

# HEAT EARLY WARNING SYSTEMS ROUNDTABLE

In February 2023, the Global Heat Health Information Network brought experts from around the world together in Washington DC to discuss the scaling of Heat Health Early Warning Systems, in line with the targets of the global Early Warning Systems for All initiative.

## DATE

27 FEBRUARY 2023

## HOSTED BY

UNIVERSITY OF ARIZONA  
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OUTREACH & COLLABORATION

## Photo

*Ladd Keith of the University of Arizona addresses the room.  
Maddie West / GHIN*

Extreme heat and heatwaves, exacerbated by climate change, pose significant threats to public health, and effective early warnings are crucial for mitigating these risks. The ambitious goal of scaling up Early Warning Systems to cover every person in the world in the next 5 years calls for considerable acceleration in methods, technologies, research, and delivery of operational systems.

This roundtable served to further the conversation on Heat Health Warning Systems initiated under the G7 Health Working Group in November 2022, under the leadership of Germany. The invitation-only roundtable brought together key actors to discuss coordination needs, new opportunities, and priorities for scaling up future heat health warning system investments, particularly aligned with the Early Warning Systems for All global initiative.

The session served to stimulate discussion and explore different strategies and investments in place to address key challenges around heatwave and heat health early warnings.



Participants were encouraged to share their initiatives and commitments to inform and coordinate efforts globally. The goal of the roundtable was to determine how to best leverage resources effectively and guide organisations like the World Meteorological Organisation (WMO) in building appropriate systems, and aimed to identify coordination gaps and promote collaboration among participants to address heat health challenges.

This report contains insights, recommendations, and best practices emerging from the discussion, highlighting the importance of collective action to protect vulnerable populations from the impacts of heatwaves.

# CHALLENGES AND SOLUTIONS

The following sections summarise the key challenges raised during the roundtable, and the various considerations, strategies and practices suggested by participants to address them.



## Challenge 1:

# INTEGRATING VULNERABILITY INFORMATION INTO EARLY WARNING SYSTEMS

### Photo

*Ollie Jay of the University of Sydney speaks about efforts to develop a personalized heat alert app with roundtable attendees, who included research donors, NGOs, Multilateral and UN agencies, national meteorological and hydrological services, private sector companies, and academia. Maddie West / GHHIN*

A one-size-fits-all approach to early warning systems may not be effective, given the extreme heterogeneity in individual responses to extreme heat and diverse geographical and socioeconomic contexts, but it can be a challenge for decision makers to design locally-appropriate systems and decide how exactly early warnings are triggered.

A system where meteorological data triggers heatwave warnings is relatively simple and cost-effective, but may not adequately capture the complex interplay between weather conditions, vulnerability, and societal impacts, and may not be effective in protecting vulnerable populations.

Impact-based systems provide a more comprehensive approach to heatwave preparedness, by considering the specific vulnerabilities and impacts of heatwaves on different populations and sectors. By providing tailored warnings and mitigation measures, it can help reduce the adverse effects of heatwaves on vulnerable communities. However, this approach may require more resources and data to implement effectively and may be more complex.

Many of the organisations participating in the roundtable have been testing impact-based approaches to heatwave early warning by integrating various types of vulnerability data, and through tiered approaches to warnings for specific populations.

- The impacts of extreme weather are more severe in low-income countries, and addressing this inequity should be a priority. Extreme heat disproportionately affects the poorest and most marginalised people, and this impact is likely to increase in lower income contexts under the influence of climate change. Understanding vulnerability and targeting the most impacted populations, particularly in humanitarian contexts, is crucial in addressing the impacts of extreme heat.
- Vulnerable populations may not necessarily be located in the hottest areas of the city, so it's important to understand demographic factors that increase their risk. There is a need to review and consolidate various extreme heat vulnerability mapping

approaches, including methods and their utility (i.e. strengths and limitations).

