



# Karachi Heatwave Management Plan: A Guide to Planning and Response



Commissioner Karachi

# Purpose of the Document

This document, Karachi Heatwave Management Plan, outlines what should happen before, during and after periods of extreme heat in Karachi. It sets out strategies that government and non-government agencies will adopt to prevent heat-related illnesses and deaths in Karachi and capacitate the public, particularly the most vulnerable residents, to take protective action. The Plan describes actions of implementation partners to ensure (1) information on weather conditions and heat health is timely and specific, (2) organizations have the capacity to respond according to their roles, and (3) strategies and actions enabling increase in effectiveness over time.

In June 2015 Karachi City experienced a severe heatwave that caused over 1,200 deaths and over 50,000 cases of heat illness. The heatwave caught all levels of government and first responders off-guard, highlighting the need for inter-agency coordination, clarity in roles, and a well-publicized trigger to activate a planned response. To address this need and to prevent health impacts from future heatwaves as climate change intensifies, the Commissioner Office Karachi requested support from the Climate and Development Knowledge Network (CDKN) to develop a heatwave management plan. Karachi's first Heatwave Management Plan is the result of a technical assistance project delivered by national and international experts between October 2016 and May 2017, working closely with the Commissioner Office and other stakeholders. The Plan will be subject to an annual performance review and updated versions will be available to implementation partners accordingly.

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## About

Commissioner Karachi is striving to transform the city into a resilient and sustainable urban centre. It has undertaken many initiatives to improve the living conditions of the citizens in this regard. The Commissioner Office is also taking lead role in heatwave management for Karachi city in collaboration with other stakeholders to improve resilience against future extreme heat episodes.



The Climate and Development Knowledge Network supports decision-makers in designing and delivering climate compatible development. We do this by combining research, advisory services and knowledge management in support of locally owned and managed policy processes. We work in partnership with decision-makers in the public, private and non-governmental sectors nationally, regionally and globally. We hold strongly to the ideals of human development and environmental sustainability. It is managed by an alliance of organisations led by PricewaterhouseCoopers LLP (PwC), and including Fundación Futuro Latinoamericano, LEAD International, LEAD Pakistan, the Overseas Development Institute, and SouthSouthNorth.



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# Executive Summary

## Introduction

Climate change is increasing the frequency, intensity and duration of hot weather in South Asia.<sup>1</sup> The occurrence of heatwaves has increased in Sindh province since the 1960s, and this trend is expected to continue to the end of the century.<sup>2</sup> In June 2015 Karachi City experienced a severe heatwave that caused over 1,200 deaths and over 50,000 cases of heat illness.<sup>3</sup> This heatwave caught all levels of government and first responders off-guard, highlighting the need for inter-agency coordination, clarity in roles, and a well-publicized trigger to activate a planned response.<sup>4</sup> To address this need and to prevent health impacts from future heatwaves as climate change intensifies, the Commissioner Office Karachi requested support from the Climate and Development Knowledge Network (CDKN) to develop a heatwave management plan. Karachi's first Heatwave Management Plan ("the Plan") is the result of a technical assistance project delivered by national and international experts between October 2016 and May 2017, working closely with the Commissioner Office and other stakeholders. The Plan will be subject to an annual performance review and an updated version will be available to implementation partners before each heat season.

Karachi's 2017 Heatwave Management Plan outlines what should happen before, during and after periods of extreme heat in Karachi. It sets out strategies that government and non-government agencies will take together to prevent heat-related illness and death in Karachi and equip the public, particularly the most vulnerable residents, to take protective action. The Plan describes actions of implementation partners to ensure (1) information on weather conditions and heat health is timely and specific, (2) organizations have the capacity to respond according to their roles, and (3) strategies and actions increase in effectiveness over time.

## What is the problem?

Karachi residents are vulnerable to extreme heat. In June 2015 Karachi had a deadly heatwave, characterized by high day and night time temperatures over a sustained period that left little relief to the population.<sup>5</sup>

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<sup>1</sup> IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

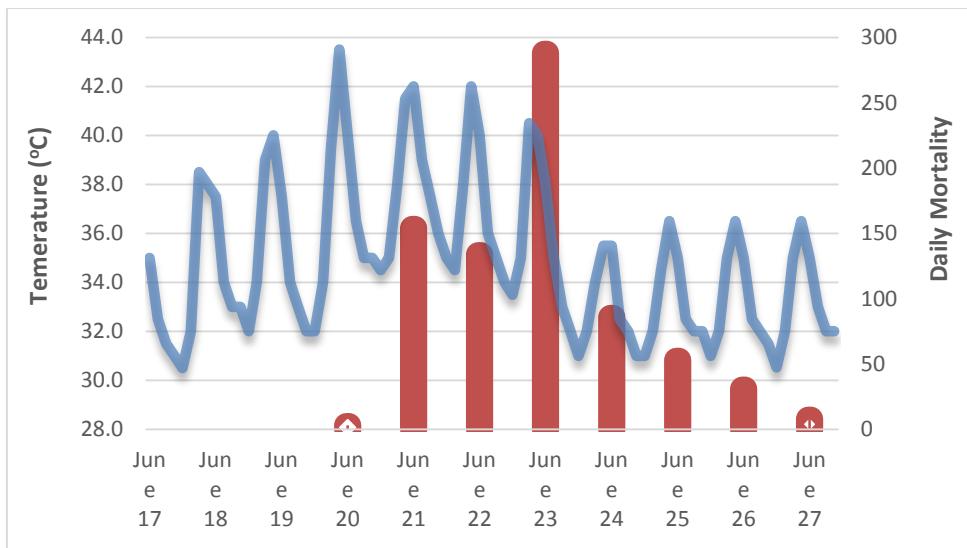
<sup>2</sup> Zahid, M. and Rasul, G. (2012). Changing trends of thermal extremes in Pakistan. *Climatic Change*, 113: 883-896.

Saeed, F. and Suleri, A.Q. (2015). Future Heatwaves in Pakistan under IPCC's AR5 climate change scenario. Sustainable Development Policy Institute. Policy Brief # 46.

<sup>3</sup> Commissioner Office, Karachi, personal communications; CDKN (2015). Karachi Heat Wave 2015: A Visual Guide

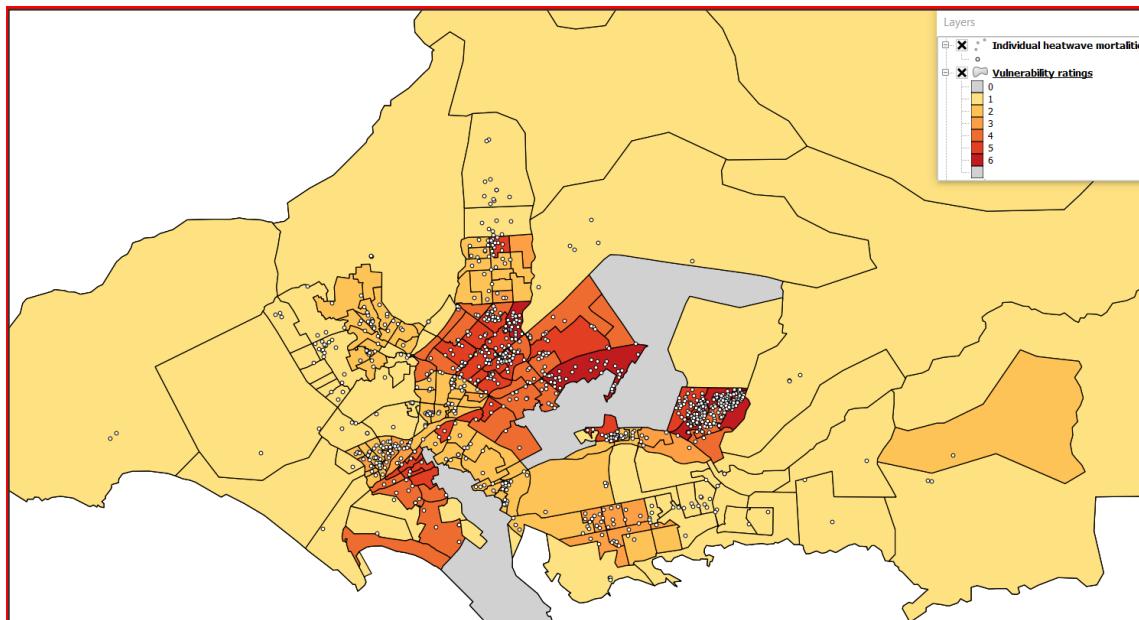
<sup>4</sup> Eyzaguirre, J., Nelitz, M., Farhan, K., Saqib, E., Ansari, U., Webb, T., de la Cueva, P., Cranmer, C. and Ahsan, N. (2017). Situational Analysis of Heatwave in Karachi City, Pakistan. Report prepared by ESSA Technologies Ltd. and The Urban Unit for the Climate and Development Knowledge Network (CDKN). 58 pp. + Annexes.

<sup>5</sup> Eyzaguirre et al. (2017), *Ibid*.



*Figure 1: Temperature (°C) and Daily Mortality During the June 2015 Heatwave*

Analysis of heat-related deaths in June 2015 revealed clusters of vulnerability in the City. This and other research suggests that housing quality and type, population size, low income levels and a lack of education are factors likely to have increased heat vulnerability in Karachi, at least in June 2015.<sup>6</sup>



*Figure 2: Home addresses of people who died during the 2015 heatwave in Karachi (white dots), and ratings of Union Councils according to six categories of vulnerability (1 = low vulnerability in yellow, 6 = high vulnerability in red).*

<sup>6</sup> Ghumman, U., and J. Horney. 2015. Characterizing the Impact of Extreme Heat on Mortality, Karachi, Pakistan. Prehospital and Disaster Medicine. 31 (3): 263-266.

## What action will the City take? What results are expected?

The ultimate goal of the Heatwave Management Plan is to prevent heat-related illness and death of Karachi residents. To achieve this goal:

- The public must be shared information on heat conditions potentially dangerous to health with sufficient lead time; and
- The public, especially those most vulnerable to heat stress, must have the information, knowledge and support needed to maintain their safety and wellbeing during extreme heat conditions.

This goal and expected outcomes guide implementation strategies and actions. The 2017 Heatwave Management Plan focuses on the following three strategies:

1. **Providing the public with timely and specific information before, during and after extreme heat emergencies.** Karachi will institute a three-tier alert system, based on temperature forecasts supplied by the Pakistan Meteorological Department (PMD). Each alert level triggers a set of actions by implementation partners, from activities to raise public awareness of health risks and protective actions all the way to deployment of emergency procedures across all agencies.

Before the heat season, the Commissioner Office Karachi, Health Department, Information Department, and Provincial Disaster Management Authority will launch a heatwave awareness campaign to disseminate public-health messages using banners, brochures, traditional and social media.

Communication strategies during the heat season will differ according to levels of alert. PMD will provide: regular information statements to senior decision makers on the three to seven-day outlook on future heat events; alert notices when heat criteria are met and an all-clear notice when the dangerous heat conditions subside. Partners will use a range of outreach activities and dissemination vehicles (mobile applications, website updates, brochures, TV/radio, announcements in Mosques) to stem health impacts of heat.

2. **Empowering implementation agencies to supply the required levels of service and support in a way that is coordinated and efficient.** Among the most significant gaps in the City's response to the June 2015 event were the lack of inter-agency coordination and unclear roles and responsibilities in the response effort. Actions to empower implementation agencies to prepare and respond to future extreme heat events are as follows:

- a. Well-defined leadership from the Commissioner's Office Karachi;
- b. Appointment of a senior Emergency Response Coordinator, reporting to the Commissioner, to oversee implementation of the Plan, learning and improvement;
- c. Creation of a Heat Emergency Coordinating Committee for ongoing input to and review of the Plan, with representatives from the Mayor's office, governmental departments and agencies (disaster management, public health, education and labour, meteorology, police), power and water utilities and social welfare organizations;
- d. A communications framework to ensure well-regulated information flow amongst agencies and effective and efficient delivery of public-health messages; and
- e. Action checklists to guide implementation partners in carrying out preparedness and response measures aligned with their mandates.

**3. Increasing knowledge of the burden of heat-related health outcomes in Karachi to better target heat action planning over time.** Robust information on populations and places vulnerable to extreme heat today and under future climate is limited for Karachi. This information is critical to design tailored responses and so the Commissioner Karachi and partners will:

- a. Install and maintain at least one weather monitoring station per district to be able to register microclimates shaped by built infrastructure and land use;
- b. Collect detailed information on cases of heat-related morbidity and mortality, at all health centers, during extreme heat events;
- c. Compile up to date information on demographics, housing conditions and land-uses in Karachi at a high degree of spatial resolution, based on the new census; and
- d. Participate in an annual review of the Plan to evaluate its effectiveness and produce a refined version based on lessons as well as new information on patterns of heat and vulnerability.

Implementation partners are responsible for deploying preparedness and response measures outlined in detailed checklists in the Plan.

## How will the Plan be implemented?

As the lead agency, the Commissioner Office Karachi is responsible for overseeing the Plan's implementation and refinement over time. The Commissioner Office, via the Emergency Response Coordinator, acts as a central node for communications and response before, during and after the heat season. The City does not anticipate significant new resources becoming available for heatwave management. Therefore, successful implementation relies on partnerships to leverage the resources and assets already available.

During the heat season, the Pakistan Meteorological Department (PMD) and the Commissioner Office each play a role in alerting implementation partners on required responses to dangerous heat conditions. In turn, Deputy Commissioners and municipal corporations initiate actions to alleviate heat stress, by, for example, setting up cooling stations, maintaining well-stocked first response centres and providing preliminary treatment. Facilitating Departments, such as Health, Education and Labour, pre-position resources and coordinate actions with subsidiary units to reduce Karachi resident's exposure to heat. K Electric and KW&SB work to minimize interruptions of electricity and water supplies, particularly in heat-vulnerable areas. Social welfare organizations and ambulance services optimize their resources and raise their own awareness to help residents stricken by heat-related illness receive the attention and medical help they need.

Ensuring Karachi residents have the information and support to protect themselves and their families from extreme heat is a major focus of response actions contained in the Plan. Union Councilors, the Information Department, social welfare organizations, media outlets, among others, all contribute to sharing information to alert the public on dangerous heat conditions and protective actions to take.

The Heat Emergency Coordinating Committee, comprising implementation partners, provide ongoing input to and review of the Plan, participating in an annual evaluation meeting at the end of the heat season.

## What next?

### Mobilization of community networks

Non-governmental organizations, such as the Sindh Scouts Association, HOPE and Alamgir Welfare Trust, provided valuable resources and support in responding to the June 2015 heatwave. The inter-agency

coordination framework embedded in the Heatwave Management Plan includes roles for social welfare and philanthropic organizations that provide ambulance services. However, the next iteration of the Plan will need to go further in defining strategies and activities that these stakeholder groups can lead or support to boost self-sufficiency among communities and leverage local assets to reduce health impacts from heat. Therefore, before the next heat season, partners in this Heatwave Management Plan will:

- Convene a dialogue with social welfare and other grassroots organizations to develop a community mobilization framework

## Longer-term strategies

Karachi's 2017 Heatwave Management Plan focuses on preparedness and response during the heat season. Longer-term strategies, incorporating changes in urban development, building design, building codes, energy, and transport policies, are part of a comprehensive approach to reducing the overall burden of heat. Opportunities for action on longer-term strategies, such as those below, will be explored during Plan review and refinement after the 2017 heat season.

- Proceeding with implementation of Karachi's Strategic Development Master Plan 2020 (SDMP 2020).
- Ensuring that long-term strategies for land use regulations and development plans respond to Karachi's diverse characteristics.
- Designating areas for high-rise development, so adequate transport infrastructure, water supply and open spaces can be provided for, while discouraging scattered and haphazard growth.
- Taking advantage of cycles of city renewal to tackle urban heat islands in inner city areas.
- Reforming existing building and land use regulations in the city and cantonment areas to incentivize green urbanization.
- Reducing congestion by nurturing the growth of several city centers.
- Investing in sustainable transport options.

# Glossary

<b>Adaptation</b>	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. <sup>1</sup>
<b>Disaster</b>	A serious disruption of the functioning of a community or society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources. It results from the combination of hazards, conditions of vulnerability and insufficient capacity to reduce the potential negative consequences of risk. <sup>2</sup>
<b>Exposure</b>	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected. <sup>3</sup>
<b>Hazard</b>	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. In this report, the term hazard usually refers to heatwave events, heat-related trends or their public health impacts. <sup>4</sup>
<b>Heatwave</b>	No universal definition exists but the Pakistan Meteorological Department uses a definition by the World Meteorological Organization (WMO): "when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 5 °C, the normal period being 1961–1990". The IPCC defines it as "a period of abnormally and uncomfortably hot weather."
<b>Heat index</b>	A measure of how hot it really feels when relative humidity is factored in with the actual air temperature. <sup>5</sup>
<b>(Heat) Mitigation</b>	A measure that eliminates or reduces the impacts and risks of hazards from heat through proactive steps taken before an emergency or disaster occurs.
<b>Urban heat island (UHI)</b>	A measurable increase in ambient urban air temperatures resulting primarily from the replacement of vegetation with buildings, roads, and other heat-absorbing infrastructure. The heat island effect can result in significant temperature differences between rural and urban areas. <sup>6</sup>
<b>Resilience</b>	The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation. <sup>7</sup>
<b>Vulnerability</b>	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. <sup>8</sup>

# 1 Introduction

Heatwaves are a growing public-health concern for Karachi and its residents. The June 2015 heatwave in Karachi was among the ten deadliest natural disasters in Pakistan since 1950.<sup>9</sup> As climate change intensifies, so too will the severity, frequency and/or duration of heat events. Recent experience and the prospect of heightened exposure to heatwaves raised the urgency and commitment of national, provincial and local stakeholders to develop a coordinated response at the city level and prepare for future events.<sup>10</sup> As a result, the Commissioner Office Karachi requested support from the Climate and Development Knowledge Network (CDKN) for technical assistance to develop a Heatwave Management Plan.

The Heatwave Management Plan (“the Plan”) contained in this document guides short and long-term efforts by Karachi to build vulnerable people’s resilience to heatwaves. Significant information gaps exist and so the Plan will need to evolve as research and experience progress. Gaps include first-hand evidence on the health burden of heat in Karachi and profiles of heat-vulnerable groups. Uncertainty is not a reason for inaction however. The Plan integrates the best available information and builds in explicit provisions for data collection and learning.

## 1.1 Purpose

This Heatwave Management Plan outlines what should happen before, during and after periods of heatwave in Karachi. It sets out strategies that government and non-government agencies will take together to prevent heat-related illness and death in Karachi and equip the public, particularly the most vulnerable residents, to take protective action. The city does not anticipate significant new resources becoming available for heatwave management. Therefore, mobilizing public, private and NGO resources and assets already available is an important precondition to attaining these objectives.

The Plan covers all facets of a comprehensive response to heatwave management but focuses on planning and action during the heat season. The Plan is specifically for agencies that could most contribute to managing the consequences of extreme heat and heatwave emergencies in Karachi and for those organizations that deal most directly with people most vulnerable to heat stress. Providers of basic services and major media outlets should also consult this Plan. Leadership will be provided by the Commissioner for Karachi with important roles being played by Local Governments, the Pakistan Meteorological Department, healthcare providers, utilities, and social welfare organizations. Specific roles and responsibilities for each organization are described within the Plan.

