

## Letter



## Climate Change and Health Adaptation: Tailored Interventions are Needed

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There have been an increasing number of studies on climate change and population health over the past 20 years, with most focusing on health risk assessment, targeting different locations and populations with various diseases (1, 2). While these studies have provided the necessary epidemiological evidence for health authorities in policymaking, it is time to develop and implement tailored health interventions to protect the health and well-being of communities, and particularly that of vulnerable groups.

### ***Climate change has led to multiple negative health outcomes and affects both our current and future burdens***

Climate change and extreme weather events, such as heatwaves, flooding, drought, and bushfires, have led to multiple negative health outcomes. Approximately 3.6 billion people live in areas that are highly susceptible to climate change, with approximately 250,000 additional deaths annually between 2030 and 2050 (1). Climate change can increase morbidity and mortality in infectious diseases, including vector/rodent-borne diseases such as dengue fever, malaria, Japanese encephalitis, Ross River virus, Hantaan virus, and West Nile virus infections; enteric infections including *Salmonella* and *Campylobacter* infections (3); chronic diseases, namely, cardiovascular, renal, and mental health illnesses; (4-7) and work-related injuries and illnesses (8). The extent to which individuals and population groups experience the detrimental health impacts of climate change varies depending on their ability to adapt to these stressors. Hence, certain populations bear a disproportionate burden of their associated health impacts. This includes children, pregnant women, the elderly, certain occupational groups, people with disabilities, people with chronic medical conditions,

and people from less developed regions (9). Climate change vulnerability is also exacerbated by social determinants of health such as social isolation, low disposable income levels, poor housing quality, housing insecurity, and access to healthcare services. Climatic and demographic change can increase such disease burdens in the future, as the WHO indicated, although the burdens might vary globally (1).

### ***Current health adaptation strategies and measurements: achievements and challenges***

Many countries have established national climate change and health adaptation strategies to guide national actions, including developed and lower-and middle-income countries (LMIC) (110). Many heat and health early warning systems have been implemented. Although such climate change health adaptation measures have helped to reduce negative health impacts with reduced morbidity and associated healthcare costs (12-13), there is no one-size-fits-all model (18). This is because most interventions are generic and do not target vulnerable populations and regions, which leaves space for tailored adaptation guidelines to be developed and implemented. Such tailored interventions should be more specific, targeted at the most vulnerable groups and regions, and should achieve cost-effective benefits with limited resources.

### ***A better coordination mechanism and localized guidelines will make a difference***

In addition to a national climate change and health adaptation strategy (10-11), a localized coordination mechanism, the development and implementation of integrated policy/guidelines at the higher risk regions, the elaboration and enactment of seasonal and disease-specific early warning systems, and their evaluation and

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refinement are necessary. In South Australia, the State Emergency Service has been assigned as an Extreme Heat Lead to tackle negative health consequences of climate change and heatwaves, together with the Department of Health and its local health service networks, the Department of Community Service, the Bureau of Meteorology, and the Australian Red Cross. Meanwhile, university researchers provide scientific evidence to frontline policy-makers and practitioners for public health actions. A South Australia Heat and Health Warning System (HHWS) has been implemented since 2010 for the general community, with a Telecross Redi service that was implemented at the same time, targeting at-risk and isolated senior citizens affected by extreme heat. The HHWS reduced both morbidity and associated healthcare costs as a “No regret action” (12-13).

#### ***At the community level for vulnerable groups***

Groups and regions vulnerable to extreme weather events and climate change have been widely identified. Therefore, tailored interventions for subgroups such as the elderly (14), outdoor workers (8), and culturally and linguistically diverse (CALD) communities are needed. There are several guidelines for the different sub-populations. South Korea has developed guidelines focusing on the health and well-being of older people during heatwaves (16). However, their effectiveness needs to be determined. A community trial conducted in an Australian community indicated that a simple message about heat and health could change older people's behavior (15). This should be encouraged for implementation elsewhere. For outdoor workers, the “Work in Heat” policy was initiated by SafeWork Australia (17), the Australian national regulator. However, detailed industrial-specific frontline guidelines and codes of practice have yet to be developed.

