GLOBAL RESEARCHER CLUB

CLIMATE CHANGE

From a Health Perspective

By the Global Researcher Club

About the Global Researcher Club

Global Researcher Club® is an international voluntary & non-profit scientific research community for researchers worldwide. GRC® was established in August 2022 in Alexandria, Egypt, by Dr. Ramy Ghazy and Dr. Assem Gebreal. The club's origins can be traced back to September 2020, when it started as an informal group for scientists and students. Over time, the group grew in membership and scope, leading to the establishment of GRC® as a global research community.

The Global Researcher Club's vision is to establish a worldwide research community that has a constructive effect on the world by promoting research and youth to address pressing health challenges and enhance the health and well-being of people everywhere. The organization is dedicated to creating a world where research is accessible to everyone and researchers are empowered to positively impact society.
We are committed to fostering excellence, integrity, and social responsibility in research, transcending geographical, disciplinary, and cultural boundaries, and becoming a leading voice and catalyst for change in the global research landscape. We strive to promote diversity, equity, and inclusion.

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CLIMATE CHANGE

Climate change refers to long-term shifts in temperatures and weather patterns apparent from the mid to late 20th century onwards. Human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil, and gas which increased levels of atmospheric carbon dioxide. Temperatures on Earth's surface are changing noticeably; they are currently 1.1°C higher than they were before the Industrial Revolution, in the late 1800s. There has never been a warming trend like this one in the last 100,000 years. The decade spanning from 2011 to 2020 has been officially recognized as the warmest on record. Since 1850, every decade has been warmer than the previous one. It's an obvious indication that the earth is changing significantly, and we should all be conscious of this and take action.

Currently, 3.6 billion people reside in regions highly vulnerable to the effects of climate change. Despite being minimal contributors to global emissions, low-income countries and small island developing states (SIDS) bear the brunt of the most severe health consequences. It is projected that the direct costs of health-related damage will range between US$2 billion and US$4 billion annually by the year 2030.

This crisis impact reaches, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms, and declining biodiversity. Undoubtedly, it poses the greatest hazard to human health. Between 2030 and 2050, climate change is expected to cause approximately 250 000 additional deaths per year, from undernutrition, malaria, diarrhea, and heat stress alone 1,2.

The Impact of Climate Change on Mental Health

The mental health of the general population can be highly affected by catastrophic events such as major storms, droughts, or wildfires stimulating anxiety and trauma. These occurrences can have a range of psychological effects on individuals, spanning from what are considered "common reactions to abnormal events" to more enduring conditions such as post-traumatic stress disorder (PTSD), adjustment disorder, and depression.

A previous study in Australia indicates that heatwaves are linked to a rise in incidence and admission for mental disorders 3. These heatwaves have been specifically associated with mood disorders, anxiety disorders, dementia, and other anxiety-related disorders 4. Exposure to extreme heat can result in both physical and psychological exhaustion, emphasizing the broad impact of climatic conditions on mental health.

This mental health impact of climate change “Climate Anxiety” has been identified all over the globe by public media such as Grist magazine as the “biggest pop-culture trend” of the year. Furthermore, it was highlighted in BBC News's “fear associated with climate change among Vietnamese Children”, Portland Press Herald's “climate anxiety”, and NBC News's “The growing emotional toll of climate change”.

The Impact of Climate Change on Disease Epidemiology (with a special concern on antimicrobial resistance)

Contemporary civilization's activities are causing unprecedented changes to Earth's climate, affecting various aspects such as the global redistribution of species, glacier retreat, and the rise in the Earth's surface temperature. These changes lead to several consequences, including diseases impacting crops, increased greenhouse gas concentrations, and shifts in rainfall patterns. Addressing human-induced climate change is crucial for environmental sustainability, necessitating comprehensive strategies and further research 6–8.

A less recognized but impactful aspect is the influence of climate change on the emergence and spread of diseases, particularly infectious ones. Disease transmission depends on climatic factors like temperature and precipitation. Climate change accelerates permafrost melting, releasing biological agents such as anthrax in the Russian Arctic. Diseases specific to certain regions, especially tropical ones, may increase due to altered climates, affecting the life cycle and spread of disease vectors like ticks 9. Antimicrobial Resistance (AMR) is highlighted as a significant global health threat by the World Health Organization (WHO). Inappropriate and excessive use of antimicrobials is identified as the primary catalyst for drug-resistant pathogens. While AMR is inherent, human activities, including the improper use of antimicrobials in humans, animals, and plants, play a major role in its development and dissemination. Addressing these issues is crucial for public health 10.