## 1.2 Karachi Background

Karachi is a megacity concentrating 10 percent of Pakistan’s entire population, 22 per cent of its urban population<sup>11</sup> and 60 percent of national revenues.<sup>12</sup> Heatwave management planning needs to consider:

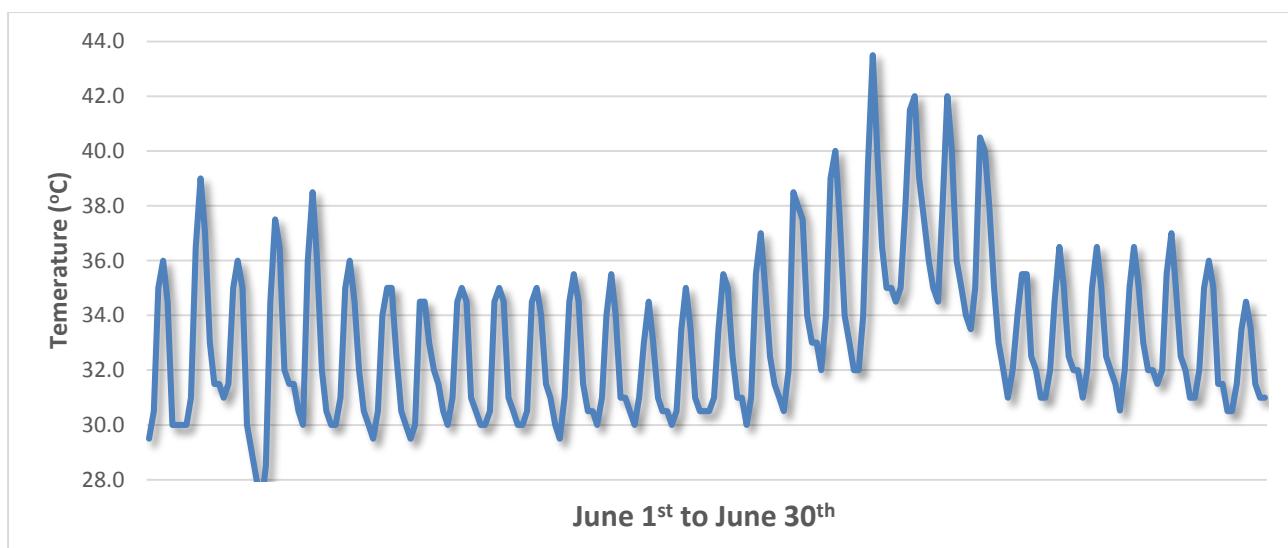
- **Urban development patterns that undermine resilience to heat.** Karachi developed in several phases without any binding master plan creating many areas of fragmented land use and urban sprawl<sup>13</sup>. 61 percent of the population lives in katchi abadis, which have existed and grown unplanned since the creation of Pakistan in 1947.<sup>14</sup> The disjointed, unplanned, nature of the city has not allowed for design of city blocks and green spaces that would help mitigate heat islands and the impacts of heat events. Poor air quality exacerbates the effects of heatwave conditions, so traffic congestion and air pollution in Karachi are a concern.<sup>15</sup>

- **Rapid population growth and the challenge of delivering basic services to residents.** On average, the city has grown by 5 percent annually, although steep changes in population size occurred between 1940 and 2008. Migration from rural Sindh, from across Pakistan and South Asia contributed to the rapid and unplanned urbanization and expansion that Karachi has sustained. With a population density of over 24,000 people per km<sup>2</sup>, Karachi is the largest city in Pakistan.<sup>16</sup> Servicing such a large population has been a challenge for governments and full provision of clean drinking water, sanitation, drainage, and reliable power to residents is lagging.<sup>17</sup>

## Exposure to Extreme Heat

Located on the Arabian Sea coast, Karachi has a semi-arid climate. The hottest months are May to July, with 30-year daily averages ranging from 30.3°C to 31.4°C. Summers generally start off dry, leading into a rainy season over July and August.<sup>18</sup> Relative humidity during summer months can range considerably (30 to 95 percent as a daily average from 2006 to 2015). The 30-year average maximum temperature for June, the hottest summer month, is 34.8°C.<sup>19</sup>

In June 2015, Pakistan suffered the deadliest heatwave in over 50 years and Karachi was one of the areas most severely affected.<sup>20</sup> Weather conditions leading up to the June 2015 heatwave included a persistent air depression over the Arabian Sea that “*cut-off the incoming sea breeze to the metropolitan city with clear skies further exacerbating the situation by making the air warmer and stagnant over the region for many days*”.<sup>21</sup> Figure 3 shows the more typical pattern in early June as compared to the heatwave conditions in the latter third of the month.



*Figure 3: Temperatures (°C) during June 2015*

Temperatures in Karachi were not as high during the June 2015 heatwave as they were in other areas of Pakistan and temperatures in Karachi did not break records for that city. Historic maximums in May and June have seen temperatures in Karachi rise as high as 47.8°C in 1938 and 47°C in 1979. In comparison, the highest recorded maximum temperature during the 2015 heatwave occurred on June 20, reaching 44.8°C.<sup>22</sup> What was remarkable during the 2015 event was that there was no relief in terms of minimum temperatures during the night time for the period over which the maximum temperatures were also high during the day; this pattern of hot weather continued for number of days resulting in heatwave.<sup>23</sup>

Exposure to extreme heat is a growing problem. Analysis of temperature data from 1961 to 2009 shows an upward trend in the number of moderate and severe heatwaves measured as 5, 7 and 10 consecutive

heat days in Sindh province.<sup>24</sup> Other work involving outputs of regional climate models projects a continued rise in the number of heatwave events to the end of the century, under a high emissions scenario.<sup>25</sup> Attribution analysis performed on the June 2015 event is also insightful. Attribution analysis allows scientists to make quantitative statements about the relationship between human-induced climate change and individual extreme events. Such analysis indicates that human-induced climate change significantly increased the likelihood of reaching heat indices seen in June 2015 (by 800 to 100,000 percent).<sup>26</sup> In other words, climate change is already increasing exposure to severe heat and it will likely be more important to anticipate exposure in the future.

## Human Health Outcomes

The 2015 heatwave provides the only recent data on health impacts to inform priorities for planning and action in Karachi. In a span of less than 10 days, the 2015 heatwave in Karachi affected 65,000 people.<sup>27</sup> 40,000 were treated at hospitals and approximately 1,200 people died<sup>28</sup>. Figure 4 shows the pattern of temperatures during the heatwave and associated mortalities from June 17<sup>th</sup> to the 29<sup>th</sup>.

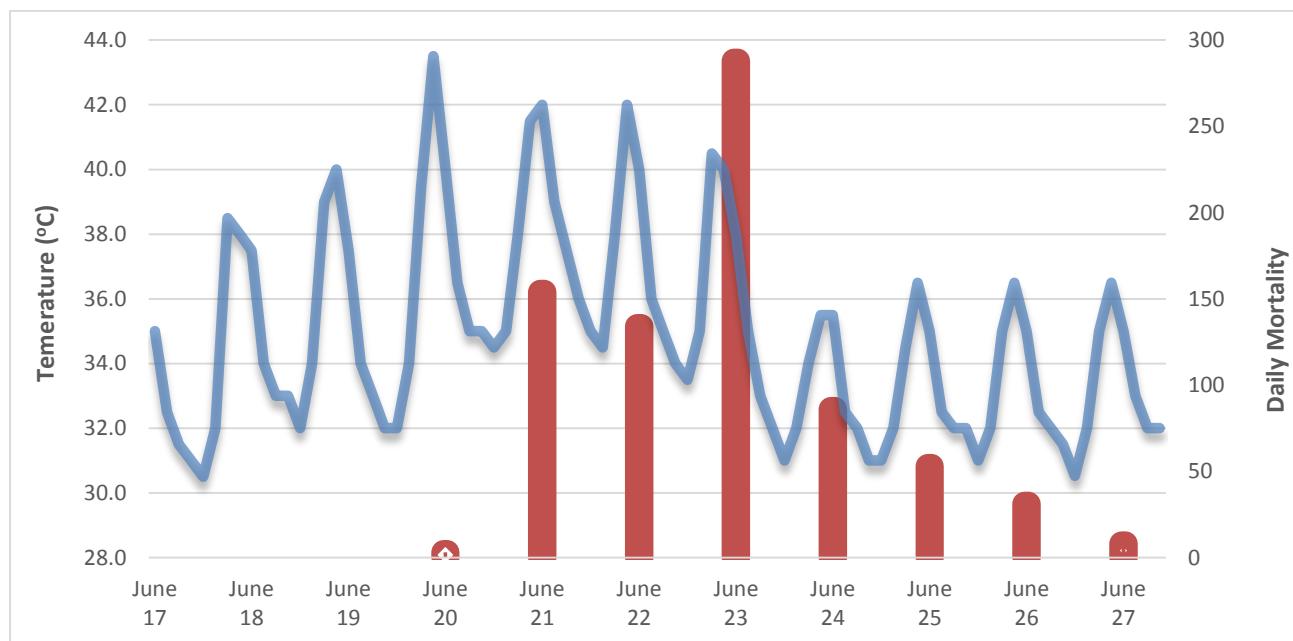


Figure 4: Temperature (°C) and Daily Mortality During the June 2015 Heatwave

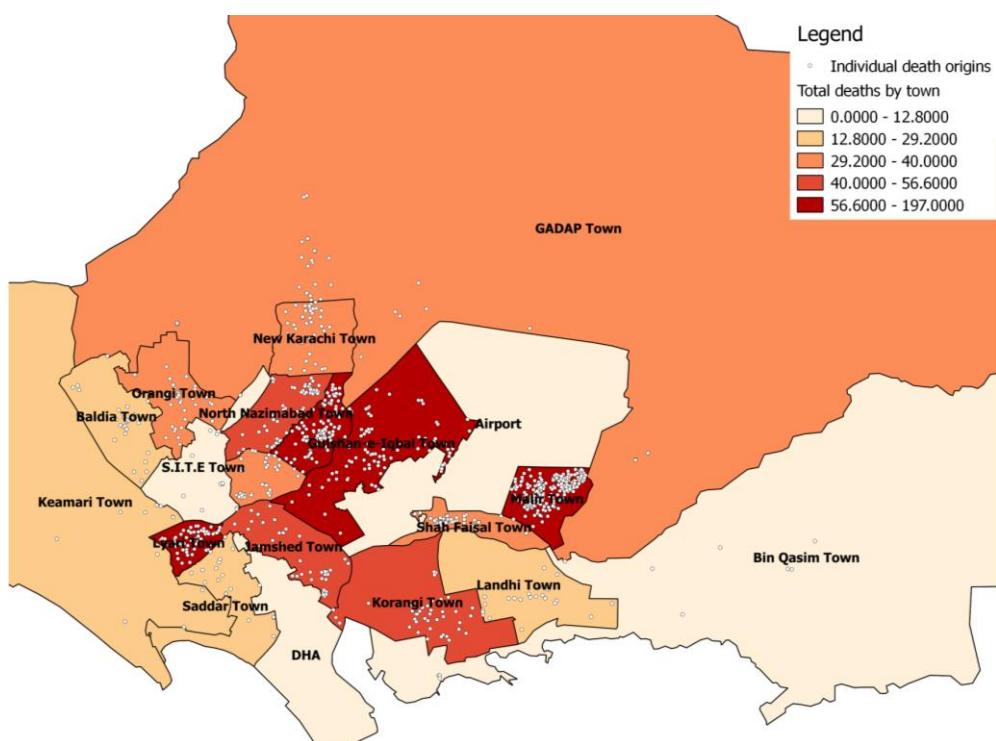
Heat exposure and vulnerability differed across the city, as shown by spatial analysis of death records.

Table 1 summarizes total deaths and rank order by towns across Karachi based on 874 observations of deaths from June 2015 collected from hospital records and determinations of ambulance origin.<sup>29</sup>

Table 1: Total heat-related deaths during the June 2015 Karachi heatwave that could be allocated to town

Karachi Town	Total Deaths	Rank by Total Deaths	Estimated Total Population in 2016
Malir Town	197	1	625,000
Gulberg Town	101	2	724,000
Gulshan-e-Iqbal Town	84	3	1,036,000
Lyari Town	59	4	974,000
North Nazimabad Town	56	5	794,000
Jamshed Town	45	6	1,172,000
Korangi Town	42	7	870,000

Liaquatabad Town	40	8	1,032,000
Shah Faisal Town	40	9	535,000
New Karachi Town	36	10	1,095,000
Orangi Town	34	11	1,154,000
GADAP Town	32	12	462,000
Baldia Town	25	13	647,000
Landhi Town	24	14	1,041,000
Saddar Town	23	15	983,000
Keamari Town	13	16	612,000
S.I.T.E Town	12	17	740,000
Bin Qasim Town	11	18	505,000
Cantt	0	19	736,000
<b>TOTAL</b>	<b>874</b>		<b>15,737,000</b>



*Figure 5: Map of Karachi with death origins from the 2015 heatwave and colour shading of towns according to the total deaths within those towns.*

The mapped mortality data and rank ordering by Town are useful for planning until better information is available but should be used with caution. The data relate to the June 2015 pattern of weather only and do not account for morbidity. The next heatwave may not show an identical pattern of morbidity and mortality as in 2015. Gathering and reviewing health information leading up to and during a heatwave to confirm the areas requiring the highest attention and resourcing is an important part of this Plan.

### 1.3 Development of the Plan

The 2015 heatwave raised the urgency and commitment of national, provincial, and local stakeholders to develop a coordinated response at the city level and prepare for future events. As a result, the Commissioner Office Karachi requested support from the Climate and Development Knowledge Network

(CDKN) for technical assistance to develop a heat action plan that built on lessons and good practice from CDKN's intervention in Ahmedabad, India. Ahmedabad was the first South Asian city to address the health impacts of extreme heat comprehensively. Karachi's first Heat Action Plan is the result of a technical assistance project delivered collaboratively by the Urban Unit and ESSA Technologies Ltd., in close collaboration with the Office of the Commissioner, Karachi, and other stakeholders.

## 2 Governance

The Commissioner's Office Karachi is the institutional home for the Plan and leads its implementation. The Commissioner will appoint an **Emergency Response Coordinator** to oversee the process. This coordinator will be appointed at the level of an Additional Commissioner, one step below the Commissioner, and will have the authority required to implement the plan, mobilize, and manage the necessary resources from partner agencies.

The Commissioner will create a **Heat Emergency Coordinating Committee** to provide ongoing input to and review of the Plan. The Emergency Response Commissioner, on behalf of the Commissioner, shall convene the Committee. The terms of reference for this Committee are in Appendix A.

The Committee will include representatives of agencies with mandates, responsibilities and resources most likely to add value to heatwave management in Karachi, including those organizations that deal most directly with vulnerable groups:

1. Chairperson/Additional Commissioner
2. Provincial Disaster Management Agency for Sindh
3. Pakistan Meteorological Department
4. Police Department
5. Medical and Health Department
6. Information Department
7. Education and Labour Department
8. District Municipal Corporations
9. Karachi Water and Sewerage Board
10. K-Electric
11. Mayor of Karachi
12. Edhi Foundation
13. Chippa

The **Emergency Response Coordinator** will establish an ongoing process to:

- Build capacity of key officials and agencies to understand their roles and responsibilities under the Heat Action Plan and to be able to execute these efficiently;
- Identify and resolve communications gaps and weaknesses between participating departments, partners, and the public;
- Gather information on heat emergencies and the operation of the plan;
- Review and refine the plan on an annual basis; and
- Conduct tabletop exercises, simulations, and drills to enhance readiness.

Details of this management process appear in the Communications Plan and Response Action Plan sections of this Plan. The Emergency Response Coordinator will establish a **Control Room/Emergency Operations Center (EOC)** in the Office of the Commissioner. This EOC will be staffed throughout the heat season (March 31<sup>st</sup> to October 31<sup>st</sup>) and will act as a central node for the collection and sharing of information and will support coordination with all other agencies. Sharing of information of predicted high and extreme temperatures is critical to preparing for heatwaves. The Pakistan Meteorological Department (PMD) will communicate with the Commissioner's Office according to a three-Tier Alerting System and the Communications Plan. Sample statements from PMD are included in Appendix B of this report.

# 3 Surveillance and Alerting

## 3.1 Surveillance

Continuous improvement through sustained collection and review of information is an objective of this Heatwave Management Plan. Throughout the heat season (March 31<sup>st</sup> to October 31<sup>st</sup>) the Emergency Response Coordinator (ERC) will ensure that the following information is reviewed on a daily basis and that appropriate actions are taken based on this information as described in this plan:

1. Forecast maximum and minimum temperatures for the next 7 days from PMD; and
2. Reports on numbers of heat related illnesses and fatalities at all hospitals and health centers.

The temperature forecasts are an integral part of declaring heat days and heatwave emergencies. Records on heat-related illness and mortality give an additional measure of the ongoing impacts of heat independent of the current weather conditions.

## 3.2 Three-Tier Alerting System

Karachi will use a **three-tier alert system**. The alert system includes Hot Day Advisories (**Yellow**), Hot Day Warnings (**Orange**), and Heatwave Emergencies (**Red**). Yellow and Orange alerts will primarily be used to raise public awareness and increase the level of readiness for both government and non-government organizations. Red alerts will **signify heatwave emergency conditions** activating emergency procedures across all agencies in the city.

Note that the Yellow and Orange criteria are based on the maximum forecast temperature on any given day. The Red Emergency level is triggered by a consistent pattern of weather that is expected to have significant health implications.

*Table 2: Alerting System*

Type of Alert	Criteria	Response
<b>Hot Day Advisory</b>	Forecast 40°C - 41.9°C	Increased communication in media on heat issues
<b>Hot Day Warning</b>	Forecast $\geq 42^{\circ}\text{C}$	High level of public awareness increased, focus and preparedness of government agencies
<b>Heatwave Emergency</b>	$\geq 42^{\circ}\text{C}$ forecast AND <b>minimum</b> temperature $\geq 30^{\circ}\text{C}$ for 2 or more days  When there are significant levels of heat related illness and even mortality there must be the declaration of a Heatwave Emergency and a rapid response regardless of specific weather criteria.	Declaration of a heatwave emergency

These criteria stem from a combination of analysis of historical daily weather records for Karachi including the 2015 event, and the application of the guideline that a heatwave be declared when the maximum

temperature is 5°C above normal (34°C for Karachi during the heat season). Appendix D describes the approach to developing these criteria.

The PMD will issue the following statements:

1. Regular **Information Statements** that provide senior decision makers with a clear understanding of the outlook for future heat events;
2. **Public Alerts** of Hot Day Advisories (**Yellow**), Hot Day Warnings (**Orange**);
3. **Heat Watches** when there is the potential for heatwaves; and
4. **Heatwave Emergency Alerts** when a heatwave event is expected in the next 1 to 2 days.

The institutional protocols and responses to these communications are described in detail in the Communications Plan. Example statements from PMD are included in Appendix B of this report.

