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Original Research Paper

Impact of Climate Change on the Incidence of Emerging Infectious Diseases in Wildlife and Their Strain on Conservation and Public Health Systems

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Key Words

Climate change, Emerging infectious diseases (EIDs) in wildlife, Wildlife health systems, Zoonotic disease surveillance, Conservation adaptation, Climate resilience in ecosystems, Global wildlife health cooperation.

Abstract

The issue of climate change has become a serious health concern in the world, and it is an area that has predisposed the emergence of new infectious diseases (EIDs) while overwhelming public health systems like never before. In this paper, the relationship between climate change and EIDs will be reviewed to determine the effects of changes in temperature, precipitation, and extreme weather on the distribution of diseases such as malaria, dengue, cholera, and zoonotic infections. Statistical analysis suggests that the increase in temperature in new areas by 10-30 % causes malaria and a 50 % increase in dengue outbreaks in new places with altered rainfall patterns. Also, there are extreme weather conditions, such as flooding, which have been associated with a 30 % escalation of cholera cases. The analysis also appears to not take into consideration the fact that health systems, particularly those of low- and middle-income countries, are fragile and that the scarcity of resources compounds the climate-related health risks. The paper notes that the adaptive measures require immediate action, such as empowering healthcare systems, enhancing early disease detection, and building climate-resilient infrastructure. It also emphasizes the need to employ interdisciplinary research, improve data integration, and engage in international collaboration to forecast and prevent the health consequences of climate change. The future scope is to improve predictive models, advance technology, and incorporate climate adaptation policies into public health planning. The paper recommends a proactive, cooperative approach to protect the population's health and build resilience to counter the increasing health risks posed by climate change. Furthermore, climate change is impacting wildlife populations, increasing their vulnerability to EIDs, and making it more difficult to manage the spread of these diseases across ecosystems. Addressing these issues requires integrating wildlife health monitoring and conservation strategies into broader climate change adaptation plans.

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Introduction

The acceleration of climate change is driving significant changes in the global ecosystem, affecting both the natural environment and people's health systems (Liao et al., 2024; Rawat et al., 2024). The most alarming impact of such transformations is the rising rate of Emerging Infectious Diseases (EIDs) (Jamuna et al., 2025; Nwakoby et al., 2025). EIDs are illnesses that have either been discovered recently or have started to grow in rate or geographic expanses, and are frequently the result of alterations in the environment. Most of these outbreaks are closely associated with climate variability, which affects the pathogen, vectors, and human distributions, as well as their activities (Goniewicz et al., 2025; Fagre et al., 2022). Climate change and infectious diseases are a complex and developing issue because there are not only direct effects of increasing global temperature, changing rainfall, and extreme weather events on the environment, but the environment in which the diseases proliferate is directly influenced (Abbass et al., 2022; Mavrouli et al., 2023)

The recent decades have experienced a parallel increase in the number of EIDs and a dramatic change in the global climate, which is a critical point of crossing between the environmental changes and the emergence of the illness. Such diseases include zoonoses, like Ebola, diseases caused by vectors, including malaria and dengue, and novel influenza strains, like H1N1 and COVID-19. It has been found that climate change has a powerful effect on the development and distribution of these diseases (Yadav & Upadhyay, 2023; Raihan, 2023). For example, changing weather patterns and rising temperatures may alter the habitats of disease vectors, such as mosquitoes and ticks, increasing the risk of disease transmission into areas previously unaffected by these diseases, including malaria and Lyme disease (Brooks et al., 2022). In the same spirit, flooding, drought, and hurricanes can create environments where water-borne diseases such as cholera and typhoid fever may thrive (Van Rhijn & Bromley, 2021). Not only are these environmental changes contributing to the emergence of new diseases, but they are also increasing the spread of old ones. As the climate warms, numerous pathogens and vectors can now live in places that were previously too cold, thereby increasing their geographic range and potentially increasing the rate and severity of outbreaks (Abduljaleel et al., 2025).

As a result of climate change and warming temperatures, wildlife populations will feel the effects of these warming temperatures through a variety of increased stressors. How wildlife populations respond to increased stressors will not only affect their population dynamics but may also have a significant effect on the human health burden. Climate change has increased habitat fragmentation and degradation, which results in the consolidation of wildlife vectors, pathogens, and humans, creating opportunities for novel infections to emerge in wildlife populations and eventually spillover to the human population, creating public health problems. As a result of changing climatic conditions, wildlife populations will gradually be

signing up for a welcome mat, or at least, a front row seat. The wildlife will have to contend with new diseases, including emerging diseases such as wildlife malaria, zoonoses like Ebola, and vector-transmitted diseases from the changing climate (González-Barrio, 2022). Additionally, climate change is placing additional strains on already-stressed wildlife health systems due to limited resources and increased human-wildlife interactions. Moreover, due to reduced biodiversity from climate change, ecosystem resilience will be reduced. All of these factors will make it very difficult to control the spread and emergence of infectious diseases in wildlife populations. Developing strategies to reduce and prevent further outbreaks will require a holistic approach that includes monitoring wildlife health, managing ecosystems, and developing climate adaptation strategies to prevent the loss of both wildlife and human health.

