Rising Temperatures, Deadly Threat:
Recommendations for Slum Communities in Ahmedabad

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The Ahmedabad Municipal Corporation (AMC) is the municipal governing body of Ahmedabad, responsible for the city's civic infrastructure and administration. Led by its mayor and commissioner, AMC has pioneered the development of heat vulnerability reduction strategies and an early warning system for extreme heat events to protect its residents.
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www.phfi.org
Key researchers and authors: Dr. Dileep Mavalankar, Dr. Gulrez Shah Azhar, Amruta Sarma, Ajit Rajiva, Nilesh Thube, Hem Dholakia

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Key researchers and authors: Dr. Jeremy Hess, Kathy Van Tran

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INTRODUCTION

Higher daily peak temperatures and longer, more intense heat waves are becoming increasingly frequent globally due to climate change.[1] Extreme heat events already have had a significant impact in India, where summer temperatures are historically high. In the city of Ahmedabad, the poorer communities are particularly at risk to heat waves' destructive impact. Residents of slum communities are more exposed to extreme heat and more susceptible to heat's effects on health, and they have fewer adaptation options available. Targeted policy interventions on multiple levels are needed to reduce the devastating health effects of heat stress in India and increase resilience in local communities to rising temperatures.

Through the Ahmedabad Municipal Corporation (AMC), Ahmedabad is leading as the first Indian city to create a comprehensive early warning system and preparedness plan for extreme heat events. The Indian Institute of Public Health (IIPH), Public Health Foundation of India (PHFI), Natural Resources Defense Council (NRDC), Mount Sinai School of Medicine, and Rollins School of Public Health at Emory University have partnered with the AMC to protect and prepare Ahmedabad for extreme heat events. This brief is one of four published to provide specific recommendations for leading stakeholders and the most vulnerable residents who will be impacted by extreme heat: key government agencies, health care professionals, outdoor workers, and slum communities.

Ahmedabad Snapshot

One of India's fastest-growing cities, Ahmedabad is the economic center of the state of Gujarat. The Ahmedabad district, including the surrounding suburban and rural areas, is home to 7.2 million people.[2] Ahmedabad is predicted to be one of the world's 19 fastest-growing urban areas in the coming decade, according to *Forbes* magazine.[3]

The city is located in the arid northwest region of India, where warm, dry conditions are conducive to heat waves. While summer is defined as spanning March, April, and May, Ahmedabad's hottest temperatures can run from March through June, with temperatures generally peaking in May and warm days through November.[4] Ahmedabad's average monthly maximum summer temperature from March through June is 38.8°C (101.8°F); in winter, November through February, the average monthly high is 28°C (82°F). The average monthly minimum temperature is 24°C (75°F) in the summertime and 15°C (59°F) in the winter.[5] Temperature peaks in Ahmedabad can be extreme, as experienced during the May 2010 heat wave when the temperature spiked to 46.8°C (116° F).

REDUCING EXTREME HEAT VULNERABILITY IN AHMEDABAD

During the historic May 2010 heat wave in Ahmedabad, temperatures reached 46.8°C (116°F). Estimated daily mortality rates increased substantially during the heat wave.[6] IIPH and NRDC are further investigating this extreme heat period to better understand its effects on the health of Ahmedabad's population. With climate change fueling higher temperatures in Ahmedabad and elsewhere, a new scale of coordinated action among municipal and other government agencies is needed to address and prevent the harmful health effects of heat stress. It is critical to first identify which populations are most vulnerable to extreme heat, including their places of residence and work. It is also necessary to identify and prioritize policies and programs to address current and projected future health risks. In addition to these assessment steps, creating and maintaining collaborative systems within the different government departments (e.g., emergency response, emergency management, health agencies, and meteorological services) is essential to ensure streamlined coordination of existing services, create successful early warning communications, promote data sharing and health education, and identify service gaps, as a foundation for an effective early warning system before extreme heat events.

Heat Stress Symptoms and Impacts

Extreme heat can lead to dangerous, even deadly, health consequences.