### 3.3 Declaring a Heatwave Emergency

Forecasting the weather is an inexact science and determining when there is likely to be a heat emergency situation will always involve expert judgement. Although expert judgement from the scientists at the PMD cannot be replaced by the blind application of fixed criteria, guidelines are valuable. The PMD can use the guidelines described in this plan to assist in determining when to issue alerts. Consistent application of guidelines is integral to the Plan's systematic review and improvement over time.

The PMD will declare a **Heatwave Emergency** event in Karachi when:

1. The maximum dry bulb temperature measured at Jinnah International Airport is forecast to be 42°C or higher with no significant relief, **and** night time air temperatures are not expected to drop below 30°C for at least 2 days.
2. When there are significant levels of heat related illness and even mortality there must be a declaration of a Heatwave Emergency and a rapid response

The declaration of a heatwave emergency will trigger significant actions by government and other agencies, as detailed in this plan.

Monitoring of health outcomes throughout the heat season provides an additional level of detection. The pattern of heat experienced during 2015 is a strong indicator of the potential for a heatwave emergency. However, the history of heatwaves in Karachi is limited and there may be other weather patterns that could cause problems. Because of this uncertainty, careful monitoring of heat related morbidity and mortality throughout the heat season is critical to act as another level of detection of an event that may have different characteristics from the 2015 heatwave.

Where there are sudden increases in morbidity and/or mortality attributable to heat the Office of the Commissioner should consider the immediate declaration of a heatwave emergency regardless of specific weather criteria.

## 4 Communications Plan

The Commissioners Office Karachi will be the institutional home for the Karachi Heatwave Management Plan and the Emergency Response Coordinator (ERC) within the Commissioner Office will be responsible for the coordination of all internal and external activities and communications regarding heatwave preparation and response. The following flow chart, describes the communication of information during the heat season.

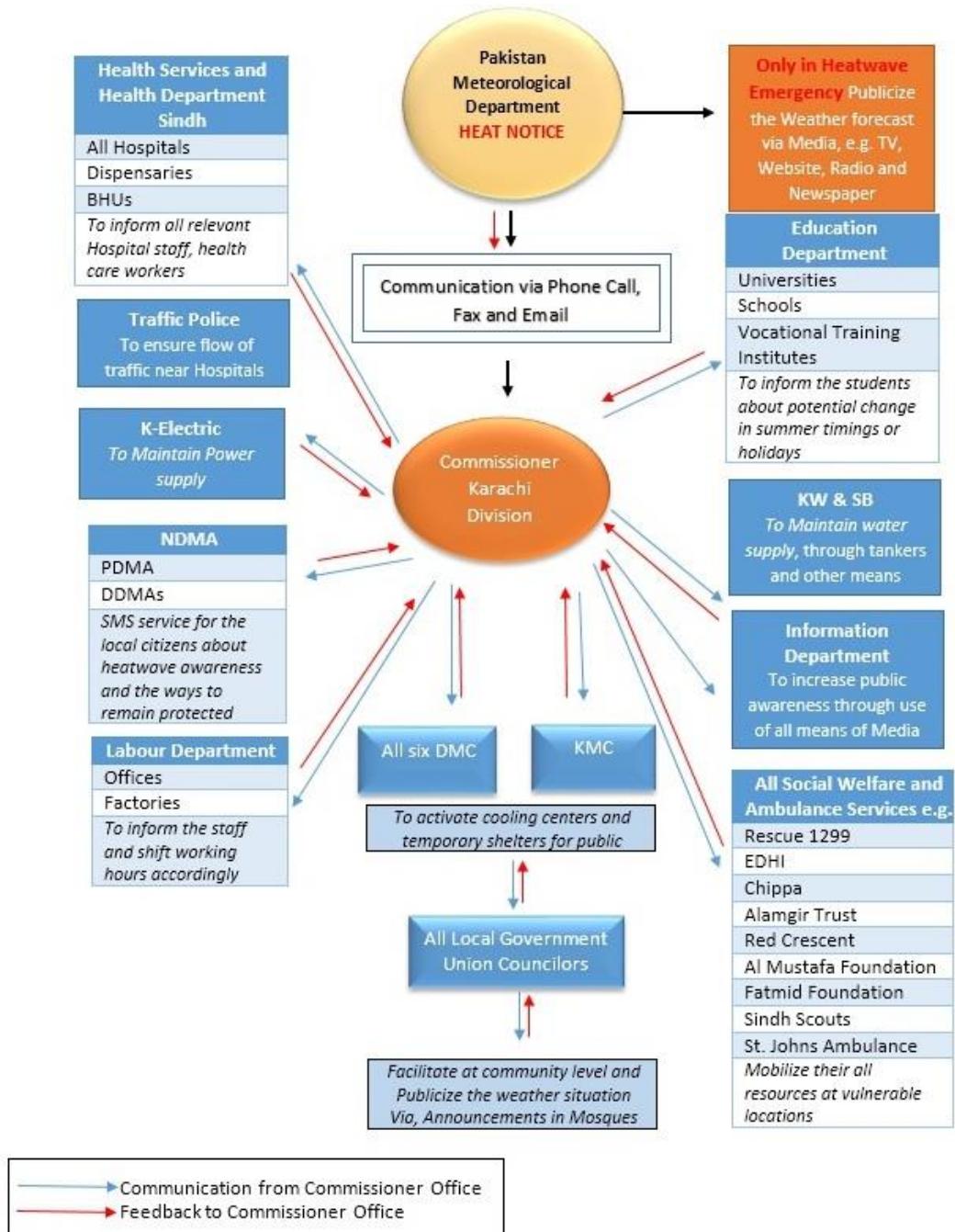


Figure 6: Communication of information by PMD during the heat season

To maintain readiness, the Commissioners Office and the members of the Emergency Response Committee will stay in constant communication throughout the heat season. Communications and stakeholder responses will amplify / taper as the level of concern is raised / diminished for a potential heat situation and alerts are issued / cleared.

As the institutional lead for the Karachi Heatwave Management Plan, the **Commissioner Office Karachi** is the central node for information-sharing and coordination.

The PMD also plays a key role. Indeed, efficient implementation of the Heatwave Management Plan is dependent upon the timely communication of weather forecast from **Pakistan Meteorological Department (PMD)** to the Commissioner Office from where the information will then go to other departments simultaneously (as shown in Figure 6).

Facilitating Departments are responsible for delivery on a range of actions, according to the alert level. Communications, however, will centre on ensuring timely and appropriate delivery on the following arrangements. Facilitating Departments are expected to share feedback with the ERC on a regular basis. The ERC will review the operation of all arrangements and if there is poor or unsatisfactory performance implementation partners will immediately respond to correct the situation.

**Deputy Commissioners:** Deputy Commissioners will be responsible for deploying resources, such as locations to be declared as heat emergency centers, coordination of cooling station and installation of camps at district level and its coordination.

**KMC and DMCs:** Municipal corporations will initiate field responses, ensuring that first response centers are established and are equipped with medical supplies and ice bags. DMCs will visit health facilities on alternate days and prepare weekly report to share with the ERC.

**Union Councils:** Union Councillors are well placed to manage community based services and engage citizens and local stakeholders in collaborative planning to enhance community preparedness. Union Councillors can share information within their areas about preventive messages and locations of cooling points; they can also assign communication tasks to mosques, including making announcements on protective actions during heatwaves.

**Health Department:** This agency will ensure that all their Hospitals, Dispensaries and Basic Health Units are equipped with emergency response medicine throughout the season.

**K Electric & KW&SB:** These utilities will make necessary arrangements for uninterrupted supply of electricity and water respectively, focusing on vulnerable areas first.

**Social welfare organizations and ambulance services** will arrange their resources needed during transportation of patients. Customized awareness material will be shared specially with ambulance drivers so that they should also aware of the fact that what type of illness the patient is facing and what can be done immediately while taking him to any health-care facility.

**Education and Labour Department** will inform their line departments to announce holidays in educational institutes or to change the timing of working hours depending upon the severity of the weather.

**Information Department** will share/publicize public health messages supplied by Commissioner Office to the public.

## 4.1 During the Heat Season

The heat season will be from March 31<sup>st</sup> to October 31<sup>st</sup> every year. Continuous engagement of implementation partners and other stakeholders will be required during this period.

### Heatwave Awareness Campaign

Every year, partners will implement a pre-summer awareness campaign for the general public.

This campaign will be led by the Commissioner Office in close cooperation with the Health Department and PDMA. The primary audience for the awareness campaign about heatwave and its precautions will be:

- People living in Karachi (preferably the highlighted vulnerable areas) and;
- People who are visiting the Karachi (preferably at Airport, Railway stations and Bus stands).

The information will be provided to Karachi residents early in the season and often, to foster preparedness and enable changes in behaviour during hot weather..

The general public will be provided information about risk characteristics, preventative actions, and appropriate behaviour during a heatwave and will be made aware of their own responsibility.

Ambulance drivers and paramedics will also be provided with information. This includes awareness material describing symptoms (heat cramps, heat exhaustion, heat stroke) in a clear way, in Urdu, and specifying the appropriate response for each level of symptoms - for example: sending them to cooling centers, refer to paramedics, primary care facility, tertiary care hospital. This is important to reduce the load on tertiary hospitals.

This Heatwave Awareness Campaign will utilize clear and simple formats with more use of pictures to convey the key messages using local languages (Urdu); the messages will be conveyed via:

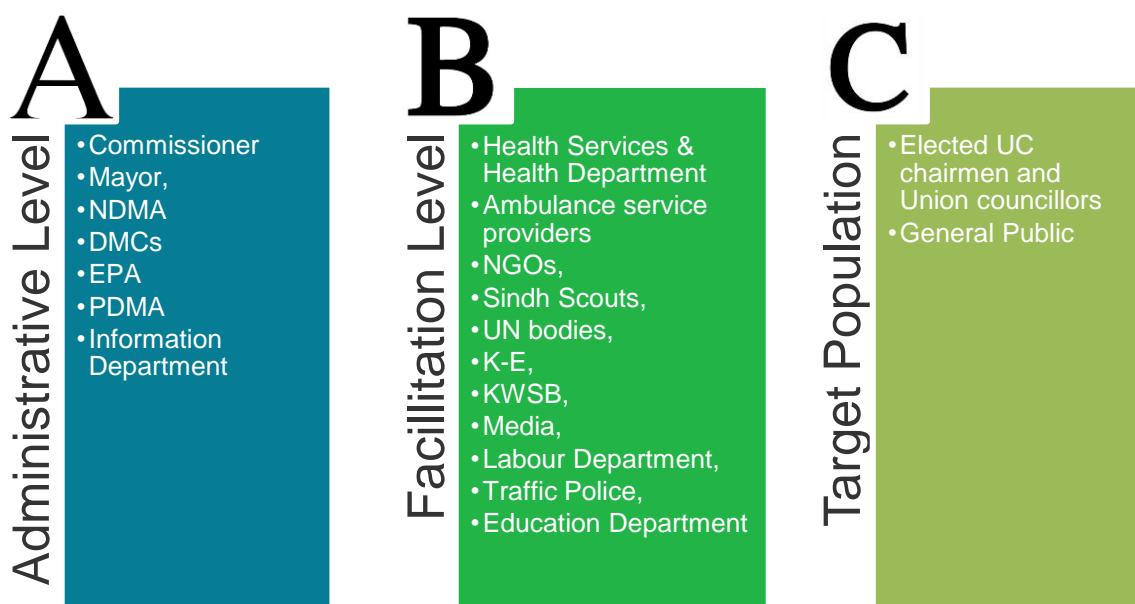
- Banners,
- Leaflets,
- Handouts, and
- Different sources of Media.

The key messages that will be communicated to the public to reduce the health impacts of heatwave will be in line with the Health Services Sindh. Messages will be in Urdu. See Appendix C for examples of public-health messages and outreach material.

## 4.2 Heatwave Emergencies

When forecast maximum temperatures meet or exceed the criteria for hot day advisories or warnings (yellow or orange alerts) the Pakistan Met Department (PMD) will issue notices for those specific days. A heatwave emergency (red alert) will most likely be triggered when approaching high maximum and minimum temperatures are predicted by Pakistan Met Department (PMD) but may also be triggered based on levels of heat related illness being reported by health care facilities.

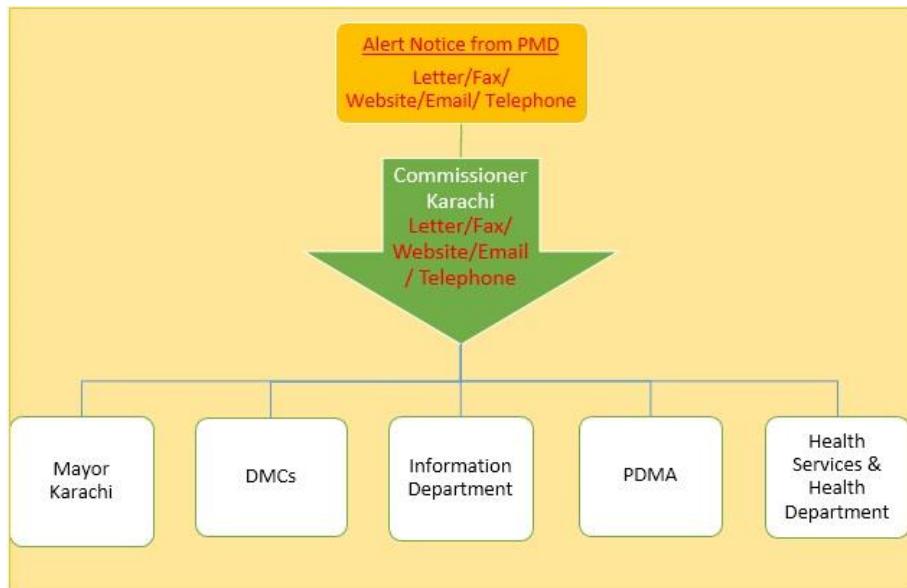
There will be different communications strategies for the different levels of alert with more groups being involved for the higher levels of alert. The groups to be targeted are:



Three types of notice will be issued by the PMD concerning potential heatwave emergencies. Depending on the type of notice different groups will be notified by the Emergency Response Coordinator as follows. Mobile applications and websites are among the vehicles to be used to share information with the public.

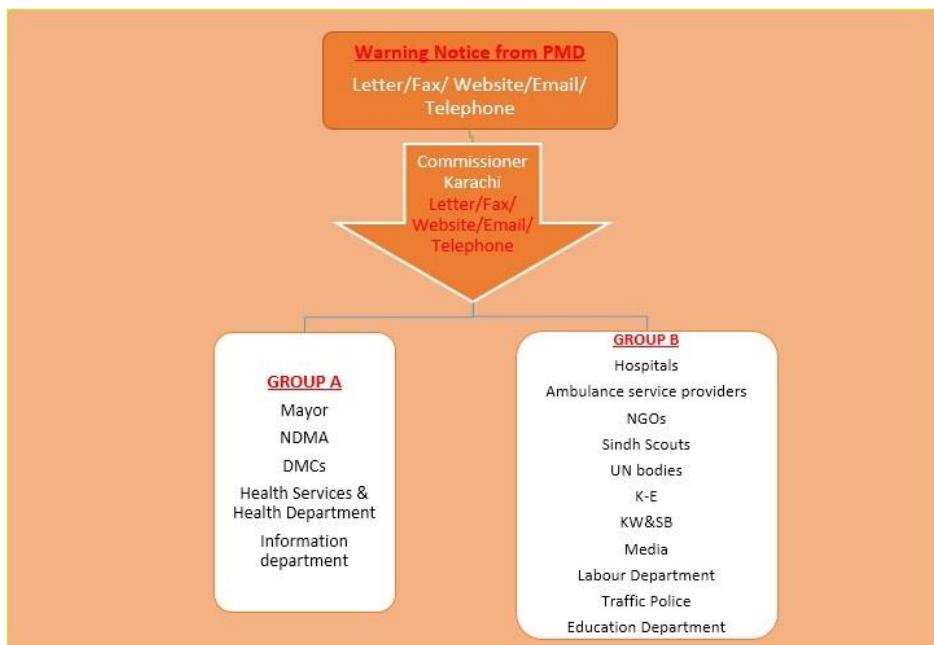
## 1. Regular Information Updates and Yellow Hot Day Advisory Alerts

Regular and consistent information will be sent out to Group A during the heat season, giving the outlook for the forecast and the potential for heat concerns in the short, medium, and longer terms. These regular statements should include concerns where the potential exists for an excessive heat event in the next 3-7 days. This provides considerable lead-time to all departments to prepare for heatwave. This same information flow will be used for yellow Hot Day Advisories.



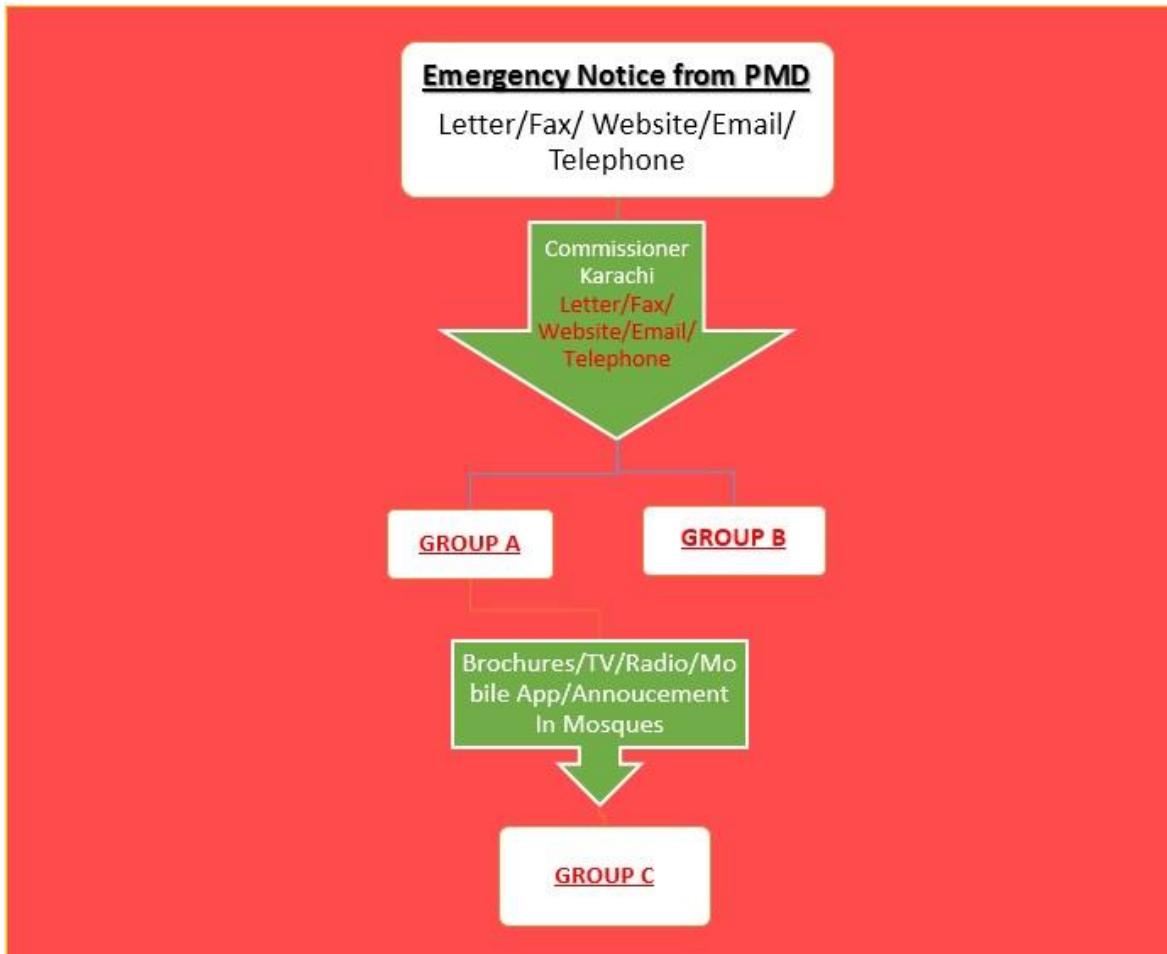
## 2. Orange Hot Day Warning Alerts

When an Orange Hot Day Warning is issued by the PMD this information will be distributed to both Groups A and B.



