HEATWAVE
GUIDE FOR CITIES

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Heatwaves are deadly and their impacts are on the rise globally due to climate change. But this is not inevitable; it is up to us to prevent this public-health crisis from impacting our neighbours, family members and friends.

Every year, heatwaves claim the lives of infants, older people, and people with chronic health conditions. The urban poor frequently bear the brunt of this silent emergency. In addition to threatening the lives and health of vulnerable populations, heatwaves have cascading impacts in other areas of society, such as reduced economic output, strained health systems and rolling power outages. The Lancet estimates that in 2017, 153 billion hours of work were lost due to extreme heat.

What is unacceptable about this silent emergency is that simple, low-cost actions such as ordinary citizens checking on vulnerable neighbours can save lives during episodes of extreme heat.

As many as 5 billion people live in areas of the world where heatwaves can be forecast before they happen, which means we have time to take early action to save lives. To address the existing need and reduce future risks posed by climate change, we need collective global action to scale up early warning systems for heat.

People living in urban areas are amongst the hardest hit when a heatwave occurs because these are hotter than the surrounding countryside. Along with climate change, urbanization is one of the most transformative trends of this century and the last. Over half the world now lives in urban areas and this is projected to increase to two-thirds by 2050. It is crucial that cities incorporate heat-reduction tactics such as green spaces into their plans for growth or retrofit them in built areas.

This emergency can only be avoided if city institutions, community groups, and planners contribute to reducing heat risk now and in the future. This guide is intended to help city staff take the first steps to understanding the heat risks they face, develop an early-warning system, work with partners to consolidate heat-action plans, and adapt urban-planning practices.

Cities are on the front lines of this public health emergency and are thus crucial in leading the fight to prevent unnecessary deaths from heat.

Francesco Rocca – IFRC President

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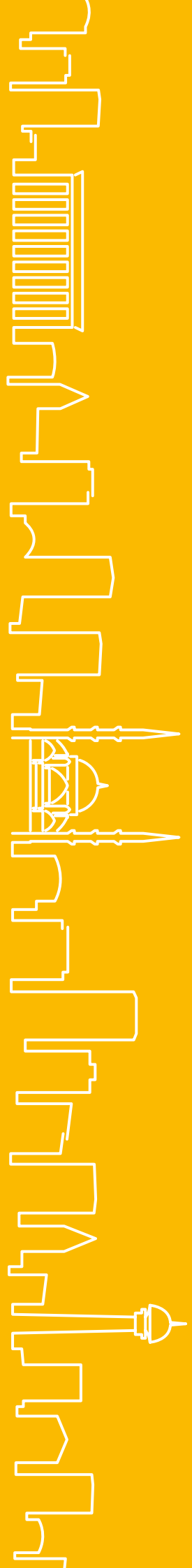

Introduction

The impacts of extreme heat are deadly, on the rise globally and preventable. In recent years, heatwaves have broken temperature records and led to the deaths of thousands of people. The 2003 European heatwave killed more than 70,000 people, and the 2015 heatwave in India reportedly killed over 2,500 people.[1] These are likely underestimates since deaths from heatwaves are often not attributed to the heatwave, but to illnesses that are made worse by heat, such as heart disease.

The city on the title page is Ankara.

Introduction

Extreme temperatures are setting heat records around the world almost every year.

More intense and frequent heatwaves are already occurring in many parts of the world. Their frequency and intensity are expected to rise globally due to climate change. Seventeen of the 18 warmest years in the global temperature record have occurred since 2001.[2] However, deaths from heatwaves are not inevitable and, in fact, they can be greatly reduced through the implementation of relatively simple and cost-effective actions. In August 2003, over 18,000 heat-related deaths occurred in France as temperatures of more than 40°C were recorded in the worst heatwave seen in decades. Temperatures at night did not cool down as they typically do, and people living in France did not have electric fans or air conditioning to cope with the persistent heat. Older people living alone were the most affected. Older people are physiologically less able to regulate body heat and may not have family or friends nearby to help them make the necessary adaptations to high temperatures. Nationally, there was no heatwave plan in place, while many doctors were on holiday, so hospitals were short-staffed. Following the 2003 catastrophe, France has created a heatwave plan that includes an alert system, public information campaigns and check-ins with older residents, amongst other actions. In subsequent heatwave events, studies have found that fewer people have died in France indicating that vulnerability to heat has been reduced since 2003.[3] For example, a study found that during a 2006 heatwave approximately 4,400 fewer deaths occurred than would be expected; this is linked to increased awareness of heat risks, the setting up of an early warning system and the implementation of preventative measures.[4]

This example shows that cities can rise to the challenge of coping with more frequent and extreme heatwaves. Cities have a unique potential to adapt to changing heat risks through effective risk management at multiple levels within a city; connecting policies and incentives; and strengthening community adaptation capacity.[5] All of these facets make it extremely important for cities to undertake heat-related risk analyses and to devise plans for reducing and managing risks. This guide is intended to be a basic introduction to this topic and a resource for cities to start planning for extreme heat.

HOW TO USE THIS GUIDE

This practical guide is designed with, and for, people working in city government to understand, reduce the risk of, and respond to, heatwaves in their cities. The guide provides information and recommendations for technical staff within city government, including on: working with partners to understand city-specific heatwave risks; operational approaches to prepare for an imminent heatwave; response strategies to reduce human harm during a heatwave; and ways to learn from a heatwave that has just ended. Case studies from cities around the world are included in this guide to highlight effective urban heat adaptation strategies, including early warning systems, climate-sensitive designs and public information campaigns. Throughout each chapter there are recommended actions that can be taken and online resources for more detailed guidance on heatwave risks. Ways to "action the chapter" are marked by the following symbols:

POLICY RECOMMENDATIONS

NEXT STEPS

FURTHER READING

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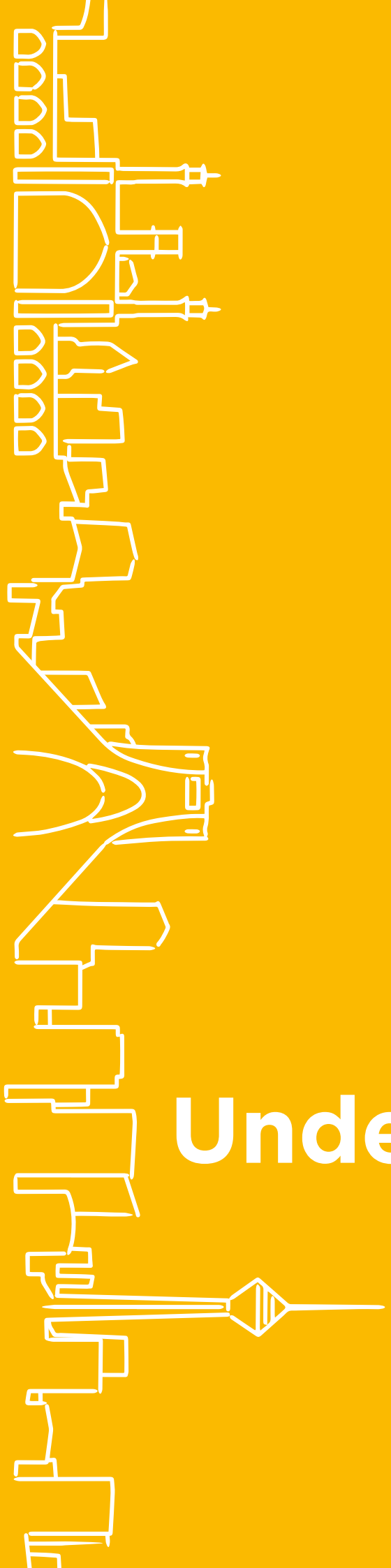
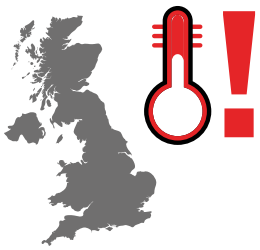


Chapter 1: Understanding heat risk

- **HEATWAVES RISKS ARE EXPECTED TO INCREASE IN INTENSITY AND FREQUENCY GLOBALLY.**
- **HEATWAVE DEFINITIONS DIFFER BY GEOGRAPHIC LOCATION.**
- **CITIES ARE UNIQUELY VULNERABLE TO HEATWAVES BECAUSE OF THE URBAN HEAT ISLAND EFFECT.**
- **HEATWAVES CAUSE DIRECT AND INDIRECT IMPACTS ON HUMAN HEALTH, ECONOMIES AND PHYSICAL INFRASTRUCTURE.**
- **AGE, GENDER, SOCIO-ECONOMIC FACTORS AND PRE-EXISTING MEDICAL CONDITIONS MAKE SOME PEOPLE MORE VULNERABLE TO HEATWAVES.**

The city on the title page is Tehran.



Extreme heat is a risk to human health and wellbeing as well as to infrastructure and services. In some parts of the world extreme heat is seasonal. Often, the hottest time of the year is prior to the start of the rainy season; although this is not the case everywhere. Extreme heat can occur over large geographic areas and can combine with other factors such as humidity to increase the risk of negative health impacts and death.

The threshold for when heat becomes dangerous can differ greatly between different locations.

One form of extreme heat is called a 'heatwave' – a period when temperatures, or temperature in combination with other factors, are unusually high and hazardous to human health and well-being. Heatwaves typically have a noticeable start and end, last for a period of days and have an impact on human activities and health.[6] There is no single, universal definition for a heatwave because different temperatures often have varying impacts in different parts of the world. For example, in London, UK 25°C is the temperature at which excess seasonal deaths start to occur, whereas in the plains of India, that temperature is closer to 40°C.[7,8] Heatwaves must be defined using thresholds that correspond to local weather conditions and their impact on human health and systems (see *Box 1*).

A green space between apartment buildings in Hong Kong.

BOX 1: Defining heatwaves

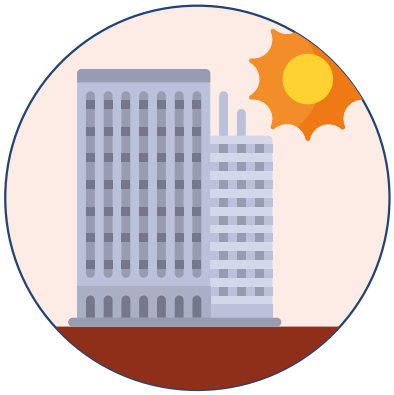
1. List the factors that contribute to heat impacts in your city.

Maximum temperature

Night-time temperature

Humidity

2. Consider existing heatwave definitions or indices that combine these factors and choose the one that is relevant to the local climate.



3. Pick a threshold, when your heatwave definition indicates that the heat has become dangerous to human health.

Heatwaves can be defined in a variety of ways ranging from a simple maximum temperature over the course of one day, to a more complex definition that incorporates multiple factors such as night-time temperature as well as maximum daytime temperature and humidity. The precise mix of factors depends on the local climate. After the National Meteorological Agency chooses the factors that will be used to define a heatwave, a 'threshold' is established in collaboration with public health officials. A threshold indicates the moment when the heat becomes extreme enough to become dangerous to people's health and livelihoods. There are many ways to choose this threshold, including looking at the levels at which there has historically been a spike in deaths due to extreme heat, or increases in hospital admissions, or simply expert judgement. It should be noted that vulnerability to heat extremes varies within a season (vulnerability is higher at the beginning of the hot season when people are less accustomed to higher temperatures and reduces as people get used to the hotter temperatures), and within the city depending on local land use. It is important for technical specialists from cities to work with meteorological and health departments to revise these heat-health thresholds considering changes in climate and the vulnerability of the population.

For more detailed guidance on defining a heatwave and setting thresholds, read chapter 5 of the Heatwaves and Health: Guidance on Warning-System Development published jointly by the World Meteorological Organization (WMO) and the World Health Organization (WHO).[9]

IMPACTS OF A HEATWAVE

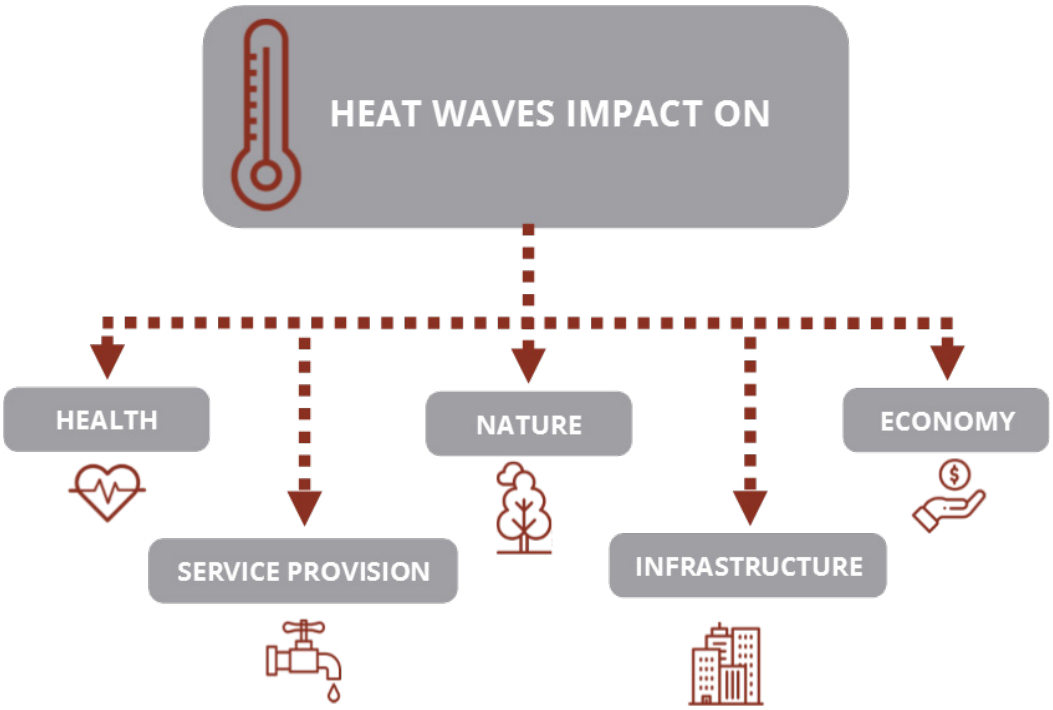
Heatwaves impact different aspects of life in a city including human health, surrounding nature, critical infrastructure, the economy and essential services. While this guide focuses on the impacts of heat on human health in cities, it is important to know that there are other impacts such as those on water availability and agricultural production in rural areas.

DIRECT IMPACTS

Exposure to extreme heat can lead to dehydration, heat exhaustion, heat stroke, loss of consciousness and other medical emergencies. Heatwaves can also exacerbate pre-existing conditions such as cardiovascular disease and respiratory illnesses and have deadly consequences. Extreme heat can also directly affect infrastructure, for example, by causing road surfaces to melt, making them inaccessible or unsafe. In India during a heatwave in 2016 the heat softened the tarmac on the roads making it difficult for people to cross them.

INDIRECT IMPACTS

In addition to the direct impacts on human health, heatwaves stretch existing health systems by increasing in the number of emergency hospital admissions. Heatwaves also impact the city economy as well as the provision of essential services by reducing the number of hours outdoor workers can be employed safely; reducing productivity in offices without adequate cooling; and impacting sectors such as tourism. In addition, physical infrastructure such as energy systems, water storage, delivery and treatment, and transport are affected by extreme heat both directly and indirectly. For example, demands for water and electricity tend to increase during a heatwave, straining existing systems and potentially leading to shortages.



POLICY RECOMMENDATIONS:

- Heatwaves are a clear and rising threat around the world. Find out if heatwaves are considered a disaster under your national disaster laws. If they are included, emergency disaster relief funding may be applicable when a heatwave occurs. If not, materials from this guide may help you to advocate for the inclusion of extreme heat in your national disaster laws.
- Women and men will be differently and disproportionately affected by heatwaves. This requires gender-based risk and vulnerability assessments and risk planning.
- Different parts of the same city may witness heat waves with different thresholds depending on the local land use pattern and extent of vulnerability and exposure of the people living in different settlements. Heat-related policies must take this into account.