- There is a challenge connecting exposure information, such as high-resolution mapping efforts, indoor/outdoor hazards, and people's movement, to relevant health outcomes like morbidity and mortality. Integration of electronic medical records and other methods may be needed to better understand the relationship between hazards, exposure, and health outcomes.
- Emergency room usage data and syndromic surveillance can be used to identify areas where people are seeking medical attention for heat-related illnesses. This data, along with emergency medical service calls, can provide a new paradigm for targeting

interventions based on health outcomes rather than just exposure. While obtaining such granular data in a timely manner may not be possible everywhere, where available, it could be piloted to assess the effectiveness of various interventions, including long-term measures like tree planting or cool surfaces, as well as targeted interventions with healthcare providers and social networks in those areas.

- Factors such as urbanisation, ageing populations, and vulnerability need to be considered when developing heat health early warning systems and action plans. The geographic dimension of thermal inequality should inform strategies, and collaboration is needed between local knowledge and international organisations.

## Challenge 2:

# PROTECTING POPULATIONS IN AREAS WITH CHRONIC HEAT AND SEASONAL RISK

In many places, a significant proportion of adverse health outcomes and hospital admissions happen at temperatures which are considered moderately hot and not extreme, often at temperatures below the thresholds at which heatwave warnings are issued.

Improving and sustaining awareness and preparedness efforts in regions where heat is a persistent threat to health or where risk remains high seasonally is a significant challenge, as the population may believe they are well-adjusted to heat and are not at risk.

- It is important to incorporate social sciences into research to better understand knowledge, attitudes, and practices related to heat stress. Understanding existing heat risk and vulnerability perceptions can inform behaviour change strategies and messaging.
- Personalized heat health warnings based on forecast data and individual vulnerability factors can reduce warning fatigue for low-risk individuals and ensure high risk individuals are alerted in a timely manner.

- Extreme heat warnings should only be the final trigger for promoting risk reduction behaviours and activating protective measures, which should be planned and in place before the heat season for example through seasonal preparedness and public awareness raising.
- It is important to distinguish between seasonal forecasts and heatwave warnings, as they may not always align. For example, a warmer than average period may not necessarily lead to more lethal heatwaves. There is a need to clarify this distinction between seasonal and short term forecasts in the context of early warning systems.

### Challenge 3:

## ENSURING WARNINGS LEAD TO ACTION AND BEHAVIOUR CHANGE

There is a knowledge gap when it comes to connecting heatwave and heat health warnings with appropriate actions. Understanding risk perception and adjusting it to ensure people take action in response to early warnings is an important step in reducing the impacts of extreme heat, but effectively communicating risk is a complex task, especially where populations are accustomed to hot weather or are unable to take the necessary steps to protect themselves.

- To reduce morbidity and mortality that occurs during extreme heat events, we need to reach vulnerable populations who may not have the ability to change their behaviour, such as those in occupational settings or with mental health problems. Identifying these populations and individuals is often challenging due to a lack of data, competing priorities, and established processes in health and social care communities.
- Tiered warnings with context-specific thresholds can provide alerts directly to service providers or caregivers for vulnerable populations. The higher mortality rate during heatwaves in certain regions highlights the need for more detailed research and messaging mechanisms, such as through pharmacies or volunteers, to reach hard-to-reach populations.
- There is a need to connect warning systems to health systems, including clinicians who can provide individual counselling and consider factors such as medications for patients. However, there can be challenges related to the separation between public health and clinical health care delivery, which is often fragmented.
- Monitor and link indoor heat risks to heatwave and heat health warning systems, recognizing it may be more dangerous to stay inside, and heatwave conditions in the built environment can occur far before meteorological thresholds trigger a warning.
- Different communications platforms and tools - including SMS blasts, social media, apps and radio channels - can be leveraged to reach specific groups when incorporated into early warning systems.
- Effective early warnings require engagement with the mass communication partners, as high temperatures are often predicted well in advance by weather models and may generate public attention and media coverage. Public health agencies and meteorological services have a responsibility to engage with these stories early, bring authority and control to the conversation, and start raising awareness about heat risks even before

official warnings are issued. This can be achieved through a tiered approach to heatwave and heat health warnings, involving multiple channels and coordination among different agencies. By building up seasonal preparedness, engaging in early discussions with partners, and gradually escalating communication efforts, the goal is to create a situation where when a warning is eventually issued, it comes as no surprise and triggers appropriate actions from the public and relevant stakeholders.

