adequate provision of basic medicine like ORS, Glucose etc.

				mechanism for heat health preparedness at state level		• Dissemination of heat health plan by organizing awareness campaigns.
			MoEF&CC	• Develop framework for tracking and modeling of Heat hot spot based on IMD data.. • Directives to maintain water bodies in the forest area for wild animals & birds. • Advisory for plantation in fallow land available with different ministries	Dept. of Forest in coordination with other department	• Identify "heat hot-spots" using framework for tracking and modeling based on IMD data. • Maintain water bodies in the forest area for wild animals & birds. • Afforestration and plantation • Prevention of forest fire
			MoRD and MoPR	• Instruction on mainstreaming heat health precautionary measures, including re-scheduling of working hours and reduce piece rate, in all schemes and programmes,	State Govt./ Dep. of Rural development and Panchayati Raj	• Implementation of instruction for mainstreaming heat health precautionary measures, including re-scheduling of working hours and reduce piece rate, in all schemes and programmes. • Ensure shed for resting and drinking water facilities for workers at all work place,
			Min.of Jal Shakti	• Issue instruction for ensuring availability of drinking water facilities.	State Govt./ Department of Drinking water	• Ensure drinking water facilities. • Identify vulnerable place and ensure drinking water facilities. • Repair/maintenance of mechanical/ electrical fault of tube wells, ponds, jorhat, at priority basis to ensure water storage. • Suitable arrangement for drinking water supply and promptly respond to water scarcity. • Ensure drinking water facilities at all common place and nearby habitation.
			Min.of HRD	• Direction to states to re-scheduling of schools timing	State Govt./ Education	• Rescheduling of school timing and vacation as per heat wave situation.

				or closer of the schools as per heat wave situation, • Instruction for ensuring cool places in all educational institutions. • Encourage research on heat wave related issues through universities	department	• Ensuring cool places for all educational institutions, and availability of water facilities • Ensure that students avoid outdoor physical activities during the summer in schools. • Research on heat wave related issues through universities
			Min.of Labour and Employment	• Directives to all states, construction companies, industries for precautionary measures to be taken during heat wave season. • Direction for rescheduling of working hours. • Necessary arrangement to regulate piece rate and requirement /urgency for undertaking physical work during summer.	State govt./ Dept. of Labour/Dept of Social Welfare	• Implement the direction for heat wave season • Re-scheduling of working hours for employees in different sectors. • Ensure drinking water facilities at work places. • Coordinate with Health department and ensure regular health check up of the workers and provide emergency ice packs and heat illness prevention materials to construction workers.
			MoA&FW / MoAH&D	• Advisory to Sates for awareness generation about farmers/animal-health related issues arising from heatwave. • Advisory to States to ensure availability of necessary veterinary medicine, equipments.	State Govt / Dept. of Ag.&AH	• Follow the advisory on heat wave • Shelter for livestock and animal husbandry should be maintained. • Pre-positioning of adequate veterinary medicines and supplies. • Update contingency plan regarding provision of drinking water for animals.
			MoHUA	• Issue advisory to all ULBs in heat wave vulnerable states for preparedness, mitigation & management of heat wave. • Give directives to construct shelters, sheds at public	State Governments / District Admin./ DDMAs, UDD/ULBs	• Open parks/open areas during daytime for providing spaces with shade • Sprinkling of water on roads • Construct shelters, sheds at public place, provide access to public parks during heat wave season.