### **3. Red Heatwave Emergency Alert**

Once a Red Emergency Alert has been issued this will initiate the full-scale response.



### **4. All Clear Notice**

When the Pakistan Meteorology Department observes that the heat wave event is over, they should send out an 'ALL CLEAR' notice to NDMA/PDMA & Commissioner stating the weather forecast for the coming days.

## Use of Mobile Applications

### **1. For citizens:**

Engage Mobile phone companies to send SMS alerts for heatwave (Precautions + alert) to citizens using Tower usage.

### **2. For Service Providers Specially Ambulance service provider:**

Mobile Application for closest Hospital, Optimal Routes, Red Zones and Push messages (alerts)

### **3. For Community Participation:**

UC Chairs and councillors can be enlisted to install the app and inform their community. UC Chairs and councillors can collect important contact numbers and SMS Messages can be sent through their offices to these selective numbers.

## Use of Web Sites

PMD and Commissioner Karachi Office will keep information on weather forecasts and key messages to citizens up to date on their respective websites.

## 5 Response Action Plan

The following tables provide a summary overview of key actions to be taken during the heat season and in response to different alert levels.

<b>Actions to be taken during the Heat Season (1st April 31st October)</b>		
<b>Departments</b>	<b>Actions</b>	<b>Facilitating Departments</b>
<b>Commissioner Office</b>	Maintain situational awareness on potential heatwave events through continual review of notifications and forecasts from PMD and discussions with PMD to clarify specific event forecasts.	PMD
	Contact point person in each department during Heatwave – prior to Heat Warnings.	DMCs, Health Services Sindh, Health Department, Local Government Union Councillors, KMC, DDMA & PDMA, EDHI, CHIPPA, Red Crescent, HANDS, Sindh Scouts & Alamgir Welfare Trust
	Activate a heat alert and the local response citywide when heat events are forecast by notifying the key agency leaders in accordance with the Communication Plan above	
	Monitor and increase the heat alert level when necessary to match the severity of the forecast and threshold established, and have the Commissioner convene a special meeting with key agency leaders.	
<b>Pakistan Met Department</b>	Predict and share forecasts, advisories, and alerts with agencies as per the communications plan.	Commissioners Office, Health Services Sindh, Health Department
	Issue heat alerts based on expert judgment of meteorologists with the guidance of the recommended thresholds.	
	In consultation with the Commissioners Office issue alerts when heat related morbidity and mortality reports require this.	
<b>Medical and Health Department</b>	Ensure that specific information on all precautions for Heat is available to the public and in all health facilities in the form of posters and other easily accessible formats.	Commissioner Office, DMCs, PDMA, DDMA
	Maintain adequate stock of life-saving drugs/vaccines for Heat Wave related health problems.	
	Post heat-related illness prevention tips and how to stay cool in locations in and around hospitals and First Response Centres	
	Have zonal health officer visit First Response Centres to confirm proper preparation has been made for heat related illness and conduct case audits during heat season.	

## **Actions to be taken during the Heat Season (1st April 31st October)**

<b>Departments</b>	<b>Actions</b>	<b>Facilitating Departments</b>
<b>Information Department</b>	Commence public messaging to the public about the dangers of heat-related illness with the Emergency Response Commissioner via press conferences.	Commissioner Office, DMCs, Medical and Health Department
	Circulate warnings via text alerts or WhatsApp mobile messages, in collaboration with private sector telecom companies utilizing centralized mobile databases, in addition to traditional media during a heat alert.	
	Circulate warnings in bulk to the public via the centralized email databases maintained by the Information Department during a heat alert.	
	Develop an SMS alert system to send direct messages to private practitioners in addition to the medical professionals at public hospitals and First Response Centres.	
	Utilize local radio FM broadcasts to disseminate heat protection tips and high temperature warnings to the city's at-risk populations during a heat alert.	
<b>Education and Labour Department</b>	Conduct publicity campaigns during high-risk days focusing on specific areas of concern and populations of workers.	Commissioner Office
	Organize training for employees, outdoor laborers/workers on impacts of heat and how to protect themselves.	
<b>District Municipal Corporations (DMC)</b>	Maintain situational awareness and ensure readiness to respond	Commissioner Office, Health Department, Education Department, Sindh Police, PDMA
	Maintain regular contact with the Emergency Response Commissioner and ensure all necessary support is provided from local government	
	Hold awareness workshops in schools and community level	
	Make Heat response centers in UCs. Open wedding halls during days and Mosque, so that people can sit under shade.	
<b>Ambulance Service Providers &amp; Social Welfare Organization</b>	Work with Office of the Commissioner, KMC and local governments to provide necessary services to local populations	Commissioner, KMC and local government
	Ensure adequate supply of ice packs and IV fluids	
<b>Karachi Water and Sewerage Board</b>	Confirm heat health points of contact with the Emergency Response Commissioner including 24x7 emergency contact information, phone, e-mail, SMS.	DMCs & Commissioner Office

## **Actions to be taken during the Heat Season (1st April 31st October)**

<b>Departments</b>	<b>Actions</b>	<b>Facilitating Departments</b>
	Maintain situational awareness including regular contacts with the Emergency Response Coordinator  Review plans for water allocation during heat events	
<b>K-Electric</b>	Confirm heat health points of contact with the Emergency Response Commissioner including 24x7 emergency contact information, phone, e-mail, SMS.	DMCs, Commissioner Office & PMD
	Maintain situational awareness including regular contacts with the Emergency Response Coordinator	
	Review plans for electricity supply allocation during heat events	
	Continue work with the Pakistan Meteorological Department Karachi according to the MoU with K-Electric. The primary component of this MoU is that whenever PMD declares that in next days high temperatures are about to hit the city, K-Electric will decrease or stop the load shedding in such days.	
<b>Police Department (Traffic Police)</b>	Confirm heat health points of contact with the Emergency Response Commissioner including 24x7 emergency contact information, phone, e-mail, SMS.	DMCs & Commissioner Office
	Maintain situational awareness including regular contacts with the Emergency Response Commissioner	
	Review plans for traffic control during heat events	
<b>NDMA</b>	Review predictions from PDMA on a daily basis.	Commissioner Office, PMD, PDMA
	Maintain close coordination with KMC and the PDMA on the current status of the heat hazard	
<b>PDMA</b>	Ensure overall coordination with national and provincial departments.	Commissioner Office, PMD, NDMA
	PDMA should continue to support and use the SMS service for the local citizens about heatwave awareness and the ways to remain protected	
<b>DDMA</b>	Carry out tasks as delegated from the PDMA.	NDMA & PDMA

Actions to be taken on an Advisory Notice		
Departments	Actions	Facilitating Departments
<b>Commissioner Office</b>	Delegate tasks and coordinate response with: District Municipal Corporations, Karachi Water and Sewerage Board & K-Electric	PMD
	Expand access to shaded areas for outdoor workers, slum communities, and other vulnerable populations. For example, confirm that night shelters stay open all day for migratory populations during a heat alert.	DMCs, Health Services Sindh, Health Department, Local Government Union Councillors, KMC, DDMA & PDMA, EDHI, CHIPPA, Red Crescent, HANDS, Sindh Scouts & Alamgir Welfare Trust
	Identify and set up public displays of temperature and forecasts.	
	Hold a daily conference call with the Emergency Response Coordinating Committee to discuss reports and breaking developments during a heat alert, and ensure that communication channels remain operational.	
<b>Pakistan Met Department</b>	Coordinate all relevant information with NDMA/ PDMA on daily basis.	
<b>Medical and Health Department</b>	Set up Information Center to share information amongst all hospitals, health centers, and health professionals.	Commissioner Office, DMCs, PDMA, DDMA
	Produce weekly reports of the public health impact for Emergency Response Coordinator during a heat alert.	
	Post heat-related illness prevention tips and how to stay cool in locations in and around hospitals and First Response Centres	
	Ensure Human Resource/Doctors/Paramedical staff are prepared and ready to respond.	
<b>Information Department</b>	Display all emergency numbers and nearby hospital details in Offices/Schools/Universities/Factories	Commissioner Office, DMCs, Medical and Health Department
	Start Media Campaigns	
	Initiate School Awareness	
<b>Education and Labour Department</b>	Pilot project to provide emergency ice packs and heat-illness prevention materials to traffic police, transit staff, and construction workers.	Commissioner Office
<b>District Municipal Corporations (DMC)</b>	Arrange locations to be declared as heat emergency centers	Commissioner Office, Health Department, Education Department, Sindh Police, PDMA
	Coordinate cooling station and camp installation	
<b>Local Government – Mayor and Union Councils</b>	Provide a liaison between local populations in Union Councils and their councillors through to the Emergency Response Commissioner to ensure that information on local conditions and concerns is rapidly and efficiently communicated.	Commissioner & DMCs

<b>Ambulance Service Providers &amp; Social Welfare Organization</b>	Ambulances must invoke early-cooling treatment once they pick up the patient.	Commissioner, KMC and local government
	Create 'displays' on ambulances during local events to enhance public awareness.	
	Mobilize human resources at vulnerable locations	
<b>Karachi Water and Sewerage Board</b>	Work with the Emergency Response Commissioner to determine critical facilities and areas on a daily basis	DMCs & Commissioner Office
<b>K-Electric</b>	Work with the Emergency Response Commissioner to determine critical facilities and areas on a daily basis.	DMCs, Commissioner Office & PMD
	Maintain situational awareness including regular contacts with the Emergency Response Coordinator	
<b>Police Department (Traffic Police)</b>	Restrict the public from travelling on rooftop of public transport during the peak heat hours.	DMCs & Commissioner Office
<b>NDMA</b>	Coordinate with Armed Forces, INGOs, UN Bodies and Philanthropists for resource mobilization.	Commissioner Office, PMD, PDMA
<b>PDMA</b>	Launch public information campaign through 'SMS' via PTA regarding heatwave and precautionary measures.	Commissioner Office, PMD, NDMA
<b>DDMA</b>	Carry out tasks as delegated from the PDMA.	NDMA & PDMA

Actions to be taken on a Warning Notice		
Departments	Actions	Facilitating Departments
<b>Commissioner Office</b>	Mobilize all line departments including, Medical and Health Department, Information Department, Education, Labour Department and Traffic Police	PMD
	Activate “cooling centers,” such as mosques, public buildings, malls, during a heat alert and/or temporary night shelters for those without access to water and/or electricity.	DMCs, Health Services Sindh, Health Department, Local Government Union Councillors,
	Communicate the suspension of all non-essential uses of water (other than drinking, keeping cool) via the KW&SB procedures used during any water shortage.	
	Coordinate with K-Electric to ensure protocols are in place to prioritize maintaining power to critical facilities such as hospitals to K-Electric and identified vulnerable areas of the city.	
<b>Pakistan Met Department</b>	Keep continuous monitoring of temperature changes and timely communicating the information with departments	
<b>Medical and Health Department</b>	Increase staffing at hospitals and First Response Centres to attend to the influx of patients during a heat alert, if feasible.	Commissioner Office, DMCs, PDMA, DDMA
	Increase link worker and community health worker outreach in at-risk neighborhoods during a heat alert, if feasible.	
	Produce weekly reports of the public health impact for Emergency Response Coordinator during a heat alert.	
	Keep the data of each patient coming to health care facility, suffering from heat illness	
<b>Information Department</b>	Involvement of Religious Scholars	Commissioner Office, DMCs, Medical and Health Department
	Launch a public information campaign regarding the nearest Heat Emergency Centres for first aid instruction, in case the ambulance service is delayed.	
<b>Education and Labour Department</b>	Advise concerned employees organizations and employers to shift outdoor workers' schedules away from peak heat hours (12.00pm – 5.00pm)	Commissioner Office
<b>District Municipal Corporations (DMC)</b>	Make necessary arrangements for all District managed hospitals and dispensaries to be prepared	Commissioner Office, Health Department, Education Department, Sindh Police, PDMA
	Coordinate with both Mayor and Commissioner for Karachi	
<b>Local Government – Mayor and Union Councils</b>	Assist vulnerable populations & Enable self-sufficiency at neighborhood level	Commissioner & DMCs

<b>Ambulance Service Providers &amp; Social Welfare Organization</b>	Allocate ambulances at densely populated areas and near the First Response Centers.	Commissioner, KMC and local government
	Mobilize human resources at vulnerable locations	
<b>Karachi Water and Sewerage Board</b>	Work with the Emergency Response Coordinator to determine critical facilities and areas on a daily basis	DMCs & Commissioner Office
<b>K-Electric</b>	Ensure uninterrupted supply of electricity especially to Health service providers like Hospitals, Emergency centers, etc.	DMCs, Commissioner Office & PMD
<b>Police Department (Traffic Police)</b>	Ensure smooth flow of traffic near Hospitals, Emergency Centers.	DMCs & Commissioner Office
<b>NDMA</b>	Ensure activation of Emergency Operation Centers as appropriate within the NDMA.	Commissioner Office, PMD, PDMA
<b>PDMA</b>	Issue timely warning upon its receipt from Pakistan Met	Commissioner Office, PMD, NDMA
<b>DDMA</b>	Carry out tasks as delegated from the PDMA.	NDMA & PDMA

Actions to be taken on an Emergency Notice		
Departments	Actions	Facilitating Departments
<b>Commissioner Office</b>	Declare a state of emergency in all KMC run hospitals	PMD
	Consider declaring Public Holidays during a heatwave emergency.	DMCs, Health Services Sindh, Health Department, Local Government Union Councillors, KMC, DDMA & PDMA
	Increase efforts to distribute fresh drinking water to the public. For example, expand potable water access during a heat alert at religious spaces including temples and mosques, transit stations, handouts to the poor, and high-risk areas.	DMCs, Health Services Sindh, Health Department, Local Government Union Councillors, KMC, DDMA & PDMA
	Send teams to monitor the proper working of cooling Points/Sabeels having necessary arrangements	DMCs, Health Services Sindh, Health Department, Local Government Union Councillors, KMC, DDMA & PDMA
<b>Pakistan Met Department</b>	Keep continuous monitoring of temperature changes and timely communicating the information with departments Keep public informed about heat impacts through Media/Website.	
<b>Medical and Health Department</b>	Launch mobile teams for First-aid and other emergency support to affected public.	Commissioner Office, DMCs, PDMA, DDMA
	Produce weekly reports of the public health impact for Emergency Response Coordinator during Emergency.	Commissioner Office, DMCs, PDMA, DDMA
	Report heat stroke patient numbers and mortalities daily to Commissioner	Commissioner Office, DMCs, PDMA, DDMA
<b>Information Department</b>	Ensure wide publicity in local languages about precautionary measures during heatwave.	Commissioner Office, DMCs, Medical and Health Department
<b>Education and Labour Department</b>	Consider declaring Holidays during a heatwave emergency.	Commissioner Office
<b>District Municipal Corporations (DMC)</b>	Monitor all activities of subordinate departments in emergency situation and update regularly to emergency response coordinator	Commissioner Office, Health Department, Education Department, Sindh Police, PDMA
<b>Local Government – Mayor and Union Councils</b>	Manage the medical surge by ensuring people go to nearest response centres where they can get medical attention, by forming partnerships with social welfare organizations.	Commissioner & DMCs
<b>Ambulance Service Providers &amp; Social Welfare Organization</b>	Ensure attendance of all calls from heat affected people and their transportation to the nearest heatstroke center.	Commissioner, KMC and local government
	Mobilize human resources at vulnerable locations	Commissioner, KMC and local government
<b>Karachi Water and Sewerage Board</b>	Arrange special supply through tankers as required	DMCs & Commissioner Office

<b>K-Electric</b>	Maintain coordination with Commissioners office and medical and health department to ensure uninterrupted power to those regions with high levels of vulnerability as shown by heat health issues	DMCs, Commissioner Office & PMD
<b>Police Department (Traffic Police)</b>	Keep smooth flow of Traffic and allocate the traffic wardens near to those intersections which usually face traffic jams	DMCs & Commissioner Office
<b>NDMA</b>	Monitor all activities in Emergency.	Commissioner Office, PMD, PDMA
<b>PDMA</b>	Advise the relevant departments on implementation of precautionary measures.	Commissioner Office, PMD, NDMA
<b>DDMA</b>	Carry out tasks as delegated from the PDMA.	NDMA & PDMA

#### **AFTER HEATWAVE SEASON**

When the heatwave period is over PMD will declare ALL CLEAR notice. The Emergency Response Coordinator will organize an annual Heatwave Management Plan evaluation meeting with key agency leaders and relevant stakeholders. This meeting will discuss the Plan process based on performance and revise. After consultation, all recommendations for improving the Heatwave plan will be recorded as minutes of meeting and will be sent for incorporation into revised Plan.

## 6 Monitoring and Evaluation

The strategies and activities contained in the Heatwave Management Plan include data collection and monitoring as an important component so implementation partners can evaluate the Plan's effectiveness and improve over time. The Emergency Response Coordinator in the Office of the Commissioner will ensure that monitoring information is compiled on the implementation of the plan and oversee a process of annual review and plan updates as new information is gathered.

Steps in the evaluation and adjustment process are as follows:

1. Guided by the questions in Table 3 the Emergency Response Coordinator (ERC) will produce a succinct report on activities carried out during the season, results and lessons for application in the next year. This report is for public distribution.
2. The ERC will organize an annual evaluation meeting with the Coordinating Committee and other implementation partners as required to review and evaluate the Plan. Each partner should come to the meeting with monitoring data and provisional recommendations for their respective domain.
3. Based on the results of the meeting and in consultation with the Karachi Commissioner, the ERC will identify priority updates and changes to the Plan for the next year to improve effectiveness. The updated plan will be disseminated to all parties at least one month prior to the next heat season.

Table 3 outlines a set of evaluation questions and potential indicators. This is an organizing framework to guide data collection, monitoring efforts and learning from implementation. Each implementation partner can add to the questions and indicators, to suit their decision-making needs. Collecting monitoring data comes with a cost so it's important to be selective.