#### Example efforts:

- There is ongoing work in the **UK**, including as part of a PhD project, to use primary care data and artificial intelligence for identifying individuals at risk during heatwaves. The evidence suggests that the risk is context-specific, and this approach aims to use individual-level data for risk stratification and identification of vulnerable individuals.
- In **Canada**, tiered warnings for heat health events are being explored for vulnerable populations such as seniors and homeless individuals, as well as emergency level warnings. They are reviewing criteria for issuing warnings, such as mortality curves, hospital admissions, and other evidence-based perspectives.
- In **Australia**, one of several platforms being developed is a personalized heat stress app that integrates environmental parameters to define individual heat risk and rate it on a decimal scale from 1 to 5. The app uses a physiological model based on individual risk factors such as age, medication, and co-morbidities to calculate heat strain in the body. When the user's risk rating rises, the app triggers an alert to encourage action. The app also aims to identify high-risk areas in advance by combining climate inputs with demographic data. However, concerns have been raised about accessibility for the most vulnerable population who may not have access to smartphones. Solutions being explored include having doctors use the app in their practices, and developing a public-facing general scale for sharing alerts at public places like bus stops.

## Challenge 4:

# ADDRESSING COMPLEX AND CASCADING HAZARDS

Extreme heat is often experienced alongside compounding hazards that magnify risk for vulnerable populations and complicate risk communications. Drought, dust, wildfires, smoke, power outages, disease outbreaks, water shortages, flash floods and other hazards can make heat risk exponentially more difficult to manage.

- Cascading risks should be incorporated into production and warning systems as well as in messaging to decision makers and communities that are facing concurrent threats to avoid conflicting or competing messaging.

Early warning systems for extreme heat and related hazards should be multi-hazard in nature, as we can expect more frequent compound disasters in the future, such as drought, heatwaves, wildfires and flash floods. Integrated and coordinated early warning systems are crucial for the management of compound hazard management.

- It is important to communicate these warnings in a simple and integrated way, as fragmented information sources can overwhelm first responders and organizations involved in response efforts. Simple, understandable, and integrated early warning systems that consider compounding hazards are needed to effectively address the challenges of extreme heat and related hazards.

## Challenge 5:

# EMBEDDING HEAT PLANNING IN LOCAL RISK MANAGEMENT SYSTEMS

Building locally owned and led systems is the most effective way to address extreme heat and related hazards in low-income countries.

- In low-income countries, preparedness and response approaches for extreme heat and related hazards should be embedded in local risk and resource management systems, governance, culture, and capacity development.
- Instead of focusing on risk response projects, there should be a shift towards building systems for managing risks at the local level.
- Local and indigenous extreme heat impact knowledge should be incorporated into local risk management systems. International efforts should support and enable local systems by providing resources, expertise, and information, while also promoting self-learning and knowledge sharing in the Global South.

- Legal recognition of heatwaves in disaster management legislation to broaden sectors and departments involvement in heatwave warning systems may help with access to disaster risk management emergency resources and mechanisms.
- The role of local leadership and technical expertise in estimating vulnerabilities and heat health warning thresholds is important to ensure extreme heat response measure responsibility is accountable at the local level.
- It is crucial to involve end users in the design of heat health warning levels that make sense and are actionable to those who receive the messages.