				places, provide access to public parks during heat wave.		• Promote cool roofs initiative such as paint roof white, create green roofs and walls, and plan trees in neighborhood to keep them cool.
			MoRT&H	• directive for protection of roads from melting and take precautionary measures	State Government / Dept. of Transport	• To ensure 1) Shelter/Sheds at bus stops, 2) frequency of transportation, 3) drinking water facilities at bus stop. • Enable better emergency transport system for affected people to health care facilities with adequate equipments
			Min of Power	• Advisory to all states as well as power generation, transmission, distribution and supply though DISCOM including repair & maintenance work for uninterrupted power supply. • Re-scheduling load shedding	Department of Power/DISCOM	• Ensure repair & maintenance work for uninterrupted power supply before and during the summer. • Re-scheduling load shedding
			Min. of Railways	• Repair/maintenance of mechanical/ electrical system on priority basis including fan and cooling system. • Ensure drinking water facilities in trains and railway stations.	All General Manager of Zone and Divisional Railways Manager /Metro Rail Corporations in states	• Repair/maintenance of mechanical/ electrical system on priority basis including fan and cooling system. • Ensure drinking water facilities in trains and railway stations.
			Dept. of Sc.& Technology	• R&D activities to promote utilization of S&T in the field of Heat wave risk reduction.	State Govt./ CORs/ Dept. of Sc.& Technology	• To develop application / App related to awareness generation, quick information sharing on the Heat Wave Risk Reduction. • R&D activities to promote utilization of S&T in the field of Heat wave risk reduction. • Promote research on heat wave related issues

Investing in DRR – Structural measures						
		Long term mitigation measures	MoRD/ MoHUA	• Long term planning for heat resilient infrastructure, • Directives to states to promote cool roofs technology and use other similar heat reducing technology • Mixed land use planning may be adopted to address heat wave affected cities • Heat appropriate planning of new buildings (consideration e.g. in architecture, width/height ratio, street development, orientation and site) in urban and rural areas. • Capacity building of structural engineers, civil engineers and architects for construction of green building, maintenance and fire safety of the structures.	State Govt./ CORs and concerned department	• Long term planning for heat resilience infrastructure, • Promote cool roofs technology and use other similar heat reducing technology • Ensure implementation of mixed use planning adopted in heat wave affected cities • Heat appropriate planning of new buildings (consideration e.g. in architecture, width/height ratio, street development, orientation and site) in urban and rural areas. • Ensure capacity building of structural engineers, civil engineers and architects for construction of green building, maintenance and fire safety of the structures. • Ensure to construction of green building, environment and building code related to heat wave risk mitigation.
			Ministry of Consumer Affairs, Food and Public Distribution	• Issue directives to states for to implements National Building Code of India 2016 Part – IV "Fire & Life Safety" in their building bye-laws	State Govt/ UDD/ ULBs/PRIs	• Ensure implementations of latest National Building Code of India 2016 Part – IV "Fire & Life Safety" in their building bye-laws
			MoEF&CC	• Issue directives to states for construction of green building, Energy Conservation Building Code (ECBC) related to heat wave risk mitigation.	State govt. /CORs/ Dept. of Forest	• Ensure construction of green building, Energy Conservation Building Code (ECBC) related to heat wave risk mitigation • Increase forest coverage and green area • Afforestration and mass plantation • Coordinate with Transport Department and Roac

				• Policy formulation to increase forest coverage and green area in view of increasing heat wave risks. • Afforestration and mass plantation		Construction Department for plantation of trees at roadside, barren land and other areas. • Prevention of forest fire and control measures.
			MoA&FW	• [4]Advisory for short duration and heat resisting crops.	State Govt./ Dept of Agriculture.	• Promote short duration and heat resisting crops.
Capacity Development						
4.	Capacity building and training	Capacity Building	NIDM with MoH&FW/ MoHRD and other concerned ministries/departments as per annexure -5	• Develop training module for different qualification at different level • Preparation of Capacity Building plan and implementation • Coordination with different ministries/departments for capacity building activity. • Conduct capacity building and training program as per domain and expertise of Ministry/Department	State Govt./ CORs/ SDMAs /SIDMs State ATIs with Dept. of Health and Education	• Develop training module and conduct proper training program for different stakeholders • Heat wave management should be added in school curriculum to sensitize school children and local people • Conduct capacity building and training program as per domain and expertise of department.
			MoHUA	• Capacity building of structural engineers, civil engineers and architects for construction of green building, maintenance and fire safety of the structures.	State Govt./CORs/, PWD, Municipal corporation, Urban local bodies	• Capacity building of structural engineers, civil engineers and architects for construction of green building, maintenance and fire safety of the structures • Long term mitigation measures construction of green building, environment and building code related to heat wave risk mitigation.

[4] Explanation: We are not moving from subject. Example – if we advise short duration and low water intensity crops and creeping plants its helps to heat reduction and climate sustainability.

