



EXPANDING HEAT RESILIENCE ACROSS INDIA: HEAT ACTION PLAN HIGHLIGHTS

Record-breaking brutally hot weather is a major health threat in India and other parts of the world. Climate change is fueling more frequent, intense, and longer heat waves.¹ This year, the COVID-19 pandemic stresses emergency response to heat-related illnesses since hospitals and urban health centers are already stressed, according to the Indian government.² To counter the deadly heat, cities and regions across India are taking strong action to build resilience and better prepare and protect communities.

Drawing lessons from the ground-breaking 2013 Ahmedabad Heat Action Plan (HAP),³ city, state, and national level authorities are ramping up to implement extreme heat warning systems and preparedness plans. In 2020, the national government is working with 23 states and over 100 cities and districts to develop and implement heat action plans across India. Government officials and healthcare professionals are working to contain the spread of COVID-19 and implement Heat Action Plans and cool roof programs to protect communities from heat waves.

The India Meteorological Department (IMD) and National Disaster Management Authority (NDMA) are leading efforts to prepare and respond to heat waves. NDMA is also the central agency overseeing the COVID-19 response, making the burden of this heat season even greater. IMD's seasonal forecast for the 2020 heat season shows that heat wave conditions are likely to be severe.^{4,5}

- 1 IPCC, Special Report on 1.5°C "Summary for Policy Makers", 2018. www.ipcc.ch/sr15/chapter/summary-for-policy-makers/ (Accessed 28 May 2019).
- 2 NMDA Letter to State Disaster Management Agencies regarding 2020 heat season, including Do's and Don'ts (April 2020).
- 3 Ahmedabad Heat Action Plan 2019, www.nrdc.org/sites/default/files/ahmedabad-heat-action-plan-2019-update.pdf
- 4 Global Heat Health Information Network (GHHIN), "Heat and COVID-19", 2020, <http://www.ghhin.org/heat-and-covid-19>.
- 5 IMD Seasonal Outlook, mausam.imd.gov.in/backend/assets/press_release_pdf/Seasonal_Outlook_for_Temperatures_during_April_to_June,_2020.pdf



NDMA has already activated the network of state disaster response agencies and city leaders to prepare for soaring temperatures and updated the list of heat wave Do's and Don'ts.⁶

Heat Action Plans are comprehensive early warning systems and preparedness plans with the objectives of public awareness and community outreach; interagency coordination; capacity building among health care professionals; and reducing heat exposure and promoting adaptive measures. The Natural Resources Defense Council (NRDC) and Public Health Foundation of India - Indian Institute of Public Health-Gandhinagar (PHFI-IIPH-G), along with other key stakeholders work with government leaders and key experts across India and internationally to develop, launch, and implement heat action plans. This annual issue brief highlights the progress at the city, state, and national levels in 2020 to improve resilience to extreme heat.

- 6 NDMA Heat Wave Do's and Don'ts, ndma.gov.in/en/heat-do-s-and-dont-s.html (Accessed May 1, 2020).

COVID-19 AND EXTREME HEAT IN INDIA

India's response for the rapidly spreading COVID-19 pandemic has been described as decisive, in many ways. By early May 2020, India had seen more than 50,000 confirmed cases and 1,800 deaths from COVID-19, with the cities of Mumbai, Delhi, Ahmedabad, Chennai and Pune as the worst affected cities.⁷ In late March 2020, India's cities and states implemented a strict lockdown that continues into the summer. With the lockdown in force, all but essential services and operations have been suspended, with most people being restricted to their homes.

This year, IMD has already issued heatwave warnings in several states in central and western India. The COVID-19 lockdown requires most people to stay indoors during this heat season, and unfortunately, for many, the pandemic situation carries additional risk. Many vulnerable communities and individuals, especially migrant workers with limited economic means have been severely affected by the lockdown and COVID-19. While community transmission of the virus remains a risk, the lockdown of cities has meant that all economic activity, including intra-city and long-range transport has been suspended. With incomes having disappeared and many people unable to travel to their hometowns, many migrants in Indian cities have been forced into temporary shelters and densely packed co-habitation areas. These conditions pose a risk to their health, especially as temperatures rise.

The lockdown and economic slowdown have resulted in a reported drop of 50% in fine particle air pollution in some cities,⁸ yet the link between heat, air quality and COVID-19



Picture: Migrant workers and children near the Delhi-Uttar Pradesh border. Image Credit: Ravi Choudhary, PTI

are not thoroughly understood. With government efforts focused on COVID-19, it is important that vulnerable sections of the population continue to take precautions, such as local HAPs and the NDMA Do's and Don'ts guidelines for Heat Waves during COVID-19.⁹

Key Resources

- **World Health Organization:** Preparing for a long, hot summer with COVID-19
<http://www.euro.who.int/en/health-topics/environment-and-health/pages/news/news/2020/5/preparing-for-a-long-hot-summer-with-covid-19>

- **Global Heat Health Information Network:** COVID-19 and Heat
<https://www.ghhin.org/>

7 Live Mint, "Half of confirmed cases, deaths in Mumbai, Ahmedabad, Delhi, Chennai, Pune" <https://www.livemint.com/news/india/half-of-confirmed-cases-deaths-in-mumbai-ahmedabad-delhi-chennai-pune-11588849868723.html> (Accessed May 22, 2020).

