BUILDING CLIMATE RESILIENCE IN INDIAN CITIES WITH HEAT ACTION PLANS

Kim Knowlton, DrPH
NRDC Senior Scientist, Science Center Deputy Director
Assistant Clinical Professor, Environmental Health Sciences
Mailman School of Public Health, Columbia University

9 June 2016 – IRI Health & Climate Colloquium 2016
Why India?
Why Now?
NRDC India Initiative on Climate Change and Energy

**India: Areas NRDC works in**

- Clean Energy (efficiency & renewables)
- Climate Resilience
- Climate Policy
Ahmedabad’s Historic 2010 Heat Wave

Heat wave in city: Over 50 people dead already

TNM | May 28, 2010, 04:56 AM IST

AHMEDABAD: Four more people died of heat stroke in the city on Thursday. All of them were elderly people. With this the total death toll has risen to 51 in the city. At least three patients were brought to VS hospital while one death was recorded in LG hospital.
May 2010 Heat Wave Media Coverage

Courtesy of TV9 in Ahmedabad, May 2010.
First scientific workshop in March 2011 followed by MOU signed with IIPHG, AMC, NRDC USA

- PHFI-IIPH and NRDC entered into MOUs with the state of Gujarat and the city of Ahmedabad (AMC) for joint work on heat.
- PHFI-IIPH and NRDC hosted *Scientific Workshop on Climate Change and Heat-Health* in Ahmedabad to convene and mobilize 40+ relevant scientists, stakeholders, and partners around heat-health adaptation (March 2011)
- Preliminary studies commissioned to assess the situation on the ground in Ahmedabad
Ahmedabad Heat and Climate Study Group

- Natural Resources Defense Council (NRDC)
- Public Health Foundation of India
- Indian Institute of Public Health
- Ahmedabad Municipal Corporation
- Emory University
- Icahn School of Medicine at Mount Sinai
- Georgia Tech

Project Team at Ahmedabad Met Centre, March 2012
Slum Community
Heat Vulnerability Survey

300 slum households in cross-sectional survey using randomized multistage cluster sampling.

Associations between heat-related morbidity and vulnerability factors were identified using multivariate logistic regression (info on 1,650 individuals).

Key Findings – Slum communities, especially age 65+, are vulnerable to effects of heat and unaware of temperature-related health risks.
A Cross-Sectional, Randomized Cluster Sample Survey of Household Vulnerability to Extreme Heat among Slum Dwellers in Ahmedabad, India

Kathy V. Tran, Gulrez S. Azhar, Rajesh Nair, Kim Knowlton, Anjali Jaiswal, Perry Sheffield, Dileep Mavalankar and Jeremy Hess
Heat related admissions and mortality among newborns in Ahmedabad hospitals in 2010

During April - June 2010, 24 NICU admissions with high temperature without infection; versus 8 and 4 in 2009 and 2011, respectively

High neonatal mortality in NICU; maternity ward was on top floor and under black tar roof

As a response, maternity ward was moved to the ground floor in 2012

At 42°C, 64% [95% CI 3%, 89%] reduction in heat-related admissions after moving to lower floor
Additional Climate Adaptations

Shardaben General Hospital replaced black tar roof to cooler, white reflective, china mosaic.
Research Article

Neonates in Ahmedabad, India, during the 2010 Heat Wave: A Climate Change Adaptation Study

Khyati Kakkad,¹ Michelle L. Barzaga,² Sylvan Wallenstein,² Gulrez Shah Azhar,³,⁴ and Perry E. Sheffield²,⁴
Creating strong partnerships

Building capacity for health professionals; highlighting public outreach

Focus group discussing heat action plan strategies
Policy Papers: 4 NRDC Issue Briefs

Online: http://www.nrdc.org/international/india/extreme-heat-preparedness/

Azhar Shah et al., PlosONE 2014
Heat-Related Mortality in India: Excess All-Cause Mortality Associated with the 2010 Ahmedabad Heat Wave