BOX 2: Economic impact of heatwaves

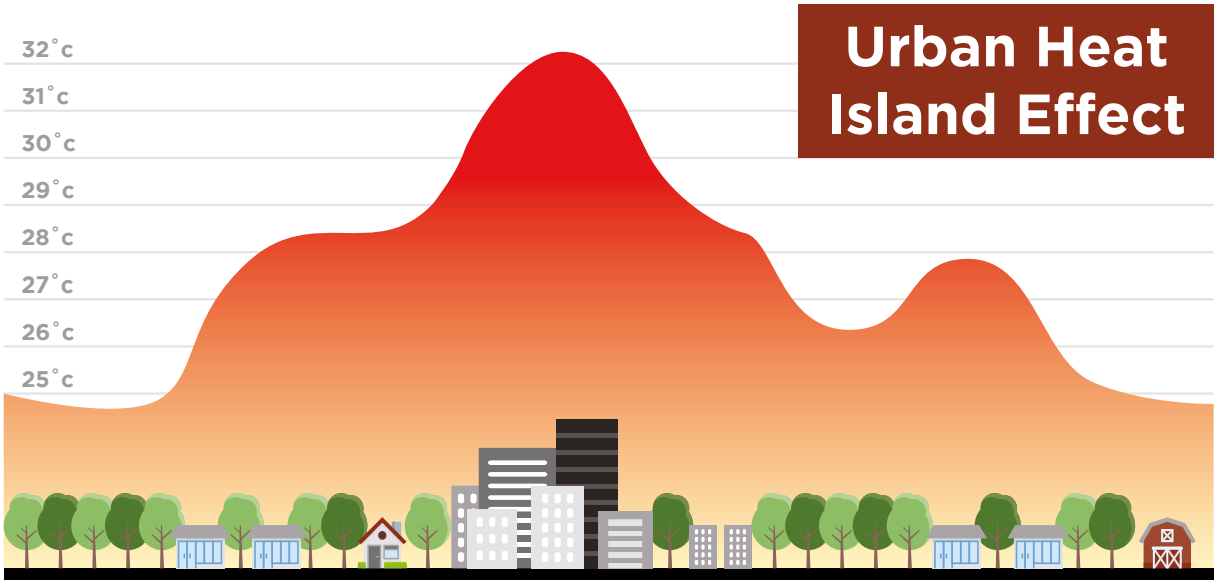
Heatwave in Nanjing, China in 2013

14-days of extreme heat

27.49 billion yuan (4 billion USD) loss due to reduced productivity

In addition to the health impacts on vulnerable people, heatwaves can also have serious economic repercussions. For example, in 2017 153 billion hours of work were lost globally due to extreme heat.[10] And researchers estimate that a loss of 27.49 billion Yuan (4 billion US dollars) was incurred due to reduced productivity during a 14-day extreme heatwave in Nanjing, China in 2013. This accounted for 3.43 per cent of the city's gross value of production that year.[11] Increased temperatures can also lead to a greater burden on a city's existing healthcare system due to increased hospitalizations. For example, one study estimated the healthcare costs associated with the 2006 heatwave in California to be 179 million US dollars based on hospitalizations, emergency room visits and outpatient visits.[12] When factoring in the value of lives lost during this heatwave, the cost is significantly higher at 5.4 billion US dollars. The cost of extreme heat on healthcare systems is understudied with few analyses in developed countries and virtually no reporting in developing countries.[13] Of the studies that do exist, it's clear that the healthcare costs are disproportionately shouldered by certain groups including low-income families, women, older people and minority ethnic groups.[14]

THE UNIQUE VULNERABILITY OF CITIES TO HEAT



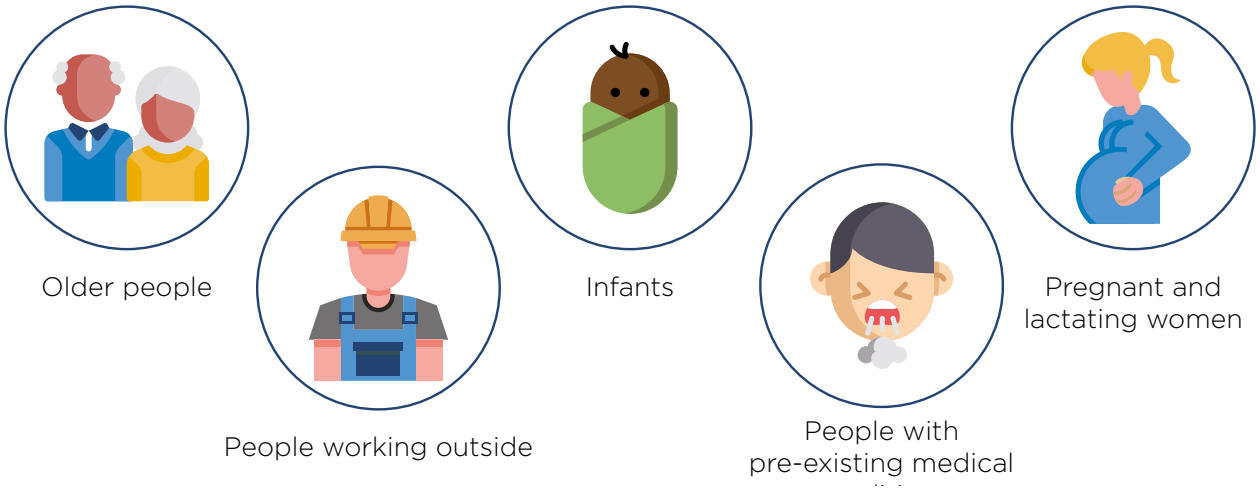
Temperatures in cities tend to be hotter than the surrounding countryside due to the prevalence of surfaces that retain heat and release it slowly; this is called the Urban Heat Island Effect. Cities consist of environments that are intensely modified by humans, which may also lead to "hotspots" within cities where the temperature is even higher. This is due to factors such as buildings that block wind, the use of dark-coloured paving or asphalt, heat generated by vehicles, air conditioners and industrial facilities, and a lack of vegetation to cool parts of a city. The effects of urban heat islands are often worse in the densest parts of the city with the fewest greenspaces. This may include central business districts, informal settlements and other areas with high population density.[15] Research indicates that in cities with wet climates, urban heat island impacts are further compounded by high humidity in the air leading to a heightened impact on human health.[16] Other factors like higher concentrations of air pollution in urban areas can also aggravate the human health impact of extreme heat in cities.

BOX 3: Heat and air pollution

Extreme heat can interact with and compound other stressors such as air pollution. Heat and sunshine are two 'ingredients' that can intensify ground-level pollution by mixing with nitrous oxide gases (from sources like car exhausts) to create ozone, a pollutant. This is the reason why hot days are often also hazy, which can be detrimental to the health of all city residents but particularly for those with lung conditions like asthma and cardiovascular disease. The combination of heat and air pollution leads to higher death rates than either factor working independently.[17] When it is hot and there is also air pollution, commonly given heatwave advice may need to change. For example, it's commonly suggested to open windows when the air temperature is cooler outside than inside, but this is not advisable when air pollution levels are high. Lastly, when wildfires occur during a heatwave smoke can significantly increase the risk of death.

During extreme heat, failure or weaknesses in city systems can also make urban vulnerability worse. For example, cities that rely on artificial cooling can face regular electricity cuts as grids become overwhelmed during spikes in demand. Electricity cuts can leave people vulnerable to the risks of heat and have knock-on impacts on other urban services. In places where water systems do not reach everyone in the city, for example – such as those living in slums and informal settlements – people may not be able to stay sufficiently hydrated to reduce the effects of extreme heat.

PEOPLE WHO ARE VULNERABLE TO HEAT



Generally, older adults, very young children, pregnant and lactating women, and those with pre-existing medical conditions (e.g. cardiovascular and respiratory conditions, obesity, mental illness), and working outside or cooking indoors in informal settlements are most at risk of negative health outcomes and mortality during a heatwave. In addition, high fatalities are common during heatwaves among those living alone or who are socially isolated. Socio-economic factors are also important. For example, those living in informal settlements are usually among the most socio-economically disadvantaged. The people who live in these areas may not have adequate housing (e.g. poor design or quality building materials, such as tin roofs, which increase indoor temperatures). They also tend to work in labour-intensive jobs, which increases their risk of heat-related illnesses. They spend longer hours commuting on overcrowded public transport or walking exposed to sun. And they may not have access to healthcare or any means of receiving warning messages due to limited access to radio, television and social media. Even when this information is available, in some contexts men are the owners of the TV or radio and women either do not receive the information or are the last to know.

BOX 4: Identifying vulnerable populations

VULNERABLE POPULATION	RISK FACTORS
Adults over 65	Less aware and adaptable to extreme heat
Individuals with chronic medical conditions	These include heart disease, lung and kidney conditions and mental illness. Those taking medications that can worsen the impact of extreme heat are especially vulnerable
Children under five years old	Sensitive to the effects of extreme heat and must rely on others to keep them cool and hydrated
Women and girls	May not have access to a variety of media, sleep in ill ventilated rooms, lack private bathing space, especially during menstruation.
Pregnant and lactating women	Pregnant women are more likely to go into early labour in the week following a heatwave. This risk goes up with more consecutive days of extreme heat.[18] Lactating women require more drinking water as breastfeeding is extremely dehydrating
Outdoor workers (inlc. traffic police and security guards)	Often engaged in strenuous labour while directly exposed to sunlight as well as heat and air pollution. More likely to become dehydrated and suffer from heat-related illness.
People living alone	May not access help quickly
Individuals with disabilities	May not be able to access help quickly
Overweight and obese individuals	May be more sensitive to extreme heat and have difficulty thermoregulating
Individuals of low socio-economic status	May not have access to clean drinking water and other cooling measures. May not be able to access information about heatwaves and cooling centres
Migrants and refugees	May not have access to current information about heat advisories and health risks, or may experience heat conditions that are different to their place of origin
Homeless people	May not receive warning messages, may be unaware of cooling centres and may have limited access to other cooling measures (e.g. cool showers or baths)
Individuals unable to read and non-native language speakers	Cannot read current information about heat advisories and health risks. Non-native language speakers also may not be able to understand advisories broadcast on TV and radio.
Tourists	May not be able to understand advisories in local languages. May not know how to access cooling centres, green spaces or other resources, including emergency management systems. May be from cooler climates and less adapted to the heat.
Animals/pets	Dependent on owner for adequate protection from heat

Adapted from the Kansas Extreme Heat Toolkit.[19]

A combination of other factors can further exacerbate the impacts of heat extremes. In some parts of the world, such as Japan, population trends mean that older people makeup a larger share of the population. In other areas, increasing migrant populations may increase the number of people living in informal settlements. Demographic trends and changes are an important consideration when developing strategies for reducing the impact of heatwaves on human health.

HEAT RISKS ARE CHANGING

Globally, as more and more people live in cities, expanding the built environment as well as the size of informal settlements, their vulnerability and exposure to heat risks is expected to rise. Alongside this, the Special Report on Global Warming of 1.5°C from the IPCC concluded that it has high confidence that hot extremes will increase in all inhabited regions due to climate change.[20] The rising temperatures will exacerbate the urban heat island effect and lead to more heat-related health problems, and an increase in energy demand for cooling.

All land areas are expected to get hotter with climate change.

Climate change is projected to increase the frequency and intensity of heat extremes globally, underscoring the urgent need for cities to manage heatwave risks effectively in order to ensure the wellbeing of citizens. Climate change is projected to impact human health in different ways, including by exacerbating health problems that already exist.[21] Recent studies have illustrated the negative impact of heat stress on urban populations in low- and middle-income countries. For example, heatwaves in 2015 caused at least 2,500 deaths in India and 1,100 in Pakistan.[22,23]

FURTHER READING ON CITIES AND CLIMATE CHANGE:

- For Cities the Heat is On is a summary of key facts regarding heat extremes in cities published by C40.[24]
- Why Half a Degree of Global Warming is a Big Deal is an article published by the New York Times which summarizes the key findings of the recent IPCC 1.5°C report.[25]

CASE STUDY 1: Changing heat risks in Prague, Czech Republic

In Prague, capital of the Czech Republic, 2018 was the hottest year recorded in more than 200 years. Temperatures were 3.2°C higher than average. Prague City Council had already approved an Adaptation Strategy and in 2018 the first Adaptation Action Plan was endorsed. City stakeholders participated in the vulnerability assessment by ranking current and future climate change-related problems. Heatwaves and the urban heat island effect were perceived as two of the most relevant problems for the cities of Prague and Brno. Stakeholders mapped areas like, for example, the densely built up areas in Prague near the Vltava river, where they perceived the highest risks. Based on this ranking and working with the Global Change Research Institute of the Czech Academy of Sciences, the City Council studied how heat risks and vulnerability will change under different climate change scenarios. This Vulnerability Assessment compared the current status to projections for 2030 under scenarios ranging from 'possible' to 'worst case'. Findings from this study indicate that the city's vulnerability to heatwaves under both of these scenarios increases by at least a factor of four. The study recommended the implementation of adaptation measures including nature-based solutions as well as structural adjustments to address urban heat island effects.

Climate projections indicate that if greenhouse gas emissions continue on their current pathway, by the year 2100 three out of four people on Earth could be subject to at least 20 days per year of potentially deadly heat and humidity levels.[26] Extreme heat is killing people now and will continue to do so in the future, at an even higher rate, if urgent action is not taken to reduce and adapt to this trend.

Extreme heat is a risk, even in places where it is already hot.

The IPCC is highly confident that the number of hot days will increase in most land regions, with the highest increases in the tropics. [27] Current research also indicates that, while higher latitudes will undergo more average warming, tropical humid areas will be disproportionately exposed to more days with deadly heat conditions because they are already hotter and have higher humidity. Heat is often not perceived as a risk in tropical humid areas because they are already hot and the people who live there are used to the heat, but research indicates that this is the very reason why global warming will create deadly conditions. In addition, many of these areas are rapidly urbanizing, intensifying the urban heat island effect and increasing residents' vulnerability to heat.[28] More research is needed to understand whether the temperature–mortality relationship found in European and North American cities applies to tropical and humid regions, which often do not have existing heat-health warning systems. Initial research in the subtropical city of São Paulo, Brazil, and the tropical city of Ho Chi Minh City, Viet Nam has indicated the same temperature–mortality relationship does exist, with deaths increasing when temperatures reach above a certain threshold.[29,30] In the first study of its kind in South Africa, mortality was found to increase immediately after exposure to high daily maximum temperatures, with the strongest associations with young children (less than five years old) and older adults (over 64 years old).[31] Those with heart and respiratory diseases exhibited a higher risk of mortality – similar to the findings in developed regions.

NEXT STEPS:

- Contact your local meteorological office for information on how climate change is affecting your city.
- Locate heat-health studies for your region. If they do not exist, commission them. Ask universities in your city to study this topic.
- Consider developing a heat island map, in order to identify which parts of your city are typically the hottest due to the built environment.

French Red Cross volunteers distribute water during a heatwave in 2015.

Chapter 2: Getting your city ready to address heat risks

» **CLOSE COLLABORATION AND COORDINATION AMONG CITY DEPARTMENTS AND EXTERNAL PARTNERS IS CRUCIAL TO ADDRESSING HEAT RISKS.**

» **CITY PLANNING, HEALTH AND SOCIAL SERVICES, METEOROLOGICAL FORECASTING AND EMERGENCY MANAGEMENT ARE THE PRIMARY ACTORS NEEDED TO ADDRESS HEAT RISK – BUT NOT THE ONLY ONES.**

» **INCORPORATE HEAT RISK REDUCTION INTERVENTIONS INTO MUNICIPAL POLICIES AND BUDGETING PROCESSES TO ENSURE SUSTAINABILITY.**

The city on the title page is Ljubljana.

