Heat action plans: Scaling up India's ambition to protect the climate-vulnerable

About this Guide

- Heatwaves may not conjure the powerful imagery of a flash flood or cyclone, but they can be damaging for society and dangerous - even deadly - for vulnerable individuals. However, reducing this risk is within the grasp of city authorities, and cities and states in India are leading the way in taking effective action.

- This CDKN Guide presents the story of how an action research initiative in a single city in India has evolved into contagious policy action in 17 cities and 11 states, with interest from national leadership. By starting small and learning by doing, heat-wave planning and response has become increasingly ambitious in Ahmedabad, the capital of Gujarat state, and success there has had a strong demonstration effect.

- This Guide outlines what other cities can learn from this experience for tackling the heat risk and also for other urban challenges. It focuses on the factors that have enabled this success.

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Heat waves in India

In India, heat waves are common throughout the pre-monsoon hot season (April to June), with a long history of fatalities.[1] Extreme heat is often underestimated and under-reported as a disaster event – but records show that in the past decade heat waves were the second most deadly disaster event in India, after floods, claiming 3,547 known lives.[2] A major and well known heat wave occurred in the east coast state of Odisha (formerly Orissa) in 1998, with 2,042 recorded deaths; and major heat-wave events have also occurred in almost half of the intervening years.[3] In May 2015 alone, heat waves affected a large part of the country: estimates indicate that the hot weather claimed the lives of more than 2,300 people as temperatures rose to 5.5°C (9.9°F) above average for nearly two weeks, predominantly in the southern regions of Telangana and Andhra Pradesh.[4]

The heat threat

The threat from heat is multifaceted, including both direct and indirect socioeconomic impacts. The most significant impact is on health and mortality: heat waves cause health problems, including severe dehydration, heat stroke and, in the worst cases, death (see Box 1). The heat threat is exacerbated in urban areas due to heat-absorbent building materials, higher air pollution and a lack of vegetation, among other factors – a phenomenon known as the urban heat-island effect.

Box 1: How can heat kill?

Sustained exposure to extreme heat can overwhelm the body's ability to regulate its core temperature. The resulting heat stress can lead rapidly to heat exhaustion, severe dehydration and heat stroke, a form of hyperthermia. Extreme daily maximum temperature is not the only factor in the heat threat; the duration of a heat wave, persistence of high temperatures overnight (high daily minimums), high humidity and polluted air also play important roles. There is a widespread lack of awareness of the symptoms of heat stress, which can include headaches, vomiting, dizziness and low blood pressure, and as a result these symptoms are often mistaken for (and misreported as) other health issues such as stomach problems.[5] If the body's core temperature rises too high, the heart is no longer able to maintain adequate circulation, leading to unconsciousness and ultimately organ failure.[6]

Extreme heat has knock-on effects for local and national economies, as well as direct impacts on the built environment. Heat waves can lower productivity if people are too unwell or tired to work, and schools and workplaces may be forced to close temporarily.[7] For instance, during the 2015 Indian heat wave, taxi unions decided to shut down taxi services between 11 am and 4 pm following the deaths of two taxi drivers.[8] Heat waves can damage

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infrastructure such as roads and rail lines. The 2015 heat wave in Delhi, for example, 'melted' several roads.[9] Heat waves can also have direct impacts on temperature-sensitive sectors such as livestock and agriculture. In the 2015 heat wave, across India 17 million chickens died within a month, with major implications for the poultry sector and corn producers, and causing the cost of chicken to jump by 35%.[10]

The impacts of heat waves are not felt equally across the population. Factors that increase vulnerability to heat waves include physical exertion in hot conditions, poor-quality housing, limited access to clean water and electricity (for cooling), old age and the presence of underlying health conditions, and low mobility and social isolation, while young children are also at higher risk.[11] Therefore, factors such as occupation and gender norms play a role in determining who is most at risk. In Indian cities, street vendors, traffic police, construction workers and others performing physical labour outdoors during the hottest hours of the day, and people living in slums, are particularly exposed and vulnerable to heat waves. Cultural norms can also influence heat risk: in neighbouring southern Pakistan, for example, the fact that the 2015 heat season coincided with Ramadan is thought to have been a contributing factor to the over 1,250 heat-related deaths recorded.[12]

Heat-related deaths are not confined to developing countries: in the USA, for example, there were more than 7,400 known