*Table 3: Indicators and evaluation questions focused on the implementation process<sup>30</sup>*

	Evaluation questions	Potential indicators
<b>Alerting system</b>	Were alerts issued efficiently?	<ul style="list-style-type: none"><li>• Frequency of notifications issued</li><li>• Timeliness of alerts received (watch notices, alerts, all clear statements)</li></ul>
	Were heat events forecasted and monitored accurately?	<ul style="list-style-type: none"><li>• Frequency of alerts and watches issued in relation to actual weather conditions occurring</li><li>• Capacity of PMD to deliver surveillance data</li></ul>
<b>Coordination framework</b>	Key elements of Heatwave Management Plan implemented?	<ul style="list-style-type: none"><li>• Emergency Response Coordinator – assigned with sufficient authority and resources to complete their ToR</li><li>• Coordinating Committee – formally struck and met? How many times? Was plan reviewed and feedback given?</li><li>• Control room set up and staffed appropriately? Volume of information handled? Communications effective?</li><li>• Regular and appropriate forecast information from PMD?</li><li>• Morbidity and mortality data from healthcare/hospitals? Complete? On time?</li><li>• Alert system used? Appropriately? Too often/not often enough?</li></ul>

		<ul style="list-style-type: none"> <li>Additional weather stations in place? (Details of some samples of weather station along with approximate prices are attached in appendix G)</li> <li>Data collected and centralized?</li> </ul>
	Did partners follow guidance in the framework and find it helpful?	<ul style="list-style-type: none"> <li>Number of partners engaged and assuming designated roles and responsibilities</li> <li>Number and types of response actions delivered by partners during the heat season</li> <li>Partners' views on the degree of coordination of activities</li> </ul>
	Were water supplies, electricity supplies and traffic control sufficient for the response effort?	<ul style="list-style-type: none"> <li>Level of water supply to each area of the city and the numbers of hours without water each experienced during heat events</li> <li>Level of electricity supply to each area of the city and the numbers of hours without electricity each experienced during heat events</li> <li>Number and type of traffic issues experienced during heat events</li> </ul>
	Were vulnerable groups well served during heatwave events?	<ul style="list-style-type: none"> <li>Capacity of health practitioners and emergency responders to attend people affected by heat-related illness</li> <li>Changes in service utilization</li> <li>Level of stakeholder satisfaction</li> <li>Number of people and their demographic / socioeconomic makeup who took advantage of cooling points and relief camps</li> <li>Number of people and their demographic / socioeconomic makeup who took advantage of other response actions</li> </ul>
	What do weather data and health records show regarding the impacts of the heat season? Did morbidity and mortality rates decline compared to previous heat seasons?	<ul style="list-style-type: none"> <li>Patterns in morbidity and mortality rates during the heat season</li> </ul>
<b>Information, communication and education</b>	Were there bottlenecks to communication during the heat season?	<ul style="list-style-type: none"> <li>Number and types of issues noted by implementation partners</li> <li>Stakeholder views on relevance and timeliness of communications</li> </ul>
	Were key messages and outreach provided to the public and target groups effectively?	<ul style="list-style-type: none"> <li>Number and type of communication and outreach activities delivered</li> <li>Vulnerable and general populations reached (groups disaggregated by sex)</li> <li>Capacity of media and dissemination channels to deliver appropriate messages</li> </ul>
	Did target groups understand and follow key messages?	<ul style="list-style-type: none"> <li>Changes in awareness and behaviour</li> <li>Capacity of target groups to recall accurate messaging</li> </ul>

<b>Identifying vulnerable people and places</b>	What more is known about differences in heat exposure and vulnerability across Karachi and its residents?	<ul style="list-style-type: none"> <li>• Number, types and geographic coverage of efforts to improve understanding of heat vulnerability (current and future)</li> <li>• Number and diversity of stakeholders involved in research efforts</li> </ul>
<b>Long-term strategies</b>	Has the city become more liveable for groups and individuals vulnerable to heat event?	<ul style="list-style-type: none"> <li>• Number and type of policies, practices, natural and technological solutions to improve liveability and access to basic services</li> <li>• Level of stakeholder satisfaction with changes / perceived changes in quality of life</li> </ul>
	What improvements have been made in the city to reduce the urban heat island effect?	<ul style="list-style-type: none"> <li>• Number and type of policies, practices, natural and technological solutions</li> </ul>
	How integrated is heatwave management with other initiatives and policy areas (urban development, energy, transportation, climate change)?	<ul style="list-style-type: none"> <li>• Extent to which budget and policy proposals account for health risks from heat events</li> </ul>
<b>Operating costs</b>	What resources are used to operate the heat alert and response system by both public and private sectors?	<ul style="list-style-type: none"> <li>• Resource contributions of each partner by Plan element</li> <li>• Staff time spent on different activities</li> <li>• Costs for enhanced weather and health surveillance</li> </ul>

## 7 Long-Term Strategies

Health impacts from heat are not limited to heat events that trigger an alert. Sustained hot temperatures that do not trigger an alert can also result in heat-related illness and deaths. A preventative approach, focused on improved urban development, building design, building codes, energy, and transport policies, that takes the needs and contributions of vulnerable groups into account, can reduce the overall burden of heat and contribute to broader community health benefits. In developing this Heatwave Management Plan the focus was on response and long term strategies were not investigated in detail. Therefore, insufficient information exists at this time to set specific priorities for long-term action. However, it is strongly recommended that opportunities for action on these longer-term strategies form an important component of the overall responses to heat events in Karachi and that they be considered during Plan review and refinement after the 2017 heat season.

Some of the opportunities for action that should be considered to help to make the population of Karachi more resilient in the face of future heat events include:

- Proceeding with implementation of Karachi's Strategic Development Master Plan 2020 (SDMP 2020). It has a number of land use development strategies, including local area development plans.
- Tailoring long-term strategies for land use regulation and development planning to the many faces of Karachi. Karachi is not homogenous in terms of urban development and land use. It varies from a highly congested, old city with mixed commercial, residential and industrial activity, with little green areas and narrow streets; to high-end low density and low height residential areas with good enough green spaces. Each of the 18 towns is different and each demands a tailored strategy.
- Designating areas for high-rise development, so adequate transport infrastructure, water supply and open spaces can be provided for, while discouraging scattered and haphazard growth.
- Taking advantage of cycles of city renewal to tackle urban heat islands. Inner city areas like Merriweather tower and Kemmari Town have become over populated and derelict and need to follow the course of renewal and regeneration, with due consideration given to minimizing the urban heat island effect.
- Reducing congestion by nurturing the growth of several city centers. Karachi, one of Pakistan's megacities, has grown rapidly and this trend will likely continue, considering the much less developed rural areas of the province. There is a need exists to transform Karachi into a policy-centric city, lessening the traffic and congestion that currently exists.
- Reforming existing building and land use regulations in the city and cantonment areas to incentivize green urbanization, including measures like rain water harvesting and west-open buildings (which is the predominant wind direction)

Strengthening sustainable transport options in the city. Major investments and institutional changes are needed to enhance the quality and availability of public transport in the long run, to improve the flow of traffic and reduce congestion, and reduce pollution from private cars and derelict buses / vans.

# Appendix A: Terms of Reference for Heat Emergency Coordinating Committee

## Background

The Karachi Heat Coordinating Committee (**The Committee**) which is created under the authority of the Commissioner for Karachi includes member organizations that may have specific roles and responsibilities outlined within the Karachi Heatwave Management Plan (**The Plan**). The purpose of **The Committee** is to provide updates on resources, services and capabilities, identify issues, and make recommendations regarding improvements to **The Plan**. In addition, **the Committee** may be activated during a heat event where required in order to facilitate the smooth and coordinated operation of **The Plan**.

## Mandate

Managing the heatwave situation in Karachi requires the coordinated involvement of numerous departments and agencies at different levels of government and non-governmental agencies. **The Committee** ensures that **The Plan** is reviewed and updated on an annual basis and to provide a venue for the discussion of key implementation issues.

**The Committee** will be action oriented and will:

1. Review, evaluate, and make recommendations to changes to **The Plan**;
2. Facilitate hot weather response communication, coordination and collaboration across departments and member agencies;
3. Identify new or emerging heat event issues to be considered in **The Plan**.

## Accountability

**The Committee** is accountable to the Commissioner Karachi to ensure the smooth functioning of **The Plan**.

## Membership

**The Committee** shall include senior representatives from:

1. Additional Commissioner (Emergency Response Coordinator) Chair
2. Provincial Disaster Management Agency for Sindh
3. Pakistan Meteorological Department
4. Police Department
5. Medical and Health Department
6. Information Department
7. Education and Labour Department
8. District Municipal Corporations
9. Karachi Water and Sewerage Board
10. K-Electric
11. Mayor of Karachi
12. Edhi
13. Chippa

## Meetings

**The Committee** shall be chaired by the, Emergency Response Coordinator (an Additional Commissioner), the Commissioner for Karachi, or their designate.

**The Committee** will meet in the spring prior to the heat season – prior to March 31<sup>st</sup> and after the heat season when information has been gathered and summarized for the year – after October 1<sup>st</sup>.

In addition, meetings may be called by the Commissioner for Karachi during the heat season when there are critical decisions or coordination issues that need to be addressed. Any member of **The Committee** may make a request for a special meeting to the Commissioner.

The meeting prior to the heat season will focus on ensuring that all departments are in high state of readiness and that all contacts, communications and materials are in place. At the meeting, each agency will review their roles and responsibilities and confirm contact information and capabilities.

The meeting after the heat season will focus on reviewing the past season, highlighting what worked and what didn't, and provide suggestions for improving **The Plan** and its operation in the coming year. This meeting will produce an action plan to be completed prior to the start of the next heat season.

Special meetings during the heat season will have an agenda focused on the issues that need to be resolved.

## Resources, Budget, and Staff Support

The Office of the Commissioner will provide staff support for **The Committee** including organizing meeting times, dates, and locations and ensuring that agendas are circulated in advance and minutes are circulated after meetings in a timely fashion.

## Appendix B: Sample PMD statements

The first and most critical communication is from the PMD to the Office of the Commissioner. If possible, there should be at least one week warning prior to the potential onset of heat conditions.

When there are initial concerns about the potential for a heatwave emergency it is proposed that the PMD issue a watch information statement with 3 to 7 days advanced notice to the Commissioners Office to give time for preparation and then declares a heatwave emergency within 24 to 48 hours of the expected start:

- **Heat WATCH Information Statement.** Heat watches are issued when conditions are favorable for an excessive heat event in the next 3 to 7 days. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain.
- **Declaration of a Heat ALERT.** An alert should be declared within 24 to 48 hours of the onset of dangerous heat conditions and is used as a trigger for activating the full appropriate heatwave response defined in this plan.

We recommend the following official communications from the PMD to support these alerts and ensure clear communications with all agencies:

- a. Regular '**INFORMATION STATEMENTS'** should be sent out giving the outlook for the forecast and the potential for heat concerns for the short, medium, and longer terms. These regular statements should include concerns where the potential exists for an excessive heat event in the next 3-7 days. This provides information to those who need considerable lead-time to prepare for the event. Where conditions are changing rapidly it may be appropriate to send out information statements more frequently.
- b. When there is a serious concern about the weather trend but not enough information or certainty to trigger a full scale alert the PMD should issue a special **INFORMATION STATEMENT** or '**WATCH**' notice. Informing people that there is reason for concern and that departments should get their plans in order in case the situation changes to a full alert. This would start a lot of processes moving including the release of public information but activation of all services would not happen until a full **ALERT**.
- c. Once the PMD determines the criteria have been met there should be a heat '**ALERT**' notice that would initiate the appropriate response.
- d. When the PMD feels that the heat event is over they should send out an '**ALL CLEAR**' notice stating the weather forecast for the coming days.
- e. At the end of the heat season an '**INFORMATION STATEMENT**' should be sent out summarizing what happened during the year and officially letting departments know that the heat season is over.

## Sample Urdu Statements

### الرٹ نوٹس

عوام الناس سے گذارش ہے کہ اگلے چند دن میں درجہ حرارت کے اضافے کو مدنظر رکھتے ہوئے ضروری احتیاطی تدابیر اختیار کریں

### وارنینگ نوٹس

عوام الناس سے گذارش ہے کہ اگلے چند روز میں درجہ حرارت کے اضافے کو مدنظر رکھتے ہوئے ضروری احتیاطی تدابیر اختیار کریں

### ایمرجنسی نوٹس

عوام الناس سے گذارش ہے کہ اگلے چند روز میں درجہ حرارت میں شدید اضافے کو مدنظر رکھتے ہوئے ضروری احتیاطی تدابیر اختیار کریں

The 7 day forecasts will include both the maximum and minimum expected dry bulb temperatures since both of these have been determined to be important factors in the impacts of heatwave in Karachi.

HEATWAVE WEATHER FORECAST, KARACHI 2017 PAKISTAN METEOROLOGICAL DEPARTMENT				
ALERT NOTICE				
Date: -----				
Time: -----				
Situation Report:				
Day	Date	Max Temp C°	Min Temp C°	Humidity %
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				

Immediate Actions to be taken:

- Communicate alert within each departments
- Consult nearby Heatwave emergency camps/Sabeels in case of any heat related illness
- Take plenty of water and stay in shady places

ISSUED BY:  
\_\_\_\_\_

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 THE URBAN UNIT  
 RRI  
Rural Research Institute  
 ESSA

**HEATWAVE WEATHER FORECAST, KARACHI 2017**  
**PAKISTAN METEOROLOGICAL DEPARTMENT**



**WARNING NOTICE**

Date: -----

Time: -----

Situation Report:

Day	Date	Max Temp C°	Min Temp C°	Humidity %
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				

Immediate Actions to be taken:

- Communicate alert to all relevant department
- Consult nearby Heatwave emergency camps/Sabeels/FRCS OR Hospital in case of any heat related illness
- Take plenty of water and stay indoors
- Avoid intense physical activity and avoid exposure to heat/sun
- Wear cap and light clothes

ISSUED BY:

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This notice was developed under a project sponsored by CDKN & executed by The Urban Unit & ESSA technologies.



**HEATWAVE WEATHER FORECAST, KARACHI 2017**  
PAKISTAN METEOROLOGICAL DEPARTMENT



**EMERGENCY NOTICE**

Date: -----

Time: -----

Situation Report:

Day	Date	Max Temp C°	Min Temp C°	Humidity %
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				

Immediate Actions to be taken:

- Communicate **Emergency** to all relevant department
- Consult nearby Heatwave emergency camps/Sabeels/FRCS OR Hospital in case of any heat related illness
- Take plenty of water/Juices and stay indoors
- Take shower minimum twice a day
- Avoid intense physical activity and avoid exposure to heat/sun
- Wear cap and light clothes

ISSUED BY:

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عوام الناس سے گزارش ہے کہ اگلے چند دن میں درجہ حرارت کے اضافے کو مدنظر رکھتے ہوئے ضروری احتیاطی تدابیر اختیار کریں

## Appendix C: Posters and Graphic Media for Public Dissemination



Figure 7: Awareness Material in Urdu regarding heat cramps symptoms and its response

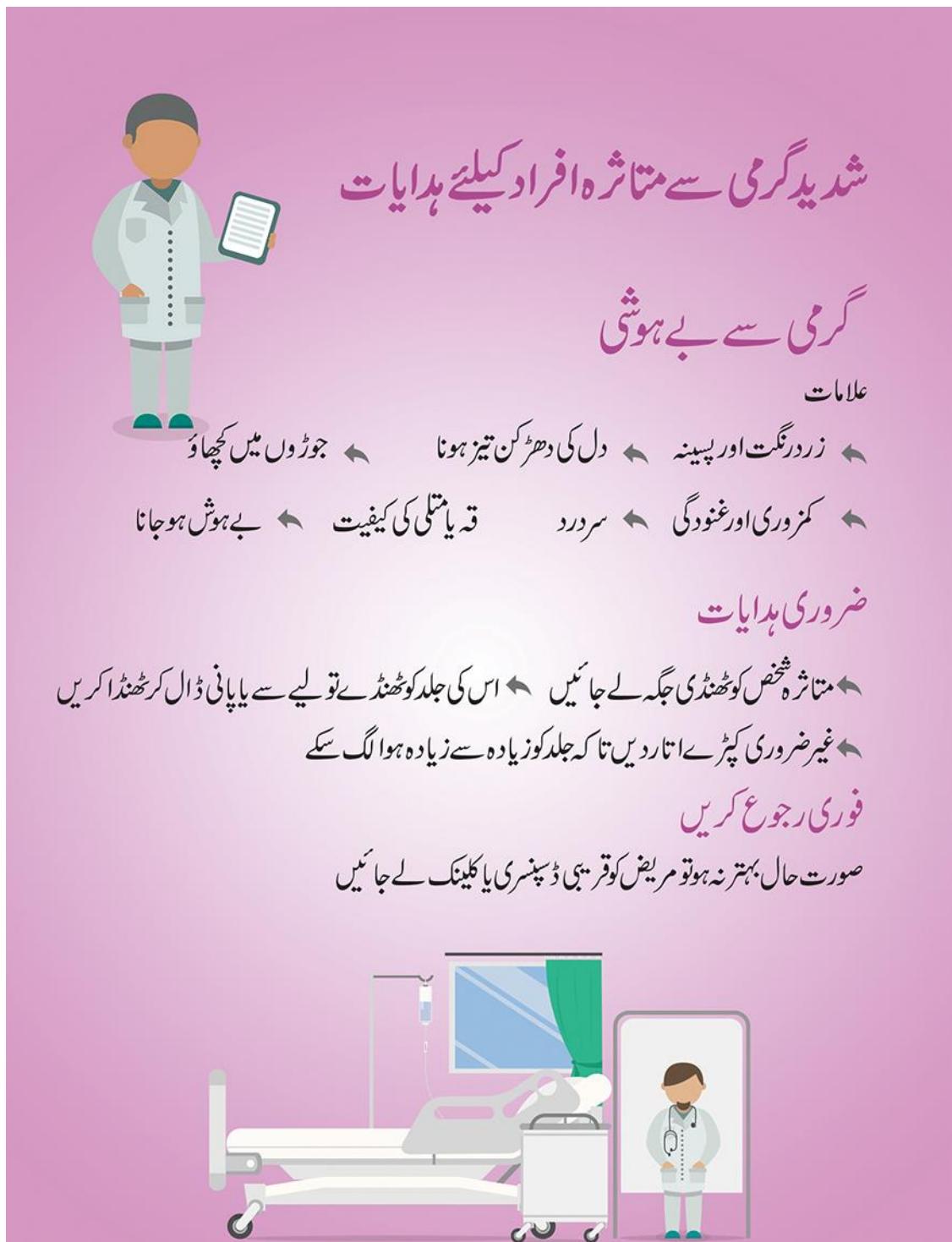


Figure 8: Awareness Material in Urdu regarding heat Exhaustion symptoms and its response



## شدیدگرمی سے متاثرہ افراد کیلئے ہدایات

### گرمی کا اسٹرُوک

علامات

- ↳ زرد رنگت
- ↳ دل کی دھڑکن تیز ہونا
- ↳ جوڑوں میں کچھا وہ
- ↳ سر درد
- ↳ کمزوری اور غندوگی
- ↳ قہیا متنی کی کیفیت
- ↳ پسینہ آنابند ہو جانا
- ↳ بہکی بہکی با تیس کرنا
- ↳ خشک اور سرخ جلد
- ↳ بے چینی اور بے ہوشی کی تمام نشانیاں