In terms of infectious diseases, such as dengue, malaria, Japanese encephalitis, and enteric infections, given their seasonal and spatial distributions, local health authorities must implement early warning systems with detailed instructions. An early warning with specific intervention guidelines for dengue fever in Southeast Asia during the warming season will help reduce morbidity in this region (22).

#### ***At the individual level***

Individuals with chronic diseases and those taking medications are vulnerable to extreme

weather events. Hurricanes have been reported to increase mortality in patients with kidney failure 30 days after the event (20). There are no specific guidelines for clinical practice for climate-sensitive patients during extreme weather periods. For example, how do we manage patients with cardiovascular diseases such as hypertension regarding their medication usage and fluid intake during hot weather days? How do we manage renal patients, particularly those on dialysis, regarding their fluid intake during hot days? How do we manage patients' mental health and medication usage during heatwaves? What guidance should be provided to pregnant women on hot days to reduce negative birth outcomes? An interdisciplinary effort is needed, including renal physicians, cardiologists, psychiatrists, clinical pharmacologists, obstetricians, gynecologists, and environmental epidemiologists, to develop disease-specific clinical guidelines to protect the health and well-being of patients.

#### ***At a service level, including emergency response and supply chain***

Resources are essential for hospitals and other health service providers to provide services to those in need. This is especially important during extreme weather events such as extended hot days, storms, drought, and flooding. Therefore, a stable and sustainable supply chain for medication and medical equipment is crucial for material preparation, manufacturing, and transportation. A sufficient healthcare workforce is essential.

#### ***Application of modern technology in climate change and health adaptation***

The application of modern technology in health adaptation to climate change should be promoted, and more investment is required. Integrating recently developed AI technology into disease and vector surveillance in vulnerable regions could help local health authorities develop a localized, tailored health adaptation strategy that is particularly useful for vector-borne diseases such as dengue, malaria, and Japanese encephalitis. Wearable equipment and the extensive use of smartphones provide excellent opportunities for health status monitoring and adaptation to extreme heat. Phone apps can be developed for users to download, which may help monitor physiological indicators such as heart rate and blood pressure during hot days. This is useful for outdoor workers to receive heat warnings to monitor their health and well-being. Wearable equipment such as cooling vests/caps and personal

protection equipment (PPE) can also help workers reduce their risk of extreme heat and associated disasters such as bushfires.

### ***A successful example is helpful for better adaptation***

Due to resource constraints, various socioeconomic development statuses, and climatic and demographic characteristics, it is important to develop a successful climate change and health adaptation model for other regions with similar climatic and socioeconomic conditions. This can help guide their climate change and health adaptation practices and is particularly important in many developing countries. The successful HHWS in South Australia, after evaluating its health and economic benefits (12-13), was a successful pilot project that was adopted as an Australian national initiative in 2022 with joint national efforts. Therefore, international and regional cooperation and collaboration are crucial for achieving success.

### ***Health adaptation and its evaluation***

Both quantitative and qualitative approaches are useful for evaluating the effectiveness and feasibility of health adaptation interventions. The HHWS was evaluated using data analyses when comparing two similar scales of heatwaves before and after the intervention (12-13), and its effectiveness was demonstrated in South Australia. A qualitative approach can also be used to explore its feasibility, applicability, and acceptability by interacting with different stakeholders.

### ***Conclusion***

Interdisciplinary and cross-sector collaborations are key to the development and implementation of tailored interventions to improve health benefits. Effective leadership is key, as the WHO suggested. Cross-sectoral coordination and policy coherence with full coverage of climate-sensitive health risks are also required. We also need to develop complete coverage of adaptation actions to monitor, evaluate, and refine their effectiveness with the necessary resources.

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