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Climate Change and Its Impact on Vector-Borne Diseases

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ABSTRACT

Climate change has become a global challenge especially in the context of health issues. Vector borne diseases are increasing in the tropical countries and this article aims to explore the relation between the climate change and vector borne diseases. Concerns have been raised on the contribution of human activities in climate change such as greenhouse gas emissions which traps son's heat and increases temperature. Vector borne diseases like Malaria, dengue, Zika virus infection and chikungunya are on the increase. The effect of increasing temperature in the lifecycle and behavior of the vectors, alteration in precipitation patterns and change in ecological landscapes are some of the reasons. The socioeconomic implication of these changes is huge. It is important to develop mitigation and adaptation strategies to prevent escalation of vector borne diseases.

Keywords: Climate Change, Vector Borne Disease, Greenhouse Gas, Mitigation, Adaptation

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INTRODUCTION

Climate change has become a global concern over the last few decades and currently is one of the most significant challenges globally. The warm climate has more consequences than rising temperatures or weather changes but serious health issues as well. The usual extreme weather and climate events are heatwaves, wildfires, floods etc and the related illness, injuries and death are also on the increase. The vector borne diseases VBDs) such as malaria, dengue and others are increasing especially in the tropical climate as the global warming has given them the warmer, more humid conditions to increase the prevalence and distribution. This article aims to explore the intricate relationship between climate change and the increase in VBDs, dealing with the scientific mechanisms, socio-economic implications, and potential strategies for mitigation.

UNDERSTANDING CLIMATE CHANGE

The UN definition for Climate change was that it refers to long-term shifts in temperatures and weather patterns which could be natural, due to changes in the sun's activity or large volcanic eruptions. But later on it was realized that the main driver of climate change is human activities itself.[1] The burning of fossil fuels like coal, oil and gas generates greenhouse gas emissions, which act like a blanket wrapped around the Earth. This blanket traps the sun's heat and raise the temperatures. Carbon dioxide and Matane are the main greenhouse gases. Apart from burning of fossils these gas emission happens from using gasoline or coal for heating buildings. Cutting down forests and clearing the land can also release carbon dioxide. Agriculture, oil and gas operations are major sources of Matane emissions.

The effect due to climate change affect the health of the humans, which include widespread hunger and malnutrition; increased prevalence of vector-borne diseases and re emergence of previously controlled diseases. Increased respiratory diseases due to poor quality of air, increased water-borne diseases, reduced access to and disruption of health care services; rise in mental health issues, varying social impacts such as loss livelihoods, poverty etc are the further consequences.

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.[2] The IPCC prepares comprehensive Assessment Reports about the state of scientific, technical and socio-economic knowledge on

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climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place. The latest report of IPCC is the 6th Assessment report finalised in 2023.

UNDERSTANDING VECTOR-BORNE DISEASES

Vector-borne diseases (VBDs) are infections transmitted to humans through the bites of infected vectors, which are typically arthropods like mosquitoes, ticks, sand flies etc. The most common vector-borne diseases include malaria, dengue fever, Zika virus, Lyme disease, and others. VBDs are the most well studied diseases associated with climate change, owing to their large disease burden, widespread occurrence and high sensitivity to climatic factors. Climate change affects the prevalence and distribution of these diseases through various mechanisms. Climate change has far-reaching implications for the epidemiology of VBDs. Warmer temperatures, altered precipitation patterns, and extreme weather events create favourable conditions for the vectors. Longer hot seasons will enlarge the seasonal window for the spread of mosquito-borne diseases and favour increasingly frequent outbreaks. The mosquitoes, responsible for transmitting diseases like malaria, dengue fever, and Zika virus, thrive in warmer environments, leading to expanded geographic ranges and prolonged transmission seasons.

1. Temperature and Vector Biology:

Temperature plays a crucial role in the life cycles and behaviour of vectors. With the global warming, the geographical range of vectors increase allowing them to prosper in regions that were previously unsuitable. Mosquitoes transmitting malaria or dengue fever may survive and reproduce in areas with milder temperatures, exposing new populations to these diseases. Dengue is primarily found in tropical and subtropical regions, In cold climate the freezing temperatures during night kill the larvae and the eggs of the vectors. With climate change and longer hot seasons and less frequent frosts makes dengue the fastest-spreading mosquito-borne disease globally

2. Altered Precipitation Patterns:

Changes in precipitation patterns associated with climate change also contribute to the spread of VBDs. Excessive rainfall creates new breeding grounds for mosquitoes, increasing their population and risk of disease transmission. Droughts may lead to the stagnation of water in containers, providing suitable habitats for mosquito larvae. More over unpredictable precipitation patterns make it challenging for communities to implement effective vector control measures.