Box 2: Climate change and heat waves

Thursday 19 May 2016 saw the highest temperature ever recorded in India, at 51°C (124°F) in the city of Phalodi in Rajasthan. Other cities, including Jaipur and Delhi, also experienced very high temperatures. Mercifully, this hottest day occurred during a relatively short, one-day heat-wave event, but still it claimed the lives of at least 40 people across Gujarat, Madhya Pradesh and Rajasthan. Evidence from the Raising Risk Awareness project, which examined this heat wave in 2016, found no detectable link between climate change and heat events of this magnitude to date.[13]

The scientists involved in this analysis found that natural climate variability was to blame for this extreme heat event. Nevertheless, heat extremes and heat waves are on the rise around the world, and scientists have linked this trend to human-induced climate change.[14]

The number of extremely hot days has been increasing steadily across much of the world in recent decades, and this trend looks set to continue, with climate models projecting that extreme heat increases are likely across much of the globe.[15] The IPCC's special report on extreme events found that it is very likely that the length, frequency and/or intensity of heat waves will increase across most continents: a 1-in-20-year hottest day is likely to become a 1-in-2-year event by the end of the 21st century in most regions.[16] In India, under a business-as-usual greenhouse gas scenario, models clearly indicate that there will be a slight increase in the intensity of heat waves but large increases in the number of heat-wave days – and therefore longer periods above extreme heat thresholds – across much more of northern and central India, and also in the southern regions, which historically are less prone to heat events.[17]

heat-related deaths between 1999 and 2012.[18] The deadliest (and most studied) heat wave in recorded history took the lives of an estimated 70,000 people across Europe in 2003.[19]

City responses

Heat waves are predictable hazards and preventable disasters. In India, the government is rapidly waking up to the risks posed by extreme heat and the relative ease and cost-effectiveness of protecting citizens – and cities and states are leading the way.

The city of Ahmedabad has been at the forefront. Action was first taken by the city authorities after research showed that a severe heat wave, which had caught the city unaware in 2010, had taken the lives of an estimated 1,344 people in Ahmedabad – calculated as the number of excess deaths when compared with a reference period.[20] This figure is much higher than the 47 deaths officially reported at the time by the city authorities.[21] A partnership formed between the Natural Resources Defense Council (NRDC), Ahmedabad Municipal Corporation (AMC), and the Public Health Foundation of India and the Indian Institute of Public Health-Gandhinagar (PHFI-IIPHG) (hereafter collectively known as 'the consortium') led to the development and implementation in 2013 of South Asia's first Heat Action Plan, for Ahmedabad.[22] The Heat Action Plan is underpinned by research identifying local heat risks and thresholds, the most at-risk groups, and cost-effective heat prevention strategies to be prioritised for implementation by the city authorities, conducted by the consortium with funding from CDKN.

In 2013 AMC implemented the highest-priority actions in the Heat Action Plan with an initial investment of around US$60,000, and appointed a nodal officer to oversee implementation and coordinate agencies in the event of a heat wave. Updated versions of the plan have been launched and implemented in each hot season since. Evaluations between 2013 and 2015 indicate that these efforts are already working: heat-related casualties in Ahmedabad were low during a major 2015 heat wave that claimed the lives of thousands of people elsewhere across India.

Experience in Ahmedabad clearly shows that tackling the threat from heat waves is urgent, feasible and cost-effective. The city-led approach for developing a Heat Action Plan has caught on in other cities, which in turn has inspired state-level action and national-level leadership. Following Ahmedabad's example, leading cities include Surat (also in Gujarat), Nagpur (Maharashtra), Hyderabad (Telangana), and Vijayawada and Amaravati (both in Andhra Pradesh), while state-level action began with Gujarat, Maharashtra, Odisha and Telangana.[24] By June 2017, some 17 cities and 11 states had released, or were developing, their own Heat Action Plan.[25]

Watch the documentary film about Ahmedabad's life-saving Heat Action Plan – 'Beat the heat: Saving lives with heat action planning in South Asia': www.youtube.com/watch?v=_Icr07IJlKs

NRDC and PHFI-IIPHG have continued to support this process, including through direct support to some cities, but this degree of scaling up has been possible due to the leadership of the Indian Meteorological Department (IMD), the Indian Meteorological Society and the National Disaster Management Authority (see Figure 1).

