Ahmedabad Heat Action Plan case study: India

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Ahmedabad Heat & Climate Study Group
India is hot – but heat waves are not seriously taken

Climate change will bring in higher average temperature and more heat waves.

Yet heat stress is an understudied area of climate change

India has projected increases in air temperature of about 2-4 degrees by 2030

Until 2013, the Indian government and National Disaster Management Agency (NDMA) did not recognise that heat waves are a natural disaster

2015 heat waves – 2000+ deaths and lot of media coverage
In Ahmedabad (pop 6 m) Annual average of Maximum Temperatures have been increasing steadily over the past 30 years.

Graph data: HOTHAPS
First scientific workshop in March 2011 followed by MOU signed with IIPHG, AMC, NRDC USA

PHFI-IIPH and NRDC entered into Memoranda of Understanding (MOUs) with the state of Gujarat and the city of Ahmedabad (AMC) to formalize collaboration for joint research on heat.

PHFI-IIPH and NRDC hosted a **first scientific Workshop on climate change and Heat-health** in Ahmedabad to convene and mobilize relevant scientists, stakeholders, and partners in March 2011.

A number of **preliminary studies** were commissioned to assess the situation on the ground in Ahmedabad.
Analysis of temperature and mortality data of Ahmedabad.

2010 Heat wave in Ahmedabad – Temp. reached 47deg C on 21st May
2010 Heat wave – daily mortality compared to 2009 and 2011

310 deaths in one day!

Daily Death Counts Avg 2009&2011
Daily Death Counts 2010

May 2010
Heat related admissions and mortality among new-borns in Ahemdabad hospitals in 2010 – Dr Kakkad and Dr Sheffield worked

During April, May, and June 2010,

24 NICU admissions with high temp. without infection in newborns: versus 8 and 4 in 2009 and 2011, respectively

Increased NN mortality in hospital ward:

Possible cause - NICU because very hot as it was on top floor and under black tar covered roof.

As a solution, NICU was moved to the ground floor and the roof was replaced with a cool roof (china mosaic).
Slum Community Heat Vulnerability Survey

Method - 300 slum households surveyed – got info on total of 1,650 individuals

Key Findings – Slum communities are vulnerable to effects of heat and unaware of temperature and extreme heat dangerous.
Construction Worker Vulnerability Survey (HOTHAPS) – 319 workers from 5 sites around Ahmedabad

Key Findings –

- All construction workers work in extreme heat conditions (above ACGIH* standards)
- 10% hospitalized at least once during summer
- Awareness of heat health impact is low.

*American Conference of Governmental Industrial Hygienists
Vulnerability Survey of Various Occupational Groups -

Occupational Groups – Construction Workers, Kite Makers, Aggarbatti rollers, Pickers and Street Vendors (368 people)

Findings

- High prevalence of heat related illnesses (dehydration, exhaustion, headache, heavy thirst, body cramp)
- Increased core body temperature during hot days
- WBGT greater than ACGIH standards
- Awareness of heat stress and illnesses is minimal
Urban Heat Island Effect and impact of vegetation on local temperatures

<table>
<thead>
<tr>
<th></th>
<th>Dry (°C)</th>
<th>Globe (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation</td>
<td>43.8</td>
<td>57.7</td>
</tr>
<tr>
<td>No Vegetation</td>
<td>45.6</td>
<td>60.4</td>
</tr>
</tbody>
</table>

Our research shows the presence of a large urban heat island over Ahmedabad.

Differences between temperatures in hotspots and “official” IMD temperatures range from 1-3°C air temperature and up to 10°C globe temperature.

Areas with vegetation (esp. grass) are cooler by 2°C than those without.

More work is needed in this area. We aim to build a heat contour map to identify areas of particular vulnerability.

Plan was developed collaboratively by IIPHG, NRDC and AMC and other partners

Review of heat action plans of cities in the west

Review of data and evidence from Ahmedabad.

Series of meetings and workshops with key stakeholders,

Deciding temperature cut off levels

Identification of locally possible key actions

Writing of draft plan and dissemination

Ahmedabad Heat Action Plan 2013-refined in 2014 – Key activities

- Analysis of local data -2010 and setting cut-offs
- Appointment of **Nodal officers** at AMC and steering committee.
- **Public awareness** of the risks of extreme heat and actions to be taken – posters, hand bills, hoardings and field workers
- **Training of medical officers** and hospital staff for better management of heat illness - supplies to hospitals
- **Information network** to inform various departments.
- **Learning from international experiences** and best practices
- **Media engagement for public awareness**
- Created advance 7-day forecast for heat early warning system with help of CFAN center at Georgia tech. USA

Temperature Thresholds decided based on mortality rise

<table>
<thead>
<tr>
<th>Condition</th>
<th>Temperature Thresholds</th>
<th>Alert Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Alert (Cool Day)</td>
<td>&lt;41.0</td>
<td>White</td>
</tr>
<tr>
<td>Hot Day</td>
<td>41.0 – 42.9</td>
<td>Yellow</td>
</tr>
<tr>
<td>Heat Alert Day</td>
<td>43.0 – 44.9</td>
<td>Orange</td>
</tr>
<tr>
<td>Extreme Heat Alert Day</td>
<td>&gt;45.0</td>
<td>Red</td>
</tr>
</tbody>
</table>
7 day Early warning system & Inter-agency emergency response plan