The effect of climate change on antimicrobial resistance

An essential support for our healthcare system is having effective antibiotics to treat bacterial infections. These medications are crucial for various medical procedures like surgeries, cancer treatments, organ transplants, and managing community-acquired infections. Without them, these procedures could become dangerous, leading to the potential loss of millions of lives annually. Additionally, the progress made in childhood survival. The concern grows with the changing climate, pushing us closer to a breaking point. We will illustrate how climate change and antibiotic resistance are closely linked, emphasizing the urgency of addressing these challenges comprehensively.

1. Increase bacterial growth rate and acquire antibiotic resistance

Temperature is closely associated with bacterial processes and infections. Rising temperatures enhance horizontal gene transfer, a primary mechanism for acquiring antibiotic resistance as presented in (Figure 1). Moreover, elevated temperatures generally result in increased bacterial growth rates 11,12. A study revealed correlations between humidity, monthly precipitation, temperature, and rates of Gram-negative bloodstream infections in hospitalized patients 12.

2. Increase infection and hospital admission

For the diagnosis of cellulitis, there is a documented dose–response relationship between incidence and temperature 13. Similarly, hospital admissions due to urinary tract infections exhibit a dose–response relationship with temperature 14. This temperature-infection relationship extends to surgical site infections after knee and hip arthroplasty, Legionnaire's disease, and other surgical site infections 15. The concurrent increase in infection numbers and the prevalence of antibiotic-resistant pathogens pose a significant threat, which is likely to intensify with climate change.

3. Re-emerging of infectious diseases

Heat and humidity contribute to heightened rates of re-emerging of infectious diseases such as salmonellosis and campylobacter disease, which is increasingly becoming antibiotic-resistant. Heat stress has been identified to elevate poultry intestinal colonization by Salmonella. Considering the millions of global cases and the synergistic impact of rising case numbers, augmented colonization rates in animals, and escalating antibiotic resistance, climate change has the potential to significantly amplify the global burden and morbidity from salmonellosis 16.

4. Pollution of floodwaters

Nitrogen fertilizers contribute to the rise of antibiotic resistance. Consequently, the pollution of floodwaters with nitrogen fertilizers during severe flooding, intensified by climate change, will exacerbate antibiotic resistance. Eutrophication, exacerbated by flooding, further amplifies antibiotic resistance, potentially leading to the dissemination of resistant pathogens and antibiotic-resistance genes 17. Microplastics in water sources augment gene exchange in bacteria 18, potentially increasing the spread of antibiotic resistance. With the warming climate, there is a concerning prospect wherein Vibrio species could proliferate due to oceanic warming, become more antibiotic-resistant owing to microplastics, and instigate outbreaks of antibiotic-resistant cholera and necrotizing fasciitis 19.

5. Expansion of vector habitats

Climate change leads to the expansion of vector habitats, increasing the prevalence of vector-borne infections. Elevated temperatures boost insect vector activity, while drought eliminates mosquito predators, enabling their uncontrolled multiplication 20. Changes in mosquito populations contribute to the spread of diseases like the West Nile virus. Rising temperatures impact species overwintering and expand the range of disease-causing vectors. For instance, Chikungunya, transmitted by Aedes sp. mosquitoes, may proliferate in warmer regions. Other diseases like filariasis, tularemia, and rabies, as well as airborne, food, and waterborne diseases, are significantly influenced by climate change. Understanding these relationships is crucial for developing effective strategies to mitigate the impact on global health 8.

6. People crowdedness and tuberculosis

Another noteworthy aspect of antimicrobial resistance related to climate change is tuberculosis. Increased transmission rates of tuberculosis are associated with crowding, and the rise in climate refugees and heightened population density will inevitably contribute to the increased spread of antibiotic-resistant tuberculosis 21.

7. Emerging zoonotic diseases and pandemics

Climate change brings humans and animals into closer contact, leading to and exacerbating outbreaks of zoonotic and vector-borne diseases with pandemic potential. Regardless of the specific nature of the interaction, climate change, given its widespread impact, is likely to influence the COVID-19 pandemic and its victims 22.