THE MANDATE TO LEAD THE REDUCTION OF HEAT RISK

Managing heat risks in an urban setting requires cross-departmental collaboration within a city. A mandate to reduce heat risks does not fit squarely within any traditional sector or government department, rather there are a variety of agencies that have crucial roles to play in the overall effort to reduce heat risks; these include: disaster/emergency management, health and social services, city planning and meteorological forecasting services. In order to successfully manage heat risks, all these specialties need to work together. The fact that heat risk does not fall neatly under one agency is part of the challenge in scaling-up heat action globally. Within a city, any of the agencies mentioned could take the lead in ensuring action across departments. Or the city may wish to elevate the mandate to a level above that of department director in order to ensure better collaboration.

ROLES OF MUNICIPAL DEPARTMENTS REQUIRED FOR REDUCING HEAT RISKS

A variety of government agencies can play a critical role in reducing heat risks.

The following departments are the most important in reducing heat risks in urban settings: city planning, health, social services, national meteorological forecasting services and emergency management. The city planning department should lead on retrofitting heat reduction measures into existing urban spaces, as well as ensuring that city growth reduces future heat risk. Strategies to reduce heat risk can include green space development in collaboration with the environmental management department, identifying locations of multi-purpose cooling centres and introducing zoning measures to reduce the Urban Heat Island Effect in other ways. These and additional urban planning strategies are outlined in Chapter 8.

A residential neighbourhood in Hong Kong.

Measuring temperature and air quality in a residential building near a construction site.

The **health department** is crucial to ensuring that health systems are ready to anticipate and absorb increased demand during heatwaves, in close coordination with its local representatives. This can include upgrading the physical infrastructure of hospitals and clinics, and training doctors, nurses and community health workers on the effects of extreme heat on human health. The health department can also assist with the necessary public health analysis to determine the threshold at which extreme heat starts to impact human health. This is explored further in Chapter 4.

Meteorological services are necessary to develop and issue forecasts of extreme heat to help city officials and the general public anticipate risks. They can also assist in interpreting climate change projections to inform city planning decisions. In many places, meteorological services are provided by a national authority, in which case cooperation between agencies can be formalized.

Emergency management services are crucial in planning for heatwave events and assisting in the heatwave response. Municipal emergency management services, working together with national emergency systems and community-based organizations, can play an important role in providing support during heatwaves by ensuring warning messages reach the most at-risk people, operating cooling centres and aiding response coordination.

Additional departments with important roles in managing heat risks include: environmental management to conduct green space development and maintenance; social services to identify those most at risk, such as older people and people living with disabilities; education to ensure schools are safe for children during heat events; central communications to develop public messaging for the most extreme events; labour department to work with the private sector to ensure worker safety; treasury or finance department to budget for sustained heat interventions; and the mayor's office to ensure local political leadership during heat action efforts. Relevant actors are also found in departments whose services can be negatively impacted by extreme heat, such as transport, waste management and electricity generation.

KEY EXTERNAL STAKEHOLDERS TO ENGAGE

In addition to cooperation across government departments, collaboration with and among external partners is key to successful heat risk reduction. Important stakeholders include:

City residents who are best placed to support neighbours, friends and family members in reducing the risks associated with severe heat. Public service announcements can help inform the general public about who to pay special attention to during heatwaves to avoid impacts.

Media outlets that deliver early warning information to the public via traditional and social media including TV, radio, newspapers, Twitter and Facebook, among others.

Healthcare professionals who work in clinics, hospitals and communities, and are on the frontline in the identification, prevention and treatment of heat-related illness. They may also be responsible for reporting on heat-related health impacts, which is essential to ensuring the appropriate and timely action of local government.

Community-based organizations, non-governmental organizations (NGOs) and faith-based organizations can all provide social care to older adults and those with physical or mental disabilities. They can also raise awareness of heat-health risks through their deep networks within vulnerable communities. During a heatwave, they can help make sure that public service announcements reach those most at risk, especially ensuring that minority or isolated groups are informed.

Schools and childcare providers can ensure that children in nurseries, kindergarten and day care centres are safe during very hot weather. This involves ensuring premises have adequate cooling measures in place; avoiding strenuous activities during the hottest part of the day; and educating children on actions to reduce heat risks, which they can then share at home.

Private sector partners can put in place safety measures to protect staff from heat exposure, especially during the hottest part of the day and especially staff working outdoors. Public-private partnerships can also be developed in order to leverage private sector resources (e.g. air-conditioned buildings) for public use during a heatwave event.

Academic institutions can assist in leading research for local government to make evidence-based choices on heat thresholds, interventions and guidelines. Integrating information on heat risk management into urban planning courses, public health courses and disaster management courses can also help to train the next generation of city leaders in key heat risk management concepts.

Red Cross Red Crescent branches can assist in emergency response measures when a severe heat warning is issued. In addition to emergency management expertise among its staff, Red Cross Red Crescent volunteers can assist in spreading messages to the general public on heat safety. Volunteers can also be deployed to check on the most vulnerable.

Community centres, public libraries, and places of worship, as well as other enclosed public spaces, can be good locations in which to establish cooling centres by ensuring they are retrofitted with active and passive cooling technologies, are well signposted, and are open to the general public during heatwaves. (Note that schools should not be used as public gathering spaces during school hours).

Civil protection may be a critical partner in high-impact heat events. In such cases, civil protection can provide surge support for checking on those most at risk and managing emergency response measures.

A worker on the World Bank-supported Panama Canal expansion project. Workers who spend long periods outdoors in very hot conditions are among those most vulnerable to heatwaves, especially in cities.

BOX 5: Key skills and roles on a heat team

In addition to effective management and leadership, the following skills and roles are critical to your heat action team and can be sourced from among the different partners outlined in this chapter:

ROLES	SKILLS	DEPARTMENTS AND PARTNERS
Developing a heat action plan	Partnership building, coordination, technical specialties, vulnerability analysis	All lead departments
Developing and issuing heat early warnings	Meteorology and public health	National meteorological service, department of health
Leading emergency response	Emergency management	Emergency management department, Red Cross Red Crescent branches
Liaising with the media	Mass communications	Central communications and the mayor's office
Liaising with city residents	Behaviour change communication, community engagement, partnership building	Social services, emergency management, community-based organizations, faith-based organizations
Strengthening health systems	Public health	Health department
Mainstreaming heat into city planning	Climate risk management, urban planning	City planning
Documenting learning	Adult learning, monitoring and evaluation	All lead departments

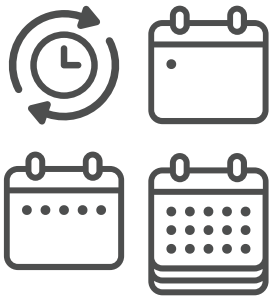
A market street in Bangladesh. People who work outdoors are among the most vulnerable to extreme heat.

SUCCESSFUL COORDINATION AND COLLABORATION

To ensure a successful partnership it is crucial that all partners have a shared vision and together outline clear objectives towards achieving that vision. The vision can be as simple as to 'reduce heat deaths in the city'. It is also important to identify clear roles and responsibilities within the group. These must have clear leads and complement – not overlap – the other roles and responsibilities. Decision-making processes as well as dispute resolution mechanisms also need to be clearly defined; while regular communication should be established, including agreement on the frequency and format (i.e. via in-person meetings, phone calls, emails etc.). Where necessary, a partnership can also be formalized through a letter of intent or memorandum of understanding. To ensure all necessary skills and roles are filled, it may also be necessary to draw on regional or national resources. This should be factored into decision-making on the set-up of the partnership to ensure regional and/or national stakeholders are able to contribute meaningfully.

SUSTAINING HEAT ACTION

Preparing a city to reduce the effects of heat extremes is one of the most impactful ways to reduce climate-related deaths. Heat action is a combination of long-term planning and seasonal and short-term considerations. To ensure that efforts are sustained, it is important to incorporate funding for heat action into municipal budgets. Other measures to sustain heat action include: outlining the mandate to reduce heat risks within municipal policies and laws; working with national stakeholders to ensure heatwaves are eligible for humanitarian financing in national disaster management laws; integrating heat action throughout city planning decisions; and encouraging the private sector and non-governmental partners to develop complementary heat action plans.



Heat action requires long-term, seasonal and short-term planning.

Chapter 3: Preparing for the heat season

» **HEATWAVES ARE OFTEN SEASONAL. START BY UNDERSTANDING THE HOT SEASON FOR YOUR CITY.**

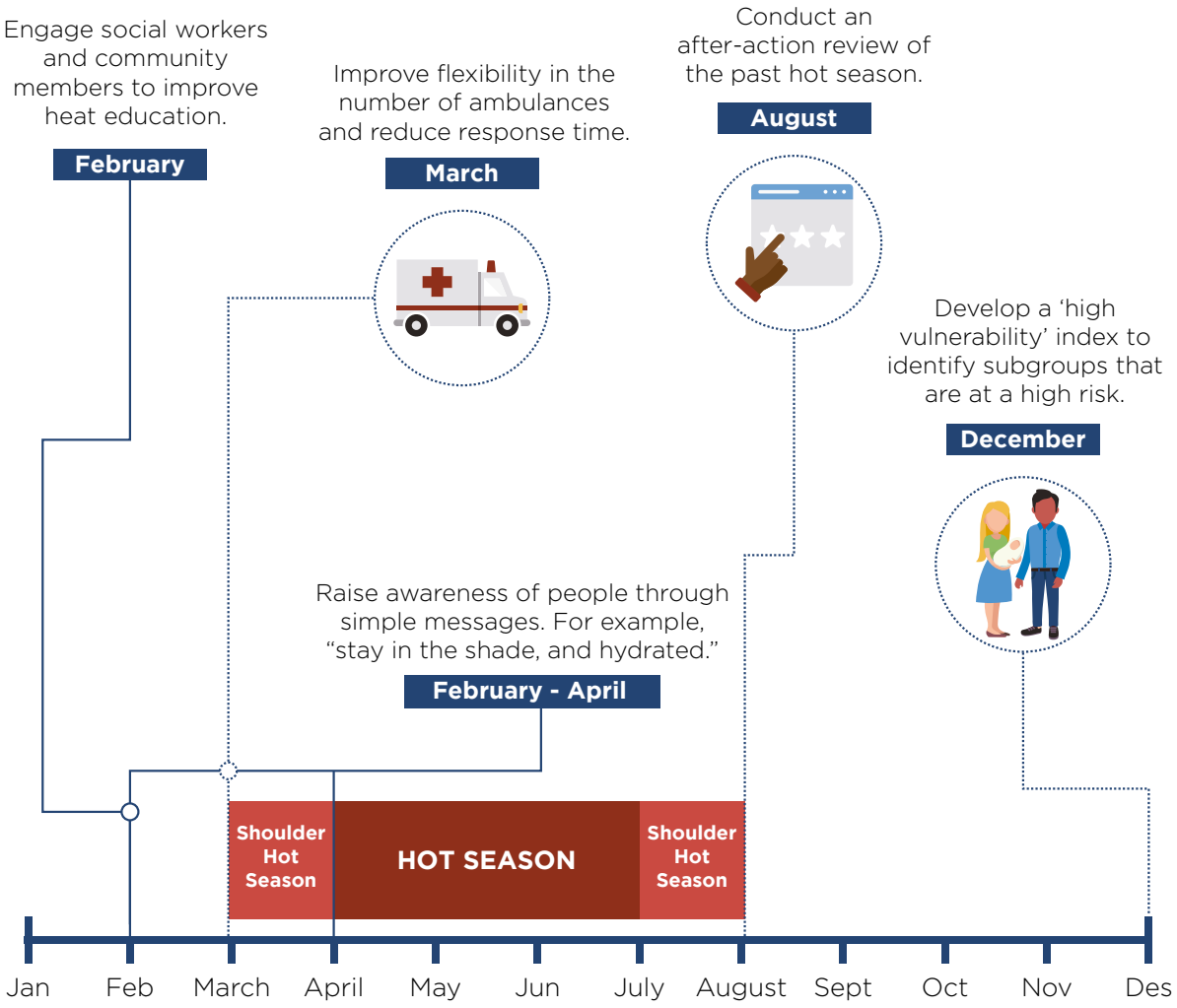
» **IDENTIFYING VULNERABLE POPULATIONS AND HEAT HOTSPOTS, PREPARING HEALTHCARE WORKERS AND SERVICES, AND WORKING WITH THE PRIVATE SECTOR TO CREATE HEATWAVE EMERGENCY PLANS ARE ALL ACTIONS THAT CAN BE TAKEN BEFORE THE HEATWAVE SEASON.**

» **BEFORE THE HEATWAVE SEASON AND THROUGHOUT THE HIGHEST RISK MONTHS, PUBLIC INFORMATION IS CRITICAL.**

The city on the title page is Lahore.

Cities can invest in planning for extreme heat to reduce risks and prepare for effective response. Often, when heat emerges as a priority risk for a city there is little to no infrastructure to support a full heatwave early warning system along with early action. (See *Chapter 4* for more information on heat-health early warning systems). Even without forecast information, data on heat impacts, and complex communications infrastructure, there are simple actions that can be taken to reduce risks.

SEASONAL PLANNING



This seasonal calendar is for a fictional place. A similar calendar can be created for your city by working with the meteorological service and health care services to understand the seasonal climate in your city.

The risk of extreme heat is often seasonal, occurring during a particular time of year depending on the local climate. For example, in India the hottest season is April to June, prior to the onset of the monsoon; while in the northern mid-latitudes the hottest temperatures most often occur from June to August. However, it's important to note that heat extremes can occur outside of typical seasonal patterns, and locations without a clear hot season can also experience extreme heat. In addition, keep in mind that climate change may have already extended or shortened the typical hot season, so it may look different than it has in the past.

Climate change may have already changed the length, or start and end dates of the typical hot season.

Preparing for heatwaves can take place throughout the year. Some action, such as stakeholder capacity building and population vulnerability mapping, should take place months in advance of the hot season. In fact, these activities can form part of a city's preparedness and development plans. However, preparations should be intensified one to two months before the typical hot season. Activities at this stage should aim to ensure that city healthcare and emergency systems are prepared for the potential increase in patients when heatwaves are most likely to occur. Public messaging can also begin before the start of the hot season in case of early onset heat extremes. Critical to any plan is budget allocation. Be sure to identify the funding sources for your preparedness activities and clearly spell out the process to access these funds.

Netherlands Red Cross volunteers check on a neighbour during a heatwave in 2018. Older people are among the most vulnerable to extreme heat.

HEALTH WORKER PREPAREDNESS

Health workers are often the first line of defence during an extreme heat event. Health workers such as community health volunteers, doctors, nurses and emergency medical technicians need to be trained to recognize the signs and symptoms of heat-related illnesses in order to correctly diagnose and treat them. Doctors should also monitor existing patients with chronic illnesses as well as those taking medications that may make them more vulnerable to heatwaves. This is difficult, however, as approximately one-third of all adults globally have multiple chronic conditions.[32] This may be an area in which to explore task-shifting, where nurses or community health workers are trained to monitor these patients specifically for signs of health complications due to extreme heat. Neighborhood associations and schools as well as local leaders can also be educated on heat risks and actions, and how to monitor their area. Education on heat-related illnesses may be integrated into existing training for health workers in order to ensure widespread knowledge and skills.

FURTHER READING:

» More information for health professionals are available in these resources from Ahmedabad and New South Wales.[33,34] In addition, please contact welfare department staff who can direct health workers to those who are the most vulnerable to extreme heat.

EMERGENCY MANAGEMENT PREPAREDNESS

Emergency-management systems should prepare to be activated during the heat season. Key actions to ensure readiness to respond to extreme heat emergencies include: reviewing heat action plans; organizing refresher response trainings for emergency-management personnel; convening key partners and stakeholders to review roles, responsibilities and commitments; liaising with cooling centres to ensure they are prepared to be activated on short notice; and ensuring key contact lists are up-to-date and communication channels are clear.