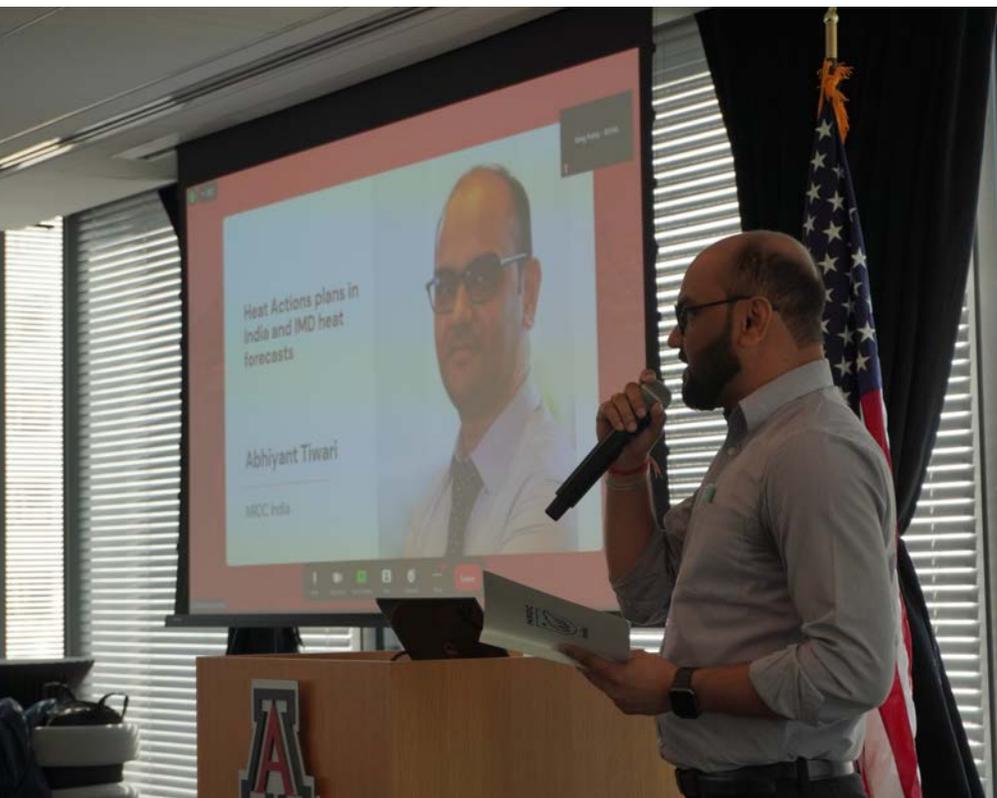
## Challenge 6:

# ENGAGING DIVERSE SECTORS IN HEATWAVE AND HEAT HEALTH EARLY WARNING SYSTEMS

Extreme heat impacts health directly and indirectly, and can affect a broad range of sectors that provide important services - from energy and agriculture, to the economy and housing. It is an important challenge to engage all impacted sectors in development of heat action plans, and to provide early warning services for them that can protect the systems people depend on.

- Coordination across sectors is needed to design early warning systems that meet multiple needs in terms of definitions, timescales etc. for coordination of policy and action (ministries of health, energy, agriculture, transport, meteorological and emergency services etc.)
- It is important to take a multi-objective approach in community engagement efforts, quantifying outcomes related to health, energy, behaviour, and other factors that people care about. Incorporating these diverse objectives into a systematic and translatable framework can help create a bigger picture of the impacts of exposures and inform decision-making.

- Framing the issue in terms of social determinants of health, including energy security and housing insecurity, allows public health to be involved in assessing the health benefits of investments in sectors such as energy, housing and urban development. Creating indicators around these social determinants of health can help build an evidence base for cost-effective interventions and give public health a place at the table in decision-making processes.
- Distinguishing between heat health early warning systems and those for other impacted sectors like agriculture and drought is important for effective preparedness and response. Differentiating between the needs of different agencies, such as the Ministry of Health, climate agencies, and disaster risk management agencies, can aid in country engagement.
- Recent reports have also shown that a significant portion (almost 80%) of heat health emergency medical services calls occur inside people's homes, particularly among elderly individuals living alone. This has raised concerns about energy security, housing insecurity, and occupational health, especially among agricultural workers who may face outdoor and indoor heat exposure.