Gulrez Shah Azhar1,2*, Dileep Mavalankar1,2, Amruta Nori-Sarma1,3, Ajit Rajiva1, Priya Dutta1, Anjali Jaiswal4, Perry Sheffield5, Kim Knowlton3,4, Jeremy J. Hess6,7, on behalf of the Ahmedabad HeatClimate Study Group†

1 Indian Institute of Public Health, Ahmedabad, Gujarat, India, 2 Public Health Foundation of India, New Delhi, India, 3 Columbia Mailman School of Public Health, New York, New York, United States of America, 4 Natural Resources Defense Council, New York, New York, United States of America, 5 Icahn School of Medicine at Mount Sinai, New York, New York, United States of America, 6 Department of Emergency Medicine, Emory University School of Medicine, Atlanta, Georgia, United States of America, 7 Department of Environmental Health, Emory University School of Public Health, Atlanta, Georgia, United States of America
Ahmedabad Heat Action Plan

Available online from:
Heat Action Plan’s Key Strategies

To achieve its overall goal of reducing heat-related health impacts and saving lives in the face of rising temperatures, the Plan primarily aims to implement three key strategies:

• Build public awareness about the health risks of heat waves through community outreach;
• Initiate an early warning system with a 7-day forecast that provides advance notice to the public about predicted high temperatures and impending heat waves; and
• Increase capacity among Ahmedabad’s health care professionals for treating people with heat-related illnesses.
Heat Action Plan Interventions – 1

Public Awareness & Community Outreach
March 2013: HAP posters on the streets of Ahmedabad.

Dec 2013: Community sensitization workshop in action.
• **Coordination and Communications**

  • AMC created *formal communication channels* to more efficiently communicate and respond during extreme heat events

  • AMC appointed a *nodal officer* who issues advance warnings and coordinates the Plan’s activities to improve communication within government and with the public ahead of extreme heat events

  • Capacity building and trainings for *health care professionals* to improve medical officers’ overall ability to recognize and respond to heat-related illnesses

  • Awareness-raising trainings and activities to improve *worker safety protocols* during heat waves

  • Community outreach and education through trainings and communication materials developed for health centers and schools to *increase resilience among vulnerable populations*
Heat Action Plan Interventions – 2
Heat Early Warning System:
Daily 7-day probabilistic forecasts by email from Georgia Tech

<table>
<thead>
<tr>
<th>Date</th>
<th>02-Jun</th>
<th>03-Jun</th>
<th>04-Jun</th>
<th>05-Jun</th>
<th>06-Jun</th>
<th>07-Jun</th>
<th>08-Jun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert Level</td>
<td>Orange</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Orange</td>
<td>Orange</td>
<td>Orange</td>
</tr>
<tr>
<td>Likelihood of Crossing Threshold</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Med</td>
</tr>
<tr>
<td>Maximum Temp (+/- 1 SD)</td>
<td>44.3°C (42.9-45.5)</td>
<td>46.1°C (44.7-47.5)</td>
<td>46.4°C (45.1-47.6)</td>
<td>45.8°C (44.0-47.4)</td>
<td>44.3°C (42.7-45.9)</td>
<td>43.8°C (42.6-45.2)</td>
<td>43.5°C (42.1-45.0)</td>
</tr>
<tr>
<td>Probability of &quot;Safe Day&quot;</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Probability of &quot;Hot Day&quot;</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td>6%</td>
<td>18%</td>
<td>33%</td>
</tr>
<tr>
<td>Probability of &quot;Very Hot Day&quot;</td>
<td>75%</td>
<td>16%</td>
<td>2%</td>
<td>16%</td>
<td>67%</td>
<td>71%</td>
<td>59%</td>
</tr>
<tr>
<td>Probability of &quot;Extreme Heat Day&quot;</td>
<td>20%</td>
<td>84%</td>
<td>98%</td>
<td>82%</td>
<td>27%</td>
<td>12%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Alert Levels:
- Safe: <41°C
- Hot: 41°C - 42.9°C
- Very Hot: 43°C - 44.9°C
- Extreme Heat: ≥45°C