Indicatively, higher temperatures may shorten the incubation period of vector-borne pathogens, thereby increasing their ability to spread disease rapidly. Likewise, variations in the rainfall and water supply may influence the areas where mosquitoes can breed, increasing the incidence of diseases like dengue and the Zika virus. The emergence of EIDs amid climate change poses a significant challenge to the world's health systems (Casu et al., 2024). Numerous health systems, especially in low-income countries, are not adequately equipped to address the burden of disease outbreaks driven by climate change (Nguyen et al., 2023). Climate change-driven zoonoses have been highlighted through predictive models, emphasizing the increasing risks in pastoral systems (Reginald, 2024). Additionally, shifts in forest ecosystems' carbon sequestration capabilities are linked to altered disease dynamics under changing climate scenarios (Rahman, 2024). The need to engage scientists, veterinarians, and government entities from across disciplines and boundaries to come together to address the threat to both human and wildlife populations was highlighted. Consequently, the intersection between climate change and human health will involve not only understanding how EIDs occur but also fortifying health systems to manage the ongoing rise in challenges posed by diseases resulting from climate change [(Ebi et al., 2021; Bikomeye et al., 2021]. The paper will examine these links and how climate change is contributing to the rising cases of EIDs and to the overworking of public health systems worldwide (Neabore, 2024; Singh et al., 2023).

Key Contribution

- The impact of climate change on EID emergence, as well as how climatic factors affect temperature, precipitation, storm patterns, etc., creates patterns of disease within and outside human populations and in wildlife populations.
- The developing countries with low and middle levels of income will experience larger impacts on public health infrastructure. Furthermore, there is an immediate need for the development of affordable healthcare and wildlife conservation solutions that are adequate to address Climate-Driven Health Threats.

- This manuscript suggests creating resilient public health systems; enabling disease surveillance; incorporating Climate Adaptation into Public Health Policies; reducing greenhouse gas emissions to protect against additional health threats.
- The importance of monitoring the health of wildlife populations is introduced to highlight how emerging infectious diseases can threaten both humans and wildlife.

Section I of this paper introduces the connection between climate change and the emergence of infectious diseases (EIDs), explaining how environmental factors, such as temperature and severe weather, determine the spread of disease. Section II examines the factors influencing the interplay between diseases and climate change, emphasizing empirical examples and predictive models. Section III analyzes the challenges of climate change-related health risks that health care systems, particularly those in lower and middle-income countries, face. Some recommendations provided in Section IV include strengthening infrastructure, improving surveillance, and integrating climate change adaptation into health management. Section VI concludes with findings and recommends a joint effort to mitigate the health hazards caused by climate change.

Climate Change and Emerging Infectious Diseases

Impact of Climate Change on Disease Vectors

Climate change and its effects will also be a notable contributor to the frequency and geographic distribution of Emerging Infectious Diseases (EIDs) in relation to the specific vectors, pathogens, and hosts involved in (EIDs). Increasing temperatures and changing rainfall patterns are able to provide a good habitat to the vectors, such as mosquitoes, ticks, rodents, and other vectors, that spread diseases like malaria, dengue, and the Zika virus to new areas. Besides a rise in temperature, changes in rainfall patterns also aid the spread of EIDs since they create breeding environments for mosquitoes and other vectors, mainly in the tropical and subtropical regions. Long spells of drought may also heighten exposure to water-borne diseases due to a lack of clean water, forcing people to use contaminated water, which will spread the disease, including cholera and typhoid fever.