8 CPCB, "Impact of Janta Curfew & Lockdown on Air Quality, www.cpcb.nic.in/air/NCR/jantacurfew.pdf (Accessed May 21, 2020).

9 NDMA Heat Wave Do's and Don'ts, ndma.gov.in/en/heat-do-s-and-dont-s.html (Accessed May 1, 2020).

NATIONAL LEVEL

At the national level, NDMA is leading efforts by supporting local heat action plans through the recently updated NDMA Heat Guidelines 2019.¹⁰ The updated NDMA guidelines provide a roadmap to states and cities to develop heat action plans. NDMA has identified 23 heat-prone states in 2020, the same number from 2019. To strengthen early planning, NDMA held a two-day national "Preparedness, Mitigation & Management of Heat Wave" workshop in December 2019, several months before the heat season. The annual workshop brings together state and city representatives, as well as experts on extreme heat and forecasting. The workshops' focus on annual

preparedness, sharing experiences on building local heat resilience, and sustainable long-term mitigation measures.

NDMA runs television and social media campaigns with heat resilience resources listed on its website. NDMA tracked 24,223 heat-related deaths across India from 1992 to 2015. Intense and sustained efforts by all stakeholders have significantly reduced mortality from 2,040 deaths in 2015 to 1,111 deaths in 2016, according to NDMA. Further reductions were seen in 2017 and 2018 with 384 and 25 deaths respectively, according to NDMA.

IMD forecasts are vital as they give communities lead-time to prepare for extreme heat. For 2020, IMD issued its annual "Seasonal Outlook for Temperature for the Hot

10 NDMA Heat Wave Guidelines, ndma.gov.in/images/guidelines/heatwaveguidelines.pdf (Accessed May 1, 2020).

Weather Season” forecasting a “severe” heat season.¹¹ In late May 2020, IMD declared heat waves in eight Indian states with temperatures reaching 46°C (114°F) in many regions, further stretching already thin response systems and compounding health risks from the deadly threats of COVID-19 and Cyclone Amphan in the Bay of Bengal.¹² To disseminate local temperatures, IMD and the regional meteorological offices provide 5-day forecasts of daily maximum temperatures to over 350 cities, an increase from 100 in 2016. The IMD forecast has evolved into a well-structured Temperature Forecast and Heat Wave Warning/ Advisory system starting from Seasonal to Extended Range to Five Day State/Met Sub Divisions to cities. The daily 5-day forecast is critical to interagency coordination,

- 11 IMD Seasonal Outlook, mausam.imd.gov.in/backend/assets/press_release_pdf/Seasonal_Outlook_for_Temperatures_during_April_to_June,_2020.pdf (Accessed May 1, 2020).
- 12 IMD, Daily Heat Wave Bulletin, http://internal.imd.gov.in/pages/heatwave_mausam.php (Accessed May 22, 2020).

allowing for planning and preparation to ensure water availability and stocking of ice-packs and oral rehydration solutions (ORS) in clinics. In 2018, IMD started to issue daily morning heat bulletins to enhance interagency coordination and alert-notifications and allow residents to plan their days to reduce heat exposure.

IMD and its affiliated Indian Meteorological Society collaborated with partners in India and internationally for the South Asian Heat Health Information Network (SAHHIN) conference in early 2020. IMD also worked to develop a report on “Heat Wave Thresholds for 100 cities with NDMA and partners and to develop ward-level mapping of economic-vulnerability hot spots for New Delhi, Rajkot and Bhubaneswar as part of their HAPs with IRADe and partners.

Evaluating Heat Action Plans

As recent study found that Ahmedabad, one of India’s largest cities, avoided an estimated 1,190 deaths a year after implementing the country’s first Heat Action Plan (or “HAP”) in 2013. This plan included a heat wave early warning system, public outreach to explain heat-health risks, and trainings aimed at health professionals who diagnose and treat heat-related illnesses.

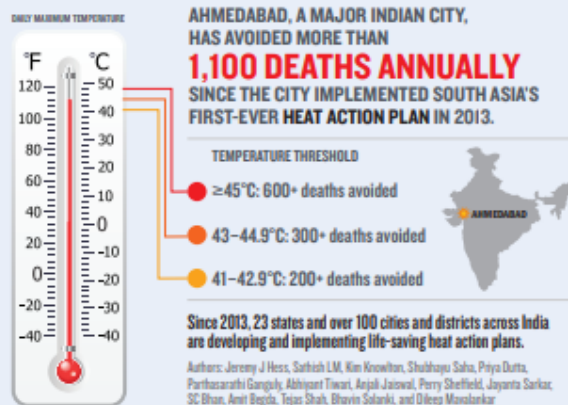
The study, “Building resilience to climate change: pilot evaluation of the impact of India’s first heat action plan on all-cause mortality” jointly authored by public health and municipal authorities in India, academic environmental health researchers in the United States, and NRDC, was published in the peer-reviewed scientific Journal of Environmental and Public Health (JEPH).⁷

By comparing citywide summertime death rates before and after the HAP was launched, researchers found that:

- The HAP was associated with a reduced death rate on hot days. Ahmedabad, a major Indian city, avoided more than 1100 deaths each year after it implemented the region’s first-ever Heat Action Plan in 2013.
- The biggest decrease in death rates was on the hottest days. Mortality rates on the hottest days (at or above 45°C (113°F) daily maximum temperature) dropped by 27% after the HAP was implemented, relative to pre-HAP years.
- While very hot days were still dangerous, the risks were much lower post-HAP. Before the HAP, death rates more than doubled on days when the maximum temperature reached 47°C (116°F), compared to rates at 40°C (104°F). After the HAP was implemented, death rates were only 25% higher on days when maximum temperatures reached 47°C (116°F) compared to death rates at 40°C (104°F).