### Photo

NRDC India's Abhiyant Tiwari presents perspectives from India's work on Heat Action Planning (HAP), where governance is key:

*Legally recognizing extreme heat as a disaster and involving different sectors and departments in early warning systems is important in order to access disaster risk management emergency resources and mechanisms, as is the need to identify and promote heat adaptation measures in various sectors of the economy, for example water and energy.*

# NEXT STEPS

Sharing of information, best practices, and lessons learned is vital to accelerate the scale-up of heatwave and heat health early warning systems.



## ACTION ITEMS

- Informal quarterly coordination meetings for continued sharing and collaboration
- Email distribution list of key actors
- Engage existing relevant coordination efforts (e.g. REAP Heat EWEA Group, and IASC EWEA, WHO-Thematic Platform for DRR-Health)
- Create a space on the GHHIN website for Heat Health EWS and inventory of services

## RESOURCES

- [Developing Climate Information Systems for Heat Health Early Warning: Workshop report, action plan and requirements](#) (2015)
- [Final Report: From the G7 Health Communiqué to Action: Health and Climate – Heat Preparedness through Early Warning Systems](#) (2022)
- [Background Report on Heat Health Warning Systems in G7 countries](#) (2022)
- [Early Warnings for All: Executive Action Plan 2023-2027 \(The UN Global Early Warning Initiative for the Implementation of Climate Adaptation\)](#)
- [Extreme heat: Preparing for the heat waves of the future](#) (2022)
- [WHO/WMO Heat Health Warning System Guidance](#) (2015)
- [Main findings and recommendations of the midterm review of the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030](#) (UNDRR 2023)
- [Early Warnings for All](#)
- [UNDRR/ISC Hazard Information Profiles: Supplement to UNDRR-ISC Hazard Definition & Classification Review – Technical Report](#) (2021)

The urgent need for global collaboration, coordination, and sharing by key actors in the heat health space cannot be overstated. The increasing frequency and intensity of heatwaves due to climate change poses a significant threat to public health, and early warning systems are critical to mitigating these risks.

Global collaboration is essential to foster information exchange, research, and innovation, allowing for the development of robust heatwave and heat health early warning systems that can effectively address the diverse challenges posed by extreme heat in different regions of the world. By working together, key actors such as governments, international organisations, scientific communities, and public health agencies can pool their expertise, data, and resources to create comprehensive and integrated early warning systems that are tailored to local contexts.

Collaboration between meteorological agencies, health authorities, emergency management agencies, and other relevant stakeholders is necessary to integrate meteorological data, health indicators, vulnerability assessments, and response strategies into early warning systems. This coordinated approach can enhance the accuracy, timeliness, and relevance of

heatwave and heat health warnings, enabling communities to take proactive measures to protect vulnerable populations.

Sharing of information, best practices, and lessons learned is vital to accelerate the scale-up of heatwave and heat health early warning systems. By fostering a culture of openness, transparency, and knowledge exchange, key actors can learn from each other's experiences and leverage existing resources and expertise to implement effective early warning systems in a timely manner. Sharing of data, research findings, and technical tools can also facilitate capacity-building efforts in vulnerable regions, enabling them to develop and implement their own early warning systems based on the best available evidence.

The challenges posed by extreme heat are complex and require a multi-faceted approach that transcends national boundaries and sectors. By working together, we can enhance the resilience of communities and protect the health and well-being of vulnerable populations in the face of increasing heat health risks. Our Networks aims to take collective action to prioritize and invest in robust early warning systems to safeguard public health in our changing climate.