5.	Public Awareness and community outreach	Media campaign and IEC activity	MoHUA/ MoRD/ MoH&FW/ NDMA and other concerned ministries /department as per annexure -5	• IEC Campaign to create awareness through print media, electronic media, social media etc. • Issue advisories from time to time	CORs/ SDMAs District Admin/ DDMAs/ Information and Public relations Dept. and other concerned departments	• IEC Campaign to create awareness through print media, electronic media, social media etc. • Display board with colour coding for heat wave alert. • Display Do's and Don'ts in the Public areas, Hospitals, Parks, etc. • Develop of mobile application for faster spread of heat related issues, alertness, space for shelters and drinking water.
6.	Data collection and Documentation		Ministry of Health & Family Welfare through IDSP	• Establish a Data monitoring cell and collecting Data from States and maintaining national-level data base. • Standardized collection of granular data • Development of a proper data sharing strategy among all stakeholders.	CORs / SDMAs / DDMAs / Health Dept. through Nodal Officer	• Establish a Data monitoring cell and collect data from district and maintain state level data base. • A standardized collection of granular data • Standard protocol for death investigation. • Adopt uniform process for registration of casualties/ deaths due to heat wave based on the post mortem report, death count, type of disease, time and duration.

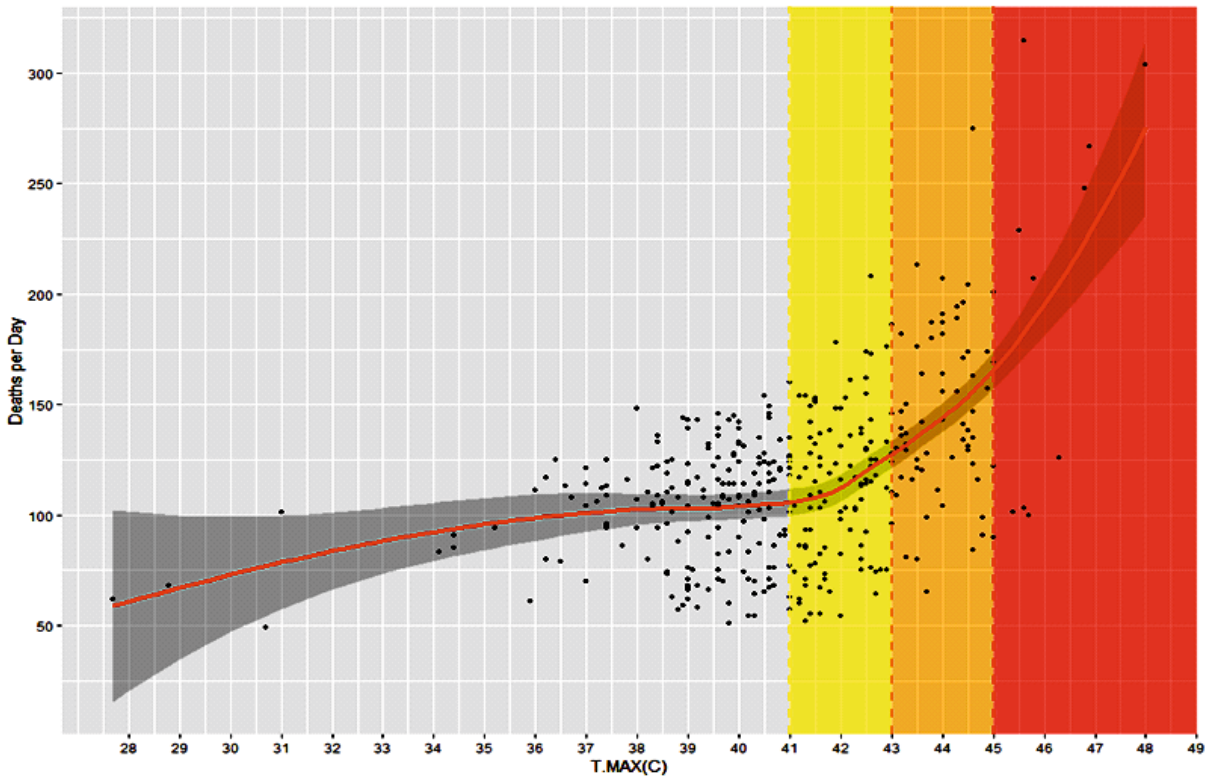
Annexure-1

Local Threshold Determination for Early Warning System

The cities of Ahmedabad, Nagpur and Bhubaneswar have chosen the daily Maximum Temperature (T.Max) to determine the threshold. In Ahmedabad, an important reason for selecting T.Max for threshold determination is the climate condition, which is dry and arid. Similarly, Nagpur also has a dry climate in summer.