### ضروری ہدایات

- ↳ متاثرہ شخص کو ٹھنڈی جگہ لے جائیں
- ↳ درجہ حرارت کم کرنے کیلئے سونھے کا استعمال کریں
- ↳ غیر ضروری کپڑے اتار دیں تاکہ جلد کو زیادہ سے زیادہ ہوا لگ سکے

### فوری رجوع کریں

یا یہ جنسی صورتحال ہے اس لیے جلد سے جلد ایمبو لینس بلاکر مریض کو فریبی اسپتال لے جائیں



Figure 9: Awareness Material in Urdu regarding heat stroke symptoms and its response

## ہدایات برائے عوام الناس

### گرمی سے بچیں

- دو پہر 11 سے 3 بجے تک سورج / دھوپ سے دور رہیں۔
- ناگزیر صورت حال میں سایہ دار جگہ میں رہیں، جلد پر سن سکرین لگائیں اور ٹوپی اور اسکارف کا استعمال کریں۔
- شدید جسمانی مشقت سے بچیں
- ڈھیلڈھالے اور آرام دہ لباس پہنیں



### خود کو ٹھنڈا رکھیں

- مشروبات کثرت سے استعمال کریں، زیادہ کافی، گرم مشروبات اور الکوالول سے اجتناب کریں۔
- ٹھنڈی تاثر والی غذا کھائیں جیسے کہ سلا دا اور زیادہ پانی والے بھل کھائیں
- ٹھنڈے پانی سے نہ کمیں
- اپنے کپڑوں اور جملہ کو پانی سے گیارہ کھیں خاص طور گردن کے پچھلے حصے کا خیال کریں۔



### اپنے گرد نواح کو ٹھنڈا رکھیں۔

- اپنے رہنے کی جگہ کو خصوصی طور پر نوازندہ بچوں، بزرگوں اور بیماروں کے لیے ٹھنڈی اور آرام دہ رکھیں۔
- بینچ اور بیڈ رومن میں درج حرارت جانشی کے لیے تھرما میٹر لگائیں
- دن کے وقت کھڑکیاں بند اور رات کو کھلی رکھیں۔
- سورج کی طرف لگئے ہوئے پردے بندر کھیں، بلاستڈز اور گہرے رنگوں کے پردے حرارت جذب کرتے ہیں  
لہذا کھڑکیوں اور پردوں کی درمیانی بچبوں پر منکری اشیاء رکھیں۔
- غیر ضروری روشنیاں اور برقی آلات مت چلا کیں کیونکہ یہ درج حرارت بڑھاتے ہیں۔
- درج حرارت کو قابو کھنے کیلئے گھر کے اندر پردے اور پانی سے بھرے برلن رکھیں۔ ہو سکتے تو سونے کیلئے ٹھنڈے کمرے میں منتقل ہو جائیں۔
- 35 ڈگری یعنی گریڈ کے نیچے کھکھوں کے استعمال سے فرق پڑ جاتا ہے۔



Figure 10: Awareness Material in Urdu regarding Precautionary actions for general Public



## رمضان میں گرمی سے بچاؤ کی ہدایات

مسلم ائمہ کے پیشہ افراد رمضان کے میں پابندی سے روزے رکھتے ہیں اگر رمضان شدید گرمی کے ہمینوں میں آئے تو روزے کے دوران گرمی کی شدت سے بچاؤ کے لائق عمل سے پہلے ہی تیار کر لینا چاہیے۔ سحر و افطار کے درمیان طویل وقت سے پانی کی کمی ہو سکتی ہے جو کہ گرم علاقوں میں روزہ داروں کی اصل آزمائش ہے۔ اس سے بچنے کے لیے سحر و افطار کے اوقات میں وافر مقدار میں پانی اور مشروبات کا استعمال لینی بانا چاہئے۔

اگر روزہ کے دوران طبیعت کی ناسازی، بے چینی اور تھکاوٹ یا بے ہوشی کی کیفیات محسوس ہوں تو روزہ قضا کر کے پانی اور وافر مقدار میں مشروبات لیں۔ ایسی کیفیات زیادہ تر بوڑھوں اور بیلڈ پریشر، ذیابتیس اور گردوں کے امراض میں بتلا مریضوں میں عام ہیں۔ اپنے ارد گرد باقی افراد خصوصاً بچوں کی صحت پر خصوصی توجہ دیں تاکہ وہ صحت کے منشاء کے بغیر روزہ رکھ سکیں۔



Figure 11: Awareness Material in Urdu regarding Precautionary actions for fasting in Ramadan



چھوٹے اور سکول جانے والے بچوں کی دیکھ بھال کرنے والوں کے لیے ہدایات

### گھر سے باہر

- 30 ڈگری سینٹی گریڈ سے زائد درجہ حرارت پر بچوں کو جسمانی سرگرمیوں میں حصہ نہیں لینا چاہیے۔
- گھر سے باہر کھلنے والے بچوں کو زیادہ سے زیادہ سایہ دار ہلگبھوں پر رکھیں۔
- بچوں کو ہلکری نگ کے ڈھیلے ڈھالے آرام دہ کپڑے پہنانیں اور چوڑے کنارے والی ٹوپیوں کا استعمال کرائیں تاکہ دھوپ سے جلن محسوس نہ ہو۔
- اگر بچوں کو 20 منٹ سے زائد بیرونی سرگرمی میں مصروف رکھنا ہو تو ڈھیلے کپڑوں کے ساتھ ساتھ دھوپ سے بچاؤ کی کریں۔
- گرمی میں بچوں کو عام دنوں سے زیادہ مقدار میں ٹھنڈا پانی پلاں۔
- ٹھنڈی جگہ پر لگے ہوئے پانی کے نکلے کا درجہ حرارت پینے کے لیے مناسب ہے۔



### گھر کے اندر

- گھر کی کھڑکیاں اور روشنداں علی الصبح یا رات کو کھول دیں تاکہ جمع شدہ حرارت باہر نکل جائے۔ سیکورٹی کی صورتحال کے مطابق کھڑکیاں کھولیں
- کھڑکیوں اور روشنداں کو کمبل بند کرنے کی بجائے ان کو تھوڑا کھول کر رکھیں تاکہ ہوا کا گذر ہو سکے۔
- سورج کی تیش سے نپخ کے لیے سازمان استعمال کریں مگر سورشیدنگ سے ہوا کے گزر نے کو متاثر نہ ہونے دیں۔
- شدید گرمی میں برقی روشنیوں کا استعمال کم سے کم کریں۔



Figure 12: Awareness Material in Urdu regarding Heatwave Precautionary actions for Children (Front)

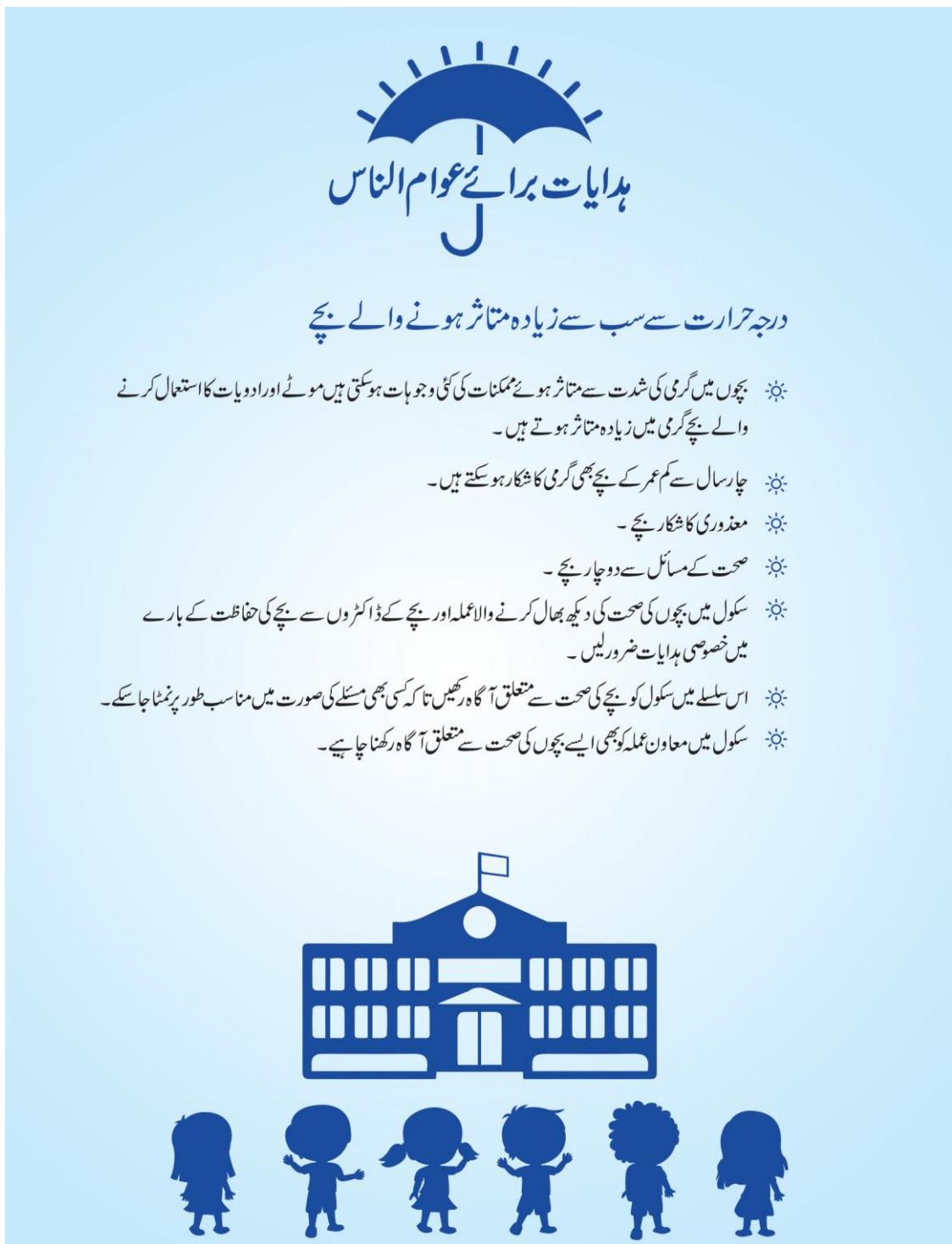


Figure 13: Awareness Material in Urdu regarding Heatwave Precautionary actions for Children (Backside)

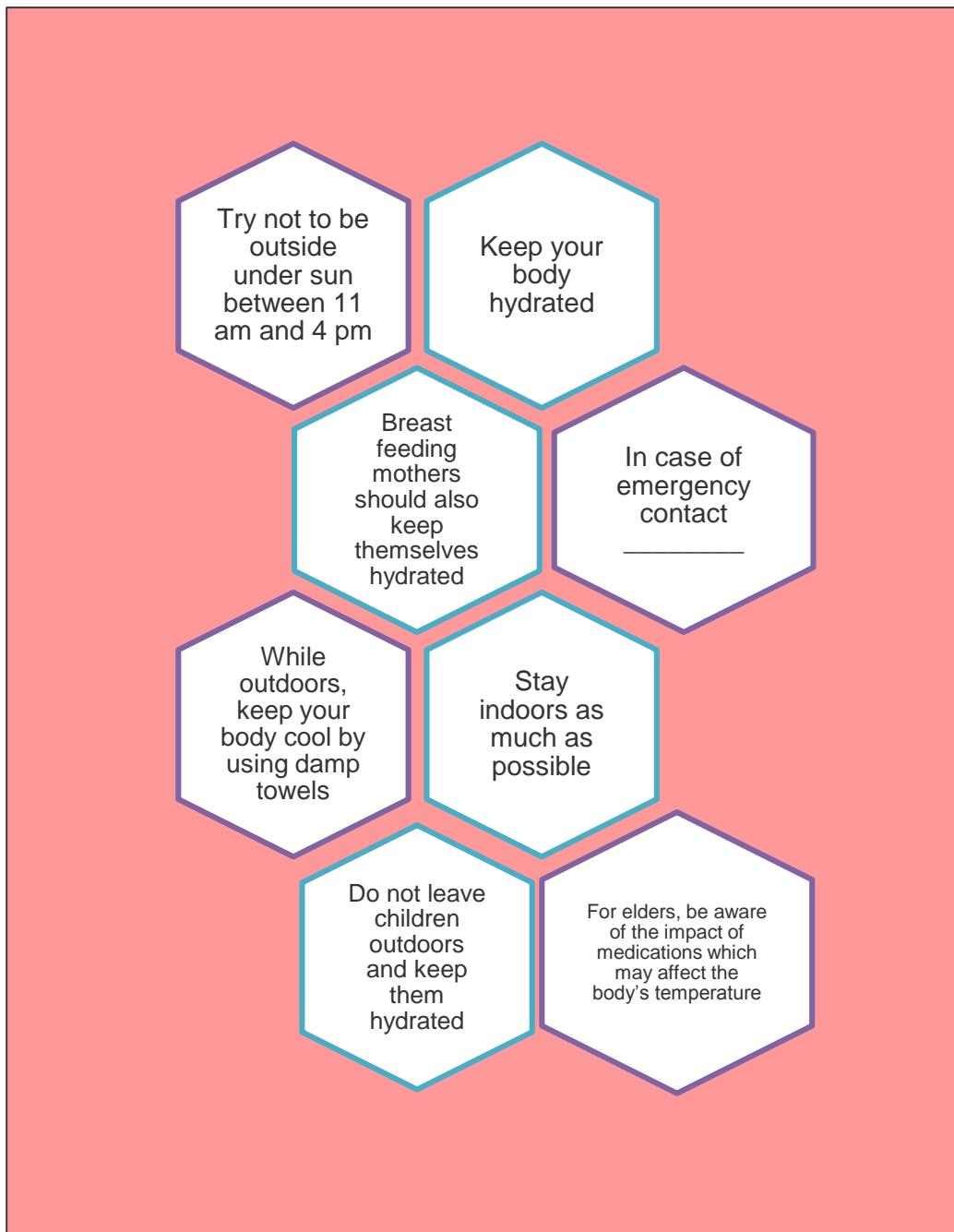


Figure 14: Awareness Material in English regarding Preventive Measures

## Appendix D: Analysis of weather data from 2006-2015 at Karachi airport and exploration of alternative heat alert systems.

Several heatwave management studies point to the importance and need for having clear criteria that trigger a response to a heatwave event (US EPA 2006; VAGO 2014; McGregor et al. 2015). Having clear criteria and thresholds will help ensure that actions to mitigate the impacts of a heatwave are mobilized transparently and consistently. It is important to give careful consideration to the criteria and thresholds being used since there can be consequences of either under reporting or over reporting heat alerts. For instance, if the criteria are too lenient (e.g., a low temperature threshold is used) there may be heat alerts that don't lead to human health effects which can be costly and lead to desensitization of the community to heat alert messaging if the alerts are too frequent and the weather does not lead to impacts on human health. Alternatively, if the criteria are too stringent (e.g., a high temperature threshold is used) a community may fail to deploy actions to mitigate the impacts of heat and can lead to losses of life which might have been avoidable. Thus, it is essential that heatwave criteria are developed in a way that relate the criteria and thresholds to heat stress and reflect the risk tolerance of decision makers, as well as the community.

A review of approaches for determining heatwave criteria reveals several common features (McGregor et al. 2015; Gachon et al. 2016). There are distinctions in the types of indices being used: climate indices which use meteorological data (e.g., direct measurement of daily maximum of the dry bulb temperature) or biometeorological indices which are based on models of how human physiology responds to heat (e.g., heat index which combines temperature and humidity using an established formula). Climate indices and their related thresholds can be based on a single meteorological variable (e.g., exceedance of a maximum daily temperature) or a combination of variables (e.g., exceedance of maximum daily temperature and minimum nighttime temperature over a specific duration). Thresholds for climate or biometeorological indices can initially be calculated based on analysis of historic records using absolute (e.g., average of maximum daily temperature over a period of interest + 5 C) or relative values (e.g., 95<sup>th</sup> or 99<sup>th</sup> percentile of the maximum daily temperature over a period of interests). Importantly, it is recommended that these thresholds also be validated by analyses of human health records to ensure there is a relationship among the criteria, thresholds, and heat stress. Once a threshold is set, they can also be combined with a forecasting probability which allows for an early warning system when using weather forecasts to anticipate near term weather conditions and issue heatwave alerts (e.g., an alert is issued when there is a 50% chance of exceeding the 99<sup>th</sup> percentile of maximum daily temperatures).

Since health data was limited to 2015, it was not possible to develop a heatwave alert system based on a relationship between climate and human health effects. Hence, we developed four heatwave alert systems based on the different approaches of others and applied them to the historic data set from 2006 to 2015 to see how they would have triggered different heat alerts in the past. We analyzed temperature and humidity data from the airport from 2006 to 2015 during the period from May 1<sup>st</sup> to July 31<sup>st</sup> to explore weather conditions at the Karachi airport and then use these analyses to inform development of alternative heatwave alert systems. The intent is that these alternative systems could be further discussed and explored with local stakeholders and decision makers in Karachi to assess how well these alert systems reflect local conditions and how well they characterize heatwave conditions in previous years.

Based on our analysis, a first determination was to propose a climate index as opposed to a biometeorological index. An exploration of the climate data revealed greater temporal variability in

heat index values (which combine maximum temperature and humidity) when compared to air temperatures. Due to the driving influence of humidity it was also expected that there would be greater spatial variability in heat index values across the city and potentially greater challenges in longer range forecasting of heat index if it were to be used as an early warning system. An analysis of average and daily maximum temperatures was then used to identify thresholds that could be used in the alert systems (summarized in Table 4). As noted by a review of the approaches of others, thresholds can be set at a +3 C / +5 C above average conditions or at threshold representing an extreme percentile (e.g., 90<sup>th</sup> to 99<sup>th</sup>). An exploration of Karachi's climate data, in particular weather conditions surrounding the 2015 heatwave, revealed some of its uniqueness compared to other years. In 2015 the maximum recorded temperature was 43.5 C, which was also recorded in May 2011. The duration of heatwave in 2015 was unusual, however, in that conditions were sustained above 40 C for 5 consecutive days and only sustained for 1 day in 2011. Moreover, nighttime lows in 2015 were sustained above 30 C on consecutive days for more than a month meaning that there was also no relief for people from daytime highs. All things considered, we developed four alert systems that could be applied against historic data for Karachi and which would represent a range of stringencies in the number of alerts that would have been issued. These four alert systems are specified in **Error! Reference source not found.** and generally described as follows:

- **Alert system 1** is based on a climate index that sets thresholds around the 95th, 99th, and 99.5th percentiles of the daily maximum of the dry bulb temperature (Tmax) between May 1<sup>st</sup> and July 31<sup>st</sup>.<sup>7</sup>
- **Alert system 2** is based on a climate index that sets thresholds around the 95th and 99th percentiles of the daily maximum of the dry bulb temperature (Tmax) between May 1<sup>st</sup> and July 31<sup>st</sup> alongside a consideration of the duration of heat conditions.
- **Alert system 3** is based on a climate index using thresholds based on average daily maximum of the dry bulb temperature (Tmax) between May 1<sup>st</sup> and July 31<sup>st</sup> plus 3 C and 5 C alongside a consideration of minimum nighttime temperatures (Tmin) above 24 C and duration of extreme conditions.<sup>8</sup>
- **Alert system 4** is based on a climate index of average that sets thresholds based on the average daily maximum of the dry bulb temperature between May 1<sup>st</sup> and July 31<sup>st</sup> plus 3 C and 5 C alongside a consideration of minimum nighttime temperatures above 30 C (a threshold that is more reflective of Karachi extreme night time lows) and the duration of extreme conditions.