Extreme heat warnings, a key part of Ahmedabad’s HAP, were associated with decreased summertime all-cause mortality rates, with the largest declines at the highest temperatures.

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Hess, J. et al. 2018. Building resilience to climate change: pilot evaluation of the impact of India's first heat action plan on all-cause mortality. *Journal of Environmental and Public Health*, vol. 2018, article ID 7973519 (8 pp.). <https://doi.org/10.1155/2018/7973519>

GLOBAL OVERVIEW

Across the world, an average temperature increase of 1°C from a pre-industrial baseline has already resulted in extreme climatic and environmental changes.¹³ While there are variations year by year, the global trend line is clear: the five warmest years in recorded history have been the past five (2015-2019). Globally, 2019's average temperature was second only to that of 2016.¹⁴

From 1990 to 2018, populations in every region of the world have become more vulnerable to heat and heatwaves. A 2017 analysis of climate trends in several of South Asia's biggest cities found that if current warming trends continued, by the end of the century, heat and humidity levels would be so high that people directly exposed for six hours or more may not survive.¹⁵ According to the Global Climate Risk Index, India ranks as the fifth-most vulnerable country in terms of extreme weather events and climate

change. India has also recorded the highest number of fatalities due to climate change and endured the world's second highest monetary losses from climate impacts in 2018.¹⁶

Soaring temperatures and heat waves are increasingly limiting the labor capacity of various populations. In 2018, 133.6 billion potential work hours were lost globally, 45 billion more than the 2000 baseline.¹⁷ Extreme heat will significantly lower the outdoor working capacity of India's labor workforce in the next three decades, putting the country's economic growth at risk, a recent report by the McKinsey Global Institute has warned.¹⁸ The Climate Risk and Response report estimated that the impact of global heating on outdoor work and the resultant loss in productivity could put 2.5% to 4.5% of India's GDP at risk annually.

- 13 IPCC, "Special Report Global Warming of 1.5°C, 2018", ipcc.ch/sr15/ (Accessed May 1, 2020); Haustein, K., et al. A Real-time Global Warming Index, *Scientific Reports*, 2017, 7(1), 15417, doi.org/10.1038/s41598-017-14828-5 (Accessed May 1, 2020).
- 14 NASA, "NASA, NOAA Analyses Reveal 2019 Second Warmest Year on Record," climate.nasa.gov/news/2945/nasa-noaa-analyses-reveal-2019-second-warmest-year-on-record/ (Accessed March 30, 2020).
- 15 Eun-Soon Im, et al. "Deadly heat waves projected in the densely populated agricultural regions of South Asia," *Science Advances* 2017 Aug 2;3(8):e1603322. doi: 10.1126/sciadv.1603322.
- 16 Hindustan Times, "India 5th Most Vulnerable to Climate Change: Global Climate Risk Index 2020," [hindustantimes.com/india-news/india-5th-most-vulnerable-to-climate-change-global-climate-risk-index-2020/story-W9WR8cquip39dVc6IWmxH.html](https://www.hindustantimes.com/india-news/india-5th-most-vulnerable-to-climate-change-global-climate-risk-index-2020/story-W9WR8cquip39dVc6IWmxH.html) (Accessed March 30, 2020).
- 17 Nick Watts, et al. "The 2019 report of The Lancet Countdown on health and climate change." *Lancet*, 2019, [doi.org/10.1016/S0140-6736\(19\)32596-6](https://doi.org/10.1016/S0140-6736(19)32596-6) (Accessed May 1, 2020).
- 18 McKinsey Global Institute, "Climate risk and response: Physical hazards and socioeconomic impacts", 2020 <https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts#> (Accessed March 30, 2020).

HIGHLIGHTED STATE LEADERSHIP

NDMA and IMD are working with 23 states that recorded high temperatures leading to heat-wave conditions to develop heat action plans. Expanding heat resilience across India shows that extreme temperatures are

becoming more frequent across the globe, including geographies that do not have a history of heat waves, such as Himachal Pradesh and Kerala.