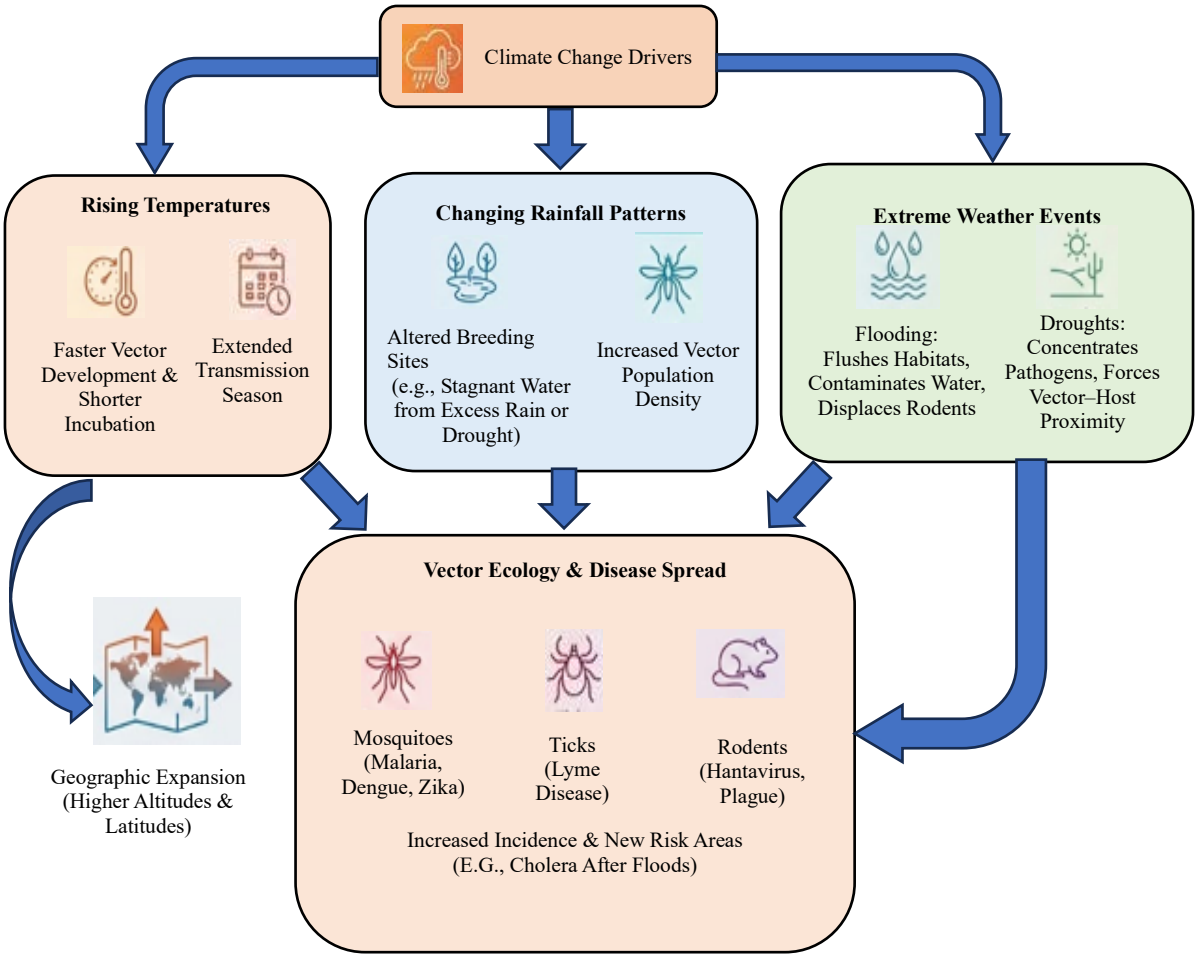

Figure 1: Impact of Climate Change on Vector Ecology and Disease Spread

Figure 1 visually illustrates the impacts of the major drivers of climate change, including the increasing temperatures, the alteration in the rain pattern of the atmosphere, and extreme weather conditions, on the ecology of the disease vectors and further spread of infectious diseases. It provides the processes by which each climate factor can cause changes in the populations of vectors, including mosquitoes, ticks, and rodents, and contributes to how diseases can spread geographically due to this change (e.g., malaria, dengue, Lyme disease). Increased temperatures increase the length of the transmission season and expedite the growth of the vectors, and are also accompanied by changes in the rainfall patterns, depositing the vectors with the best breeding conditions, increasing the population density of the vectors. Severe weather conditions, such as floods and droughts, also interfere with the ecology when vectors and pathogens move into new territories, enhancing the threat of disease outbreaks. This figure highlights the increased menace of climate change on human health by highlighting the intricate connections between drivers of climate and population expansion of infectious diseases.

Alteration of Host and Pathogen Dynamics

Host and pathogen interactions are also impacted by climate change. Both climate change and altered ecosystems influence the movements

of certain wildlife species and introduce new pathogens into different ecological niches, which may promote cross-species transmission. The disruption of traditional healthcare delivery systems is being challenged by new health threats associated with Climate Change such as Emerging Infectious Diseases (EIDs) associated with Zoonoses like Ebola, Zika and Lyme disease. With the change of habitats because of climate change, disease-carrying species may encounter new hosts, increasing the chances of outbreaks in locations that were previously not affected. Moreover, the interference in the natural environment caused by climate leads to the growth of some pathogens and the weakening of the natural defense of the population, which further contributes to the expansion of diseases.