Figure 1: Cities and states in India that have adopted or are developing Heat Action Plans[26]

HARYANA

DELHI

UTTAR PRADESH
Rahat

BIHAR

GUJARAT
Ahmedabad
Rajkot
Surat

JHARKHAND
Hazaribagh

ODISHA
Bhubaneswar
Puri
Koraput
Baleshwar

MAHARASHTRA
Nagpur
Gondia
Chandrapur
Nanded
Akola
Jalgaon

TELANGANA
Hyderabad

ANDHRA PRADESH
Vijaywada/Amravati

KARNATAKA

In each state, the authorities have coordinated with a range of national, regional and local partners, including key state departments, urban local bodies and civil society organisations, and have been supported by leadership from IMD. Each state has tailored the model and state-level leadership according to its own circumstances.

To support heat action across India, IMD in collaboration with regional meteorological centres now provides five-day forecasts of daily maximum temperatures to over 300 cities, expanding from 100 in 2016 (and none prior to Ahmedabad's pioneering Heat Action Plan).[32] Ahead of warnings from IMD that the 2017 summer could be the warmest since 1901, cities and states launched their 2017 plans early in the year. For example, around US$160,000 was allocated for implementation of the Andhra Pradesh 2017 Heat Action Plan.[33]

CDKN supported this process for over four years between 2012 and 2016. This began with the action-research initiative that led to Ahmedabad's original Heat Action Plan, which was awarded funding through an open research call, followed by support for scaling up, initially in Nagpur, Surat and Bhubaneswar. CDKN has recently also supported a similar process in Karachi, Pakistan.

"These regional heat preparedness and disaster-response activities together represent a growing movement to respond to climate threats with strong adaptation strategies that connect and empower vulnerable communities and ultimately save lives," said Kamal Lochan Mishra, an officer of the Odisha State Disaster Management Authority.

The Odisha Heat Action Plan focuses on poorer workers – such as employees of construction sites, brick kilns and stone-crushing units, who are required to perform physical labour during the hottest hours of the day – and aims to scale up and institutionalise protections.[34]

Success can be contagious

The experiences outlined above have shown that success can be contagious, producing a domino effect of action. There is much that can be learned from the Indian experience, both for addressing the heat risk and for tackling other challenges; former Ahmedabad Municipal Commissioner D. Thara described the heat action planning process as "a model for future adaptation efforts" more broadly.[35] We reflect below on the factors that have enabled this process.

Political will and leadership

Igniting a spark of political leadership was central to success. Prior to the commencement of the CDKN-funded research in Ahmedabad, the consortium invested time in working with the city authorities to encourage them to recognise heat as a threat, and one that they can tackle. The consortium shared preliminary research demonstrating the increased mortality during past heat-wave events, and examples of Heat Action Plans initiated by cities in other parts of the world, which could be adapted for Ahmedabad. This longer-term involvement and discussion built motivation and trust, which provided a vital foundation for political buy-in. Without it, the research is unlikely to have led to

the development and/or implementation of the Ahmedabad Heat Action Plan. Continued engagement has allowed momentum on heat action to build further.

Leadership has come from different places in different cities and states, due to the self-selecting, bottom-up nature of expansion and the relatively decentralised nature of Indian governance. This influences the degree to which heat risk has been integrated into the range of relevant policies and plans. For example, in Odisha, where the Heat Action Plan process is led by the Odisha State Disaster Management Authority (which has one of India's most advanced disaster management systems), the Heat Action Plan is directly connected to the State Disaster Management Plan, but this is not necessarily the case where health authorities

are leading. Similarly, Heat Action Plan processes led by cities tend not to be integrated into state-level policy. In any case, turning motivation into action is easier where cities and states have the autonomy to carry out initiatives, such as in Maharashtra and Odisha.

In Ahmedabad, political buy-in has been maintained throughout six changes of municipal commissioner over the course of the programme. Leadership from AMC has continued and strengthened, and over time heat action planning has increasingly become a normal activity for which AMC holds responsibility. Nevertheless, the breadth and depth of the partnership across the city working on this issue has helped to keep and build this momentum.