Figure 16, Table 6, and

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<sup>7</sup> This alert system is similar to the one developed for Ahmedabad though is around 3 degrees Celsius cooler due to the coastal influence of Karachi and higher humidity, which can lead to a higher Heat Index compared to inland areas.

<sup>8</sup> This alert system is similar to the one used by the National Weather Service Forecast Office of the National Oceanic and Atmospheric Administration (<http://www.nws.noaa.gov/om/heat/www.shtml>) which is also used in Sri Lanka.

Table 7 Summarizes the type (yellow, orange, or red) and number of alert days that would have been issued if these alternative systems were applied between 2006 and 2015. A separate data file is available to illustrate how these alerts would have been distributed across days in these years. The total number of yellow, orange, and red alert days across these alternatives ranges from 18 to 80 days over 10 years of record (or on average 1.8 to 8 alert days per year). Of particular interest is the number of red alert events. Alerts for these events are expected to trigger the fullest extent of deployment of actions to mitigate heat stress across the city.

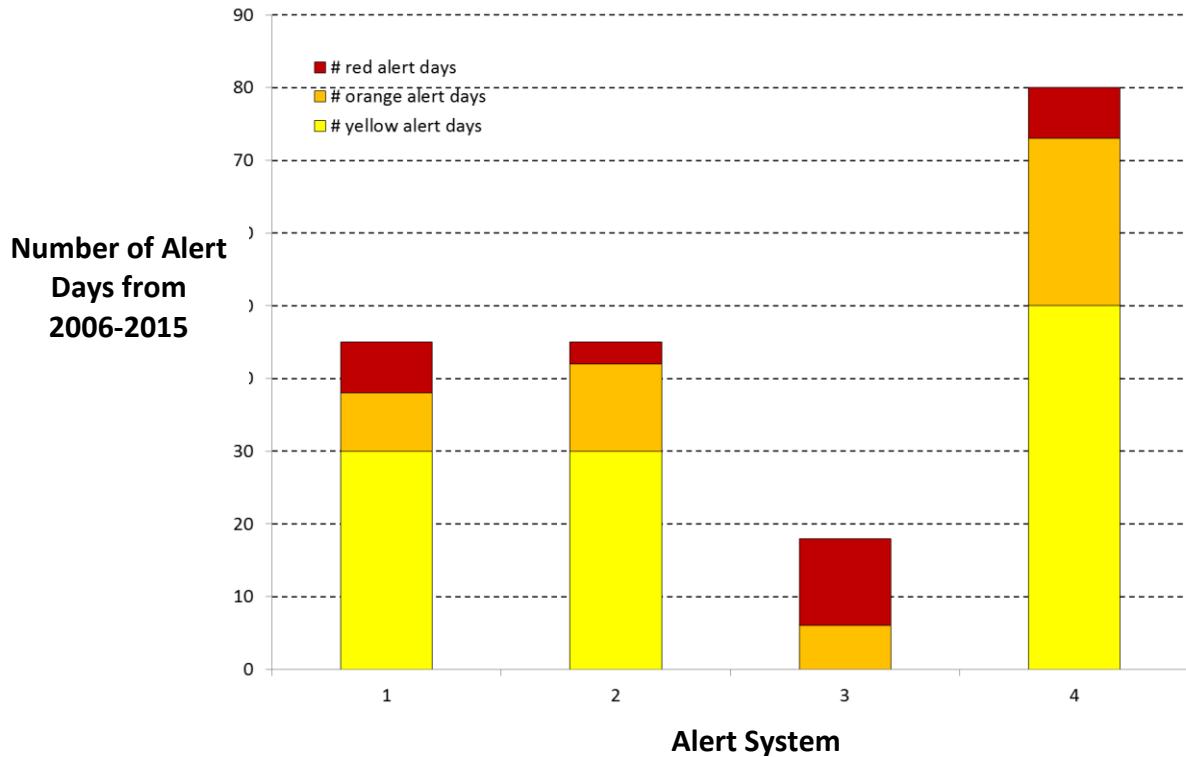
Table 7 represents the number of red alert events and years in which they would have occurred using these different alert systems. All systems would have triggered a red alert event around the extreme conditions in 2015, though other red alerts would have been issued in other years depending on the criteria and thresholds that are used.

*Table 4: Summary statistics of the daily maximum dry bulb temperature (Tmax) from 2006-2015 at the Karachi airport during the period from May 1<sup>st</sup> to July 31<sup>st</sup>.*

Temperature criteria	Value
Average Tmax	34.0 C
Average Tmax + 3 C	37.0 C
Average Tmax + 5 C	39.0 C
90th percentile of Tmax	36.5 C
95th percentile of Tmax	37.5 C
99th percentile of Tmax	40.9 C
99.5th percentile of Tmax	42.0 C

*Table 5: Summary of the alternative alert systems for Karachi which were applied against historic weather data from 2006-2015 at the Karachi airport.*

Warning level	Alert system 1	Alert system 2	Alert system 3	Alert system 4
White (no alerts)	Tmax is 37.9 C or less	Tmax is 37.9 C or less		Tmax is 36.9 C or less
Yellow	Tmax is between 38 C and 39.9 C	Tmax is between 38 C and 39.9 C	No trigger	Tmax is between 37 C and 38.9 C
Orange	Tmax is between 40 C and 41.9 C	Tmax is 40 C or higher for less than 72 hours	Tmax is between 37 C and 38.9 C AND Tmin is higher than 24 C for 48 hours or more	Tmax is 39 C or higher
Red	Tmax is 42 C or higher	Tmax is 40 C or higher for 72 hours or more	Tmax is 39 C or higher AND Tmin is higher than 24 C for 48 hours or more	Tmax is 39 C or higher AND Tmin is 30 C or higher for 48 hours or more



*Figure 15: Summary of the number of alert days after applying the different alert systems to historic weather data from 2006-2015 at the Karachi airport. These data are summarized in*

*Table 7.*

*Table 6: Summary of the years and number of red alert events that would have been issued after applying the alert systems to historic weather data from 2006-2015 at Karachi airport. Each X indicates a red alert event that would have been triggered in a given year. In some cases, a single event includes multiple consecutive red alert days (e.g., 2015). In 2011, alert system #1 and #4 identified different red alert events at different times of year (denoted by \*).*

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<b>Alert system 1</b>						X*	X		X	XX
<b>Alert system 2</b>										X
<b>Alert system 3</b>	X			X		X*	X	XX	X	X
<b>Alert system 4</b>	X							X	X	X

*Table 7: Summary of the types and number of alert days from May 1<sup>st</sup> to July 31<sup>st</sup> after applying the alert systems in **Error! Reference source not found.** to historic weather data from 2006-2015 at the Karachi airport. These data are shown in Figure 16.*

Types of alert days	Alert system 1	Alert system 2	Alert system 3	Alert system 4
Number (%) of yellow alert days	30 (3.3%)	30 (3.3%)	Not applicable	50 (5.4%)
Number (%) of orange alert days	8 (0.9%)	12 (1.3%)	6 (0.7%)	23 (2.5%)
Number (%) of red alert days	7 (0.8%)	3 (0.3%)	12 (1.3%)	7 (0.8%)
Total number (%) of alert days during period from May 1 to July 31 across 2006-2015	45 (4.9%)	45 (4.9%)	18 (2.0%)	80 (8.7%)
Average number of alert days per year	4.5 days	4.5 days	1.8 days	8 days

## References

- Gachon, P., Bussières, L., Gosselin, P., Raphoz, M., Bustinza, R., Martin, P., Dueymes, G., Gosselin, D., Labrecque, S., Jeffers, S., and Yagouti, A. 2016. Guide to identifying alert thresholds for heat waves in Canada based on evidence. Co-edited by Université du Québec à Montréal, Environment and Climate Change Canada, Institut National de Santé Publique du Québec, and Health Canada, Montréal, Québec, Canada, 71 p.
- McGregor, G.R., P. Bessemoulin, K. Ebi and B. Menne (editors). 2015. Heatwaves and Health: Guidance on Warning - System Development. Prepared by the World Meteorological Organization and World Health Organization.
- US Environmental Protection Agency (US EPA). 2006. Excessive Heat Events Guidebook. EPA 430-B-16-001. Updated Appendix in 2016.
- Victorian Auditor-General's Office (VAGO) 2014. Heatwave Management: Reducing the Risk to Public Health. Victorian Auditor-General's Report.

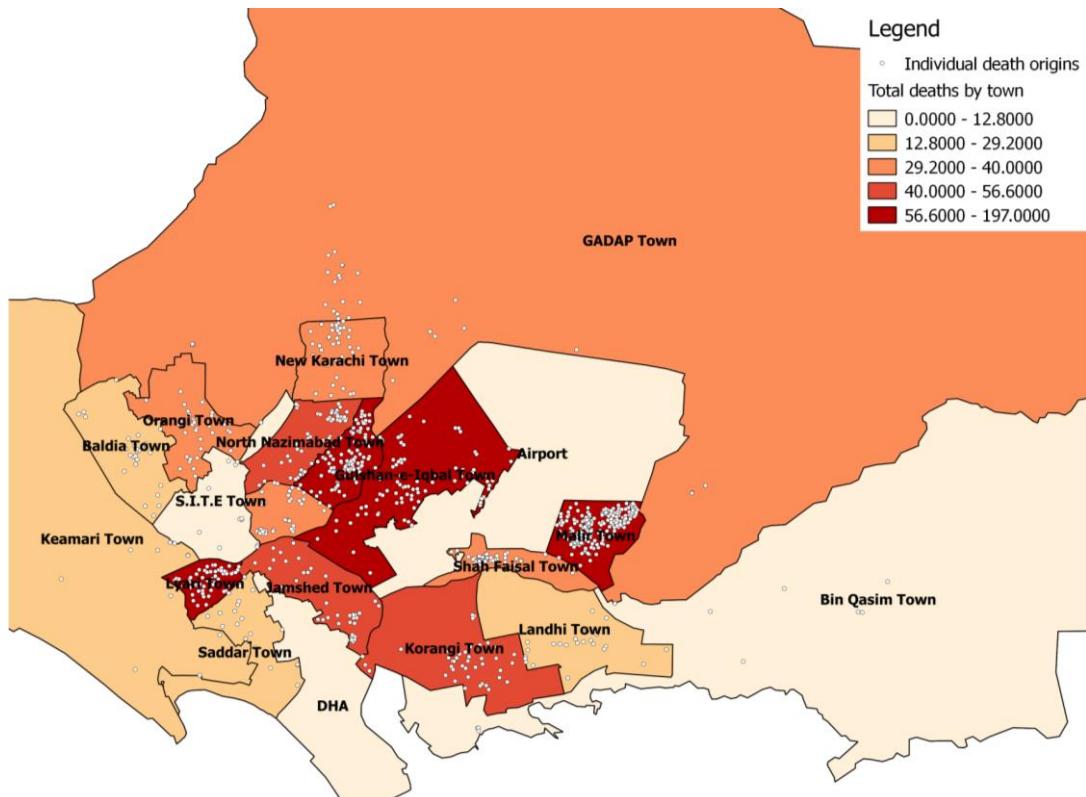
## Appendix E: Spatial pattern of heat-related deaths across Karachi from the 2015 heatwave

To inform the Heatwave Management Plan, it is useful to understand the spatial pattern of deaths from the 2015 heatwave event. This information may be helpful to understand the location of Towns and Union Councils that may be most vulnerable during future events. As noted in the situational assessment report, hospital and ambulance data was collected to understand the locations of origin for 874 people that died and were admitted to hospitals during the 2015 heatwave event. The distribution of deaths across Karachi and a summary of the data are presented here to inform the Heatwave Management Plan.

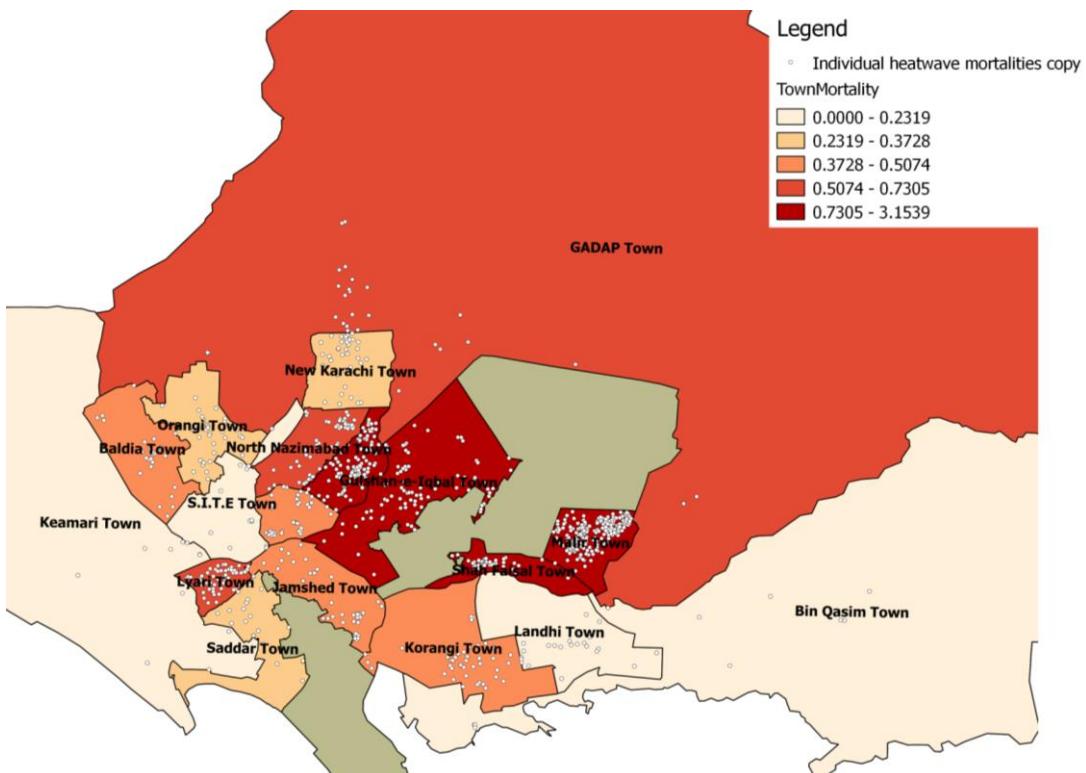
Based on observations of deaths from 2015, the data can be summarized in a variety of ways. Deaths can be summarized according to the boundaries of Karachi's Towns or Union Councils. The preferred spatial scale for summarizing these data will depend on the needs of decision makers and the way in which they can or will mobilize resources during future heatwave events. For instance, a summary of deaths by Town would be of value if there is an interest by decision makers to identify towns with the highest mortalities from 2015 so they can dedicate sufficient resources in the future. There are also two ways in which to summarize deaths from 2015. A first approach is to summarize deaths according to total deaths, either across Towns or Union Councils. These data provide an indication of the areas that were hit hardest in 2015 and for which it may be necessary to consider additional mitigation actions in future events. Another approach is to summarize death rate based on the number of deaths per 10,000 people, for instance. Differences in death rate may represent differences in vulnerability after accounting for population size within a Town or Union Council, since Towns or Union Councils with higher populations will tend to have high mortality if all other factors are equal.

Figure 16 provide a summary of total mortality across Towns, while Figure 17 provide a summary of mortality rate per 10,000 people across Towns. As noted, the rank order of most affected Towns is different based on these two ways of summarizing the data. Figure 18 provide a summary of total mortality for Karachi at a finer spatial scale – across Union Councils, while Figure 19 provide a summary of mortality rate per 10,000 people across Union Councils. Again the rank order of most affected Union Councils is different. A note of caution is that these data represent a pattern of mortality from 2015 and that this pattern may not necessarily be the same in future events. As well, the observations of mortality represent about 70% of documented mortalities in 2015. Hence, there is the potential for bias in these data since a large proportion of deaths are not represented.

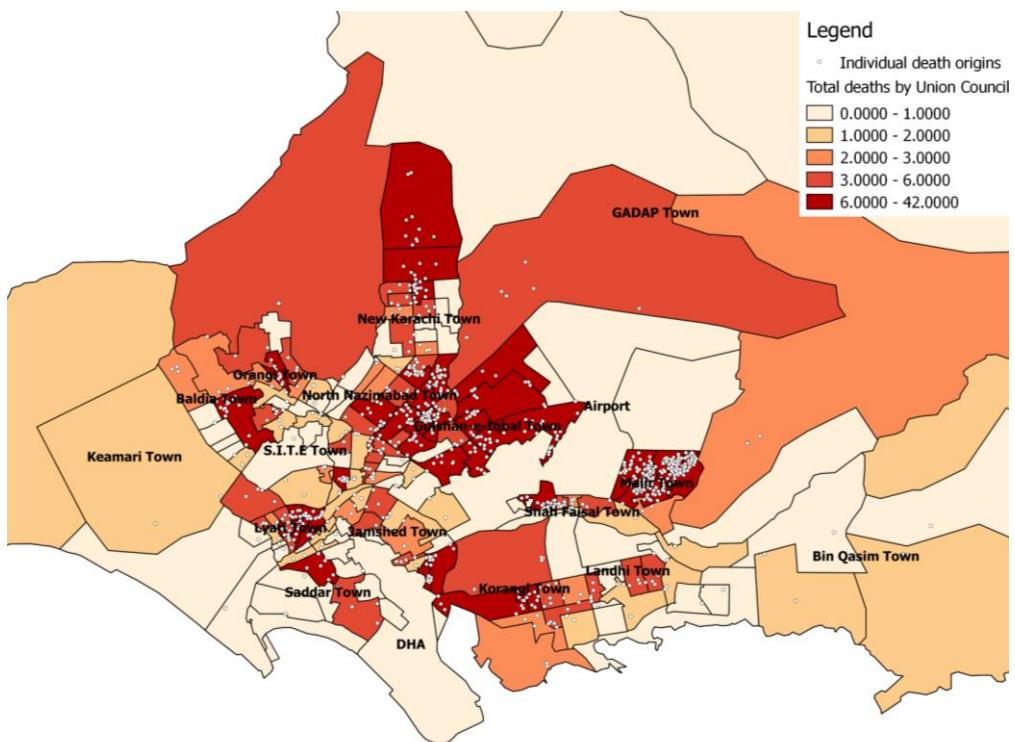
To use this information it is important to be clear on the spatial scale that is most appropriate for managers to help them make decisions about how to mobilize resources across the city (i.e. Town or Union Council). It is also important to use the summary that best represents the interests of decision makers (i.e., total mortality or mortality rate) and how they may use this information when responding to future events.