OCCUPATIONAL SAFETY DURING HEATWAVES

Companies and organizations (state and private) should prepare their workers for heatwaves, for example, by providing early risk communication, standard operating procedures and emergency response plans within the workplace to avoid detrimental health impacts. Generally, it is good advice to start work early, take regular breaks, and schedule most physical activity early in the morning or late afternoon when it is cooler.[35] Companies should also add heatwaves to their list of occupational hazards and establish more shelters, drinking-water points and rest hours during peak heat for outdoor workers, like those who work in loading areas, making sales visits or engaged in distribution (increasing with online sales). In advance of the hot season, cities can encourage employers to

devise emergency-response plans that include changes to employees' schedules or other necessary changes to ensure safe working conditions during a heatwave.

Sporting events and practices – whether informal or professional – should be reviewed for necessity and potentially cancelled or postponed. Athletes should be advised to drink plenty of water when competing, to pace themselves, to wear loose, lightweight, light-coloured clothing, and limit outdoor activity, especially during the hottest time of the day.[36] Educational institutions should reschedule physical training slots to cooler parts of the day.

Information specific to worker safety can also be found at the United States Department of Labor, Occupational Health and Safety Administration website.[37]

PUBLIC EDUCATION ABOUT HEAT RISKS

As indicated in Chapter 1, heat is notorious for being an under-appreciated risk, especially in countries that already have warm climates. For example, in India, Bangladesh and Pakistan thousands of people have died during heatwaves. In countries near the tropics where it is warm for much of the year, there is a public perception that 'it is always hot', so that 'heat is not a problem.' This is changing now due to recent heatwaves that have received widespread media coverage along with efforts to raise awareness of the risks.

It is important for the public to recognize that extreme heat can be dangerous, and to be aware of how they can reduce their own exposure to heat-related illnesses. City governments can publicize the risks and actions for extreme heat through common public forums, radio and television, particularly before the start of the hot season (noting that it may differ from the past). The timing is important because people are less acclimatized to the heat early in the hot season, so the first heatwave can be the deadliest. In addition, the communication channel used to share the messages should reflect the socio-economic, education and behavioural characteristics of the most vulnerable people in the city. (See *Chapter 5, Box 8* for guidance on communicating the risks of extreme heat to the public).

CASE STUDY 2: Public awareness-raising in Dhaka, Bangladesh

In May 2017, BBC Media Action led a 16-day campaign to increase youth awareness of extreme heat risks in Bangladesh. The campaign focused on increasing knowledge of heat-related risks and heat risk reduction strategies by developing short videos with practical messages in the local language. It also provided a platform for youth to engage with policy-makers. A national You Tube star was enlisted to develop engaging content which was broadcast through Facebook. He conducted live Facebook chats, interviewing health professionals and government officials, while taking questions from a live audience. Through the campaign over 3.9 million people were reached and encouraged to reduce heat risk during Bangladesh's hot season, including specific actions to ensure the safety of vulnerable relatives.

IDENTIFYING AND PRIORITIZING VULNERABLE POPULATIONS

The most vulnerable populations to extreme heat can be identified and prioritized for heat-related education and services. The city government can create data summaries and/or maps to identify the most vulnerable populations in their community and where these populations reside, so that appropriate preventative actions and strategies can be determined before an extreme heat event. These populations can also be targeted by public education campaigns. The populations that are typically most vulnerable to extreme heat are outlined in Chapter 1 Box 4, but it's important to also identify additional people who may be uniquely vulnerable in your city that are not mentioned in the chart. For example, if your city houses a large refugee population, they may not live in formal settlements making them uniquely vulnerable to extreme heat.

Vulnerable populations may be difficult for a city government to reach directly, so establishing a progressive partnership with informal networks, NGOs and community leaders is essential in order to meet the needs of these people.

CASE STUDY 3: Micro-heat islands in Nairobi, Kenya

During the 2015/2016 hot season in Nairobi, Kenya researchers investigated temperature variations throughout the city through a combination of remote sensing and a temporary, in situ, high-density observation network. Findings from this study show the existence of micro-heat islands over Nairobi's informal settlements. Here, temperatures were regularly several degrees hotter than that recorded by Nairobi's official temperature monitoring station, located in a relatively green part of the city. This temperature difference is probably due to the density and type of buildings in the settlements as well as a lack of green spaces. It is also consistent with the temperature variations shown in other studies to have a negative impact on public health. Research findings from Nairobi raise important questions for emergency managers in the city, such as how to incorporate the hotter temperatures found in the informal settlements into early warning system development, potentially triggering warnings in parts of the city sooner than in others.[38]

NEXT STEPS:

- Contact your national meteorological service to learn more about the typical heat season in your city.
- Make seasonal mapping part of practical school curriculum on environmental studies or some similar subject.
- Make heatwave part of first aid training and introduce this in middle and high schools.

CASE STUDY 4: Identifying vulnerable populations in Surat, India

Working together, the World Resources Institute's Urban Health and Climate Resilience Center for Excellence and the Surat Municipal Corporation used an Urban Community Resilience Assessment to gauge the vulnerability of different city residents as well as their capacity for resilience to climate-related disasters.

Surat city, located in the state of Gujarat on the floodplain of the Tapti River, is currently home to five million people. Since 1950, the city's population has approximately doubled every decade, making Surat the fourth fastest-growing city in the world. Over this time, migrant workers, attracted by the diamond and textile industries, have poured into the city's slums along the floodplain of the river. The arrival of these migrants has created a complex social fabric populated by different regional, religious, linguistic and caste identities. By 2013, Surat's migrant population was the highest in India, at 58 per cent of the total population.

By studying three different sites, the joint team was able to look at vulnerabilities within different communities, including low-income housing with varying access to urban infrastructure, basic services and political leadership. For example, in Kosad Awas – a massive slum relocation and rehabilitation settlement – people live in 4-storey, concrete buildings with cross-ventilation. Despite this, the team found that women preferred to stay at home, even during extremely hot days, and were afraid to leave their windows open in daytime because of a high frequency of petty crime. It is also a community that is constantly in flux with new migrants regularly moving in as tenants. Most residents are employed on short-term contracts and are fearful of losing this income, so they do not have the option of working flexible hours to avoid the hottest part of the day.

See the full case study on the WRI website.[39]

CHANGES IN THE PROVISION OF PUBLIC SERVICES

Additional action that can be taken prior to the hot season, and in the absence of forecast information, includes infrastructure improvements and service provisions. Chapter 8 outlines urban planning interventions such as green roofs and cool pavements. Cities may also consider mapping micro-heat islands where temperatures are higher due to the built environment (i.e. a lack of breeze and shade within a highly modified environment). These activities could be completed with the help of local universities that have the capacity to undertake such assessments.

Buildings intended to house those who are most vulnerable to heatwaves, such as care homes for the elderly or disabled, should be designed or retrofitted to prevent indoor temperature extremes. Extreme heat also puts pressure on a city's health and emergency systems, often to the point where they're unable to cope. Improving the city's healthcare system to ensure a 'surge capacity' of health workers and ambulances during times of high demand is another way that cities can plan in advance of the hot season. Other types of infrastructure such as roads, electricity provision and transport may also be affected by extreme heat, so planning for potential disruptions and finding ways to avoid them are similarly important at city level.

Ensure that there are extra resources available, such as ambulances when there is high demand.

Chapter 4: Heat-health early warning systems

» **HEATWAVES ARE PREDICTABLE IN MANY PARTS OF THE WORLD, SO IT IS POSSIBLE TO DESIGN A HEAT-HEALTH EARLY WARNING SYSTEM IN MOST CITIES.**

» **CREATING A HEAT-HEALTH EARLY WARNING SYSTEM IS A MULTI-STAKEHOLDER PROCESS, PREFERABLY CHAMPIONED BY THE CITY.**

The city on the title page is Dar Es Salaam.

5,000,000,000

About 5 billion people live in a place where extreme heat is predictable on some timescale.

There is huge potential to forecast heatwave events – globally almost 5 billion people live in regions that have predictable seasons, including heatwaves and/or cold snaps.[40] In many parts of the world, heatwaves are predictable days or weeks in advance. This ability to predict heatwaves makes it possible to take anticipatory action to reduce the impacts before a heatwave occurs. A heat-health early warning system, coupled with an effective early action plan, can reduce heatwave impacts and ensure an effective response when a heatwave occurs. City emergency management departments can develop heatwave plans, with triggers for action that are clearly defined and understood. All key municipal and non-government actors should know exactly who does what and when as soon as a heatwave is forecast.

BASICS OF EARLY WARNING SYSTEMS FOR HEAT HEALTH

According to the WMO, a heat-health early warning system is a weather-based alert that provides information to decision-makers and the general public about impending hot weather and its possible impacts, and triggers preventative action. There are some shared features within heat-health early warning systems, but they also differ depending on the local context (e.g. meteorology, politics, availability of resources, level of urbanization etc.). However, all heat-health early warning systems have a common goal of protecting vulnerable people from the adverse impacts of extreme heat.[41]

Potentially, many more cities across the world could receive notice for heatwaves a few days or even weeks in advance. Contact the national meteorological service in your city to find out which forecasts are currently available and explore ways to fulfil information gaps in order to meet decision-making needs related to heat.

A city street in Ho Chi Minh City, Vietnam.
People who work outdoors are among the most vulnerable to extreme heat.

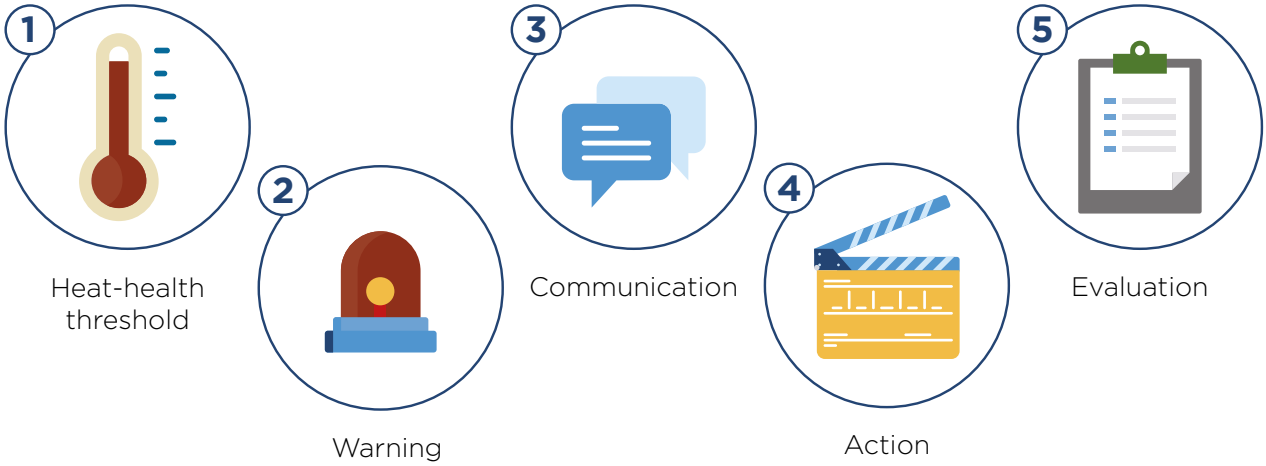
FURTHER READING:

» For a quick global snapshot of places where there is potential to predict heatwaves see the maps in Global Predictability of Temperature Extremes published in the Environmental Research Letters journal in 2018.[42]

CASE STUDY 5: Costs and benefits of the Hot Weather-Health Watch/Warning System in Philadelphia, USA[43]

In Philadelphia, USA, a 2004 study looked at the costs and benefits of the city's Hot Weather-Health Watch/Warning System during the 1995-8 period. Most action that the city took in advance of hot weather was found to not incur any additional costs. This is because these preventative actions were taken by city employees as part of their normal jobs or by volunteers and included delaying tactics, such as not stopping essential services like electricity due to missed payments. In total, the study estimated the costs to the city did not exceed $10,000 per day once a heatwave warning was issued; while the benefits were on average two lives saved every day of the heatwave. The study concluded that the costs of running the system were irrelevant, given the magnitude of benefits.

CREATE A HEAT-HEALTH EARLY WARNING SYSTEM



The basic components of a heatwave early warning system include a heat-health threshold, warning mechanism, communication, action and evaluation. Full guidance on developing a heat-health early warning system is provided by the WMO and WHO in, Heatwaves and Health: Guidance on Warning System Development.[44] This chapter provides a short overview of the process and suggestions on how to start developing a warning system, with references to other chapters for more details.

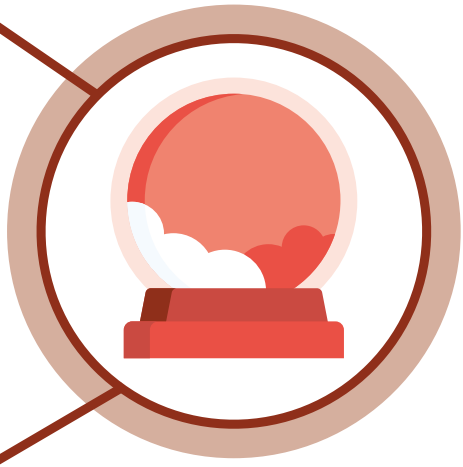
Your first step is to connect with the national meteorological service, which can assess whether or not a heat-health early warning system can be developed for your city. It may also be useful to include university researchers focused on heat-health in these conversations, particularly around thresholds.

BOX 6: Information needs for a heat-health threshold

A heat-health threshold indicates the value at which heat becomes extreme enough to pose a threat to people's health and livelihoods. There are many ways to set this threshold: by using the temperature at which there has historically been a spike in deaths due to extreme heat or increases in hospital admissions, or simply expert judgement. A locally tailored heat-health threshold is a core element of an effective heat-health early warning system.

DATA AVAILABILITY

- Is there health, temperature and humidity data available for the city?
- Is the data reliable?
- At what scale is the data collected?
- How frequently is the data collected?
- How far back do the records go?



FORECASTS

- How far in advance are temperature forecasts available?
- Are forecasts available throughout the year?
- How accurate are the forecasts?
- How often are the forecasts issued?
- Could temperature forecasts be improved including increasing accuracy or lead time?

THRESHOLD

- At what time of year do heatwaves typically occur in this city?
- Can we compare weather and health (impact) data to determine when the heat becomes dangerous?

CASE STUDY 6: Scientists and policy-makers collaborate to reduce climate impacts in New York City, USA

Science-based planning for climate change formally started in New York City in 2008 when Mayor Bloomberg established the New York City Panel on Climate Change (NPCC). A collaboration of climate experts from around the New York metropolitan region, the NPCC was convened with the objective of providing the city with the most up-to-date climate science information relevant for the region that could be used in preparing for the impacts of climate change. Among other risks, NPCC has analyzed future changes in extreme heat days and heatwaves and uses this to inform policies to prepare residents, infrastructure and buildings for these changes.

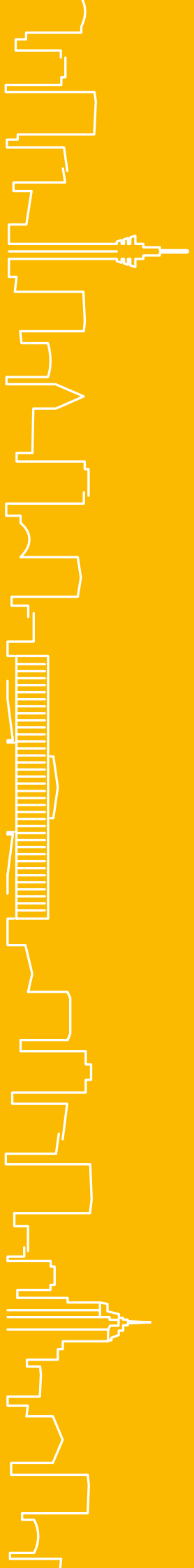
The NPCC established a baseline to understand how extreme heat and heatwaves have changed over time. Using temperature data from a station in Central Park, they found that in the period 1971–2000, New York City saw an average of 14 days over 90°F (32°C), 0.4 days over 100°F (38°C) and two heatwaves a year lasting about four consecutive days each, with the number of events in a year being highly variable. This analysis has been used to inform decision-making within the city, such as the Cool Neighborhoods NYC initiative – a comprehensive program that provided $106 million to help keep New Yorkers safe during hot weather, mitigate the drivers of the urban heat island effect, and protect against the worst impacts of rising temperatures from climate change.[45]

A heat-health warning system can be a key component of a broader Plan of Action that is triggered once the temperature threshold is met. Working in urban areas involves many partners, so the plan of action needs to coordinate the involvement of key stakeholders. The plan's success depends on stakeholder identification and engagement, and on formalizing the action each stakeholder will take once a warning is triggered as well as how they will work together to avoid duplication. This process may require several consultation meetings and workshops in order to identify the roles and strengths of different stakeholders and to compose a plan of action. Chapters 2 and 5 include suggested institutions and actions that can be included in the plan.