Likelihood of Crossing Threshold:
- High: >75%
- Med: 50-75%
- Low: <50%
TEMPERATURE FORECAST TRIGGERS
ISSUANCE OF HEAT ALERT
OR HEAT WARNING

AMC Nodal Officer CALLS HEAT ALERT as an Intervention
via email, with phone call or fax to verify

AMC Press Liaison notified: Media outreach begins
Alert mobile phone companies to send text msg
Promote Heat Hotline
Posters & Pamphlets
TV, Print, Radio alerts

Gujarat State Disaster Mgmt Authority notified
Gujarat State Surveillance Unit of IDSM notified

Non-Governmental Groups
PHFI/IIPH, 108 workers, AIDMI (All-India Disaster Mitigation Institute), Community health groups, and others to help reach the heat-vulnerable

Link workers
Hospitals/ERs
Health center workers

Provide water, shade to workers and alter work shifts to cooler hours

Provide water tankers to slum dwellers and limit non-essential water use

Maintain power to critical facilities/vulnerable groups

Provide bus stops as sites of shade & water distribution

Temples and libraries as cooling centers

Information to school students and potential change in summer holiday schedule

Extend hours

Parks, Zoo, Swimming

Hospital
Labour
Water
Torrent Power
Transpont Officer
Religious Groups/Library Board
School Board

Provide water, shade to workers and alter work shifts to cooler hours
Provide water tankers to slum dwellers and limit non-essential water use
Maintain power to critical facilities/vulnerable groups
Provide bus stops as sites of shade & water distribution
Temples and libraries as cooling centers
Information to school students and potential change in summer holiday schedule
Extend hours
Opportunity for Steering Committee practice and discussion on what works well vs. what needs work

Committee members were each given a description of their roles and responsibilities

Talked through different Heat Alert scenarios re: ‘What would you would be doing in response?’

Committee played roles as if the scenario were happening in real life

Followed by discussion in small breakout groups & exit survey on experiences and suggestions
Expanding outreach – social media
### Heat Action Plan Intervention – 3

**Building Capacity in Health Sector**

<table>
<thead>
<tr>
<th>Heat Illness - Typical Presentations</th>
<th>Case Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical Entity</strong></td>
<td><strong>Age Range</strong></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Heat Exhaustion</strong></td>
<td>All, but frequently children</td>
</tr>
<tr>
<td><strong>Heat Cramps</strong></td>
<td>All</td>
</tr>
<tr>
<td><strong>Heat Exhaustion</strong></td>
<td>All</td>
</tr>
<tr>
<td><strong>Heat Syncope</strong></td>
<td>Typically adults</td>
</tr>
<tr>
<td><strong>Heat Stroke</strong></td>
<td>All</td>
</tr>
</tbody>
</table>
Development and Implementation of South Asia’s First Heat-Health Action Plan in Ahmedabad (Gujarat, India)

Kim Knowlton 1,2,3,*, Suhas P. Kulkarni 4, Gulrez Shah Azhar 3,5, Dileep Mavalankar 3,5, Anjali Jaiswal 1,3, Meredith Connolly 1,3, Amruta Nori-Sarma 2,3,5, Ajit Rajiva 3,5, Priya Dutta 3,5, Bhaskar Deol 1,3, Lauren Sanchez 1,3, Radhika Khosla 1,3, Peter J. Webster 6, Violeta E. Toma 6, Perry Sheffield 3,7, Jeremy J. Hess 3,8,9 and the Ahmedabad Heat and Climate Study Group 3
Historic May 2015 Heat Wave Across India

43-44°C = 109.4-111°F
45-47°C = 113-116.6°F
IMD now issues forecasts for ~300 large cities

Local Weather Report and Forecast For: Ahmedabad

Dated : Jul 09, 2015

Past 24 Hours Weather Data

<table>
<thead>
<tr>
<th>Maximum Temp (°C)</th>
<th>33.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departure from Normal(°C)</td>
<td>-2</td>
</tr>
<tr>
<td>Minimum Temp (°C)</td>
<td>27.7</td>
</tr>
<tr>
<td>Departure from Normal(°C)</td>
<td>2</td>
</tr>
<tr>
<td>24 Hours Rainfall (mm)</td>
<td>2</td>
</tr>
</tbody>
</table>

Todays Sunset (IST) | 19:29
Tommorows Sunrise (IST) | 06:01
Moonset (IST) | 13:11
Moonrise (IST) | 00:24

Today's Forecast: RAIN OR THUNDER SHOWER WOULD OCCUR.