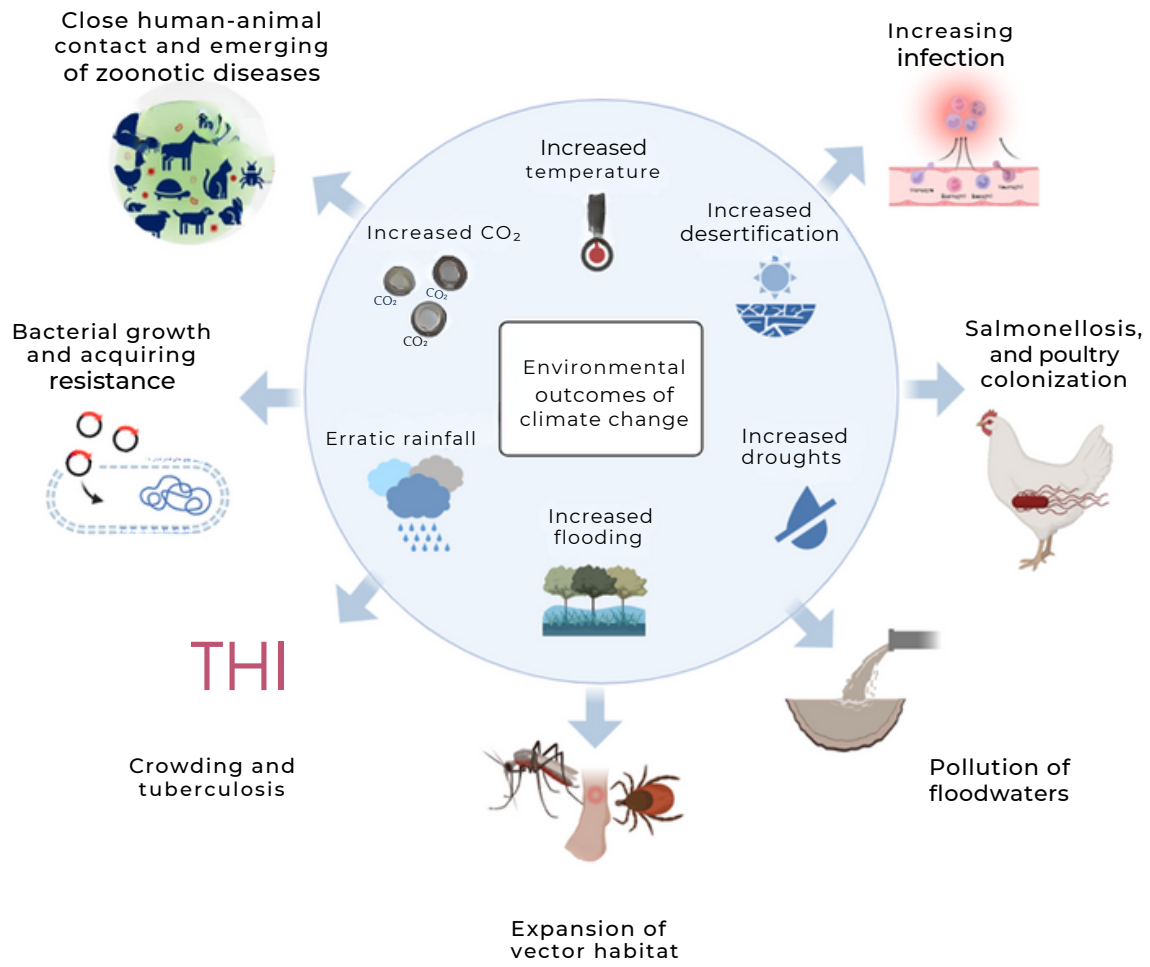


Fig. 1. The effect of climate change and antimicrobial resistance.

Let us Take Control and Shape our Future

The world has reached a critical point where we must address the consequences of climate change. We must take control of our future by making necessary changes before the world forces them upon us. **What steps can we take to ensure a positive outcome?**

At COP28, a historic agreement was reached by nearly 200 countries that marks a turning point in our collective fight against climate change. The agreement states that we need to move away from using fossil fuels as they are the primary cause of greenhouse gas emissions. It is a compromise but a significant step in the right direction; for the first time, a global climate agreement explicitly calls for limiting the use of fossil fuels. It is a cause for optimism and a sign that we can work together to create a better future for ourselves and the planet.