Generating political will and leadership remains the biggest challenge for rolling out the initiative countrywide. In any new context, whether at city or state level, a champion or anchor is needed to lead the initiative and to bring in other stakeholders. Outreach and relationship-building play a vital role in generating political will in new cities. However, the media have played a significant part in sparking interest, including local, national and international media in both English and local languages. This has helped to raise the profile of heat as a risk both to health and to the economy, while highlighting positive steps being taken by progressive cities and states to combat this risk, and linking this to the wider discussion. Media coverage in local languages has also been important for holding the government authorities accountable. Understanding the importance of media coverage in raising awareness of the heat risk and of heat action, the consortium involved media outlets in local workshops for Heat Action Plan agencies, bringing them in as part of the extended project team. The regular recurrence of severe heat waves in India since the original Heat Action Plan was put in place has also been a motivating factor, building political momentum for tackling this issue and keeping heat waves in the media.

The IMD has increasingly played a key leadership role in the expansion of heat planning across the country, collaborating with the Indian Meteorological Society to convene city, state and national health officials, in addition to civil society and other key sectors, to expand the Heat Action Plan process. They have also been pioneering new forecasting systems with the aim of supporting heat responses, issuing a 'Seasonal outlook for temperature for the hot weather season' from 2016, to warn officials and citizens about above-average temperatures.[36]

Small beginnings can lead to great success
The first Ahmedabad Heat Action Plan in 2013 prioritised a first phase of practical, affordable solutions to protect the most vulnerable, which could be implemented quickly by the city, helping to ensure that heat action moved off the page and into practice that summer. Rapid and visible benefits helped to galvanise political will to take heat action further. From this starting point, as momentum has built, the city has deepened implementation and broadened the reach of the Heat Action Plan to include more challenging and longer-term aspects of the heat problem. For instance, Ahmedabad's Heat Action Plan now works with additional sectors that employ vulnerable groups (such as the police and construction industry), and in 2017 includes a new citywide 'cool roofs' initiative aiming to reduce heat risk in vulnerable slum settlements.

Dr Tejas Shah, a health officer at AMC and lead officer of the Heat Action Plan, outlined measures taken in 2015 by AMC and other stakeholders to protect residents from extreme heat.

- Large billboards and banners with heat-preparedness messages were posted across the city, including in vulnerable slum areas, and at all government hospitals and urban health centres.

- More than 400,000 heat-preparedness handouts were distributed to citizens through link workers in urban health centres, focusing on slum and industrial areas.

- Meetings were held with medical officers in all zones to discuss the 2015 Heat Action Plan.

- Existing drinking water stations were identified, and more than 1,100 were installed around the city in collaboration with NGOs.

- The Estate Department ordered construction sites to provide labourers with drinking water and shelter, and a survey of water and shelter availability was conducted at all construction sites.

- Public gardens in all zones were kept open as cooling spaces, including gardens that were usually closed during the noon hour.

- Advisories were issued in all leading newspapers, electronic and radio media, to alert the public to forecast orange heat alert days.

- WhatsApp messages were sent to all AMC department groups, requesting them to advise citizens to avoid going outdoors in the afternoon before 4:30pm on extreme heat days, when possible.

- Departments such as water and electricity were instructed not to schedule maintenance or other interruptions to service delivery on extreme heat days.

- The labour and traffic police departments received guidance to ensure the safety of their workforces during extreme heat days.

- Regular follow-up with medical officers and government hospitals was conducted to ensure their preparedness for, and management of, heat-related illnesses.

- Daily reports of heat-related illness and deaths were monitored in all government hospitals. Similarly, daily all-cause deaths were monitored to ensure that any rise in heat-related mortality was not missed.

- Sensitisation and training-of-trainers workshops for NGOs working with vulnerable communities were held, with the help of IIPH and NRDC.

- The school summer vacation was extended so that students did not resume classes during persistent heat waves. Some schools shifted to morning classes to avoid the hottest part of the day.

White reflective roofs are already helping people in Ahmedabad's slums, like Meenaben (who goes by one name). Like many poor women in Ahmedabad, Meenaben works from home, sewing quilts and bedsheets. Meenaben told reporters that "we used to really suffer from the heat [during the hot season]. We could not sit inside, we could not work, people were falling sick. This year it has been so much better. The paint brought the temperature down by several degrees and I have been able to sit in my home, and do my work."[38]

To launch the cool roofs initiative in 2017, AMC led by example: Mayor Gautam Shah visited slums and himself began painting a roof with white reflective paint, which helped to spark the interest of local residents.[39] The initiative, which aimed to paint 500 roofs white, surpassed the goal to reach 3,000, supported by a team of volunteers and NGOs such as Mahila Housing Trust, and is already benefiting slum communities.[40] Of course, the tangible changes seen in Ahmedabad also inspired action elsewhere. By taking an incremental approach and building ambition year on year, the consortium has turned small beginnings into much greater success.