- ◆ Andhra Pradesh
- ◆ Arunachal Pradesh
- ◆ Bihar
- ◆ Chhattisgarh
- ◆ Delhi
- ◆ Gujarat
- ◆ Goa
- ◆ Haryana
- ◆ Himachal Pradesh
- ◆ Jharkhand
- ◆ Jammu and Kashmir
- ◆ Karnataka
- ◆ Kerala
- ◆ Maharashtra
- ◆ Madhya Pradesh
- ◆ Odisha
- ◆ Punjab
- ◆ Rajasthan
- ◆ Tamil Nadu
- ◆ Telangana
- ◆ Uttarakhand
- ◆ Uttar Pradesh
- ◆ West Bengal

→ ANDHRA PRADESH - PUBLIC AWARENESS CAMPAIGNS

Hit by blistering temperatures in 2019, Andhra Pradesh continues to step up efforts to combat extreme heat in 2020. For the 2020 heat season, IMD warned of extreme weather conditions in Andhra Pradesh and the state has been put on high alert for possible heat waves.¹⁹ Key aspects of the plan include reducing heat-related morbidity and deaths by issuing heat-health warnings, with particular emphasis on the vulnerable groups, and raising awareness among the public and health workers.²⁰

Andhra Pradesh focuses on communication to a range of media. For example, the state launched an awareness campaign to inform citizens to avoid peak heat times between 11 am and 5 pm and to take extra precautions for pregnant women in rural areas. Several of the districts distributed ORS (oral rehydration salts) to commuters and made drinking water available in public places. Andhra Pradesh also has 1,168 automatic weather stations – approximately one for every hundred square kilometers – to better monitor heat conditions.²¹

For the 2020 heat season, in addition to continuing existing programs, the Andhra Pradesh is stepping up efforts for temperature predictions and community outreach through All India Radio services for wider dissemination.²²

→ MAHARASHTRA

With a regional approach in the Nagpur area developed in 2016, the first in India, Maharashtra developed a state-wide Heat Action Plan in 2017.²³ For 2020, the Maharashtra's mitigation and response measures are focused in the Vidarbha, Madhya Maharashtra and Marathwada, in addition to existing HAPs in the Nagpur

region.²⁴ The Nagpur Municipal Corporation also updated its Heat Action Plan in 2019 from the original plan developed in 2016, along with five neighboring districts. The HAP consists of heat mitigation measures in accordance with the guidelines issued by NDMA. Prior to the 2020 heat season, two out of seven municipal corporations in Maharashtra, Nagpur and Chandrapur, have implemented the mandatory Heat Action Plan, even as the country has recorded a spike in heatwave incidents. Nashik, Dhule, Jalgaon, Gondia and Wardha were yet to introduce the updated plan but several of these cities have earlier plans.²⁵ Maharashtra is also observing higher temperatures in coastal cities, such as Mumbai, Harnai, Dapoli, and Ratnagiri.²⁶

The Maharashtra State Disaster Management Authority, Maharashtra Disaster Management Unit, Maharashtra State Health Department, and local IMD office work closely together on public awareness and preparedness for the state. For example, Maharashtra developed a state-wide awareness campaign, using media, such as text messages, local television advertisements, pamphlets, hoardings, local newspapers, radio jingles, WhatsApp messages, among others.²⁷ The government is working to modify office and school timings, as well as working hours for rural workers to avoid the hottest time of day. Other efforts include providing drinking water at public transit locations, keeping markets closed in the afternoon, providing public shelters, equipping traffic police with cool jackets and helmets, sprinkling mist at public places and keeping ice bags available at public health centers. Long-term measures include town planning to reduce heat vulnerability with afforestation, plantation drives, rainwater harvesting, providing shelter for traffic police, using green nets for shade in market areas and strengthening inter-sectoral coordination. The city of Pune also announced plans for a cool roofs initiative in 2019.

19 Times of India, "IMD warns of extreme weather conditions in Andhra Pradesh during summer," timesofindia.indiatimes.com/city/visakhapatnam/imd-warns-of-extreme-weather-conditions-in-ap-during-summer/articleshow/74430548.cms (Accessed May 1, 2020).
20 Andhra Pradesh Heat Wave Action Plan 2019, apsdma.ap.gov.in/latestupdate_pdfs/heatwave/March2019/Heat%20wave%20Action%20plan%202019.pdf (Accessed May 1, 2020).
21 Jaiswal, A, Preparing for the heat: Indian Cities", 2018. nrdc.org/experts/anjali-jaiswal/preparing-heat-indian-cities [NDMA Workshop Presentation] (Accessed 28 May 2019).
22 NDMA, Notes from National Workshop on "Preparedness, Mitigation & Management of Heat Wave 2020," December 5-6, 2019.
23 Indian Express, "Maharashtra, other states to follow Ahmedabad's heat action plan now," indianexpress.com/article/cities/pune/maharashtra-other-states-to-follow-ahmedabads-heat-action-plan-now-4590265/ (Accessed May 5, 2020).

24 NDMA, Notes from National Workshop on "Preparedness, Mitigation & Management of Heat Wave 2020," December 5-6, 2019.
25 Indian Express, "Maharashtra: As civic bodies sit on Heat Action Plan, heatwave cases on the rise," indianexpress.com/article/cities/pune/pune-civic-bodies-sit-on-heat-action-plan-heatwave-cases-on-the-rise-6268894/ (Accessed May 5, 2020).
26 Communication with Maharashtra IMD office in Mumbai (May 2020).
27 Communication with Maharashtra IMD office in Mumbai (May 2020).