Signs and symptoms of heat-related illnesses include:[7]

- Heat cramps, edema (swelling), and syncope (fainting). These conditions are accompanied by fevers generally under 39°C (102°F) and are readily treatable; however, they are important warning signs to immediately move the affected individual to a cool location and provide first aid.

- Heat exhaustion, which is marked by fatigue, weakness, dizziness, headaches, nausea, vomiting, muscle cramps, and sweating.

- Heatstroke, defined as a core body temperature of 40°C (104°F) or greater, with the presence of altered mental status such as delirium, seizures, or coma. It can be fatal.

Severe long-term health impacts of heatstroke include:

- Renal insufficiency, kidney failure, and malfunction.
- Neurological defects, headaches, and blurred vision.
- Cardiac ailments, chest pain, and heart attacks.
- Increased mortality risk for years following heatstroke for those who survive.

Scientific Methodology for Summer 2011 Heat-Health Assessment

An assessment of slum communities was conducted in the summer of 2011 by IIPH and as part of a master's degree thesis by Kathy Tran (advised by Dr. Jeremy Hess), a student at Emory University's Rollins School of Public Health. The study was done in collaboration with Mount Sinai School of Medicine and NRDC after a March 2011 heat and health vulnerability workshop with local and state officials in Gujarat. The survey used a clustered randomized sampling to identify target households located in 13 urban slum communities in Ahmedabad, since slum residents were identified by local public health authorities as having greater susceptibility and less resilience to extreme heat exposure. The study focused on factors that affect heat exposure, susceptibility to heat-related illness, and adaptive capacity, all of which feed into heat vulnerability. Indicators of these factors were identified through literature review and expert opinion, and characterized via a cross-sectional household survey. Survey topics included demographics, occupational conditions, housing conditions that might confer heat exposure, coping methods, access to heat/health information, and social connectedness. Three hundred respondents (primarily female heads of household) provided information on behalf of their households, providing information for a total of 1,650 individuals.

SLUM COMMUNITIES' VULNERABILITY TO EXTREME HEAT

In the city of Ahmedabad, slum communities have greater exposure to extreme heat, and residents are more susceptible to its negative health effects.[8] Compounding this is the fact that the almost two million Ahmedabad residents living in slums have fewer options available to adapt to rising temperatures. All of these factors increase vulnerability to heat and result in greater impacts on these communities.[9] Identifying the specific factors that increase exposure and vulnerability to extreme heat is necessary to craft targeted recommendations for building resilience to future heat events.[10]

- **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 tarp roofs, and their communities lack trees and shade.

- **Greater Susceptibility to Health Effects of Extreme Heat:** A lack of accessible water, poor sanitation, crowding, malnutrition, and a high prevalence of chronic medical conditions 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 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.

What Defines a Heat Wave in Ahmedabad?

The Met Centre currently determines whether to declare a heat wave once the daily maximum temperature exceeds 40°C (104°F).[11] A heat wave is declared if the normal maximum temperature should be 40°C or lower and the forecast maximum temperature is actually 5°C to 6°C above normal; it is also declared if the forecast maximum is higher than 45°C (113°F) regardless of the normal maximum. A severe heat wave is declared if the forecast maximum temperature is 7°C higher than the normal maximum.[12] A heat wave is forecast 48 hours in advance and can be declared for a single day.[13]

Summer 2011 survey administrator and respondents in Ahmedabad

Ahmedabad resident in her home kitchen, August 2011

An assessment of slum communities in Ahmedabad conducted during the summer of 2011 identified specific factors that affect heat exposure, susceptibility to heat-related illness, and adaptive capacity, all of which add to vulnerability to heat (see text box, "Scientific Methodology for Summer 2011 Heat-Health Assessment," on previous page). The following challenges specific to Ahmedabad's slum communities make people living there more vulnerable to extreme heat and hamper efforts to protect residents' health:[14]

- **Poverty:** The average slum resident in Ahmedabad lives in poverty. This lack of income results in less access to potable water, modern sanitation, reliable transportation, and medical care.

- **Drinking Water Access:** Most residents have limited or unreliable access to water. During periods of "alternate-day supply," when water is delivered only once every two days, fights over water may occur. Some residents purchase their water jugs on a monthly basis and therefore drink less to conserve it. And some water that is consumed may not be potable, making residents sick and exacerbating dehydration and susceptibility to heat stress.