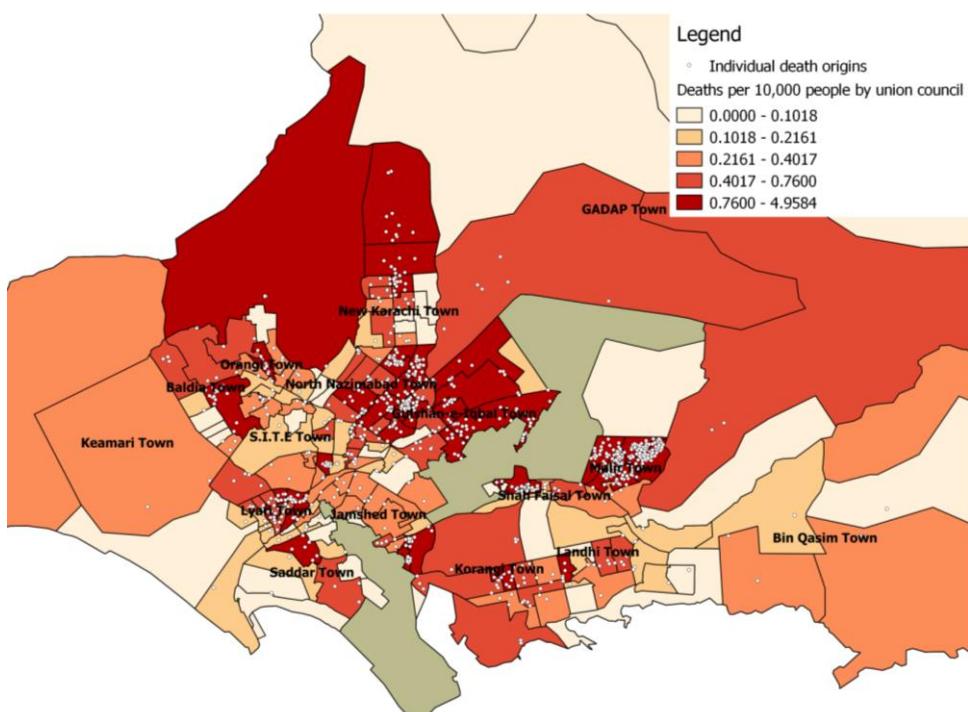
*Figure 16: Map of Karachi with death origins from the 2015 heatwave and colour shading of towns according to the total deaths within those towns.*



*Figure 17: Map of Karachi with death origins from the 2015 heatwave and colour shading of towns according to the deaths per 10,000 people within those towns (based on an estimate of 2016 population).*



*Figure 18: Map of Karachi with death origins from the 2015 heatwave and colour shading of union councils according to the total deaths within those union councils.*



*Figure 19: Map of Karachi with death origins from the 2015 heatwave and colour shading of union councils according to the deaths per 10,000 people within those union councils (based on an estimate of 2016 population).*

# Appendix F: Detailed Strategies

Two of the most significant weaknesses in the city's response to the June 2015 heatwave were (i) the lack of a heat alert or well-publicized trigger to activate a response and (ii) the lack of inter-agency coordination and unclear roles in the response effort. Karachi's Heatwave Management Plan includes three foundational components to address these issues:

- A three-tier alert system,
- A communications plan to ensure well regulated information flow amongst agencies and effective and efficient delivery of public-health messages, and
- Clear roles and responsibilities to ensure a coordinated and effective multi-agency response.

The strategies presented below contribute to meeting the Plan's main objectives of reducing vulnerable groups' exposure to heatwave and increasing their capacity to take protective action. Literature reviews, data analysis of health outcomes of the June 2015 event and consultations with stakeholders in several formats informed the selection of these strategies. They are based on the best available information and adjustments over time are expected, especially in the way strategies and activities are targeted to vulnerable groups. Strategies follow three time frames:

- Action during heat events to protect vulnerable groups.
- Seasonal planning and action each year to ensure partners are prepared to respond and resources are available to deploy.
- Urban planning and management to address root causes of vulnerability, including issues related to the built environment, liveability, and provision of basic services.

## Action during Heatwave Events

### Gathering Data and Information on Weather and Health Outcomes

It is critical that a significant effort is put into gathering additional information during heat events in Karachi so that the plan can be refined and improved. At present, there is limited information on the detailed patterns of temperature and humidity across the city and minimal information on health effects other than mortalities recorded at hospitals.

Two of the most critical uncertainties encountered in the development of the current plan for Karachi are:

- A. The temperature and duration guidelines for triggering different levels of heat alerts including heat emergencies; and
- B. The spatial patterns of morbidity and mortality from heat related illnesses and how these relate to local temperature and humidity and other factors such as age, gender, pre-conditions, and occupation.

To address these uncertainties the following information gathering activities should be implemented during the heat season and specifically during heat events:

1. Collection of hourly temperature and humidity data at many more locations across the city.  
**We recommend that at least one weather station be set up in each Union Council.**
2. Update admissions and emergency case record procedures in hospitals and clinics to track heat-related morbidity and mortality including additional information on the circumstances of the illness such as:

- a. Date and time of record,
- b. Hospital or health unit name,
- c. Location of residence,
- d. Ambulance pick up location (if available/appropriate),
- e. Member of a vulnerable population? Select as many as apply: Nomad, Internally Displaced Person, below poverty line, living in a slum, pregnant woman, malnourished child, senior citizen)
- f. Residence description (single story, multistory, mud, etc.),
- g. Location of work,
- h. Type of work,
- i. Age,
- j. Gender,
- k. Marital status,
- l. Contributing pre-existing conditions, and
- m. Any specific risk factors.

## Informing, Communicating, and Educating

A heat wave alerting system is of limited utility unless the public have been educated in what to do with this information. It is critical to reach people to educate them on the risks and appropriate responses both prior to an event and as a refresher during an event. To be effective and maximize reach, a range of different media and educational approaches should be used and selected based on communication and education objectives and audiences.

- **Conduct public and media campaigns to raise awareness and promote adaptive behaviours:** Three types of campaigns appear most relevant, at present: (1) a public information campaign regarding the nearest Heat Emergency Centres for first aid instruction, in case the ambulance service is delayed, (2) sustained communications on emergency information, heat protection tips and high temperature alerts to the city's at-risk populations during a heat alert; and (3) a campaign tailored to specific areas of concern and populations of workers during high-risk days, providing information on how to prevent heat illness. Dissemination methods for consideration include public displays, local radio FM broadcasts, SMS alerts or WhatsApp mobile messages. Partnerships with telecommunications companies should be pursued to minimize costs and maximize reach. It is important that the media be educated to provide accurate and appropriate information and not raise unnecessary levels of fear. Annex C contains tools to help develop targeted messages.
- **Disseminate messages through health-care facilities:** Hospitals, First Response Centres and ambulances are ideal places to disseminate visual displays and messages to prevent heat-related illness and tips on how to stay cool and keep others (dependents, employees, neighbours) cool.
- **Undertake outreach in schools and communities.** Focused outreach during heat alerts can be beneficial, especially if outreach targets individuals who will then share information with others. This includes holding awareness workshops in schools (with teachers and children as messengers) and with known local leaders, including community and religious leaders.

## Reducing Heat Exposure

Since 2015, the Commissioner and partners instituted targeted actions to reduce the health impacts of heat in the city. This included providing coolers and safe-drinking water at numerous public locations and ensuring that a number of air-conditioned ambulances were available at First Response Centres. Additional efforts to consider are as follows:

- **Increase access to cool spaces and shade.** Three activities are envisioned. First, designating “cooling centers,” such as mosques, public buildings, malls, during a heat alert and/or temporary night shelters for those without access to water and/or electricity. Second, expanding access to shaded areas for outdoor workers, slum communities and other vulnerable groups so they can get relief from heat. This includes confirming that night shelters stay open all day for migratory populations during a heat alert. Third, government and non-government organizations need to coordinate the placement and number of cooling stations and camps to maximize reach.
- **Provide relief to heat-exposed workers and others exposed to outdoor heat.** This includes two types of activities. The first is establishing guidance and rules to limit exposure to heat. For example, providing guidance to employers to shift outdoor workers’ schedules away from peak heat hours and restricting travel on bus rooftops during peak heat hours. Shifting schedules for indoor workers exposed to waste heat and non air-conditioned environments may also be appropriate. The second involves direct interaction with vulnerable groups such as traffic police, transit staff, construction workers and rickshaw drivers to provide cool drinking water and ice packs in tandem with information on how to prevent heat illness.
- **Ensure reliable access to water for drinking and keeping cool.** Activities here span the gamut from coordinating with the water utility to suspend non-essential uses of water during heatwave emergencies, ensuring non-interrupted supply to critical facilities and areas of the city, arranging special supply through tankers and distributing cool drinking water to the public.

## Seasonal Planning and Action

After the June 2015 event, some actions were put in place to prepare for future heat events. Efforts focused on reducing the load on primary health centers by decentralizing care through the establishment and equipping of 185 First Response Centers. Roll out of the following strategies also merits close attention.

### Identifying Vulnerable People and Places

Although some information is available, understanding of heat vulnerable people and places in Karachi is incomplete. Analysis undertaken as part of the heatwave planning process revealed spatial differences in heat vulnerability across Karachi based on the distribution of the number of people who died from heat, but data were insufficient to design tailored responses. Qualitative research pointed to occupational differences between men and women as the cause of disproportionate deaths of men during the 2015 event. Further, local knowledge indicates that vulnerable groups in Karachi include slum dwellers, outdoor workers, the elderly and the very young. In intergenerational households, several vulnerable groups can be found. Other groups at risk include street vendors, beggars, traffic police, hawkers, and homeless people.

Ensuring heatwave mitigation actions target the most vulnerable requires **bolstering the information about who they are, where they are and how they are vulnerable.** Activities to generate such information are:

- Using maps of construction sites to identify locations of high-risk outdoor workers.
- Mapping or creating lists of high-risk areas, taking into account weather conditions, concentrations of activities that contribute to urban heat gain and concentrations of socially and economically disadvantaged people.
- Undertaking phased community vulnerability assessments such that all of Karachi city is covered over time. Results of these vulnerability assessments would be used to improve the focus and relevance of activities to prevent heat impacts on health.

## Informing, Communicating, and Educating

For outreach to be effective during heat events, a number of activities should be undertaken to prepare. Since people have a number of concerns unrelated to the need to prepare a heat event that may or may not happen, it's important to reinforce messages about vulnerability to heat and City responses so preparing for the heat season becomes routine. Activities would include:

- **Conduct training and information workshops:** These can range from short awareness-raising workshops for the general public and training focused on the needs and roles of specific audiences (frontline workers, employers, outdoor laborers and worker, school children and community groups).
- **Disseminate information on Karachi's heat alert and response system:** The Heatwave Management Plan is new and it is important for Karachi residents to learn about key elements of the Plan, especially the three-tiered alert system, support they can expect from agencies during an event and available resources for the public. To build public awareness of weather conditions that trigger emergency responses, the City will consider installing LED screens with updated temperature forecasts in public spaces.
- **Disseminate information on how to prevent heat illness:** Distribute materials such as brochures, pamphlets, ads and videos to warn the public and raise interest in advance of the heat season. Distribution channels can include institutions, such as hospitals, schools and professional associations as well as traditional and social media. Outreach should focus on areas identified as high risk and messages should cater to identified vulnerable groups.

## Preparing the Health Care and Emergency Response System

Effective response during a heat event requires advanced planning by a range of groups, including frontline workers, facilities management staff, police, paramedics, public health practitioners, health care facilities, social welfare organizations and many others. The following strategies can help guide this process:

**Take stock of organizational response capacity and resource allocation:** Capacity and resources that should be assessed in advance of the heat season to inform responses during the heat season are as follows:

- Handling capacity to attend health emergencies at the district level
- Availability of additional staffing in hospitals and First Response Centres to deploy during a heat alert
- Availability of extra units and beds to attend heat-related illness
- Stocks of life-saving drugs/vaccines, medical supplies (including IV fluids) and ice packs to attend heat-related illness
- Cooling capacity inside hospitals and ambulances
- Water and electricity supplies available to hospitals and other critical facilities during heat events
- The fleet of ambulances and their optimal distribution throughout the city

**Build capacity of health care professionals:** Two types of efforts are envisioned here. One involves undertaking targeted training programs and communications on heat illness for medical staff at local hospitals and health centres. These activities should include nursing staff, paramedics, field and front-line staff, and consider the susceptibility of particular districts and UCs (e.g., heat and occupational-related hazards in industrial zones). The other involves strengthening examination procedures and record-keeping so (1) medical staff can efficiently diagnose and treat patients presenting heat illness or symptoms complicated by heat illness and (2) hospitals update their admissions and emergency case records to track heat-related morbidity and mortality.

**Ensure agreements are in place where roles and resources are shared:** At least two types of agreements or arrangements require clarification before summer hits. One relates to utilities. Protocols are required to maintain reliable power supplies to hospitals and other critical facilities, which will entail coordination among the Commissioner's Office, the medical and health department and K-Electric. Government agencies and KW&SB also need to work together to ensure the utility follows procedures to suspend non-essential uses of water when heat alerts are triggered. The second type of arrangement involves identifying appropriate locations for heat response centres and relief camps, which can entail coordination with commercial and institutional stakeholders.

## Mobilizing Community Networks

NGOs and other social welfare organizations, such as the Sindh Scouts Association, HOPE and Alamgir Welfare Trust, provided valuable resources and support in responding to the June 2015 heatwave. For example, HOPE had a considerable presence in urban slums and poor areas of Karachi, distributing drinking water and disseminating public-health messages, among other activities. Alamgir Welfare Trust established road side camps equipped with all basic necessities. The Heatwave Management Plan's Inter-agency coordination framework includes roles for social welfare organizations and philanthropic organizations that provide ambulance services. However, the next iteration of the Plan will go further in defining strategies and activities that these stakeholder groups can lead or support to boost self-sufficiency among communities and leverage local assets to reduce health impacts from heat.

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## End Notes

<sup>1</sup> IPCC, 2014: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130.

<sup>2</sup> <http://www.ndma.gov.pk/plans/NDMP-Main%20Vol.pdf>

<sup>3</sup> IPCC (2014)

<sup>4</sup> IPCC (2014)

<sup>5</sup> [http://www.nws.noaa.gov/om/heat/heat\\_index.shtml](http://www.nws.noaa.gov/om/heat/heat_index.shtml)

<sup>6</sup> <https://www.epa.gov/heat-islands>

<sup>7</sup> IPCC (2014)

<sup>8</sup> IPCC (2014)

<sup>9</sup> Pakistan (1950-2016), top ten disasters as measured by deaths.

[http://www.emdat.be/country\\_profile/index.html](http://www.emdat.be/country_profile/index.html)

<sup>10</sup> CDKN, LEAD Pakistan, The Urban Unit and the Office of the Commissioner – Karachi. (2015). Data analysis report Heat wave management planning for Karachi city.

<sup>11</sup> Hasan, A. (2016). Emerging urbanization trends: The case of Karachi. International Growth Centre Working Paper C-37319-PAK-1. <https://www.theigc.org/wp-content/uploads/2016/12/Hasan-2016-Academic-Paper.pdf>

<sup>12</sup> Sajjad, S. H., Hussain, B., Khan, M.A. and Ahmed, I. (2009). On rising temperature trends of Karachi in Pakistan. Climatic Change 96(4):539-547 · October 2009. DOI: 10.1007/s10584-009-9598-y.  
[https://www.researchgate.net/publication/200461975\\_On\\_rising\\_temperature\\_trends\\_of\\_Karachi\\_in\\_Pakistan](https://www.researchgate.net/publication/200461975_On_rising_temperature_trends_of_Karachi_in_Pakistan)

<sup>13</sup> Qureshi, "The Fast Growing Megacity Karachi as a Frontier of Environmental Challenges: Urbanization and Contemporary Urbanism Issues."

<sup>14</sup> Anwar, "KARACHI CITY CLIMATE CHANGE-ADAPTATION STRATEGY A ROADMAP."

<sup>15</sup> Ellis, P. and Roberts, M. (2016). Leveraging Urbanization in South Asia: Managing Spatial Transformation for Prosperity and Livability. South Asia Development Matters. Washington DC: World Bank.

Hasan, A., Pervaiz, A., and Raza, M. (2017). Drivers of climate change vulnerability at different scales in Karachi. IIED.

<sup>16</sup> Sajjad et al., "Study of Urban Heat Island of Karachi by Using Finite Volume Mesoscale Model."

<sup>17</sup> Ellis, P. and Roberts, M. (2016). Leveraging Urbanization in South Asia: Managing Spatial Transformation for Prosperity and Livability. South Asia Development Matters. Washington DC: World Bank.

Hasan, A., Pervaiz, A., and Raza, M. (2017). Drivers of climate change vulnerability at different scales in Karachi. IIED.

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<sup>18</sup> WMO Climate Normals for KARACHI (AIRPORT) 1961–1990". National Oceanic and Atmospheric Administration. Retrieved 2014-03-15.

<sup>19</sup> WMO Climate Normals for KARACHI (AIRPORT) 1961–1990". National Oceanic and Atmospheric Administration.

<sup>20</sup> Cheema, A.R. High-rise buildings worsened heatwave. (2015) Nature, Correspondence. Vol 524, p.35.

D. Guha-Sapir, R. Below, Ph. Hoyois - EM-DAT: The CRED/OFDA International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.

<sup>21</sup> Chaudhry, Q.Z., G. Rasul, A. Kamal, M.A. Mangrio and S. Mahmood. 2015. Technical Report on Karachi Heat wave June 2015. Prepared by the Government of Pakistan Ministry of Climate Change.

<sup>22</sup> Chaudhry, "Technical Report on Karachi Heat Wave June 2015."

<sup>23</sup> Eyzaguirre, J., Nelitz, M., Farhan, K., Saqib, E., Ansari, U., Webb, T., de la Cueva, P. Cranmer, C. and Ahsan, N. (2017). Situational Analysis of Heatwave in Karachi City, Pakistan. Report prepared by ESSA Technologies Ltd. and The Urban Unit for the Climate and Development Knowledge Network (CDKN). 58 pp. + Annexes.

<sup>24</sup> Zahid, M. and Rasul, G. (2012). Changing trends of thermal extremes in Pakistan. Climatic Change, 113: 883-896.

<sup>25</sup> Saeed, F. and Suleri, A.Q. (2015). Future Heatwaves in Pakistan under IPCC's AR5 climate change scenario. Sustainable Development Policy Institute. Policy Brief # 46.

For Saeed and Suleri, if the daily maximum temperature remains 45°C or more at a continuous stretch of five days, the event is considered a heatwave.

<sup>26</sup> Wehner et al., "The Deadly Combination of Heat and Humidity in India and Pakistan in Summer 2015."

<sup>27</sup> Commissioner Office, Karachi; CDKN Karachi Heat Wave 2015: A Visual Guide.

<sup>28</sup> Commissioner Office, Karachi; CDKN Karachi Heat Wave 2015: A Visual Guide.

<sup>29</sup> Eyzaguirre, J., Nelitz, M., Farhan, K., Saqib, E., Ansari, U., Webb, T., de la Cueva, P. Cranmer, C. and Ahsan, N. (2017). Situational Analysis of Heatwave in Karachi City, Pakistan. Report prepared by ESSA Technologies Ltd. and The Urban Unit for the Climate and Development Knowledge Network (CDKN). 58 pp. + Annexes.

<sup>30</sup> Adapted from Brisbois, Séguin, and Berry, "Heat Alert and Response Systems to Protect Health: Best Practices Guidebook."

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