Picture: Kiosks set up to facilitate medical assistance during Heat Waves in Chandrapur (Left); A man takes a drink of water from a hydration station (Right). Image Credit: NRDC

→ KERALA

Learning from the unprecedented extreme temperatures in 2019, the Kerala State Disaster Management Authority (KSDMA) is planning to release the Kerala State Heat Action Plan 2020 this year.²⁸ The HAP will lay out guidelines and short- and long-term strategies for tackling heat-related incidents. It will list measures to be adopted by government departments and agencies, District Disaster Management Authorities and the public for tackling heat-related health issues in humans and animals. The HAP will define the roles and responsibilities of 24 concerned departments during summer. Threshold temperature conditions and longer-term weather forecasts will be made available to departments to alert the public under KSDMA's guidance.²⁹

→ ODISHA

Odisha continues as a pioneer in disaster preparedness in India from cyclones to heat waves. Building on its 2015 Heat Action Plan, the State Disaster Management Authority (OSDMA) tackles heat waves through an early warning system that considers both temperature and humidity levels to issue heat alerts.³⁰ A state-level preparatory meeting on heat wave management is held annually by the chief secretary and involves key departments and stakeholders. The Odisha District

28 The Hindu, "Heat action plan in the works for State," www.thehindu.com/news/national/kerala/heat-action-plan-in-the-works-for-state/article30958955.ece (Accessed May 5, 2020).

29 New Indian Express, "Kerala to install meters to monitor UV rays," www.newindianexpress.com/states/kerala/2020/feb/23/kerala-to-install-meters-to-monitor-uv-rays-2107253.html (Accessed May 5, 2020).

30 OSDMA, Heat Action Plan 2020 for Odisha, osdma.org/preparedness/one-stop-risk-management-system/heat-wave/ (Accessed May 1, 2020).

Disaster Management Authorities holds periodic meetings for monitoring heat preparedness and response.

OSDMA issues directives to key departments to prepare and take precautionary measures and disseminates alerts and warnings to institutions and the public once they are received from IMD. OSDMA coordinates awareness campaigns and information, education and communication (IEC) actions. Temperature forecasts and heat alerts are sent as bulk messages on mobile phones, including to the media for wider broadcast. Electronic screens at busy traffic intersections and market places display warnings and heat information. Odisha has also developed a website and a mobile phone app that provides heat alerts and helps users identify, via maps, heat shelters and drinking water sources along highways. To build capacity in among healthcare workers, Odisha has set up dedicated sections in hospitals to provide treatment for heat-related illness and increased staffing during heat alerts. OSDMA also facilitates capacity building for stakeholders and involves civil society organizations for activities.³¹

OSDMA conducts studies to identify threshold temperatures for different cities and regions in the state.³² Given Odisha's distinct geophysical region, it is important to determine region-specific thresholds that combine temperature and humidity, which together cause heat wave related morbidity and consequent mortality. According to OSDMA, there is also the need to assess community vulnerability and then to design preparedness and cooling strategies.

31 NDMA, Notes from National Workshop on "Preparedness, Mitigation & Management of Heat Wave 2020," December 5-6, 2019.

32 Dutta, A., et al. "At which temperature do the deleterious effects of ambient heat 'kick-in' to affect all-cause mortality?" *International Journal of Environmental Health Research*, 30(2), doi.org/10.1080/09603123.2019.1587389

→ CITY AND DISTRICT LEADERSHIP

In addition to state and national efforts, heat action plans led by city officials are vital in protecting local communities. City leaders have a clear mandate to protect residents and are effective in communicating with citizens. Municipal corporations can design programs better tailored to their communities as well as provide early planning, coordination, capacity building, surveillance and longer-term measures to combat the heat island effect and climate change. City leaders are often charged with issuing “heat alerts” in association with a color-coded early warning system developed specifically for the city, while the IMD issue “heat wave warnings” that are more climatology-based than health-based. IMD looks to city and regional governments to issue more health communication-based “heat alerts” and to use the forecasts to strengthen heat resilience.

→ AHMEDABAD

Ahmedabad has been the leading city in India for its work on building resilience against extreme heat. Its 2015 Heat Action Plan serves as a template for many cities and states across India, and internationally. Future actions

on reducing heat-health risk include adopting cool roofs technology and a Carbon Neutral Plan for all buildings. In 2020, Ahmedabad, led by the city health department continues to implement its HAP and is planning innovative heat interventions.³³ Some activities are being modified, given the COVID-19 pandemic. To support the overall plan, Ahmedabad is strengthening pre-season and regular meteorology forecasts and dissemination by adding temperature and humidity to the early warning system and inter-agency coordination activities.

To ramp up the earlier pilot programs, the Ahmedabad Municipal Corporation (AMC) is planning to launch a larger “Heat Exposure and Promoting Adaptive Measures” initiative under which: all AMC buildings (over 1000, in total) will adopt cool roofs technology; about 15,000 “slums and slum like” buildings are to adopt cool roofs technology; AMC will plant 500,000 trees annually between 2020 and 2025, to reduce the urban heat island effect; and solar panels will be installed on AMC buildings to reduce direct exposure to heat. Ahmedabad started the cool roofs efforts for the 2020 heat season in February 2020; however, given the COVID-19 pandemic effort have been curtailed.