# ACTIVITIES SUMMARY

The following partners shared their major activities, plans, and advancements for contributing to heatwave and heat health early warning systems.

|  |   |
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| <p><b>WMO</b></p>  | <ul style="list-style-type: none"> <li>• Co-sponsor of GHHIN</li> <li>• Updating HHWS Guidance and developing roadmap to accelerate Heat and Health work in WMO</li> <li>• Early Warnings for All initiative</li> <li>• <a href="#">ClimaHealth portal</a> provides descriptions of country-specific climate service providers and a heat health topic page</li> </ul>  |
| <p><b>UN-OCHA</b></p>  | <ul style="list-style-type: none"> <li>• Produced report with IFRC and the Red Cross Climate Centre on <a href="#">Extreme Heat: Preparing for the Heatwaves of the Future</a></li> </ul>   |
| <p><b>UN-HHS</b></p>   | <ul style="list-style-type: none"> <li>• <b>Climate Health Outlook</b>, a multi-hazard early warning system which will combine seasonal and subseasonal forecasts with social vulnerability, environmental vulnerability, and health burden indicators to provide localised forecasts of heatwaves and other climate-related hazards.</li> </ul>  |
| <p><b>NOAA</b><br/>(See <a href="#">report</a> for EWS description)</p>      | <ul style="list-style-type: none"> <li>• NIHHS: National Heat Health Information System</li> <li>• <a href="#">Community-based citizen science urban heat island mapping compaigns</a></li> <li>• Tabletop exercises</li> </ul>   |
| <p><b>US-CDC</b></p>   | <ul style="list-style-type: none"> <li>• <b>Heat Risk tool</b>: Partnership with NOAA’s National Weather Service to develop colour-coded and numeric heat forecasts for every location. <i>In development for the end of 2023.</i></li> <li>• <b>Heat and Health Tracker</b>: Online tool that provides real-time updates on heat-related illness based on emergency department visits from the previous day. The data is available at the regional level, divided into 10 EPA regions, and provides information on heat distribution and potential adverse health outcomes.</li> </ul> |
| <p><b>Health Canada</b> (See <a href="#">report</a> for EWS description)</p> | <ul style="list-style-type: none"> <li>• Making advancements in EWS to provide tiered emergency warnings for vulnerable subpopulations.</li> </ul>  |

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| <b>University of Sydney</b>                        | <ul style="list-style-type: none"> <li>• <a href="#">Heat and Health Research Incubator</a></li> <li>• Personalized heat stress scale app: In pilot testing</li> <li>• Public facing heat risk scale being explored for vulnerable populations without smartphones</li> </ul>   |
| <b>GEO</b>   | <ul style="list-style-type: none"> <li>• <a href="#">GEO's Heat Working Group</a> is working on a concept for a Global Integrated Heat and Health Information Service that will be accessible to cities worldwide. The goal is to produce data, develop tools, and combine hazard and vulnerability information to create actionable insights for cities to inform early warning systems and cater to the needs of different users who may have different timescales beyond emergency response.</li> </ul>  |
| <b>University of Arizona</b>                       | <ul style="list-style-type: none"> <li>• Working with state government and health services to coordinate cooling centres across Arizona</li> </ul>  |
| <b>NRDC</b>  | <ul style="list-style-type: none"> <li>• In the US, efforts are focused on policy advocacy and enhancing evidence on the economic impacts of heat.</li> <li>• In India, emphasis on vulnerability is being integrated into early warning systems for effective decision-making and action.</li> </ul>   |
| <b>World Bank</b>                                  | <ul style="list-style-type: none"> <li>• Efforts and investments in disaster risk management, including hydrological disasters like floods, hurricanes, seismic resiliency, and urban resilience, are ongoing at the World Bank. Heat and health have emerged as a new initiative, with requests from ministers of health to include heat as part of climate actions.</li> <li>• <a href="#">Heatwave Data Collaborative</a>: Using data from multiple sources including the private sector, to inform policy decisions. The initiative focuses on problem statements that can be tackled within 18 months, covering a wide range of subjects related to heatwaves. Examples include analysing health impacts of heat using mobilisation and telemetry data, and analysing sentiment on social media to estimate well-being and correlate it with early warning systems. The goal is to create data goods, or methodologies that can be applied in different countries.</li> </ul>  |
| <b>Arsht-Rock Extreme Heat Resilience Alliance</b> | <ul style="list-style-type: none"> <li>• 6 HHWS pilot projects are underway in cities around the world as part of a process to develop a low-cost and easy-to-implement warning system for developing countries with limited resources. The project involves analysing weather data from the past 15 to 25 years and linking it to all-cause mortality data to create an algorithm that can predict mortality increases based on weather conditions. The system uses categorizations based on local conditions and is being tested with different messaging strategies in different locations. Preliminary results show positive changes in individual and social behaviour in response to the messaging.</li> <li>• Cool Capital Stack Initiative (CCSI): Blended finance facility that can prepare and fund projects. This includes traditional debt and equity, concessional financing, risk transfer options, and philanthropic funding to capture different return and risk profiles. These funds can be used to prepare and fund projects related to warning systems, transformation of the built environment, and more.</li> <li>• Partnering with the <a href="#">Resurgence DARAJA program</a> in East Africa to build a system that delivers heat warnings through local radio stations and trusted messengers.</li> <li>• Collaborating with the National Association of Community Health Clinics to explore incorporating heat resilience messaging into health issues for patients.</li> </ul> |