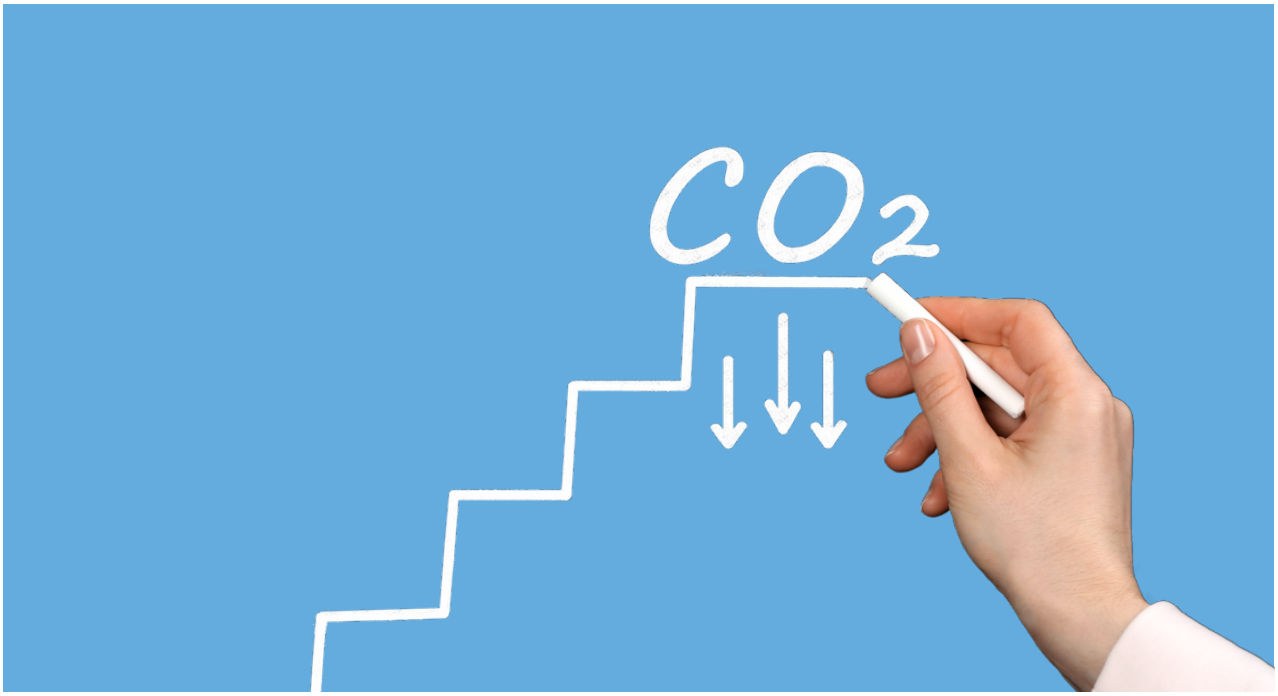
The Sustainable Development Goals are a call to action for protecting our planet and combating climate change. We must take immediate and decisive action to preserve our forests, oceans, and all other natural resources. It starts with each of us being mindful of our electricity usage and travel habits and taking stock of our consumption patterns. Reuse whatever we can and reduce waste wherever possible. We cannot afford to wait any longer. We must act now to secure a sustainable future for ourselves and future generations. There is a significant variation in greenhouse gas emissions per capita across different countries. For instance, the United States of America records emissions exceedingly twice the global average of 6.5 tons of CO_2 equivalent

In contrast, India's per capita emissions are less than half of the same average. Globally, the top 10% of the population with the highest income is responsible for almost half of all emissions. To reduce the environmental impact, it is imperative to implement several actions. Further exploration of climate action, science, and solutions is recommended to gain more insight into this issue. The WHO has responded to challenges and actions by setting specific goals.

Fig. 2. WHO's main goals for responding to these challenges

The effect of climate change on human health demands the implementation of effective strategies. To end this, **the below measures have been proposed in detail to address the impact of climate change on health comprehensively and effectively:**

Firstly, it is recommended to promote measures that reduce carbon emissions and improve health. It can be achieved by implementing policies prioritizing health in climate change mitigation, advocating for policy change and public support, and mobilizing the health community. Further, it is advisable to implement actions that provide the most significant health benefits while ensuring a speedy and equitable transition to a clean energy economy.



Secondly, it is recommended that more resilient and environmentally sustainable health systems be developed. It involves making environmental sustainability, climate resilience, and core services integral to universal health coverage and primary healthcare. It also entails supporting health systems in adopting cheaper, cleaner, and more dependable solutions while reducing their carbon footprint and integrating climate resilience and environmental sustainability into health service investments, including the capacity of the healthcare workforce.