33 NDMA, Notes from National Workshop on “Preparedness, Mitigation & Management of Heat Wave 2020,” December 5-6, 2019.



Picture: Passers-by rest near a bus-stop in Ahmedabad, with a hydration station in the background. Image Credit: NRDC

For awareness and community outreach, the AMC distributes Information, Education and Communication (IEC) materials, including Ahmedabad HAP pamphlets to vulnerable sections of the population (2000 per urban healthcare center); develop and disseminate materials for cool roofs; put up flex banners and stickers at construction sites and Anganwadis locations; and install billboards/hoardings. The AMC conducts sensitization workshops for vulnerable sections of its population. The heat advisories and IECs are regularly circulated in electronic media. Ahmedabad City Heat Awareness Day is to be celebrated on May 1st annually, but again was put on hold given the heightened COVID-19 response. The estate department plans to set up drinking water stations across the city, as well as to work with construction companies to establish and maintain drinking water stations through the heat season.

→ NAGPUR REGION

Nagpur formulated its HAP in 2016. Through the leadership of the Maharashtra State Public Health Department and Nagpur Municipal Corporation, the Nagpur Regional HAP was coordinated between Nagpur and four neighboring cities, creating the first regional approach to heat wave planning in India.³⁴ Nagpur and Chandrapur are located in the eastern part of Maharashtra, where the state that experiences extreme heat during summer. Here, summer months are extremely dry and arid, with day temperatures ranging between 45°C (113°F) and 48°C (118°F), making it one of the hottest regions in India.³⁵

Citizens are actively involved with the HAP and have carried out awareness marches and information sessions. Part of the Nagpur Regional HAPs also identify particularly vulnerable populations, such as children and elderly. These cities are also using social media platforms, such as WhatsApp to spread awareness and document the actions taken. Nagpur has been acknowledged by the Department of Science and Technology under the National Mission on Strategic Knowledge for Climate Change for the development and testing of a robust and scientific Heat Action Plan. Under this initiative, an innovative

approach will be incorporated into the city's existing HAP.³⁶ In 2019 the Nagpur Maha Metro have launched a “Heat Action Plan” under which the metro workers can take a rest to help avoid illness and casualties due to heatstroke; and all contractors working under the Nagpur Metro Rail Project have been instructed not to work between 12 pm and 4 pm through the month of May.³⁷



Picture: A pedestrian uses a mobile hydration station in Chandrapur, Maharashtra. Image Credit: NRDC

34 Huff Post, “A Tale Of Three Cities: Heat Action Plans Combat Soaring Mercury,” www.huffingtonpost.in/anjali-jaiswal/a-tale-of-three-cities-he_1_b_10216614.html (Accessed May 5, 2020).

35 Indian Express, “Maharashtra: As civic bodies sit on Heat Action Plan, heatwave cases on the rise,” indianexpress.com/article/cities/pune/pune-civic-bodies-sit-on-heat-action-plan-heatwave-cases-on-the-rise-6268894/ (Accessed May 5, 2020).

36 Indian Express, “Here Comes The Sun,” indianexpress.com/article/opinion/columns/heatwave-summer-temperature-weather-5765412/ (Accessed May 5, 2020).

37 The Live Nagpur, “Nagpur Maha Metro’s ‘Heat Action Plan’ for workers to avoid casualties,” thelivenagpur.com/2019/04/30/nagpur-maha-metros-heat-action-plan-for-workers-to-avoid-casualties/ (Accessed May 5, 2020).

GUJARAT AND TELANGANA - COOL ROOFS

As part of their heat resilience efforts, the cities of Ahmedabad in Gujarat and Hyderabad in Telangana are ramping up cool roof programs. Cool roofs reflect sunlight and absorb less heat. Depending on the setting, cool roofs can help keep indoor temperatures lower by 2 to 3°C (3.6 - 5°F) as compared to traditional roofs. Cool roofs can cost as little as Rs. 1.5 (~\$0.02) per square foot for a simple lime-based paint, to more expensive reflective coatings or membranes.

Building on their pilot cool roof programs in 2017 and 2018, Ahmedabad and Hyderabad have painted over 3,000 roofs in slum communities. Both cities are launching larger cool roofs programs. Telangana incorporated cool roofs as part of the Telangana Municipalities Act 2019.³⁸ A draft “Telangana State Cool Roofs Policy” is awaiting formal adoption but has been delayed as COVID-19 response efforts take priority.³⁹ Ahmedabad started its 2020 efforts with cool roof installations, aiming for 15,000 cool roofs this year including government buildings and low-income housing, but the COVID-19 pandemic has delayed progress currently.⁴⁰ In addition, local groups, such as the Mahila Housing SEWA Trust (MHT) have programs in Ahmedabad and elsewhere to install cool roofs.

At the national level, the Indian Cooling Action Plan (ICAP) released in 2019 focuses on reducing the demand for air conditioning with cool roofs as a major solution. Cool roofs help keep temperatures cooler and reduce energy costs. Cool roofs are also critical in limiting air conditioner use, which limits the urban heat island effect, carbon dioxide emissions and emissions of hydrofluorocarbon (HFC) super pollutants.

38 Telangana Municipalities Act 2019, <https://cdma.telangana.gov.in/pdfs/Municipaliteis%20Act-English.pdf> (Accessed May 20, 2020).

39 Available at, https://tsredco.telangana.gov.in/PDFs/Telangana_Cool_Roofs_Policy_for_Public_Comments.pdf Deccan Chronicle, “Telangana State Government to Provide Cool Roof for Denizens” (2019) <https://www.deccanchronicle.com/nation/current-affairs/071119/telangana-state-government-to-provide-cool-roof-for-denizens.html> (Accessed May 20, 2020); Discussing with MAUD (May 2020).