Once the thresholds and plan are in place, they need to be tested, monitored, evaluated and, if necessary, refined to ensure they are effective. More detail on how to do this can be found in Chapter 7.

FURTHER READING:

» The City Resilience Toolkit outlines step-by-step how to develop a Heat Action Plan based on the Ahmedabad experience.[46]



Chapter 5: Preparing for an imminent heatwave

» **ACTION TAKEN IN ANTICIPATION OF A HEATWAVE DEPENDS ON HOW FAR IN ADVANCE YOU CAN PREDICT THE HEATWAVE (1–2 DAYS TO A WEEK OR MORE).**

» **COMMUNICATING HEATWAVE WARNINGS EFFECTIVELY TO THE MOST VULNERABLE PEOPLE IS VERY IMPORTANT. THE NATURE AND FREQUENCY OF THIS COMMUNICATION DEPENDS ON THE CHARACTERISTICS OF THE TARGET GROUP AND THE AMOUNT OF TIME AVAILABLE BEFORE A HEATWAVE BEGINS.**

» **PREPARATIONS BEFORE THE HEATWAVE SHOULD ADDRESS PREVAILING RISK PERCEPTIONS AMONG PEOPLE THAT MAY STOP THEM ACTING ON THE EARLY WARNING.**

The city on the title page is Kinshasa.

Chapter 5: Preparing for an imminent heatwave

Anticipating a heatwave in the days and weeks before it occurs can provide a critical time to prepare. How far in advance of a heatwave's onset you can receive a forecast is called the 'lead time' and varies from location to location based on local meteorology and capacity of the met service to produce forecasts.

The longer the lead time, the more comprehensive action can be taken. For example, with a one-week lead time, a city may consider registering older people living alone and providing special visits to ensure they have adequate drinking water, access to cooling and information. A one-day lead time may provide just enough notice to warn the public via TV, radio and social media about the impending heatwave and the actions they can take to reduce the risk.

A patient has their vital signs checked by a medical worker in Bolu, Turkey. Health systems play an important role in preventing heat impacts.

2–3 DAYS LEAD TIME	1-WEEK LEAD TIME
 Broadcast tips on how to stay cool during a heatwave.	 Review emergency plans.
 Alert hospitals, clinics and emergency services.	 Alert hospitals, clinics and emergency services.
 Contact high-risk individuals living alone or via nursing homes, senior care centres and neonatal wards; evaluate their health status and environmental conditions.	 Involve community-based organizations and NGOs. Contact and evaluate the environmental conditions of locations likely to have concentrations of high-risk individuals (e.g. nursing homes, senior care centres, neonatal wards).
 Staff existing cooling centres; ensure signage is visible so that people know when the centre is open; stock with first aid materials, drinking water, games/activities for children and any other context-specific equipment.	 Alert pre-identified cooling centres. Brief volunteers to assist at cooling centres and to distribute drinking water.
	 Change work schedules and shifts, especially for outdoor workers.
	 Establish medical support via telephone as a prehospital measure to help people and relieve the pressure on hospitals

Table adapted (Kovats and Ebi, 2006)[47] and (Hintz et al., 2017).[48]

CASE STUDY 7: The 'We're Cool' Initiative in Phoenix, Arizona, USA

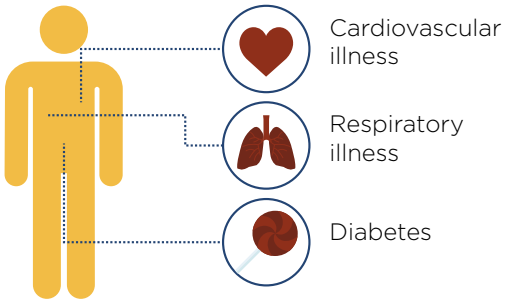
The City of Phoenix in Arizona, USA, launched in 2016, the 'We're Cool' initiative to help mitigate the impacts of extreme heat on individuals who are especially at risk and unable to access the resources they need to stay safe. The initiative involves volunteers connecting with low-income individuals and the homeless to make them aware of designated cooling centers and support during times of extreme heat. During the hottest summer days volunteers canvassed target areas, distributing drinking water and heat safety information including maps to the cooling centres, Initial evidence suggests that the new initiative is making a difference. In 2018, 92 skilled volunteers collectively donated more than 220 hours of their time over a ten-day period to help protect the city's most vulnerable residents from the dangers of extreme heat. In this time, 8,000 cooling centre maps were distributed along with drinking water and heat safety information.

BOX 6: Heat-related illnesses

The main causes of illness and death during a heatwave are NOT heat strokes and related conditions, but pre-existing respiratory and heart-related diseases. Heat can further aggravate chronic lung conditions, heart conditions, kidney disorders and mental illness, causing increased risk. People suffering from heart disease, diabetes or mental illness are at a greater risk of heat-related illnesses and death.

CARDIOVASCULAR ILLNESSES – a healthy cardiovascular system (heart, arteries and veins) is required to regulate heat in the body. Those with cardiovascular illnesses such as heart disease, or who are taking medication that alters the function of their cardiovascular system, may have a harder time regulating heat in their body making heatwaves particularly dangerous.

RESPIRATORY ILLNESSES – disorders that affect the lungs such as asthma, chronic obstructive pulmonary disease and respiratory tract infections (e.g. the flu, bronchitis, pneumonia or tuberculosis) can be made worse by extreme heat. Heat, along with other factors (e.g. air pollution) can inflame the airways resulting in sudden and severe respiratory distress.



MENTAL ILLNESSES – those of impaired cognitive status and unable to self-care are also at increased risk during a heatwave.

MEDICATION – certain medication may reduce a person's ability to regulate their body temperature, inhibit normal sweating, affect cognitive alertness, change blood pressure or cardiac output and alter kidney function. Doctors should be aware of the interaction between these medicines and heat, monitor the patients taking them and provide appropriate advice during a heatwave. It may be prudent for community healthcare workers to check-in on residents taking these medications during a heatwave.

FURTHER READING:

» For more information on the interaction between heat and medicine, see WHO guidance titled Public Health Advice on Preventing Health Effects of Heat.[49]

In addition, specific heat-related illnesses exist. The public and healthcare workers should be aware of their symptoms and treatment as detailed in the box below:

ILLNESS	SYMPTOMS	CAUSE	FIRST AID ACTION
Heat cramps	Muscle cramps, often following exercise	Dehydration and loss of electrolytes	Move to a cooler place, drink fluids with electrolytes* (i.e. sports drinks)
Heat rash	Patches of small, red, itchy bumps, spots or blisters	Sweat glands are blocked and the sweat cannot get to the surface of the skin to evaporate	Move to a cooler, less humid place
Heat oedema	Swelling of hands or ankles/feet	Heat causes a widening of blood vessels and blood pools in the extremities	Move to a cooler place, elevate swollen extremities
Heat syncope	Dizziness and fainting	Drop in blood pressure due to dehydration and/or a widening of blood vessels	Move to a cooler place, hydrate with electrolytes
Heat exhaustion	Discomfort, vomiting, circulatory collapse, core temperature of 37–40°C	Dehydration and/or sodium depletion	Move to a cooler place, seek medical attention, hydrate with electrolytes. If untreated can lead to heat stroke
Heat stroke	Confusion, disorientation, unconsciousness, hot dry skin, core temperature exceeding 40°C for between 45 minutes and 8 hours	Body's temperature control system fails. Can be caused by heat exposure or physical exertion	MEDICAL EMERGENCY Move to a cooler place, remove excess clothing and seek medical treatment immediately. Use ice packs or cool body temperature by whatever means available. Then give fluids to replace those lost.

FURTHER READING:

» Further reading on symptoms of heat-related illnesses and first aid actions can be found on the United States Centers for Disease Control and Prevention website.[50]

* Electrolytes are essential minerals (e.g. salt) found in the body that are required for proper nerve and muscle function, and maintaining hydration. Electrolyte imbalances are bad for the body and can be caused by excessive sweating, vomiting or diarrhea.

COMMUNICATING WARNINGS

The heat-health early warning could contain an alert indicating the likelihood of exceeding the temperature threshold, along with advisories on what this means for various groups such as outdoor workers, people in informal settlements and key stakeholders like healthcare professionals. The mode of communication will vary depending on the target group and amount of time available before the start of the heatwave. For example, communication could be via bulk SMS messaging, social media and printed posters. The message may need to be in multiple languages to reflect those spoken by different groups of city residents. In addition, older people may have difficulty reading or have hearing or visual impairments so a combination of visual and textual media is most helpful.

INTERNAL MESSAGING

Heat-related warnings need to be communicated internally to appropriate city departments and stakeholders to trigger appropriate actions as well as externally to alert the public and raise awareness of the impending heat risk. Messages must be tailored appropriately.

An internal warning would go to the department of health, city officials, emergency management and press offices among others. These officials would be responsible for disseminating the warning throughout their departments and ensuring that appropriate action takes place as a result of the warning. For example, when a municipal press office receives a heatwave warning, it may act by contacting local TV and radio stations and sending out a press release on the warning with messages for the public. The department of health may distribute the message to hospitals and healthcare workers who can start to prepare for a potential surge in hospitalizations by increasing the availability of healthcare staff.

PUBLIC MESSAGING

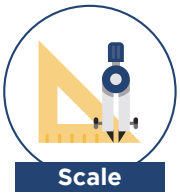
When issuing an emergency warning to the public it is important to be sure that the message includes the following six elements[51]:

Timing

When is the heatwave due to start?

Location

Which areas of the city will be affected?

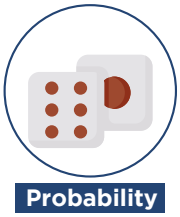


Scale

How high are temperatures likely to rise?

Impact

Who is most likely to be impacted by the heatwave?



Probability

What are the chances of this heatwave occurring?

Response

What should at-risk populations do to protect themselves?

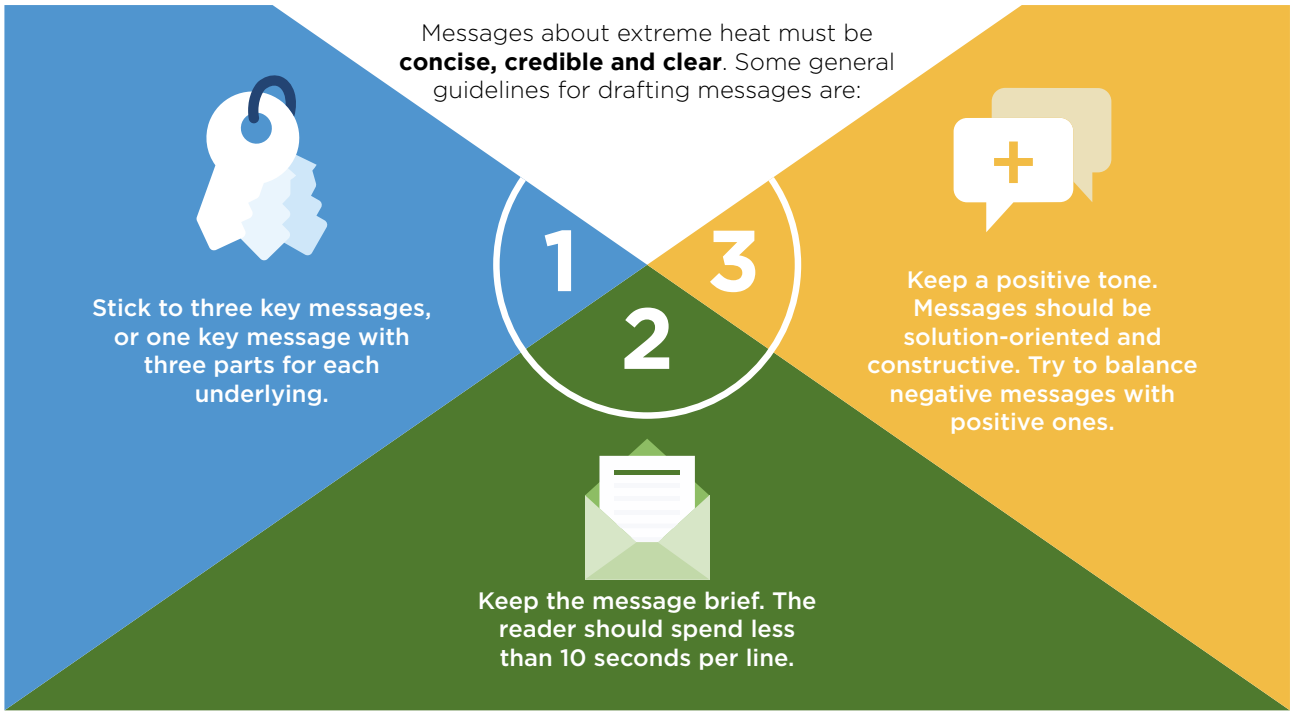
External warnings are messages to the general public. In order to reach as many people as possible, particularly the most vulnerable, it is important to involve key messengers in this effort. This can include teachers who can warn students and, through them, their parents; community leaders who may be more trusted by the communities they serve; and the media which can help develop and deliver messages efficiently and effectively. It is critical to consider the types of media used by the people of your city and place messages where they are most likely to be seen by those most vulnerable to extreme heat. Combined messaging strategies using multiple channels is recommended. For example, in Ahmedabad, India, heat warning messages are printed and posted on the sides of rickshaws, in addition to other communication channels.

Heat warning messages must be tested for understanding before they are issued to the public.

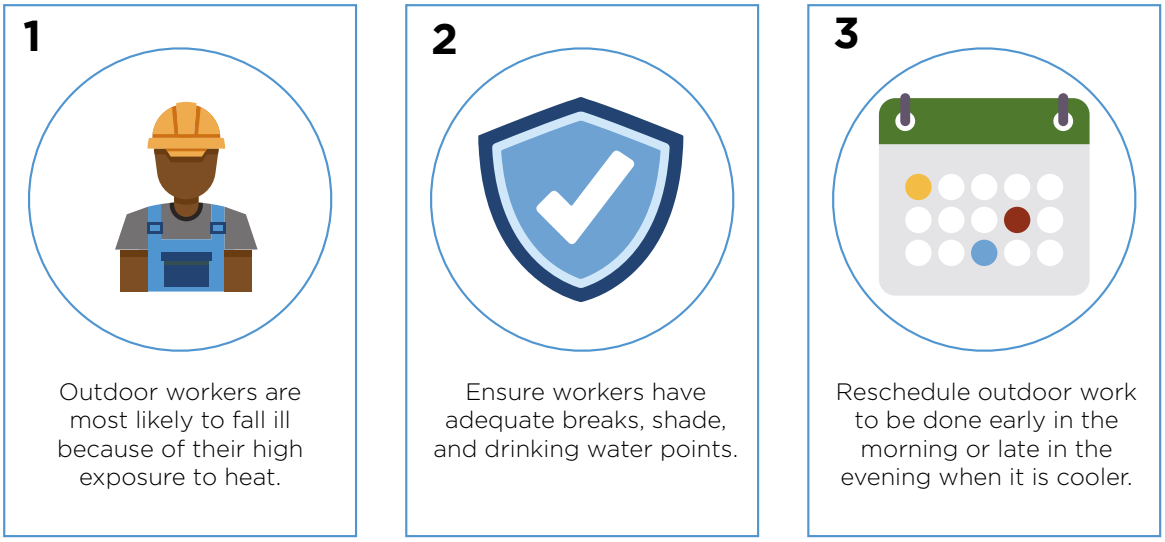
It is very important that messages are tested for understanding before they are used for any communication. This can range from simple testing for comprehension with a focus group of the target audience, to working with an academic institution with expertise in behaviour change communications to test which messages best achieve the desired action.