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| <p><b>UNDRR / UK Health Security Agency</b></p>                                    | <ul style="list-style-type: none"> <li>• Contributing to the midterm review process of the Sendai Framework, with a strong focus on multi-hazard early warning systems</li> <li>• Working closely with WMO on the "Early Warnings for All" initiative to catalogue hazardous events and improve heatwave definitions for climate adaptation.</li> </ul>   |
| <p><b>Red Cross (IFRC, GDPC, American Red Cross, Red Cross Climate Centre)</b></p> | <ul style="list-style-type: none"> <li>• Several global initiatives underway that are focused on the "last mile" of early warning systems, with a focus on engaging communities and vulnerable populations in the development of solutions.</li> <li>• Climate Centre is involved in ENBEL work and indoor heat risk research</li> <li>• Wrapping up small grants for heat research across 13 countries</li> <li>• Supporting adaptation work in secondary cities in Indonesia, Tanzania, and Honduras through a larger grant from the US government (BHA, USAID), as well as smaller efforts in Nepal, Bangladesh, Burkina Faso, and other places.</li> <li>• Launched heat action day last year in collaboration with global offices, with heatwave flash mobs being done in over 50 different locations. Plans for this year's efforts are currently being discussed.</li> <li>• Efforts are being made to incorporate social media into warning systems to improve information sharing, especially for vulnerable communities in Latin American countries.</li> </ul> |
| <p><b>Wellcome Trust</b></p>   | <ul style="list-style-type: none"> <li>• Major research investments on climate and health (100 million GBP per year) which include heat adaptation needs.</li> <li>• Recently launched a climate and health strategy with a focus on heat-related health impacts.</li> <li>• initiated funding calls for research projects evaluating adaptation interventions to reduce the burden of heat in lower and middle income countries, as well as exploring the relationship between heat and health in the context of biological vulnerability, particularly in maternal and child health.</li> </ul>   |
| <p><b>National University of Singapore</b></p>                                     | <ul style="list-style-type: none"> <li>• New <u>Heat Resilience and Performance Centre</u> being developed with support from the Singapore Ministry of Defense.</li> <li>• The <u>HeatSafe Project</u> aims to build capacity in the region, focusing on occupational sectors where workers may have limited control over their behaviours. Economic analysis is used to convince stakeholders, such as employers and CEOs, that investing in strategies for heat safety can lead to both health benefits and increased productivity.</li> </ul>  |
| <p><b>DWD</b><br/>(See <u>report for EWS description</u>)</p>                      | <ul style="list-style-type: none"> <li>• Advancements in the German Heat Warning System include moving from a 2 day to a 6 day heat trend forecast with UV warnings, an indoor model for the elderly in care homes, and a UHI model.</li> </ul>   |
| <p><b>UK Met Office</b><br/>(See <u>report for EWS description</u>)</p>            | <ul style="list-style-type: none"> <li>• Advancing the Heat Service to include more tailored and tiered warnings; scenario approaches</li> </ul>  |

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