Partnerships and collaboration

Multiple layers of partnership and collaboration have been central to success at every stage. The initiative itself began with a partnership that formed at a Vibrant Gujarat summit,[41] where a memorandum of understanding was signed between the consortium partners to work together to advance heat preparedness in India. At city level, inter-agency coordination and communication is a central pillar of the Heat Action Plan process. The most essential partners in heat action planning are agencies responsible for health, disasters and temperature forecasting, and while any one of these agencies could tackle heat risks, they are much stronger together. Coordination is led by a nominated nodal officer, a role assigned to an individual already working for an agency with a relevant mandate for protection. Where they sit differs across cities depending on the lead agency, local administrative structure and other factors. For instance, in Ahmedabad the nodal officer is situated in the health department and nominated by the chief medical officer, while in Odisha the nodal officer is situated in the State Disaster Management Authority.

Meanwhile, vertical partnerships between city-, state- and national-level agencies, and horizontal lesson-sharing between cities, have driven the scaling up and scaling out of heat-wave action. Crucial partners for scaling up have been IMD, and the state disaster management authorities and health departments, which then partner with city officials. Within states such as Odisha, where multiple cities have been involved in the Heat Action Plan process, the regional approach has supported knowledge-sharing across neighbouring cities supported by shared state authorities, namely (in Odisha's case) the IIPH-Bhubaneswar and the Odisha State Disaster Management Authority.

City-to-city learning exchanges involving representatives from experienced and interested cities, including space for informal relationship-building, have been critical in helping to facilitate this scaling-up process. An initial workshop in April 2015, supported by CDKN, brought officials from cities where the PHFI already had a local presence together with the Ahmedabad partners, with the aim of inspiring further action and providing technical support to enable this to happen. It included Bhubaneswar (Odisha), Delhi (National Capital Territory), Hyderabad (Andhra Pradesh), Nagpur (Maharashtra) and Surat (Gujarat). Over three days the participants worked together through the city resilience toolkit[42] and its how-to manual. By the workshop's completion, ambition levels had risen: Maharashtra intended to develop city action plans for five other cities in addition to Nagpur; and Odisha similarly wished to work in three cities in addition to Bhubaneswar. Further exchanges have helped to roll out heat action to new cities and states, while international exchanges have enabled sharing of experience and lessons more widely; for instance, NRDC hosted a week-long, two-way international knowledge-exchange forum on heat health in September 2015 with delegations from India and New York. Informal networks have emerged from the city-to-city learning exchanges, for example through a WhatsApp group where partners share updates, photographs and experiences. PHFI-IIPHG and IMD have taken the lead in facilitating the Heat Action Plan process in new cities, and IMD is now taking this learning-exchange process forward to extend the reach of heat action.

Evidence and resources

Robust scientific research is the cornerstone of this initiative. Evidence of prior heat-wave mortality (e.g. Figure 2) enabled

NRDC and PHFI-IIPHG to make the case to AMC to partner with them to tackle heat risk in Ahmedabad, and the consortium's research into the heat risk in Ahmedabad directly informed the Heat Action Plan.

The evidence-building effort has continued in later phases of the initiative in Ahmedabad. Research conducted in collaboration with Ahmedabad's traffic police department in 2016, for example, sought to enhance understanding of the impact of high exposure to heat and pollutants experienced by traffic police, with a view to informing interventions to protect the occupationally exposed.[44] Research findings have been published in academic journals and in shorter, more accessible briefings.

In addition, the city resilience toolkit and how-to manual have been instrumental in the expansion of heat action. The toolkit has been used in city-to-city workshop exchanges to work through the process, and has also been picked up and shared by other cities to create their own action plans, for example in Telangana, where the consortium has not been involved in the state's Heat Action Plan process.