<table>
<thead>
<tr>
<th>Date</th>
<th>Temperature (°C)</th>
<th>Weather Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>10-Jul</td>
<td>28.0</td>
<td>34.0</td>
</tr>
<tr>
<td>11-Jul</td>
<td>28.0</td>
<td>34.0</td>
</tr>
<tr>
<td>12-Jul</td>
<td>27.0</td>
<td>35.0</td>
</tr>
<tr>
<td>13-Jul</td>
<td>28.0</td>
<td>34.0</td>
</tr>
<tr>
<td>14-Jul</td>
<td>28.0</td>
<td>36.0</td>
</tr>
<tr>
<td>15-Jul</td>
<td>27.0</td>
<td>34.0</td>
</tr>
</tbody>
</table>
April 2015 Workshop for new cities developing HAPs
Where We Are Working

- NEW DELHI
- STATE OF MAHARASHTRA
  - Nagpur
  - Gondia
  - Chandrapur
  - Nanded
  - Akola
  - Jalgaon
- STATE OF ODISHA
  - Bhubaneswar
  - Puri
  - Koraput
  - Baleshwar
- AHMEDABAD
- SURAT
- MUMBAI
- HYDERABAD
- VIJAYAWADA/AMARAVATI

Heat Action Plans
- Heat Action Plans under Development
Where We Are Working

STATE OF MAHARASHTRA
Nagpur
Gondia
Chandrapur
Nanded
Akola
Jalgaon

STATE OF ODISHA
Bhubaneswar
Puri
Koraput
Baleshwar

NEW DELHI
AHMEDABAD
SURAT
MUMBAI
HYDERABAD
VIJAYAWADA/AMARAVATI

HEAT ACTION PLANS
HEAT ACTION PLANS UNDER DEVELOPMENT
2015: 7 million residents prepared for extreme heat through heat action plan

2020: 63+ million residents protected and prepared through heat action plan

- Ahmedabad Heat Action Plan (7 million)
- Nagpur Heat Action Plan (2.4 million)
- Surat Heat Action Plan (4.6 million)
- Hyderabad Heat Action Plan (9.5 million)
- Mumbai Heat Action Plan (22 million)

Delhi Heat Action Plan (16 million)

Population of Heat Resilient Cities

New Heat Action Plan
Among a cohort of 16 police, interviewer-administered survey on heat exposures, self-report symptoms, coping strategies, pre-existing vulnerabilities

Baseline survey & 3 follow-ups (every 2 weeks)

Temperature loggers worn around neck

Initial pilot findings: 50% of the participant reported that heat leads to:

- Absenteeism
- Irritation
- Diminished social life

More than 50% of the participants complained about insufficient water availability in the work place.

Apart from extreme temperature, other reported workplace stresses were Air Pollution, Noise and Standing position

Summer 2016: expanded Heat Survey among 40-45 Traffic Police Officers + adding an Air Pollution exposure assessment
Heat Action Plan – Communication and Engagement
India Initiative has accomplished a lot with very few people: Ahmedabad’s Heat Action Plan has become a model for other cities thanks to Partnerships, Coordination & Successful International Working Relationships. But there are still enormous opportunities and needs in India.
Thank you to Ahmedabad Heat & Climate Study Group, Climate Development Knowledge Network, Indo-US Science & Technology Forum, National Institutes of Health, and

to the people of Ahmedabad, 10 other cities and 2 regions in India

kknowlton@nrdc.org; kmk47@columbia.edu

http://www.nrddc.org/international/india/extreme-heat-preparedness/
THANK YOU