Flyers from the Centre for Health Protections warning people of the signs of heat stroke and ways to avoid it.

BOX 7: Communicating risks of extreme heat



Employers should create a heat emergency plan to ensure the safety of workers during a heatwave.



Adapted from Wisconsin Extreme Heat Toolkit.

NEXT STEPS:

» Pre-develop some standard heatwave messages for the residents of your city on heat risks, services that residents can access to reduce their risk and individual action they can take. These can be used as part of a press release or information campaign during a heatwave.

FURTHER READING:

For more examples and guidance on communicating the risks of extreme heat, please refer to the resources below:

» The Wisconsin Extreme Heat Toolkit provides guidance on "message mapping" a process that helps local health officials convey important information in a concise and easy to understand way.[52]

» Crisis and Emergency Communication Toolkit for Extreme Heat can help develop public messages during periods of extreme heat. It includes sample key messages, talking points, press releases, factsheets and social media messages.[53]

» Chapter five of the WMO-WHO guidelines on heat and health focuses on communicating heat-health warnings and heat-related information to stakeholders and the public.[54]

A radio show host in Accra, Ghana. Media outlets are important partners in informing the public of heatwave risks.

ADDRESSING RISK PERCEPTION

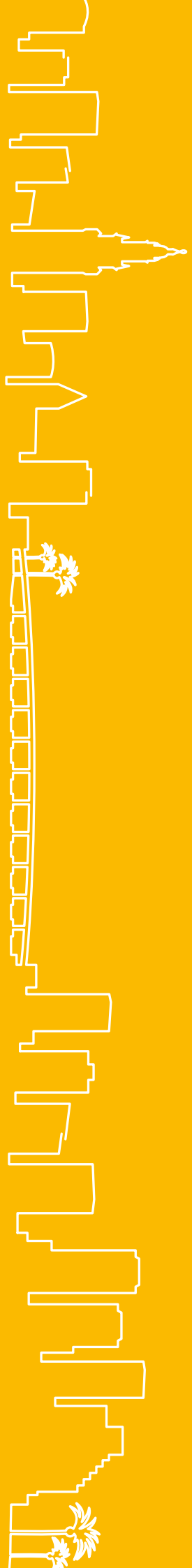
Messaging before and during a heatwave must address the risk perception of recipients. Evidence suggests that people who perceive themselves as being personally vulnerable to the effects of extreme heat are more likely to protect themselves by drinking water, dressing in light-coloured and loose-fitting clothes, and avoiding strenuous activity.[55] An interview-based study of people aged 72–94 years in London and Norwich, UK found that most participants did not consider themselves vulnerable to, or threatened by, extreme heat – they saw other people of the same age group as vulnerable, but not themselves.[56] In fact, few respondents recognized that their own medical conditions make them more vulnerable to heat, even while being able to point it out in others. Advice should be targeted towards, and explicitly identify, those who are most vulnerable to the adverse effects of heat (older adults, pregnant women and those with cardiovascular disease or respiratory illnesses. The message may be ignored if blanket warnings are issued.[57]

'Optimism bias' occurs when people perceive that they are at a lower risk than others of experiencing a negative event. Even when they have information that indicates they are in a high-risk group, people tend to optimistically assume that "it will never happen to me". Illustrated by Rebeka Ryvola.

Both direct and indirect previous heat illness experiences have been shown to increase the perceived risk of heat[58,59,60], suggesting that risk messaging designed to remind the audience of their or a family member's previous heat illness experience may increase risk messaging efficacy. For example, "have you or someone you know ever felt dizzy, nauseous, or extremely tired from the heat? these are all symptoms of heat illness. Avoid strenuous activities during the hottest times of the day and make sure to drink extra water during heat warnings".

Perceived self-efficacy and adaptive efficacy have been consistently shown to increase self-protective behavior[61], suggesting that messaging focused on increasing perceived adaptive efficacy will more effectively spur self-protective action, e.g. a message like, "avoiding exercise between 1:00 and 4:00pm has been shown to be extremely effective at reducing heat illness", will be more likely to result in people avoiding exercise in the heat than a message like, "afternoon heat is extremely dangerous, avoid outdoor exercise in the afternoon".

Local organizations that work with vulnerable people should be engaged in planning and implementing the action plan. This will make it easier to identify appropriate strategies as these organizations already carry out successful outreach activities targeted to specific populations. It is critical that the action plan clearly articulates the roles and responsibilities of all the organizations involved.



Chapter 6: During the heatwave

» **ACTIONS TO REDUCE HEAT IMPACTS SHOULD BE IMPLEMENTED AT INDIVIDUAL AND CITY LEVEL.**

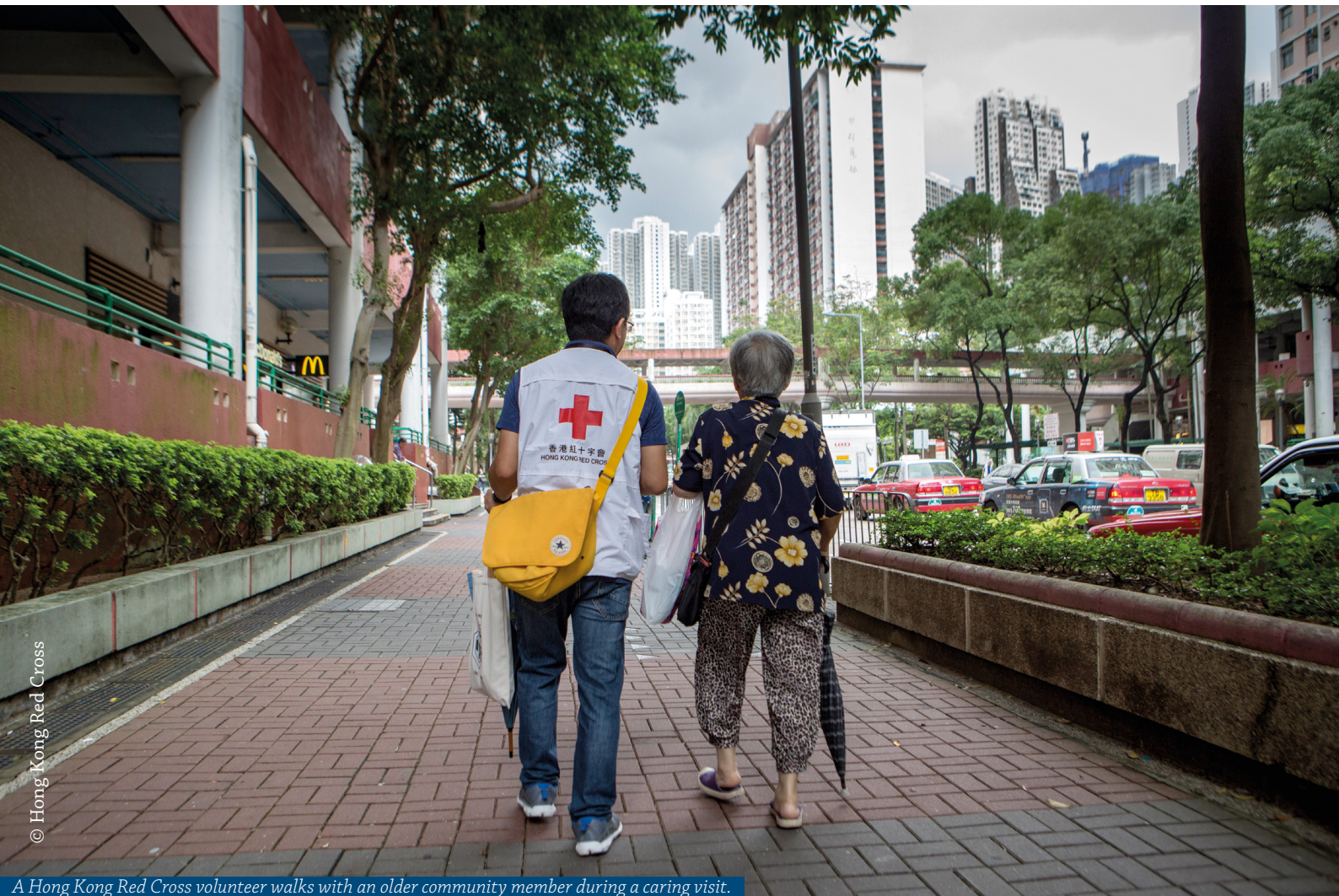
» **CITY-LEVEL ACTIONS REQUIRE CLOSE COORDINATION WITH VARIOUS ACTORS TO MINIMIZE HEAT IMPACTS.**

The city on the title page is Minneapolis.

Chapter 6: During the heatwave

Responding to extreme heat requires close collaboration between government departments, agencies and NGOs – especially those that serve the community and vulnerable people.[62] Authorities and other actors should intensify communication, alerting the general public about the severity of, and exposure to, extreme heat along with precautions to avoid the dangers. Messages to the general public must be coordinated, consistent and complementary (see *Box 8* on communicating risks of extreme heat).

It is important to provide targeted information to health and social care providers as well as to the most vulnerable people. This information should contain information on what to do (e.g. how to prevent heat-related illness), the symptoms of heat-related illness, the location of services such as cooling centres, and the characteristics of people who are more vulnerable to extreme heat. Communication should be via a wide range of media including TV, radio, bulk SMS messaging, newspapers, social media, emails and websites. In addition to communication, it is important for actors to support the implementation of simple actions to reduce the impact of extreme heat. It is critical to monitor the impacts of the heatwave on residents as well as on the city infrastructure and services, and to manage unexpected impacts in an integrated and coordinated way. This involves emergency managers, community-based organizations, healthcare workers, city leaders, meteorologists and the media all working together.



A Hong Kong Red Cross volunteer walks with an older community member during a caring visit.

CASE STUDY 8: Selecting forecast-based actions for heatwaves in Hanoi, Viet Nam

Like many other cities, Hanoi is faced with multiple challenges, including heatwaves. The city's outdoor workers, older people, children under five years old, and individuals in care centres and hospitals are among the populations most vulnerable to heatwaves. The Viet Nam Red Cross Society and partners are working with the Vietnam Institute of Meteorology, Hydrology and Climate Change to co-create heatwave forecasts for the city. In addition, the Red Cross in Viet Nam has conducted an extensive knowledge, attitude and practice survey to understand the current capacity of the

© German Red Cross

population to cope with heat risks. The survey was supplemented by a comprehensive stakeholder analysis to identify potential partners as well as with geographic information system mapping to show the locations of vulnerable people. Working with healthcare providers and local communities, the Red Cross in Viet Nam has also identified cooling centres for communities and household retrofitting (e.g. shading tin roofs with white plastic tarpaulin and using sprinklers during the daytime) as well as providing cooling fans with ice tanks for night-time use for the most vulnerable households as some of the early actions needed to reduce heat-health impacts. Learn more about Forecast-based Financing in Vietnam here.

SIMPLE ACTIONS TO REDUCE RISK

Simple actions can be taken to reduce the adverse impacts of heatwaves. [63] Some of these aim to reduce indoor and outdoor heat exposure, while others ensure that people at risk stay cool and hydrated during the heatwave. Depending on the scope and budget, action takes place at city-, community- or household/ individual level. Here, you will find examples of actions for cities and individuals:

CITY-LEVEL ACTIONS

1. **Conduct public awareness campaigns:** Provide information to the general public on what to do to keep cool during a heatwave and how to seek help in case of adverse effects on health.

2. **Increase access to water:** Set up drinking water distribution points in public places such as hospitals, parks, transit stations and religious centres. Work with the public and private water suppliers to ensure the continuous availability of water during the heatwave. Ensure that fountains work in public parks and squares to deliver fresh drinking water. Ensure schoolchildren have adequate access to water as well. Consider provisions of open flowing water in and around the city to decrease the local temperature.

3. **Plan for a sudden increase in electricity demand:** Anticipate cooling demands to drastically increase electricity consumption for the duration of the heatwave. This stresses the generation, transmission and distribution of electricity, leading to blackouts or a reduced electricity supply. Serious disruptions to the electricity supply, as a result of higher peak demand, can have a knock-on effect for other infrastructure (e.g. hospitals) and essential services that depend on the steady supply of energy such as water provision in high-rise buildings. This can cause an increase in vulnerability, especially for resource-constrained city residents. Ensure that there are alternative energy sources, such as backup generators, for critical facilities and communicate with the public about the possible cuts in electricity.

4. **Organize home outreach visits to vulnerable people:** Use a pre-existing network of volunteers (e.g. Red Cross Red Crescent volunteers) or professionals (e.g. community healthcare workers) to visit people in their homes and ensure they have sufficient access to drinking water, cooling, medical assistance and other inputs. This may require a registry of vulnerable people that is created in advance or in coordination with social services.

5. **Evacuate vulnerable people from their homes to cooling centres:** Use the existing registry of vulnerable people to arrange their temporary evacuation to cooling centres, if deemed necessary by trained volunteers, community health workers or emergency management personnel who have visited them at home. In many European countries people can voluntarily sign up for such a registry.

Conduct public awareness campaigns

Increase access to water

Plan for a sudden increase in electricity demand

Home outreach visits to vulnerable people

Evacuate vulnerable people from their homes to cooling centres

Operate a telephone helpline to provide guidance

Keep electricity and water services on despite non-payment

Ensure a functional health system

Enhance emergency management systems

6. **Operate a telephone helpline to provide guidance.** Set up a dedicated telephone service that is opened for the heatwave with a well-publicized phone number, or use a pre-existing general health advice helpline.

7. **Keep electricity and water services on despite non-payment:** Encourage utility companies to work with city officials to support heatwave risk reduction by keeping water and electricity services running despite non-payment, especially in areas that rely on air conditioning.

8. **Ensure a functional health system:** Make extra space for increased patient inflows and ambulance services, and plan for the greater availability of health workers.

9. **Enhance emergency management systems:** Prepare for increased capacity to respond to needs, check on the most vulnerable people, open cooling centres and water distribution points.

10. **Ensure the safety of outdoor workers:** Schedule outdoor work during the early morning or late in the evening when temperatures are cooler; ensure workers take regular breaks in shaded areas and have access to plenty of water.

Children stay cool in a spray park in Cape Town, South Africa.

CASE STUDY 9: Spray parks for cooling in Cape Town, South Africa

Heat risks, including heatwaves and a higher number of very hot days, are becoming an increasing problem in Cape Town, South Africa. Most residents do not have access to air conditioning or swimming pools at home to help them cope with the heat. Beaches provide opportunities for swimming but can be dangerous for inexperienced swimmers. Disadvantaged neighbourhoods in the city also tend to lack trees and other green vegetation that provide shade and other methods of cooling. To overcome these challenges, the City of Cape Town installed six spray parks within recreational spaces in the city's lower income areas. During a heatwave, the spray parks provide cooling services for children, ranging from toddlers to teens. Unlike swimming pools, people with disabilities can access the spray parks too; which, interestingly, use only 15–20 per cent of the water used by a medium-sized municipal pool – an important consideration for water-stressed cities.

© City of Cape Town

INDIVIDUAL ACTIONS

Individual health protection messages about extreme heat fall into three categories: decreasing exposure to high temperatures by avoiding outdoor exposure and accessing cool environments; keeping oneself well-hydrated with the right amount of proper fluid while avoiding those with diuretic effects; and knowing what symptoms of heat illness to look for and who to contact in an emergency. In addition to following these actions oneself, it is important for individuals to be aware of family members and friends who may be more vulnerable (e.g. chronically ill, older persons, etc.) and also help them follow the individual actions, especially if they are not able to themselves.

Individuals can help save lives by ensuring neighbors, family, and friends who are older, chronically ill and otherwise vulnerable to heat, have sufficient access to water and cooling.