3. Shifting Ecological Landscapes:

Alterations in ecological landscapes due to climate change again will have its impact on the habitats of vectors. The preferred environment for those animals who are reservoirs for disease gets modified and this results in alteration of dynamics of disease transmission. One of the best examples for this is the prevalence of Lyme disease in areas with a shift in temperature and vegetation patterns causing alteration of distribution of ticks and the animals they feed on.

SOCIO-ECONOMIC IMPLICATIONS

The consequences of the interplay between climate change and vector-borne diseases produce profound socio-economic impacts

a. Health Burden:

Vector-borne diseases account for more than 17% of all infectious diseases causing more than 700 000 deaths annually. Among these malaria causes an estimated 219 million cases globally and more than 3.9 billion people are at risk of contracting dengue fever with an estimated 96 million symptomatic cases. So the most direct and immediate consequence of increase in vector-borne diseases is the increased health burden in the communities. These diseases can cause significant morbidity and mortality, especially in regions with limited access to healthcare and in resources poor settings. Disproportionate increase in disease burden occurs in low-income countries, probably because of the inadequate public health system to cope with the sudden disease outbreaks.

b. Economic Costs:

Vector-borne diseases result in heavy toll on costs, at the individual as well as the national levels. The direct costs include medical expenses for treatment, and indirect costs from lost productivity due to illness and the associated expenses.

c. Displacement and Migration:

The burden of disease and other climate change-related challenges such as extreme weather and rise of sea-level, force populations to move in search of safer and healthier environments, This often leads to increased competition for resources and will cause a further divide on the existing social and economic inequalities.

MITIGATION AND ADAPTATION STRATEGIES FOR ADDRESSING ESCALATION OF VBDS[3]

A multifaceted approach incorporating both mitigation and adaptation strategies is required to address the challenges due to global warming and enhanced vector-borne diseases.

MITIGATION STRATEGIES

1. Vector Control measures:

Efficient vector control is the cornerstone of mitigating the impact of climate change on VBDs. Measures such as use of insecticides, bed nets, and environmental management to reduce the vector populations, indoor residual spraying, and larval source management are some of the strategies. These activities must be tailored to the specific characteristics of each disease and its vector and also should take into consideration the local climate and ecological conditions

2. Improved Surveillance and Early Warning Systems:

Developing robust surveillance systems and early warning mechanisms is crucial for timely response to emerging vector-borne disease threats. This involves monitoring vector populations, disease incidence, and climate variables to predict and prepare for potential outbreaks. This would also facilitate timely interventions and targeted control measures.

Other mitigation strategies include encouraging sustainable land use practices, such as reforestation and conservation of natural habitats, which would help preserve biodiversity and limit the expansion of disease vector populations. Access to clean water and sanitation facilities has a role in preventing the transmission of VBDs. by reducing breeding sites for mosquitoes and minimizing human-vector contact.

ADAPTATION STRATEGIES[4]

Adaptation strategies focus on building resilience and enhancing preparedness to cope with the impacts of climate change on VBDs.

- **Strengthening Health Systems:**

Building resilient health systems is essential for addressing the health burden imposed by vector-borne diseases. This includes improving access to healthcare services, training healthcare professionals, and ensuring the availability of diagnostic tools, improving the laboratory services and ensuring access to essential medicines and vaccines. Building climate resilient infrastructure, such as drainage systems to prevent waterlogging and flooding, can reduce the risk of vector breeding and disease transmission in vulnerable areas. Strengthened health systems can better cope with the increased demand for healthcare during disease outbreaks, particularly in vulnerable regions.

- **Community Engagement and Education:**

Empowering communities through education and awareness-raising campaigns can enhance their capacity to prevent and control VBDs. Engaging communities in vector control efforts and promoting behaviour change initiatives can also contribute

- **Climate Change Mitigation:**

While adaptation strategies are vital, addressing the root cause of the problem necessitates global efforts to mitigate climate change. Reducing greenhouse gas emissions, adopting climate-resilient agricultural practices can help limit the extent of climate change and mitigate its impact on vector-borne diseases

CONCLUSIONS

Climate change and vector-borne diseases form a complex and interconnected issue with far-reaching consequences for human health and well-being. The scientific evidence linking climate change to the acceleration of VBDs is robust, highlighting the urgent need for comprehensive and coordinated strategies. Mitigation and adaptation efforts must go hand in hand, addressing both the root causes of climate change and the immediate health threats posed by vector-borne diseases. Among these challenges, a collective and collaborative approach is essential to protect vulnerable communities and build a resilient future in the face of a changing climate. UN's Intergovernmental Panel on Climate Change (IPCC) indicates that crossing the 1.5°C threshold risks unleashing far more severe climate change impacts, including more frequent and severe droughts, heatwaves and rainfall. So the world leaders have stressed the need to limit global warming to 1.5°C by the end of this century.

END NOTE

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