- **Housing:** A host of factors stemming from typical housing in slum neighborhoods increase vulnerability to extreme heat.

  - Heat-trapping building materials—such as tin roofs, asbestos, plastic coverings, PVC tarps, and bricks— increase temperatures inside homes and reduce the ability for residents to cool down.

  - Cooking stoves and/or open fires are usually located in a room that serves multiple purposes, such as living room/ kitchen, often with poor ventilation, thus exposing all family members to increased heat.

  - Crowding and a lack of open space within slum neighborhoods;

  - Unreliable electricity supply, for those residents who can afford power;

  - Lack of greenery and shade around slums, including trees and parks, which increases the heat island effect; and

  - Lack of access to cool spaces such as buildings with mechanical air-conditioning.

- **Access to Information:** Households that lack access to information about impending heat waves and heat-related illnesses, or who do not seek out such information, could have limited opportunity to prepare for extreme heat events or change their behavior in anticipation of them.[15] The daily temperature is not currently made widely available in public spaces by the government or other groups. Tips on how to stay cool and protect communities during a heat wave—beyond traditional measures—are not currently disseminated to slum communities by the government or by health groups.

- **Age and Pre-existing Conditions:** The elderly and children are generally more vulnerable to the health impacts of heat. Also, the odds of heat-related illnesses increase by more than 50 percent for slum residents with pre-existing chronic, diarrheal, or infectious conditions.[16]

- **Occupations:** Working in the direct sun greatly increases the odds of heat-related illness. Nearly 90 percent of employed slum residents surveyed work outdoors during the summer.[17] These workers have little control over their work environment, including the degree of safety and protection from exposure to hazards. Such work often involves construction or other heavy labor, which exacerbates an individual's heat stress.

- **Perception of Risk:** High temperatures are generally not considered a health risk among Ahmedabad's residents. As a result, many slum residents overlook minor ailments and do not see a doctor for heat-related symptoms and illnesses.[18]

Ahmedabad survey participants, August 2011

Typical roof materials in an Ahmedabad slum, March 2012

BUILDING RESILIENCE TO EXTREME HEAT WITHIN SLUM COMMUNITIES

Coordinated early action by government, health care, and community stakeholders to prepare for heat-health vulnerability is one of the most effective ways to build resilience and protect human health.[19] Based on IIPH and NRDC's research and analysis with partners in Ahmedabad over the past two years, we have identified the following strategies to prepare residents of Ahmedabad's slum communities for increasing temperatures.

Ahmedabad Municipal Corporation (AMC) Actions

Ahmedabad's municipal government has a leading role in developing an early heat warning system and helping its vulnerable residents adapt to rising heat. The related Issue Brief regarding the role of Ahmedabad's local government offers comprehensive policy recommendations for stakeholders to enact an effective early heat warning system citywide. To achieve the goal of protecting slum residents from extreme heat, some vital strategies include communicating early heat warnings, delivering heat and health information, and providing cooling opportunities through water supply and shaded locations.

Communication strategies:

■ *Temperature and Forecast Displays:* Working with the Meteorological Center, Ahmedabad could publicly display temperature and weather forecasts so people could plan to avoid unessential travel or work on the hottest predicted days. Priority should be given to high-traffic locations where many people can view the information, and to highly vulnerable sites where the possibility of the heat island effect is magnified due to lack of trees, dense vehicle traffic, large amounts of paved area, and local heat-generating sources.

■ *Early Heat Warnings:* Ahmedabad can identify community leaders and neighborhood "gatekeepers" to disseminate heat warnings and information in slums. When extreme heat is forecast, these trusted individuals could help activate community networks to spread the word, warning slum residents and also providing information on how individuals can protect themselves during a heat wave. AMC and partner stakeholders can promote and coordinate public service announcements via television, radio, newspapers, and text messages, ideally at least two to five days before heat waves are forecasted.