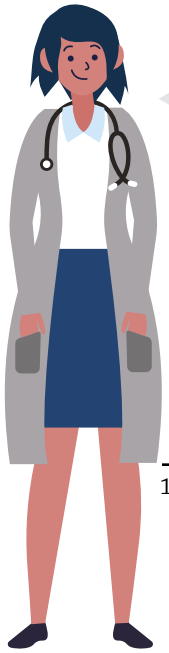
PRACTICAL HEAT ADVICE FOR INDIVIDUALS[64,65]

- Vulnerable people should stay in cool or air-conditioned[1] environments during an episode of extreme or unusual heat. A city can designate public places as refuges during a heatwave, including air-conditioned common spaces such as museums, malls, community centres, libraries and other large spaces that can justify a backup generator in case of a blackout.

Move to a cool part of the house, close and cover windows facing the sun during the day and open them at night. Cool off with a cold bath, shower or sprinkle of water. Wear loose fitting, lightweight, and light-coloured clothes and a sun hat.

- Increasing fluid intake during periods of extreme heat is beneficial. Drinking frequently without waiting to feel thirsty can reduce the risk of heat impacts. This is especially important for older people. It is also important for caregivers to be alert to hydration levels in those who are unable to care for themselves (bedridden patients, children, cognitively impaired).

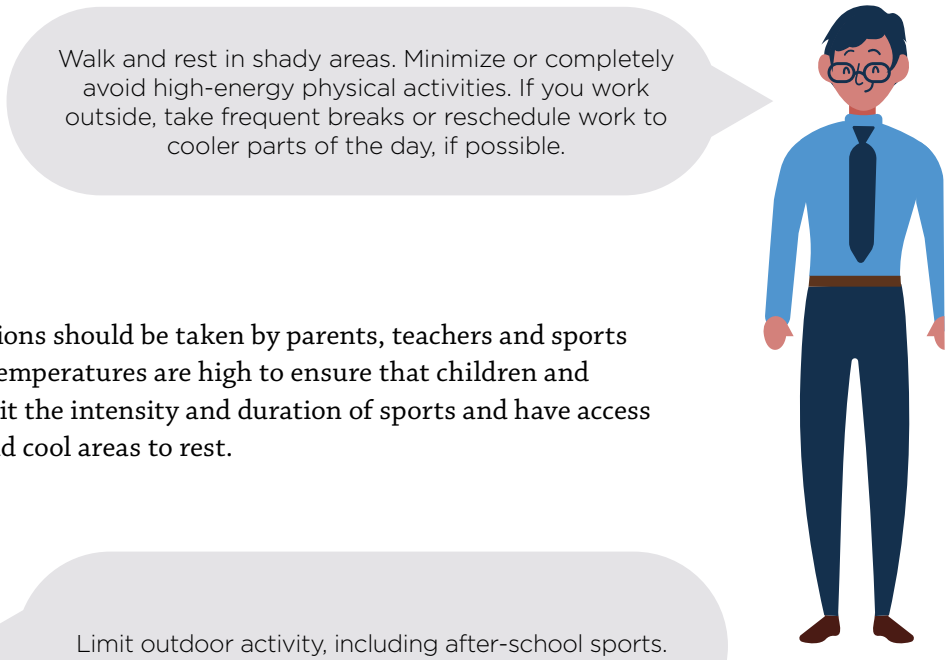
Drink plenty of water, without waiting to feel thirsty. Avoid alcohol and caffeine.



Contact family and friends, especially older people, to ensure they are keeping hydrated and cool. Do not leave family members (especially infants and pets) in a parked, closed vehicle.

1 While studies demonstrate that air-conditioning can offer protection against extreme heat, it is also controversial because air conditioners tend to use a lot of electricity which is generated using fossil fuels that contribute to global warming. In addition, use of an individual air conditioner can drive up electricity demand during a heatwave resulting in blackouts. In places where electricity supply is limited or unable to handle high demand, it is generally preferred to provide public air-conditioned spaces, rather than encouraging the use of individual air conditioners at home.

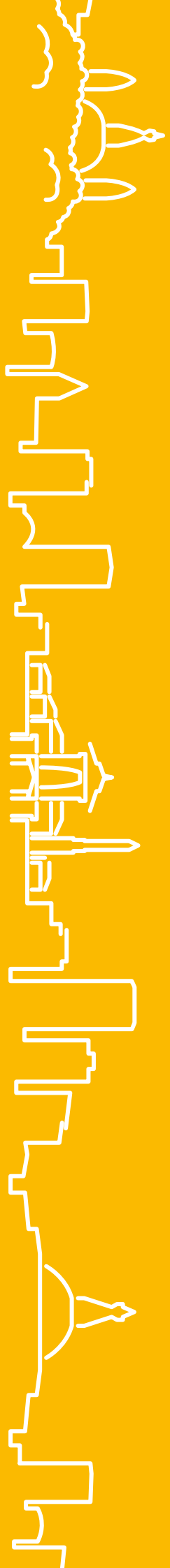
- Reduce normal activity levels during extremely hot weather. An individual's metabolic heat production varies with fitness level, acclimatization, age and body type. People should be aware of the inherent risks of activity in the heat along with the symptoms of heat exhaustion and heat stroke. They should reduce activity to a comfortable level and avoid beginning any new activities particularly outdoors during extreme heat. It is essential that people make sure they have easy access to cool areas, plenty of rest and proper hydration.



- Special precautions should be taken by parents, teachers and sports coaches when temperatures are high to ensure that children and adolescents limit the intensity and duration of sports and have access to hydration and cool areas to rest.

COMMON MISPERCEPTIONS IN HEAT ADVICE

Some of the activities recommended in existing heatwave guidelines require further study to understand whether or not they are actually effective cooling methods. For example, the use of electric fans is often suggested as an action during a heatwave, but they can be ineffective or even increase heat risk during the hottest and most humid days.



Chapter 7: After the heatwave

» **CONDUCT AN AFTER-ACTION REVIEW**

» **LIAISE WITH INDIVIDUALS, BUSINESS PARTNERS AND MUNICIPAL COLLEAGUES TO ADVANCE LONG-TERM OBJECTIVES ON HEAT ACTION.**

The city on the title page is Kathmandu.

After a heatwave ends, it is important to let the public know that the heatwave is over along with any impacts it might have had as well as any continuing services that will be available to those affected. A relief and recovery plan can also be outlined which assigns responsibility to different stakeholders for follow-up action. Any emergency stocks that have been depleted should be restocked.

An after-action review also helps those who responded to the heatwave understand how well existing plans worked and where there may be room for improvement. For example, measuring the effectiveness of the heat-health early warning system might include monitoring various outcome indicators such as estimates of the number of lives saved and levels of heatwave awareness or education.

After action reviews can be simple and easy to conduct focusing on what worked well and improvements for the future.

THE BASICS OF REVIEW AFTER ACTION

An after-action review is a structured, reflective process used to garner insights and lessons learned for guiding and improving future heatwave preparedness and response. After-action reviews broadly focus on what happened, how it happened, what worked well and what improvements can be made for the future. This is an important process in building strong systems to reduce the future impacts of heatwaves. Insights gained through the review may also help to inform long-term heat-risk reduction strategies.

AN AFTER-ACTION REVIEW

An after-action review should be conducted shortly after the end of the heatwave while details are still fresh in people's memories. It is recommended to hold an after-action review within the first month after the end of the heatwave.

PLANNING AN AFTER-ACTION REVIEW

After-action reviews are best held in person at a central, easily accessible location. It is important to ensure all key parties are present and that everyone attending understands the objective of the meeting in advance. Rooms that allow roundtable discussion instead of stadium seating tend to work better when multiple stakeholders are involved to ensure everyone has an equal voice. It is important to appoint a facilitator for the meeting as well as one or two rapporteurs. For a large-scale heat response, a one-day review in both a semi-structured and a fully structured environment can be enough to solicit key insights and learnings.

STAKEHOLDERS IN AN AFTER-ACTION REVIEW

After-action reviews should be an inclusive process with representatives from all key parties present to share their views. This means that at least one person from each function (e.g. coordination, emergency management, public messaging etc.) should be present, along with the decision makers and specialists. A series of after-action reviews may be necessary following a major heat response, beginning at team or department level and ending with heads of departments. It is important to ensure that documented lessons are shared across levels.

STEPS FOR CONDUCTING AN AFTER-ACTION REVIEW

For large after-action reviews it is recommended to appoint an external facilitator. When facilitating, it is important to ensure that everyone shares their views. This can be ensured by encouraging opening reflections from every participant or by inviting those who have not yet shared their views to do so. It is helpful if the facilitator reminds everyone that all views are welcome, and that the objective of the review is to strengthen future heatwave responses. When citing what went wrong, participants should be encouraged to suggest how improvements can be made in the future. When sharing what worked well, it is important to be specific so that good practice can be noted and replicated. It is important that all participants are made to feel they have an equal voice and that their views matter, even if they differ from those of more senior staff. At the end of the discussion, the facilitator should summarize key points and share the timeline for the final report.

QUESTIONS FOR AN AFTER-ACTION REVIEW

There are four primary guiding questions for an after-action review:

1. *What was planned?*
2. *What actually happened?*
3. *What worked well and why?*
4. *What could be improved and how?*

It is important to remember that the purpose of an after-action review is to record what worked well and should be repeated in future and to suggest improvements to try next time.

DOCUMENTING AND SHARING LEARNING

Following the after-action review, a report documenting lessons and recommendations should be drafted and circulated for comments and clearance by those who attended the meeting. Once finalized, wider dissemination of key outcomes is important to help staff, partners and other cities in their learning. Key recommendations that require system change should also be assigned to leaders within the city who will be responsible for ensuring these modifications are made. This requires a management response in order to ensure that recommendations are actioned. A process for following up and reporting on these changes should also be outlined.

Sharing the results of an after-action review between city, provincial and national authorities and agencies (vertical sharing) is critical and so is lesson-sharing between cities (horizontal sharing). Vertical and horizontal lesson-sharing helps to ensure that heat action plans are robust and continually improved; while sharing methods and lessons learned with other cities sparks new ideas, increases impact and may even facilitate the development of heat action plans in all cities.

ENGAGING CITY RESIDENTS

It is imperative that there is also engagement with city residents by creating opportunities to provide feedback. Platforms through health and education programmes should be established, allowing city residents to share their experiences with local authorities while supporting increased awareness and better preparedness.

A city street in Kampala, Uganda.

BOX 8: Additional questions to consider when reviewing a heatwave response

In addition to the standard after-action review process, the following more specific questions could also be considered:

HEATWAVE DEFINITION

Was the right mix of metrics chosen?

THRESHOLD USED TO TRIGGER ACTION

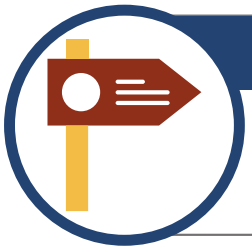
Was the threshold triggered at the appropriate time? Was it too late or too soon?

INTERNAL COMMUNICATION

How efficiently did municipal departments, municipal staff and key partners receive critical updates during the response? Did the different agencies within the city work together effectively?

EXTERNAL MESSAGES

Did the general public access and understand the warnings? How did they perceive the risks? Were the alerts effective at catalyzing appropriate action?



INTERNAL ACTION

Did key departments, partners and personnel understand their roles clearly? Were these identified roles appropriate? Did they have the anticipated impact?

COMMUNITY ACTIONS

Did people heed the warnings and follow the advice? Were some pieces of advice followed over others? Which vulnerable groups took the most action? Which vulnerable groups need to be reached more effectively in the future? And how?

HOW TO CONNECT WITH OTHER CITIES TO LEARN AND SHARE EXPERIENCES

Connecting with existing city networks can be a great way to learn from others' experiences, while also sharing new insights. There are a variety of city networks to choose from with varying membership fees and entry requirements. Here are some of the primary global networks. In many places, there are also regional and national networks.

CITY NETWORKS (IN ALPHABETICAL ORDER):

- C40 Cities: A network of the world's megacities that helps cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change.
- Cities Alliance: A global partnership focused on supporting cities in sustainable development efforts. It is a partnership of cities as well as national governments, multilateral institutions, NGOs, the private sector and others.
- Global Covenant of Mayors: The world's largest coalition of city leaders addressing climate change.
- Global Alliance for Urban Crisis: A multi-disciplinary, collaborative community of practice working to prevent, prepare for and effectively respond to humanitarian crisis in urban settings.
- International City/County Management Association: An international association focused on supporting local government professionals.
- ICLEI: Local Governments for Sustainability: A global network providing technical consulting, training and information services to build capacity, share knowledge and support local governments in the implementation of sustainable development.
- United Cities and Local Governments: An umbrella organization that supports cities and their associations and facilitates programmes, networks and partnerships to build the capacities of local governments.

FURTHER READING:

» The Global Solution Networks is a useful starting point to finding more city partnerships and resources.

CREATING OPPORTUNITIES

The weeks and months following a major heatwave can also present important opportunities to further the long-term effort to reduce heat risks. This work might include advancing policy revisions and building code changes as well as increasing municipal investment in strengthening the health service or emergency management structures. While each of these processes will still take time, the period following a heatwave can provide momentum to reopen conversations, jumpstart stalled discussions and engage the public for greater action to reduce heat risks. This can also be a good time to forge new public–private partnerships to increase investment in heat action or spur businesses' investments in retrofitting their offices to ensure improved worker safety and productivity during a future heat event.

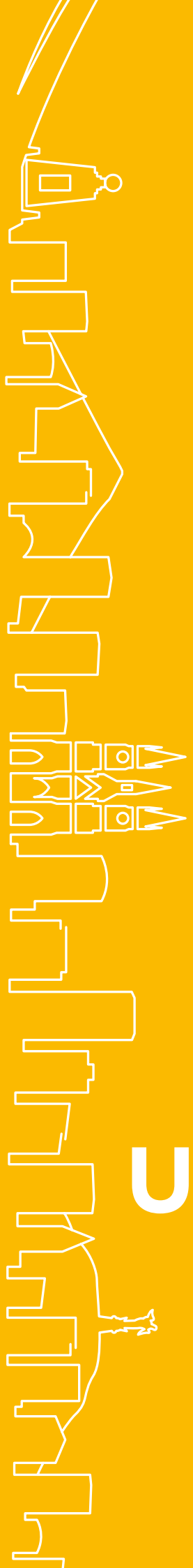
CASE STUDY 10: Second Annual Extreme Heat Planning Workshop in Arizona, USA

The Second Annual Extreme Heat Planning Workshop in Arizona, USA, in Spring 2018 convened representatives from organizations and departments who are on the state's frontline in addressing extreme heat. The concept of an inclusive annual heat planning workshop evolved from a working group spearheaded by the Arizona Department of Health Services (ADHS). At the time, the ADHS was already organizing a heat-health working group after receiving funding from the Centers for Disease Control and Prevention's Climate-Ready Cities and States Initiative. The working group decided to expand these planning efforts to include stakeholders across sectors, beyond public health. The group recognized that prevention and response efforts could be improved by collaborating with non-traditional public health partners while addressing the perception that efforts to plan for extreme heat were siloed, leading to inefficiencies. The new partners included the National Weather Service in Phoenix, Arizona State University and The University of Arizona. Through a large and inclusive in-person annual meeting, the group now successfully increases communication and connectivity among all heat stakeholders.

Cities do not need perfect heat action plans; it is more important to build on real-life experience. Within the process of testing, evaluating and learning, a city can update and expand its heat action plan, making it more effective over time in response to local conditions and lessons learned. This can be complemented by engaging with city partners, national and provincial stakeholders, local communities and other cities. By taking a scalable approach to its heat action plan, with time a city can implement a plan that is much more successful in the event of a heatwave.