A simple method used for developing the threshold is response-specific: obtain the long term (10-15 years) daily mortality data for the summer months from the city administration and correlate with the daily Maximum Temperature from IMD. A simple scatter plot of daily Maximum Temperature and daily All-cause mortality will give us the visual representation of the Temperature – Mortality relationship. Shown in below (Fig.2), by fitting a curve on the scatter plot, we can see a point of inflection or rapid rise of mortality - this is the threshold point. At this point (Temperature), the curve starts to go up (increase in deaths) rapidly.

The scientific community has developed many ways to determine the threshold. One is based only on the meteorological parameters, where the health data is not available or not reliable. A percentile-based threshold (90th, 95th and 99th percentile) of maximum daily temperature could be contemplated as a warning trigger value if climate data is available and health date is not available or reliable. Recent research has indicated that this percentile based threshold works well in the data-sparse regions. This method is also used in developed countries. In Belgium, the 95th percentile of summer maximum temperature has been set as the threshold to issue warnings. While this threshold is set to capture the most extreme days, it should be noted that they have not been developed from, nor are they related to, any specific health impact, but are location specific.



Figur 2: Highlight Ahmedabad Temprature and Mortality relationship

Annexure: 2

Case Definitions

Range of Heat Illness - Typical Presentations-symptoms, sign and prognosis[5]

Clinical Entity	Age Range	Setting	Cardinal Symptoms	Cardinal / Important Signs	Pertinent Negative findings	Prognosis
Heat rash/ prickly heat/ Miliaria	All, but frequently children	Hot environment; +/- insulating clothing or swaddling (wrap in tight clothes)	Itchy rash with small red bumps at pores in the skin. Seen in setting of heat exposure; bumps can sometimes be filled with clear or white fluid	Diffused red colour skin or vesicular rash, itching of the skin without visible eruption	Not focally distributed like a contact dermatitis	Full recovery with elimination of exposure and supportive care
Heat cramps	All	Hot environment, typically with exertion, +/- insulating clothing	Painful spasms of large and frequently used muscle groups	Uncomfortable appearance, may have difficulty fully extending affected limbs/joints	No contaminated wounds/tetanus exposure; no seizure activity	Full recovery with elimination of exposure and supportive care
Heat exhaustion	All	Hot environment; +/- exertion; +/- insulating clothing or swaddling (wrap in a tight clothes)	Feeling overheated, lightheadedness, exhausted and weak, unsteady, feeling of vomiting, sweaty and thirsty, inability to continue activities	Sweaty/diaphoretic; flushed skin; hot skin; normal core temperature; +/- dazed, +/- generalized weakness, slight disorientation	No coincidental signs and symptoms of infection; no focal weakness; no difficulty in swallowing food or speech; no overdose history	Full recovery with elimination of exposure and supportive care; progression to heat syncope / stroke if continued exposure
Heat syncope	Typically adults	Hot environment; +/- exertion; +/- insulating clothing or swaddling (wrap in a tight clothes)	Feeling hot and weak; lightheadedness followed by a brief loss of consciousness	Brief, generalized loss of consciousness in hot setting, short period of disorientation, if any	No seizure activity, no loss of bowel or bladder continence, no focal weakness, no difficulties in food swallowing or speech	Full recovery with elimination of exposure and supportive care; progression to heat stroke if continued exposure
Heat Stroke	All	Hot environment; +/- exertion; +/- insulating clothing or swaddling (wrap in a tight clothes)	Severe overheating; profound weakness; disorientation, not fully alert, convulsion, or other altered mental status	Flushed, dry skin (not always), core temp ≥40°C or 104°F; altered mental status with disorientation, incoherent behaviour, coma, convulsion; tachycardia; +/- hypotension	No coincidental signs and symptoms of infection; no focal weakness; no difficulties in swallowing food or speech, no overdose history	25-50% mortality even with aggressive care; significant morbidity even if survives