### Monday 02 June 2014 - ORANGE ALERT LEVEL

<table>
<thead>
<tr>
<th>Forecast (01-Jun)</th>
<th>02-Jun</th>
<th>03-Jun</th>
<th>04-Jun</th>
<th>05-Jun</th>
<th>06-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>
</tr>
<tr>
<td>Food of Threshold</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Min Temp (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>
</tr>
<tr>
<td>Ability of Day&quot;</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Ability of Day&quot;</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Ability of Day&quot;</td>
<td>75%</td>
<td>16%</td>
<td>2%</td>
<td>16%</td>
<td>67%</td>
</tr>
<tr>
<td>Ability of Heat Day&quot;</td>
<td>20%</td>
<td>84%</td>
<td>98%</td>
<td>82%</td>
<td>27%</td>
</tr>
</tbody>
</table>

### Temperature forecast triggers issuance of heat alert or heat warning

- AMC Nodal Officer CALLS HEAT ALERT as an intervention
- Gujarat State Disaster Management Authority notified
- Gujarat State Surveillance Unit of IDSM notified

### Non-Governemental Groups
- PHFI/IPH, 108 workers, AIDMI (All-India Disaster Mitigation Institute), community health groups, and others to help reach the heat-vulnerable

### Alert mobile phone companies to send text message via email, with phone call or fax to verify
- Promote Heat Hotline

### Key Intervention Areas
- Hospital
- Labour
- Water
- Torrent Power
- Transport Officer
- Religious groups/library board
- School Board

### Likelihood of crossing threshold
- High > 75%
- Med 50 - 75%
- Low < 50%
Public Awareness, Community Outreach & training
## Planning cycle for the Heat action in summer of 2014

<table>
<thead>
<tr>
<th>Before Extreme Heat Season (Jan-Feb)</th>
<th>During Extreme Heat Season (Mar-Jun)</th>
<th>During Heat Wave</th>
<th>After Extreme Heat Season (Jul-Sep)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biweekly preparation &amp; information sharing meetings with stakeholders.</td>
<td>More frequent meetings &amp; preparation</td>
<td>Steering Committee members meet daily</td>
<td>Collection and analysis of data on heat-related illness and mortality</td>
</tr>
<tr>
<td>Public media events to raise awareness about heat-health vulnerability</td>
<td>Weekly meeting of Steering Committee members</td>
<td>Media outreach &amp; communications to the public</td>
<td>Evaluations of HAP - what worked well, what didn’t</td>
</tr>
<tr>
<td></td>
<td>Community, NGO groups meet weekly &amp; contact Steering Committee Liaison</td>
<td>Municipal Departments heat-reduction interventions</td>
<td>Discuss climate change scenarios, multiple emergencies, resources needed</td>
</tr>
</tbody>
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Health outcomes of the Heat Action Plan

– Did HAP help reduce mortality?

Measuring the impact of the heat action plan is primarily dependent on the mortality reduction achieved as a result of the plan.

Difficult – as data for mortality comes from very few heat wave events in the past decade.

Our current knowledge of mortality temperature relationships comes from the 2010 heat wave from one city - Ahmedabad.

2010 summer used as a base for calculating the impact of the HAP.
Method for calculating mortality decline

Temperature-mortality relationship calculated using data from 2010.

This temperature-mortality relation of 2010 applied to 2014 heat wave temperatures to predict mortalities in 2014.

Compared against actual mortality data from the same source (death registration for AMC) for 2014.

For heat stroke and deaths – data was collected by the AMC from 5 of Ahmedabad’s municipal/government hospitals – VS Hospital, LG Hospital, Sola, Sardar Patel Hospital and Civil Hospital.
Summer of 2014 (April-June) – temperature & mortality

Expected deaths (13,896) Vs. Actual deaths (11,697)

Lives saved = 2,199 [351-4,048] (95% CI)

- Temp: 45
  - Mortality Reduction: 35.0%
  - Reduction: 33.5%
  - Temp: 46
  - Mortality Reduction: 36.5%

Maximum Temperature (°C)

Mortality (deaths/day)

Expected Actual Maximum Temp (METAR)
Mortality Temperature Relationship: Actual of 2014 (Post HAP) as compared to pre-HAP years (2010)
# Heat Wave 2014: Hospital Case reports

<table>
<thead>
<tr>
<th></th>
<th>2010 (temp 47)</th>
<th>2014 (temp 46)</th>
<th>Crude reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total heat stroke mortality *</td>
<td>65</td>
<td>15</td>
<td>76.19%</td>
</tr>
<tr>
<td>Total heat stroke cases*</td>
<td>274</td>
<td>63</td>
<td>76.28%</td>
</tr>
</tbody>
</table>

*Cases reported from 5 of Ahmedabad’s municipal hospitals – VS Hospital, LG Hospital, Sola civil hospital, Sardar Patel Hospital, and Civil Hospital Asarwa.
Reported number of heat stroke Case and deaths: 2010 and 2014
Comparing temperature, heat stroke cases and death

2010

2014

Deaths
Cases
Temperature

Deaths
Cases
Temperature
Ahmedabad Traffic Police Study by IIPHG

Lal-Darwaja # Ahmedabad
18th June 2015 09:30 am

Temp. - 42.8°C

Temp. - 42.5°C

Lal-Darwaja # Ahmedabad
18th June 2015 02:30 pm

Temp. - 59.3°C

Temp. - 59.8°C
Lessons and future Plans:

The success of this plan can be attributed to the strong partnership and communication between the various institutions and the leadership and commitment of Local government - AMC

Good prediction system for weather for 7 days in advance

Focus on doable action at local city level

Involve all stakeholders

Write a plan and disseminate – use media widely.

Monitor progress and evaluate using morbidity and mortality data

Use rigorous scientific methods and publish the results

We plan to help other cities and states make HAPs. And make adaptation to heat waves part of the national dialogue on climate change.
Helping develop HAPs in other cities

Nagpur and other 7 cities in central India.

Orissa state in east

Hyderabad and Telangana state in south

Discussions with Health dept, NDMA and IMD for national replication
Journal Publications


City leadership releasing the 2015 HAP