■ *Media Information Campaigns:* AMC can work with local press and media outlets to kick off a media campaign to deliver important health and heat information. This media campaign can focus on newspapers, radio, and television outlets, which should be encouraged to provide low- or no-cost space for public interest announcements. These campaigns could include tips on how to stay cool, how to prevent getting sick from heat, and what to do in the event of extreme heat advisories. Telephone companies can also play an important role in sending text messages as alerts.

■ *Informational Pamphlets:* AMC can work with the Health Department to create pamphlets on heat-related illness prevention in English, Gujarati, and Hindi to distribute to hospital staff, labor unions and professional associations serving at-risk occupations, community groups (with a focus on slum neighborhoods), and schools.[20] An initial pamphlet for the general public with tips and illustrations on how to keep cool was circulated in English and Gujarati during Ahmedabad's hottest months in 2012 (see Figure 1).

- *Heat-Line Call Center:* Ahmedabad can create a free "heat line" call center to support the public during heat waves and publicize this service within slum communities. The heat line could have an information system to provide response to heat stroke victims and tips on heat stress prevention. The Meteorological Centre currently has an emergency service number to call for temperature information, but it is not widely operational.

- *Assessing Heat-Vulnerable Communities:* AMC can identify the most heat-vulnerable neighborhoods, including slum communities, by assessing heat risk factors such as high numbers of elderly residents, limited daily water service, and a high incidence of heat-related illness during extreme heat events. Then the government can prioritize these locations for educational outreach by link workers and implementation of measures to reduce heat vulnerability. Records of interventions could be kept, and evaluations could be conducted to determine what strategies are effective and what needs improvement.

Cooling opportunities:

- *Public Access to Potable Water:* AMC can provide safe drinking water fountains, preferably with cold water, and additional potable water supply using tankers during summer and during heat waves, in slums and at nearby bus stops. The government can work with the Ahmedabad Municipal Corporation Water Project Department to commit tankers solely to deliver drinking water to ensure no other materials compromise the safety of the drinking water.

- *Public Access to Cool Places:* Slum residents' access to places to cool off throughout the city can be increased. Currently, most parks, lakes, swimming pools, public libraries, shopping malls, and Bus Rapid Transit System (BRTS) routes are concentrated in the northwest part of Ahmedabad. These areas are not easily accessible to the poorer populations because they are not located near slum communities. Cooling spaces could be provided throughout the city in locations close to slum communities. For example, the AMC currently runs 40 overnight homeless shelters whose hours could be extended, or additional shelters could be opened to increase the number of cooling places.

Ahmedabad residents carrying potable water, July 2012

Ahmedabad resident staying in the shade, July 2012

- *Public Parks:* The city's primary public parks, including Law Garden, Anandnagar, Vastrapur Lake, Kankaria, and Atira, are gated but are open late into the evening. Additional public parks, near slum neighborhoods, could be created to provide cool resting spaces for slum residents.

- *Shaded Bus Shelters with Drinking Water:* Ahmedabad Municipal Transport Services or civil society organizations could install shaded bus shelters that protect slum residents and other passengers from the heat, and extend bus routes eastward where more vulnerable slum populations reside. Potable drinking water could be provided at local bus shelters during heat waves as well.

- *Community Resources Map:* The Ahmedabad Urban Development Authority (AUDA) could create a map of community resources near slums, including public parks and other green spaces, health centers and hospitals, homeless shelters, temples, BRTS routes, and public libraries, to increase awareness of extreme heat safety resources and adaptation strategies.

- *City Greening Campaigns:* The AMC can complete the urban tree canopy inventory, and publish the 2012 tree census. This documentation of the number and types of trees can inform the expansion of canopy cover and urban green space—particularly in slum neighborhoods—to help alleviate the impacts of extreme heat on vulnerable populations.[21] Starting in 2010, the AMC organized one of the world's largest tree planting drives to counter the negative effects of climate change. More than 29,000 people planted 848,301 saplings in 400 preselected sites, and 500,000 seedlings were distributed throughout Ahmedabad. Residents could adopt a tree nurturing campaign to maintain the planted trees, which should provide shade as they grow.[22]

- *Cool Roofs or White Roofs Initiative:* Urban planners can launch programs such as a cool roofs initiative to paint roofs white or cover them with tiles, create green roofs and walls, and plant trees in and around slum neighborhoods to keep them cool.[23] Incentive mechanisms can be implemented to accelerate green urban planning initiatives. A strategy to evaluate the efficacy of these efforts and the highest-priority locations for intervention could help target limited resources.