Weather and climate information

Vulnerability to extreme heat varies from region to region in India, necessitating heat-wave definitions that are equally versatile. States in the south that are historically less affected by heat waves tend to have lower tolerance for high temperatures; and those with large poor populations can be at higher risk in the future. In each city, tailoring a specific heat threshold for the city/region and local weather conditions is an important step in developing a Heat Action Plan. Experience from Ahmedabad

Figure 2: Temperatures and daily all-cause mortality associated with the 2010 Ahmedabad heat wave versus 2009-2011 reference period[43]
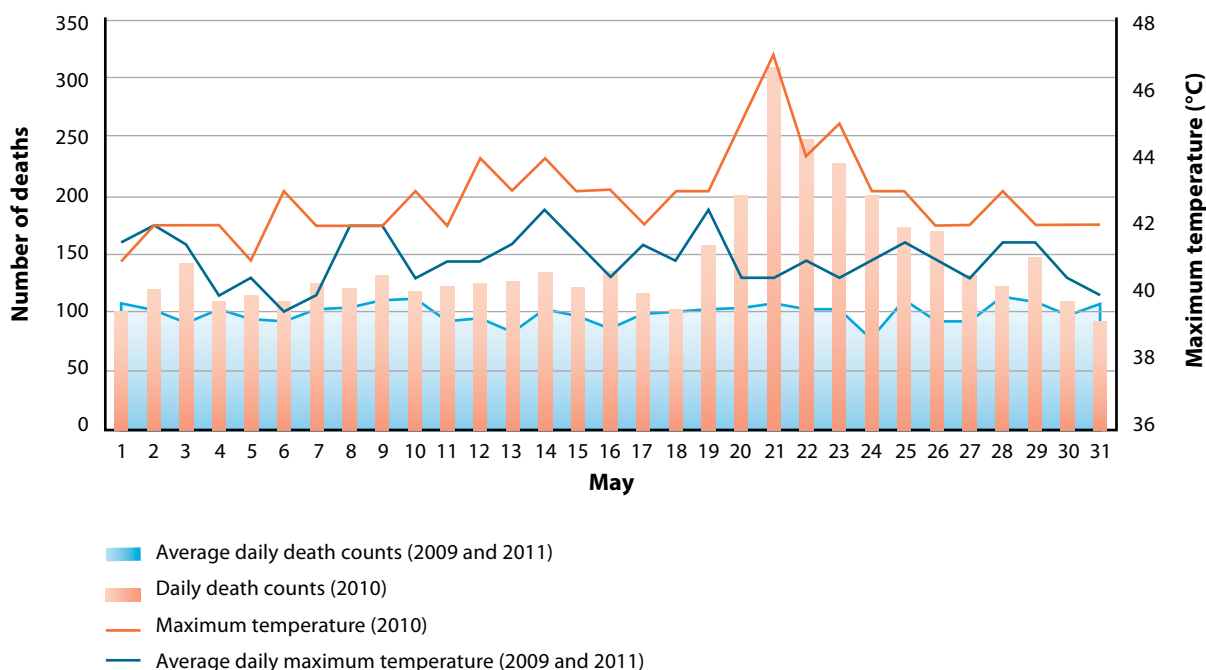
and other cities has shown that determining precise thresholds to one decimal place is not necessary. While the threshold needs to be accurate enough to ensure protections come into place during heat emergencies while avoiding false alarms, rounded estimates are sufficient. What is important is that thresholds exist to trigger the activities set out in the Heat Action Plan. In Maharashtra State, for example, the Nagpur region used 43°C for the orange (heat) alert threshold, and 45°C for the red (extreme heat) alert threshold. Without thresholds to trigger actions, governments do not take proactive measures to reduce heat risks, but only respond once people are already affected.

For the earlier Heat Action Plans such as Ahmedabad's, establishing the 'safe' temperature thresholds for the local population and environmental conditions required the correlation of past daily temperatures and mortality data over the pre-monsoon hot period. However, collecting the necessary data and developing thresholds in this way can take time. To address this, based on guidelines from the World Meteorological Organization and the World Health Organization, NRDC has developed a simpler percentile-based threshold system based purely on temperature data, which has been successfully tested for accuracy against the original process.[45]

The IMD is a crucial partner in driving forward heat-preparedness efforts across India, having taken steps over the past few years to support the development of heat thresholds and to make heat-wave prediction more accurate and accessible for Indian cities. Initially, in Ahmedabad, the heat threshold-setting process was led by civil society organisations with support from a US-based university, and there was a communication gap between IMD and cities. Now, IMD is working with local IMD offices to define thresholds for different cities – and these agencies have the technical knowledge and data needed for this process. The IMD now provides a five-day forecast to over 300 cities in India, enhancing cities' capacities to warn citizens and respond to impending heat waves. To achieve this, the central IMD in New Delhi is working with local meteorological offices to ensure the forecasting information they provide is suited to local needs. In March 2016, IMD issued its first 'seasonal outlook' warning, expecting a warmer-than-normal hot season.[46]

Flexibility, evaluation and learning by doing
Heat planning is still relatively new in India, and there is no perfect blueprint that works first time, or for every city. While actions and at-risk groups can be prioritised based on existing information and resources, these differ between cities and can change over time. Experimentation, flexibility and a process of evaluation and learning – sometimes known as adaptive governance or learning by doing – has helped to ensure that Heat Action Plans are as effective as possible, year on year, as well as deepening and expanding implementation.