Lastly, safeguarding health against the various impacts of climate change is critical. It includes assessing health vulnerabilities and devising health plans, incorporating climate risk, and implementing climate-informed surveillance and response systems for critical risks such as infectious disease and extreme heat. Support for resilience and adaptation in sectors that affect health, such as water and food, is also necessary, along with closing the financing gap for health adaptation and resilience.

The Centers for Disease Control and Prevention (CDC) and the National Center for Environmental Health addressed these issues. They provided different response programs, building on existing programs And the Essential Public Health Services.

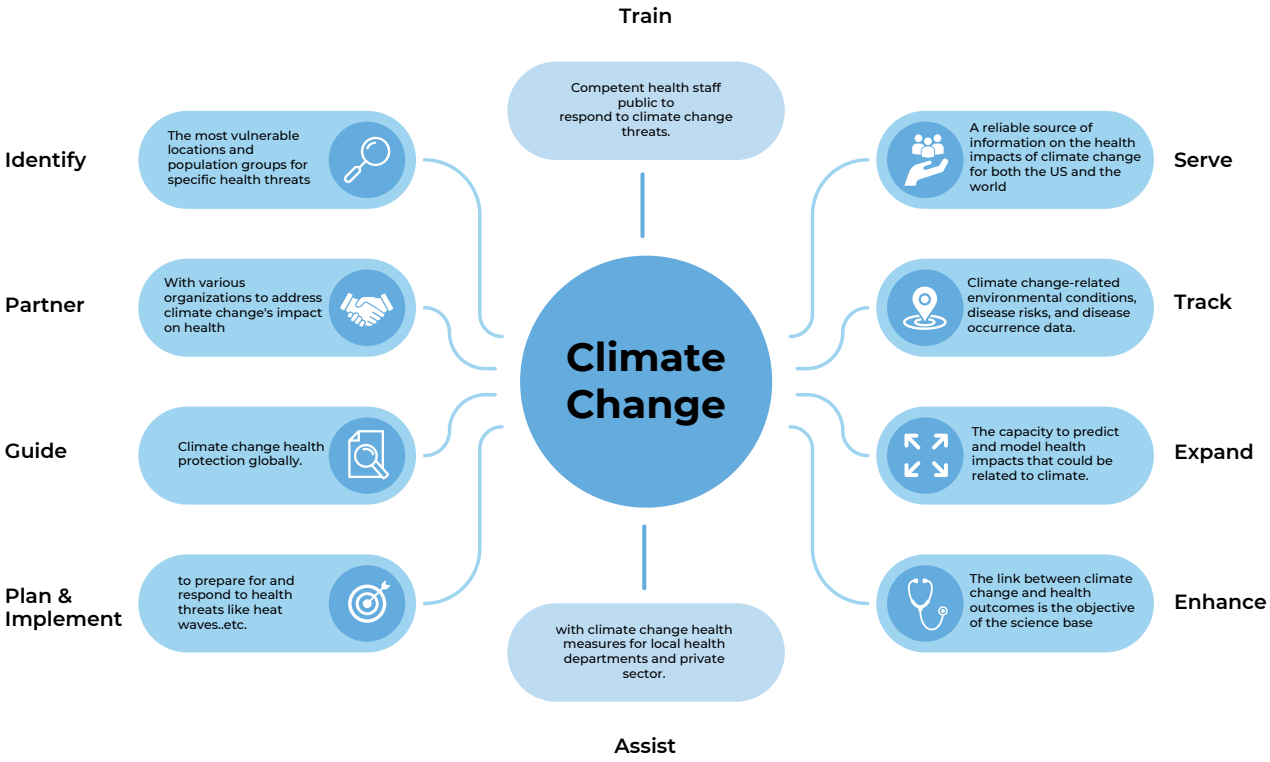


Fig. 3. CDC health actions for climate change.

WHO is crucial in tackling the health effects of climate change. To achieve this, WHO partners with significant health agencies, professionals, and civil society to prioritize climate change in health policies such as Universal Health Coverage (UHC). Additionally, WHO aims to achieve carbon neutrality by 2030 and provides assistance to countries through its network of global experts; the focus is on deploying effective policies and enhancing access to knowledge and data; moreover, WHO supports ministries of health through its offices by collaborating across sectors, providing updated guidance, hands-on training, and support for project preparation and execution, as well as securing funding for climate and health initiatives. Additionally, WHO leads the Alliance for Transformative Action on Climate and Health (ATACH), which brings together a range of health and development partners to support Countries in achieving their commitments to climate-resilient and low-carbon health systems.

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