Occupational strategies:

- *Outdoor Laborer Education:* The Ahmedabad Labour and Employment Department can work with the AMC to educate laborers and workers whose occupations require intensive work outdoors during extreme heat events (e.g., rickshaw drivers, street vendors, traffic police, construction workers, and kiln and quarry workers). Local businesses can be incentivized to provide fans and cool water to occupationally at-risk workers, shift work hours to cooler times of day, and organize training and educational workshops to enable workers to recognize and react to extreme heat.[24] To limit occupational exposure during heat waves, employers could recommend that unessential travel or work be avoided on the hottest predicted days.

- *Labor Law Compliance:* The relevant labor departments can increase the number of government officials and inspectors overseeing construction sites, quarries, factories and other vulnerable worksites where slum residents work, particularly during high temperature periods, to enforce labor laws related to heat safety.

- *Cooling Incentives for Local Businesses:* The AMC can create incentives and requirements for local businesses employing outdoor workers, particularly slum residents, to provide cool water, shade, and rest periods.

Health Worker Actions

The AMC is responsible for 64 outdoor urban health centers and 26 city hospitals that serve the health care needs of Ahmedabad residents. Approximately 1,100 link workers are also employed by the AMC to provide direct health care assistance to about two million Ahmedabad residents, most of them living in slums, for whom hospitals and clinics are financially and geographically out of reach.[25] The related Issue Brief regarding the role of Ahmedabad's health care sector offers comprehensive policy recommendations for stakeholders, but the following strategies address public health officials' capacity to deliver heat warnings, disseminate heat-related health information, and perform preventive health measures for vulnerable residents.

Communication strategies:

■ *Heat Wave Warnings:* Public health officials and link workers could caution all patients about potential health effects of high temperatures at the start of and during the summer.

■ *Heat Illness Prevention Tips:* Tips for staying cool and preventing heat illness could be posted at urban health centers. Link workers could distribute informational pamphlets and verbal or other audio messages in slum communities.

■ *Link Worker and Community Health Worker Outreach:* Link workers and community health workers could be educated about heat danger and prevention of heat-related illness during their training; there is currently no training on heat hazards. These workers could then raise awareness within slum communities by communicating health effects, heat-related symptoms, and tips for keeping cool, during their routine rounds in communities. Link workers could also encourage neighbors in slum communities to check on each other during heat waves, and they could train community leaders to help the elderly and children during heat waves.

Preventive Measures:

■ *Heat-focused Examination Procedures:* Examination of hospitalized patients for signs and symptoms of heat-related illnesses could become routine, adding a brief procedure during the peak-heat summer months at a minimum. The basic statistics of such patients should also be recorded to identify the locations, occupations, and sociodemographics of Ahmedabad's residents most vulnerable to heat stress and illness.

■ *Maternity Education:* Doctors can ensure that women in maternity wards, particularly in hospitals near slum communities, are educated on the specific dangers of heat stress to mothers and children, and how to prevent heat illness.

Ahmedabad residents working in the shade, July 2012

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Rickshaw driver in Ahmedabad, March 2012

© Meredith Connolly

■ *Increased Staffing Capacity During Heat Waves:* To handle the influx of patients during heat waves, hospitals near slums could adopt staffing plans and protocols that increase capacity during extreme heat events. Such a hospital staffing protocol could be modeled on the Rapid Response Teams (RRTs) organized through the Integrated Disease Surveillance Program (IDSP) to respond to disease outbreaks.