40 Discussion with AMC staff in preparing for 2020 heat season (February, March, April 2020).

KEY ELEMENTS - HAPs

An effective heat action plan requires a combination of strong local leadership, interagency coordination, scientific expertise, broad communication strategies, and community engagement. Locally-developed plans are the most effective; one size does not fit all. Yet, the heat action plans in India have common features that are important to protecting communities from extreme heat. The five core elements are:

1. COMMUNITY OUTREACH TO BUILD PUBLIC AWARENESS

- Locally-developed and scientifically-supported IEC pamphlets, hoardings/billboards, and videos to inform people on how to protect themselves from extreme heat.
- Social media channels, bulk text messages, emails, radio and mobile applications such as WhatsApp, aiming to reach the public.
- Special efforts to reach vulnerable populations through focused sessions and direct communication by health care professionals in local clinics, ambulance service, and urban health centers.

2. EARLY WARNING SYSTEMS AND INTER-AGENCY COORDINATION

- Early warning systems (at yellow, orange, red levels corresponding to increasing heat levels) trigger joint response by relevant city and state authorities during extreme heat and alerts residents.
- Formal communication channels to alert state and city government agencies, including health officials and hospitals, emergency responders, local community groups, media outlets and other key stakeholders – with an identified “nodal” officer.
- Standard Operating Procedures (SOPs) for activities before, during and after heat season for each department to successfully implement a HAP that identify and define responsibilities of government departments.

Temperature Thresholds and Heat Warning Triggers

A key component to successfully activating and implementing heat-health early warning systems are locally developed temperature thresholds. Local temperature thresholds are the triggers for cities to initiate early warning systems. Thresholds also trigger a set of coordinated actions for stakeholders based on the early warning systems. Cities and states using local thresholds have a better understanding of the temperature that corresponds to a level of heat beyond which people are likely to face adverse health effects, if they do not take adequate precautionary measures. This approach provides the authorities an opportunity to prepare and respond better to extreme heat episodes.

Thresholds are developed based on local temperatures and calculated using either a mortality and temperature-based approach or a percentile-based approach.

Mortality and Temperature Based Threshold Approach

This approach requires both heat and mortality data. It involves obtaining long term (10-15 years) daily mortality data, if possible, for the summer months from the city administration and analyzing correlation with daily maximum temperature observations. Historical temperature data is available from the IMD; the local authorities responsible for developing thresholds can request data access from IMD regional centres.

Mortality data can often be obtained from city medical department or local medical colleges. To activate early warning systems, some cities in India have developed thresholds using the mortality and temperature approach, including Ahmedabad (see figure below) and Nagpur. Mortality and temperature-based

thresholds can be challenging to establish as few cities in India have publicly available long-term records of daily mortality data.

Alert Category	Alert Name	Temperature Threshold (°C)
Yellow Alert	Hot Day Advisory	41.1 °C – 43 °C
Orange Alert	Heat Alert Day	43.1 °C – 44.9 °C
Red Alert	Extreme Heat Alert Day	≥ 45 °C
White	No Alert	≤41°C

Figure 1: Temperature thresholds developed by the Ahmedabad Municipal Corporation for issuing heat alerts (Taken from Ahmedabad HAP 2016)

Percentile-Based Threshold Approach

The unavailability of daily mortality or other health outcome data can hinder the calculation of temperature-mortality based thresholds and thus impede development and implementation of early warning systems. In these situations, where meteorological information is available but sufficient health data is not, a percentile-based threshold (90th, 95th, 99th) based on local temperature data can be used as a warning trigger value that captures the relative severity of observed temperatures.