[5]Source: IIPH Gandhi Nagar, Gujarat

Annexure: 3

Heat Illness Treatment Protocol[6]

Recognizing that treatment protocols may vary slightly according to the setting (EMS, health centre, clinic, hospital emergency department, etc.), the following should apply generally to any setting and to all patients with heat related illnesses:

1. Initial patient assessment primary survey (airway, breathing, circulation, disability, exposure), vital signs including temperature

2. Consider heat illness in differential diagnosis if:

   a. Presented with suggestive symptoms and signs
   b. Patient has one or more of the following risk factors:

      i. Extremes of age (infants, elderly)
      ii. Debilitation/physical deconditioning, overweight or obese
      iii. Lack of acclimatization to environmental heat (recent arrival, early in summer season)
      iv. Any significant underlying chronic disease, including psychiatric, cardiovascular, neurologic, hematologic, obesity, pulmonary, renal, and respiratory disease
      v. Taking one or more of the following:

         1. Sympathomimetic drugs
         2. Anticholinergic drugs
         3. Barbiturates
         4. Diuretics
         5. Alcohol
         6. Beta blockers

3. Remove from environmental heat exposure and stop physical activity

4. Initiate passive cooling procedures
   a. Cool wet towels or ice packs to axillae, groin, and around neck; if patient is stable, may take a cool shower, but evaluate risk of such activity against gain and availability of other cooling measures
   b. Spray cool water or blot cool water onto the skin
   c. Use fan to blow cool air onto moist skin

5. If temperature lower than 40°C, repeat assessment every 5 minutes; if improving, attempt to orally hydrate (clear liquids, ORS can be used but not necessary; cool liquids better than cold). If temperature is 40°C or above, initiate IV rehydration and immediately transport to emergency department for stabilization.

[6] Source: Ahmedabad Heat Action Plan (HAP) https://www.nrdc.org/sites/default/files/ahmedabad-heat-action-plan-2017.pdf

Annexure-4

Heat Wave DO's and DON'Ts

DO's

Must for All

- Listen to Radio; watch TV; read Newspaper for local weather news.
- Drink sufficient water - even if not thirsty.
- Use ORS (Oral Rehydration Solution), homemade drinks like lassi, torani (rice water), lemon water, buttermilk, etc. to keep yourself hydrated.
- Wear lightweight, light-coloured, loose, cotton clothes.
- Cover your head: Use a cloth, hat or umbrella.

Employers and Workers

- Provide cool drinking water near work place.
- Caution workers to avoid direct sunlight.
- Schedule strenuous jobs to cooler times of the day.
- Increasing the frequency and length of rest breaks for outdoor activities.
- Pregnant workers and workers with a medical condition should be given additional attention.

Other Precautions

- Stay indoors as much as possible.
- Keep your home cool, use curtains, shutters or sunshade and open windows at night. Try to remain on lower floors.
- Use fans, damp clothing and take bath in cold water frequently.
- If you feel faint or ill, see a doctor immediately.
- Keep animals in shade and give them plenty of water to drink.

DONT's

- Avoid going out in the sun, especially between 12.00 noon and 3.00 p.m.
- Avoid strenuous activities when outside in the afternoon.
- Do not go out barefoot.
- Avoid cooking during peak hours. Open doors and windows to ventilate cooking area adequately.
- Avoid alcohol, tea, coffee and carbonated soft drinks, which dehydrates the body.
- Avoid high-protein food and do not eat stale food.
- Do not leave children or pets in parked vehicles - as they may get affected by Heat Wave.