■ *Special Control Rooms:* The mandate and capacity of the special control rooms that have been created as central round-the-clock offices where residents can report issues and receive help during monsoon season can be extended to control rooms dedicated to relief during heat waves, particularly near slum communities.
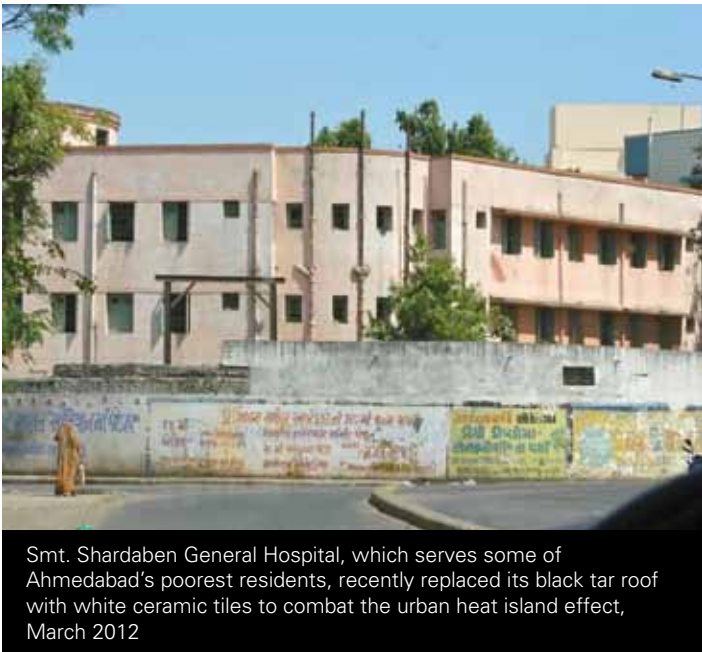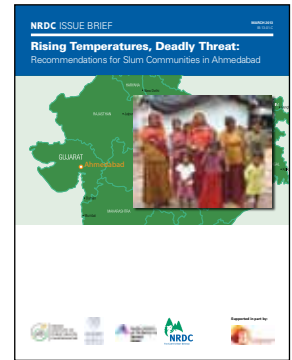
Smt. Shardaben General Hospital, which serves some of Ahmedabad's poorest residents, recently replaced its black tar roof with white ceramic tiles to combat the urban heat island effect, March 2012

CONCLUSION

Extreme heat events in the arid northwest region of India already have had a deadly impact on Ahmedabad's population. Residents of slum communities are more exposed to extreme heat, are more susceptible to heat's effects on health, and have fewer adaptation options available. With peak daily temperatures and the frequency and intensity of heat waves predicted to increase with climate change, targeted policy interventions coordinated across multiple levels are needed to reduce the devastating health effects of heat stress in India. Under the Ahmedabad Municipal Corporation, Ahmedabad is leading as the first Indian city to create a comprehensive early warning system and preparedness plan for extreme heat events, but more remains to be done. This report's recommendations aim to increase the resilience of the city's vulnerable slum populations to rising temperatures. Looking ahead, these extreme heat adaptation strategies can be adjusted for other at-risk regions within and beyond India, helping to protect people from the increasingly severe effects of climate change.

Endnotes

1   Intergovernmental Panel on Climate Change, "Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation," March 8, 2012. www.ipcc-wg2.gov/SREX/.

2   Government of India. Census of India 2011: Provisional Population Totals, Ranking of Population Districts, 2001–2011. Census of India website, Office of the Registrar General & Census Commissioner, India. www.censusindia.gov.in/2011-prov-results/prov_data_products_gujarat.html.

3   Kotkin, Joel. "The World's Fastest-Growing Cities," *Forbes*, October 7, 2010. www.forbes.com/2010/10/07/cities-china-chicago-opinions-columnists-joel-kotkin.html.

4   Maps of India. "Weather and Climate in Ahmedabad." www.mapsofahmedabad.com/general-information/weather.html.

5   Hong Kong Observatory, Climatological Information for Ahmedabad, India. www.hko.gov.hk/wxinfo/climat/world/eng/asia/india/ahmedabad_e.htm. Weatherbase.com, Weather for Ahmadabad, India. www.weatherbase.com/weather/weatherall.php3?s=74624&refer=&units=metric&cityname=Ahmedabad-Bihar-India.

6   Calculations based on Ahmedabad's daily mortality data during May 2010, received by IIPH and NRDC from the AMC.

7   Oklahoma State University, Environmental Health & Safety. "Safety Training: Heat Stress." www.ehs.okstate.edu/training/Heat.htm.