The Ahmedabad Heat Action Plan is now in its fifth year of implementation, while those in several other cities are now in their second year. In Ahmedabad, the coalition holds a stakeholder-evaluation workshop every year following the hot season to gather lessons and feedback from the government and from non-governmental agencies involved in its delivery, and recommendations are integrated into the following year's Heat Action Plan. For example, feedback from the 2014 experience in Ahmedabad led to an enhanced focus in 2015 on vulnerable groups in the city, including primary schools ('teaching the teachers' and tree planting around schools to provide more shade), and a step up of the use of radio in communicating heat-protection tips and heat-wave warnings. In 2016, Ahmedabad focused special attention on the city's traffic police, who are especially vulnerable as they are under the raw heat all day. A similar process of evaluation and learning is also being followed in other cities.

Where next?

Heat preparedness in India is no longer a technical problem. There is widespread acceptance that heat is a threat, and with IMD involved, city authorities are armed with the data they need to prepare for and respond to heat waves. The challenge now – rolling out heat action country- or region-wide – is one of politics and leadership. The IMD is exploring ways to further scale up and scale out heat preparedness across the country, with the support of partners, including NRDC and PHFI-IIPHG. With momentum building year on year, it seems likely that more cities will take steps to protect their citizens during the hot seasons to come.

The fourth pillar of the Heat Action Plans – reducing future heat-health risks through urban planning and adaptation measures – presents a larger, longer-term challenge, but also an opportunity. India is in the process of an urban transformation: the country's urban population currently stands at around 420 million (33% of its total population) and by 2050 is expected to almost double to 800 million.[48] Decisions taken over the next decade will lock in the urban pathway for many years to come.

Many of the urban heat-adaptation measures outlined in the city resilience toolkit are relatively low-cost, and provide other health and/or climate change mitigation co-benefits that can

Box 7: Ahmedabad's Air Information and Response Plan

The effectiveness of the Heat Action Plan in raising awareness and reducing heat-related illness and deaths has led city officials in Ahmedabad to pilot a similar programme to fight air pollution. The Air Information and Response (AIR) Plan, launched in May 2017, is a collaborative effort between AMC, IIPHG, NRDC, the Indian Institute of Tropical Meteorology, and IMD's System of Air Quality and Weather Forecasting and Research (SAFAR) network. Modelled on the Heat Action Plan process, it creates a colour-coded air-quality index that measures daily pollution levels, and an early warning system alerting people to days when air quality is likely to reach 'very poor' or 'severe' levels. Activities suggested for when the AIR warning is triggered include promoting the use of public transport and masks, limiting burning, and increasing hospital and community health-worker staffing. In addition, the AIR Plan appoints a dedicated nodal officer; promotes interagency coordination, public awareness and capacity-building among medical professionals; and initiates research on ways to reduce local air pollution and exposure. To implement this pilot phase, AMC has set aside a budget of Rs30 lakh (approximately US$45,000).[47]

address other immediate concerns of both municipal governments and citizens, providing added incentives for action. For example, Indian cities, including Delhi, are among the most polluted in the world, and schools and construction sites across the capital were closed for three days in November 2016 during a government-declared emergency.[49] Heat-adaptation measures such as city forestation and greening, and policies to reduce traffic and pollution, would address this high-profile urban health problem while also contributing to climate change mitigation efforts. While most cities already implementing urban heat mitigation strategies are in the global north, Ahmedabad and the other cities pioneering Heat Action Plans in India are well positioned to lead the way in South Asia.

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Acknowledgements

Contact

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The Climate and Development Knowledge Network (CDKN) aims to help decision-makers in developing countries design and deliver climate compatible development. We do this by providing demand-led research and technical assistance and channelling the best available knowledge on climate change and development to support policy processes at country level.

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