Annexure- 5

List of Ministries/Departments concerned with Heat wave Management

IMD	India Meteorological Department, New Delhi
MHA	Ministry of Home Affairs
MoA&FW	Ministry of Agriculture and Farmers' Welfare
MoAH&D	Ministry of Animal Husbandry and Dairying
MoCAF&PD	Ministry of Consumer Affairs, Food and Public Distribution
MoEF&CC	Ministry of Environment Forest and Climate Change
MoES	Ministry of Earth Sciences
MoH&FW	Ministry of Health and Family Welfare
MoHRD	Ministry of Human Resource Development
MoHUA	Ministry of Housing and Urban Development
MoJS	Ministry of Jal Shakti
MoL&E	Ministry of Labour and Employment
MoP	Ministry of Power
MoPR	Ministry of Panchayati Raj
MoR	Ministry of Railways
MoRD	Ministry of Rural Development
MoRT&H	Ministry of Road Transport and Highways
NDMA	National Disaster Management Authority
NIDM	National Institute of Disaster Management

Annexure-6

Format A: Death reported due to Heat Wave (States report to NDMA)

Name of the State: **Year:** **Reporting Periods:** **Date of Reporting:**

District		Location						Occupation					Economic		
		Urban		Rural		Total		Farmers	Labours	Hawkers	Others	Total	BPL	APL	Total
	Age Group	M	F	M	F	M	F								
District 1	0-6 years														
	7-18 years														
	19-35 years														
	36-60 years														
	61 > above														
	Sub Total														
District 2	0-6 years														
	7-18 years														
	19-35 years														
	36-60 years														
	61 > above														
	Sub Total														
Total State															

*If any other information related to heat wave, please enclose a separate page.

Name and designation of the reporting officer: Signature with Date

Format B: Details of the death reported due to Heat-Wave (record kept with State government)

S. No.	Name and Address	Age	Sex (M/F)	Occupation	Place of death	Date and time of death	Max Temp recorded (Rectal and Oral)	Deaths reported during heat wave period or Not	List of chronic diseases present (Ask the family members)	Date and time of post mortem (If conducted)	Date and time of joint enquiry conducted with a revenue authority	Cause of death	Remarks	
													Related to post-mortem	Related to Joint enquiry
1														
2														
3														
4														

Name and designation of the reporting officer:

Signature with Date

Annexure- 7

Format A

DAILY REPORT OF HEAT STROKE CASES AND DEATHS (District report to State government)

S. No.	Village	PHC	Block/City	Name & Son/ Daughter/Wife of	Urban U Rural R	BPL Y/N	Age/Sex	Date of attack of Heat Stroke	Any Antecedent illness	Cause of death	Death confirmed by MOs and MROs

Format B

(To be cumulated at the State Level and sent to Central Government)

DEATHS DUE TO HEAT RELATED ILLNESS -State …… **Date:**

S. No.	Name of the district (Name of all districts)	New cases admitted due to Heat Related Illness since the last reporting period	Cumulative no of cases admitted due to Heat Related Illness since 1st April ……..	Deaths reported due to Heat Related Illness since the last reporting period	Cumulative no of deaths due to Heat Related Illness since 1st April …..	Remarks (If any shortage of ORS/ IV fluids/ Treatment facilities etc…)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
TOTAL						

Format C

CASES AND DEATHS DUE TO HEAT RELATED ILLNESS - INDIA (Cumulated at the National Level)

Cumulative Data Form: **For the week ending:**

SN	Name of the State	Cases reported due to Heat wave Related Illness in the State (Since 15 March 2019)			Deaths reported due to Heat wave Related Illness in the State (Since 15 March 2019)						Remarks
					Suspected deaths			Confirmed deaths			
		Up to last week	Last 7 days	Total	Up to last week	Last 7 days	Total	Up to last week	Last 7 days	Total	
1	Andhra Pradesh										
2	Bihar										
3	Chhattisgarh										
4	Delhi										
5	Gujarat										
6	Haryana										
7	Jharkhand										
8	Karnataka										
9	Maharashtra										
10	Madhya Pradesh										
11	Odisha										
12	Punjab										
13	Rajasthan										
14	Tamil Nadu										
15	Telangana										
16	Uttar pradesh										
17	West Bengal										
18	Arunachal Pradesh										
19	Himachal Pradesh										
20	Jammu & Kashmir -										
21	Kerala										
22	Goa										
23	Uttarakhand										
TOTAL											

***Added new heat-prone States**

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