CASE STUDY 11: Telecross REDi

The Telecross REDi service supports people by calling them daily during declared heatwaves. It is activated by the South Australian Department of Human Services when an extreme weather event is declared. Volunteers from the Australian Red Cross call pre-registered clients to check on their wellbeing. The callers ask people how they are coping and remind them of important measures that will help them through the extreme weather. If a call goes unanswered or if someone is in distress, an emergency procedure is activated to ensure the safety and wellbeing of the client. People in the community who are at risk during extreme weather events and require telephone support during this time are encouraged to register for the service. This includes people who live alone, have a disability, are experiencing mental illness, are housebound, frail, aged, recovering from an illness or accident, or have an ongoing illness such as diabetes or a heart condition. For more information please visit the Telecross REDi webpage.[66]



Chapter 8: Urban planning for heat risks

» **EXISTING URBAN PLANNING TOOLS SUCH CITY MASTER PLANS, BUILDING CODES AND ZONING SHOULD BE USED TO REDUCE HEAT RISKS.**

» **NATURE-BASED SOLUTIONS AND GREEN TECHNOLOGY CAN HELP TO MODERATE A CITY'S TEMPERATURE.**

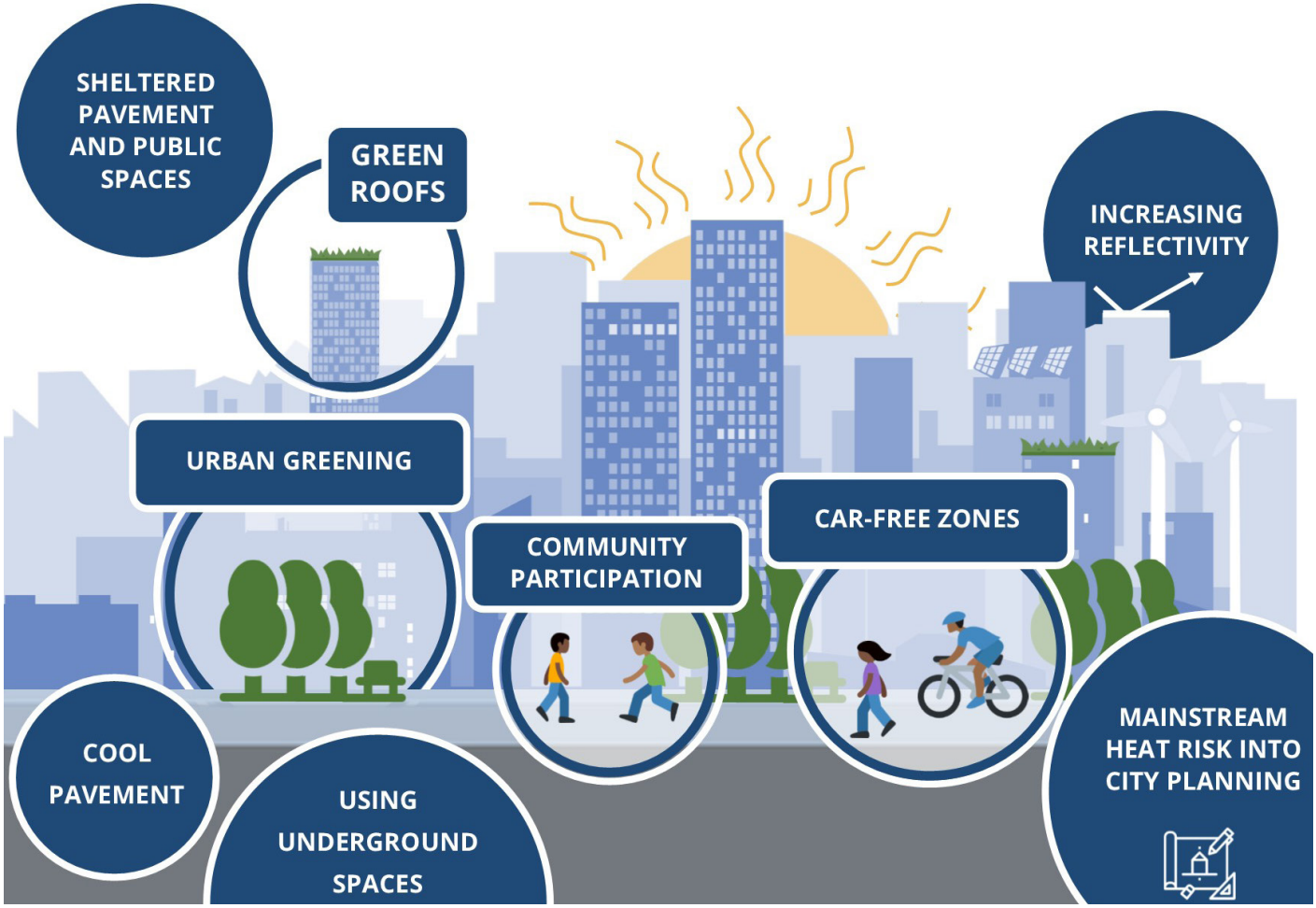
The city on the title page is Quito.

Previous chapters of this guide have focused on the short-term measures that can be taken to manage heat risk. This chapter focuses on different urban planning measures that can also contribute to a long-term heat-risk reduction strategy. The built environment, public services, legal and cultural norms as well as institutions and the general public should all adopt strategies to reduce heat risk, present and future. It is important to mainstream heat-risk reduction measures into city planning and across departmental policies and strategies for it to have the greatest impact.

Urban planning tools such as city master plans, building codes, zoning and transport plans determine how cities are laid out, population densities and how people move from one point to another within the city. Homes, workplaces and hospitals should be built to minimize heat risks, as should public spaces and public transport networks. In addition, local governments and municipalities should develop incentive programmes that encourage businesses and citizens to adopt measures to reduce dangerously high temperatures in buildings.

FURTHER READING:

» Ahmedabad in the Indian state of Gujarat is an example of a megacity in a low- or middle-income country that mainstreams heat risks and climate adaptation into policies. Read more about how the city of Ahmedabad is addressing heat-related risks through a Heat Action Plan.[67]



Urban planning measures that can contribute to a long-term heat-reduction strategy.

BUILDING CONSTRUCTION

The orientation of new buildings should be planned to reduce direct exposure to the sun in hospital wards, schools, offices and community spaces. Existing office buildings can change their internal layouts to ensure that the areas in which employees spend most of their time are not in direct sunlight during the hottest parts of the day, and designating those spaces that are in direct sunlight as meeting rooms and other short-use communal spaces. Companies, schools, hospitals and other large buildings can also incorporate cooling measures within their premises. Passive cooling strategies include fitting insulation to prevent indoor temperatures from rising, installing blinds on windows, planting trees across western-facing windows and ventilating buildings in the evening when temperatures are cooler. These can be incorporated into building codes to standardize good practices. Municipal governments can help to ensure workers' safety by providing incentives to companies to prioritize their workers' health during extreme heat or mandating this through legislation.

HOSPITALS

Hospitals need special attention to increase their resilience to heatwaves. It is especially important during times of extreme heat that patients along with computer systems, medical equipment and medicines are kept cool. Building orientation, exterior shading and structural density are three building considerations that can mitigate the effects of heatwaves on hospitals. Hospital wards that face West experience the highest peak temperatures, while wards that face East experience the highest overall temperatures, as they cool the most slowly. Any external barriers between the hospital and direct sunlight, such as trees, hills, other buildings or man-made shading, help to decrease the temperature within the hospital during times of extreme heat.[68] Hospitals also need to prepare for a large influx of patients during heat events, which exceed typical daily admission rates. They may also have to change their layouts so that those patients most threatened by heat are accommodated in cooler parts of the building. For example, in a hospital in Ahmedabad, India, the maternity ward was on the fourth and, reportedly, hottest floor. After a heatwave in May 2010, the ward was relocated to the ground floor where it is much cooler. Analysis of this shift indicates that it had a protective effect with fewer heat-related admissions to the neonatal intensive care unit.[69]

CASE STUDY 12: 'Smart hospitals' in the Caribbean

Smart hospitals proactively incorporate climate adaptation and disaster preparedness measures to reduce the impact of disasters on health. This includes heatwave risk reduction measures such as planting trees to provide shade, increasing ventilation and air flow, using highly reflective paint on the roof and materials to reduce energy consumption by keeping hospitals cool, and adapting roofs to collect rainwater and solar energy.

This initiative caught the attention of the local authorities for its capacity to improve resilience to disasters and reduce energy consumption at hospitals and became a model for a 'SMART Schools' and 'SMART Hotels' initiative. The SMART Hospitals initiative started as a pilot in 2012 in two countries. Since then, interventions have been scaled to 12 countries and Pan American Health Organization teams are retrofitting seven hospitals. Healthcare facilities are deemed smart when they link green interventions with structural and operational safety. The importance of a reasonable cost-benefit ratio is also emphasized, increasing efficiency, as the health sector is also one of the heaviest consumers of energy.

For more information, go to www.paho.org/disasters/newsletter.

URBAN GREENING

Urban green helps reduce heat and flooding during storms.

Urban greening can be a very effective method for city heat mitigation, as shade decreases the surface temperature which, in turn, reduces the heat transmitted into buildings and the atmosphere. Establishing parks and open spaces, planting trees and landscaping can help create places of refuge during a heatwave, keeping the city functioning. There are also important benefits to urban greening such as more effective management of water runoff during storms. The distribution of these measures throughout the city should be for all residents, regardless of their socio-economic status. It is important to take account of the spaces used by the most people and plant trees along streets, walkways and between buildings. The types of plants used, the design of the green space, and practices for irrigation also need to be considered carefully in order to maximize heat reduction[70]. The maintenance of these green spaces also needs to be incorporated into annual budgeting and planning processes to ensure they stay healthy and effective.

CASE STUDY 13: Tree audit and forestry management plan in Kampala, Uganda

At an urbanization rate of 5 per cent every year, Kampala, Uganda, is among the fastest growing cities in sub-Saharan Africa. By 2050, it is estimated that the city will be home to 10 million people. However, past unplanned rapid urbanization has greatly impacted the city's residents and ecosystems, exposing them to various hazards including heat and floods. In 2016, Kampala Capital City Authority developed a Climate Change Strategy for the city that aimed to mainstream climate change into all city services as a step towards low carbon development. Recognizing the multiple benefits of trees, the city conducted a tree audit to gauge the current tree stock and identify new

© Kampala Capital City Authority

planting areas. City officials have also mobilized communities and institutions to increase tree density from the current 13 trees per acre to 20 trees per acre over the next ten years. Increased tree-canopy cover provides shade and enhances cooling through evapotranspiration, protecting city residents and infrastructure from devastating heat. In addition, trees and shrubs remove smoke, dust and other pollutants from the atmosphere, improving air quality within the city.

GREEN ROOFS

Green roofs are an emerging technology that should be considered in urban planning. A green roof is a vegetated layer grown on the roof surface. As with trees, vegetation shades the roof's surface, reducing the heat emitted back into the atmosphere through evapotranspiration. Standard rooftop surfaces are often hotter than the surrounding air temperature, but a vegetated surface is cooler.

Green roofs can be incorporated into most building designs. There are, however, a number of challenges. The vegetation will require watering so waterproof layers need to be installed, taking into consideration run-off and root systems. This waterproofing layer also needs to be maintained, so it is important to incorporate maintenance at design stage. Choosing the right plants also requires careful consideration and a professional team should be called in to determine if the building's structural frame is strong enough to support the soil and plants.

FURTHER READING:

» Learn more about using green roofs by reading The Benefits and Challenges of Green Roofs on Public and Commercial Buildings.[71]

CASE STUDY 14: Green Roof Pilot Project in eThekwini Municipality, South Africa

In 2004, eThekwini Municipality, South Africa, initiated the Green Roof Pilot Project as part of its Municipal Climate Protection Programme. Since then, the Project has shown tangible benefits including lower temperatures inside buildings, reducing the need for air-conditioning; rainwater attenuation and slowing the release of this water into the stormwater system, ameliorating flood risk in the city; increased inner-city biodiversity; and, the improved visual appeal of buildings, especially of roofs that people look down onto. Now the other opportunities of green roofs can potentially be harnessed, such as the production of food crops on the rooftops to support food security.[72]

INCREASING REFLECTIVITY

Heat is also retained in a city by dark surfaces and urban structures with low reflectivity. For example, the lack of reflectivity of asphalt is a major contributor to heat within a city and alternative surfaces should be considered. City planners can increase heat reflection by painting surfaces and structures white or other light colours. This simple technique can be extremely effective at reversing the urban heat island effect.

Painting building roofs light colors can increase reflectivity and reduce temperatures.

COOL/PERMEABLE PAVEMENTS

A new concept being introduced in urban planning and development is the idea of cool or permeable pavements. Reflective or permeable pavements help to lower surface temperatures, reducing the amount of heat trapped on the surface, or allowing air and water into voids in the pavement, keeping it cool. As this is an evolving technology and a relatively new concept, decision-makers and city planners should work with local experts to guide them on the most suitable materials and processes for their city.

CAR-FREE ZONES

A major contributor to heat emissions within a city are cars and other vehicles. One way to address this is for planners to designate areas within a city as car-free zones. These areas are then only accessible by public transport, foot or bicycle, reducing emissions of heat, pollutants and greenhouse gases. Bus lanes can also be incorporated into a city's design, to encourage more use of public transport.

WATER SERVICES

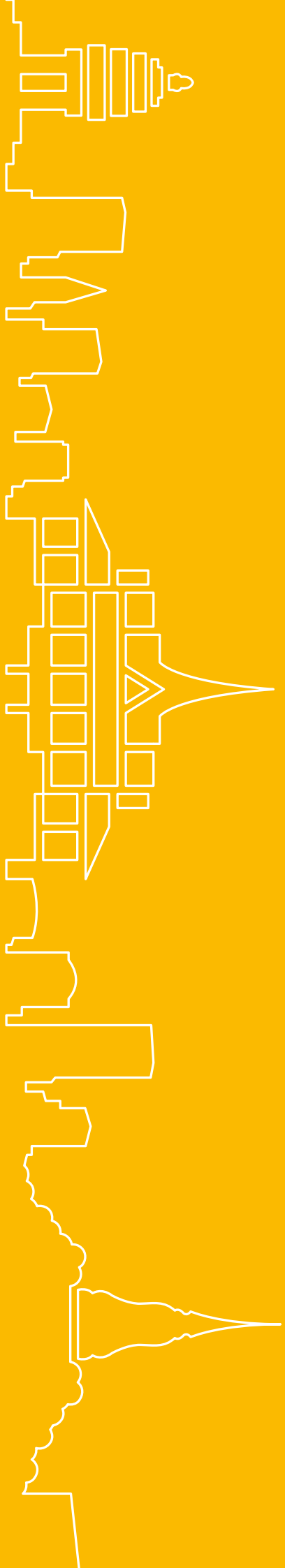
Local government investment in water services and infrastructure can strengthen a city's resilience to heatwaves. Measures can include installing (or repairing) drinking water fountains and water sprays as well as spraying streets with water. Cities in water-stressed locations should focus on installing and repairing drinking water fountains so that people can stay well hydrated during a heatwave.

ENERGY MANAGEMENT PLANS

Heatwaves can represent a significant problem for electricity service providers. During a heatwave demand for cooling can increase dramatically, leading to blackouts or a reduction in electricity supply. Electricity disruptions can have knock-on effects for other infrastructure and essential services that depend on a reliable supply of energy.[73] It is therefore important that officials manage peak electricity demand, work to incorporate passive cooling strategies in buildings, and ensure the availability of backup energy sources for critical infrastructure. Installing solar panels on rooftops can provide an alternative eco-friendly source of energy that can also reduce the demand on central power generation.

FURTHER READING:

» Local governments may find "Adapting to Urban Heat: A Tool Kit for Local Governments" a useful analytical tool for considering different changes to the built environment and criteria for selecting an approach, as well as guidance on how to pursue these changes.[74]



The city on this page is Phnom Penh.

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Case study 13: Daniel Padde, Kampala Capital City Authority, *Tree audit and forestry management plan in Kampala, Uganda*.

Box 5: Lauren Rogers-Bell, Global Disaster Preparedness Center, *Heat related illnesses*.

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Notes

Notes


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