8   The Government of India defines a slum as "any compact housing cluster or settlement of at least 20 households with a collection of poorly built tenements which are mostly temporary in nature with inadequate sanitary [and] drinking water facilities and unhygienic conditions." See Aarti Dhar, "New Definition for Slums," *The Hindu*, September 4, 2010. www.hindu.com/2010/09/04/stories/2010090463881300.htm.

9   Tran, Kathy. "Assessing Vulnerability to Extreme Heat Among Residents of Urban Slums in Ahmedabad, India" (master's thesis, Rollins School of Public Health, Emory University, 2012), p. 5. http://pid.emory.edu/ark:/25593/br127.

10   Ibid.

11   India Meteorological Department, Terminologies and Glossary. www.imd.gov.in/doc/termglossary.pdf.

12   In seasons when normal maximum temperature exceeds 40º C, a heat wave is declared upon a departure from the normal maximum of 4ºC to 5ºC. If the forecast maximum temperature is 6º C (or more) higher than the normal maximum, a severe heat wave is declared. For additional information, contact: Director Meteorological Centre, RS/RW Building, Airport Colony, Ahmedabad; Toll free number:1-800-180-1717; email: mcahm@rediffmail.com.

13   Discussion at the Heat-Health Roundtable with representatives from the Met Centre, NHL Municipal Medical College, Health and Family Welfare Department, IIPH, and NRDC, Ahmedabad, September 2012.

14   See Tran, Kathy. "Assessing Vulnerability to Extreme Heat Among Residents of Urban Slums in Ahmedabad, India," (master's thesis, Rollins School of Public Health, Emory University, 2012). http://pid.emory.edu/ark:/25593/br127

15   However, all surveyed households reported hearing of extreme heat warnings during summer 2011, with 53 percent hearing from other people and 46 percent being notified through media sources (primarily TV, with newspapers ranking second). Ibid.

16   Ibid.

17   Ibid.

18   This unrecognized risk persists despite the fact that nearly all households reported that seeing a doctor was convenient. See ibid.

19   Ebi, Kris, and Knowlton, Kim. Summary of presentation, March 2011 Kickoff Workshop, Ahmedabad, India. Workshop presentation data included in IIPH, NRDC report, "Climate Change and Health Preparedness in India: Protecting Local Communities in Ahmedabad, Gujarat From Extreme Heat," March 2012. www.nrdc.org/international/india/india-health-report.asp.

20   Providing written materials raises literacy issues. Developing alternative approaches to communicate with the illiterate population warrants further discussion, but the issue is beyond the scope of this report.

21   "Enumerators Take Stock of Ahmedabad's Green Quotient," *DNA India*, February 6, 2012. www.dnaindia.com/india/report_enumerators-take-stock-of-ahmedabad-s-green-quotient_1646508.

22   Green Ahmedabad Campaign. gujaratforest.org/Portal/News/4_1_green-ahd-campaign.pdf.

23   For an example of another cool roof initiative, see New Delhi Municipal Council's program, rolled out in August 2012. Gupta, Geeta, "'Cool Roofs' Mandatory for All New Buildings," *The Indian Express*, August 16, 2012. www.indianexpress.com/news/-cool-roofs--mandatory-for-all-new-buildings/988898.

24   Fans should be installed with caution. If interior air temperatures are hotter than outdoors, using indoor fans without outside ventilation can harm health by creating a convection oven effect. See US EPA, "Excessive Heat Events Guidebook," EPA 430-B-06-005, Ofc of Atmospheric Programs, pp. 37-38 (Washington, D.C. 2006).

25   "AMC Link Workers Shout Slogans Against Civic Body, Held," *Daily News & Analysis*, October 12, 2011. www.dnaindia.com/india/report_amc-link-workers-shout-slogans-against-civic-body-held_1598719. "Link Workers' Issue May Prove Fatal for Anti-Malaria Drive," *Times of India* June 23, 2009. articles.timesofindia.indiatimes.com/2009-06-23/ahmedabad/28179904_1_anti-malaria-drive-workers-disease.

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