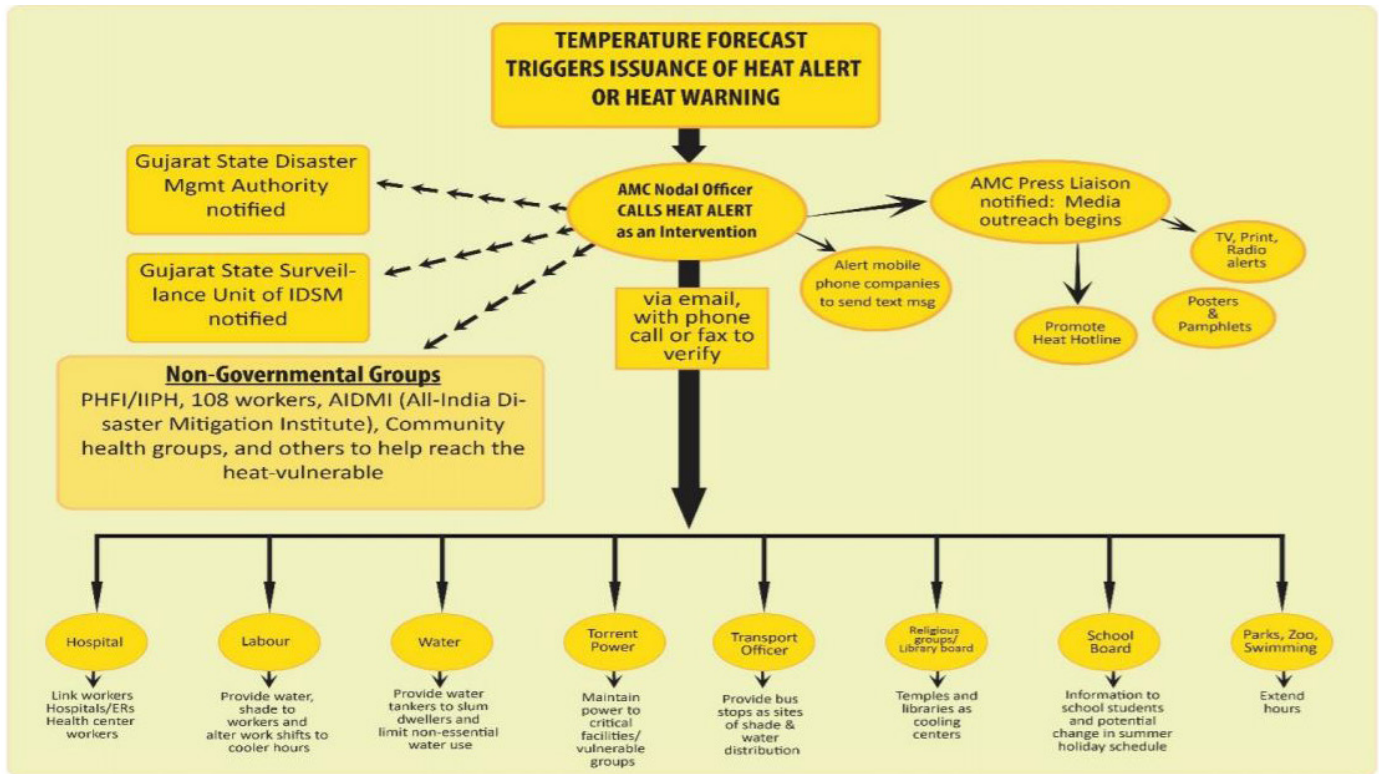
NDMA, in its 2017 Heat Action Guidelines, recommends considering a percentile-based threshold (using 90th, 95th, 99th percentile temperatures) as a warning trigger value where climate and weather data are available but not reliable daily health data. The percentile method is relevant for India and can help in a number of cities, smaller urban centres, and rural areas that lack adequate mortality data to determine local health-relevant temperature thresholds.

3. CAPACITY BUILDING AMONG HEALTHCARE PROFESSIONALS

- Special training modules for health staff in urban health centers.
- Training programs for private general medical practitioners to equip first responders with knowledge of effective diagnosis and first-aid treatment for heat-related illnesses.
- List of “Do’s and Don’ts” with help of local health professionals and disseminate to public through effective use of various media (print and social media, radio stations, TV ads).

4. ADDRESSING VULNERABLE GROUPS

- Focused efforts, such as awareness and drinking water, for children, elderly people, people exposed to prolonged periods of extreme heat due to their profession (e.g. construction workers, farmers, traffic police), who are more vulnerable to extreme heat.
- Affordable space cooling solutions and health care for vulnerable groups.
- Adaptive measures, such as cool roofs for vulnerable communities.



5. IMPLEMENTING ADAPTIVE MEASURES

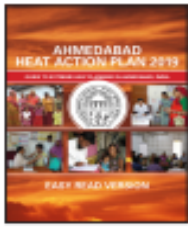
- Communication on response methods, including drinking water, cooling centers, gardens, and shade spaces during extreme heat days.
- Land use strategies to reduce the urban heat island effect, including green infrastructure, cool roofs, tree and vegetation, and increasing green spaces.
- Streamlining traffic and congestion reduction policies and strategies.

Sample Pamphlet: New Delhi Heat Wave Advisory developed by NDMC and IRADe

ONLINE RESOURCES

Heat Action Plan and Research Materials are available at:

<https://www.nrdc.org/resources/rising-temperatures-deadly-threat-preparing-communities-india-extreme-heat-events>



Ahmedabad's Heat Action Plan



City Resilience Toolkit: Response to Deadly Heat Waves and Preparing for Rising Temperatures (Includes How-to-Manual)



Inside Story: Addressing heat related health risks in urban India: Ahmedabad's Heat Action Plan



Cool Roofs: Preventing Local Communities from Extreme Heat



Guidelines for Preparation of Action Plan – Prevention and Management of Heat-Wave 2017

CUTTING EDGE SCIENTIFIC RESEARCH AND JOURNAL ARTICLES



International Journal of Environmental Research and Public Health: A Cross-Sectional, Randomized Cluster Sample Survey of Household Vulnerability to Extreme Heat among Slum Dwellers in Ahmedabad, India (June 2013)



International Journal of Environmental Research and Public Health: Development and Implementation of South Asia's First Heat-Health Action Plan in Ahmedabad (Gujarat, India) (January 2014)



Journal of Environmental and Public Health: Neonates in Ahmedabad, India, during the 2010 Heat Wave: A Climate Change Adaptation Study (January 2014)



PlosOne: Heat-Related Mortality in India: Excess All-Cause Mortality Associated with the 2010 Ahmedabad Heat Wave (March 2014)



Rising Temperatures, Deadly Threat: Series of Four Issue Briefs of Recommendations for Heat Adaptation in Ahmedabad



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