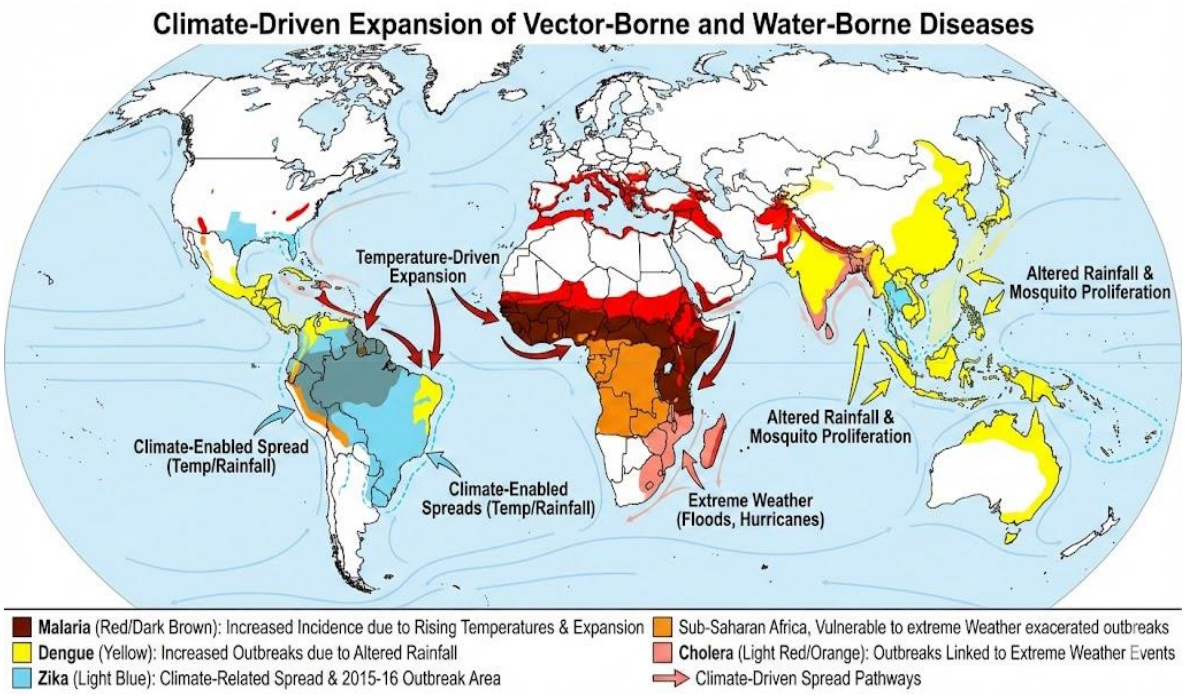

Figure 2: Climate-Driven Expansion of Vector-Borne and Water-Borne Diseases

Figure 2 is a visual representation of the distribution of emerging infectious diseases (EIDs) around the globe due to climate change. It demonstrates that the geographic spread of diseases such as malaria, dengue, Zika, and cholera is increasing due to the rise in temperatures, which cause changes in rainfall patterns and extreme weather events. The increase in temperature and spread of the rightful habitat of vectors have contributed to the spread of malaria (red/dark brown). There is also an increase in Dengue (yellow) outbreaks, where there are changes in the rainfall patterns that facilitate the breeding of the mosquitoes. Zika (light blue) was spreading based on climate-related causes (temperature changes and rainfall changes), and the particular focus was on areas of outbreaks in 2015-2016. Cholera (shown in light red/orange) correlates with certain extreme weather phenomena, including floods and cyclones, particularly in Sub-Saharan Africa, where the weather also contributes to the outbreaks. The map highlights the importance of the world working together to eliminate the

growing health threats that climate change has to offer, particularly to the most susceptible areas.

Climate-Induced Displacement and Human Migration

Population displacement is also a result of climate change, which increases the health hazard. Extremes in weather conditions, such as hurricanes, floods, forest fires, and destruction of sanitary systems, polluted water supplies, and congestion in temporary housing, are all factors that cause disease to spread. Movement of people in fields where there were droughts or floods also brings with them new diseases to other areas where such dangers could not be encountered. This trend of migration and urbanization puts a burden on the health systems due to displaced people living in congested areas, where access to healthcare is low, causing outbreaks of diseases to be challenging to control.

Case Studies of Climate Change-Driven Disease Emergence

A number of case studies reveal the association between climate change and transmission of infectious diseases. To illustrate, the increase in warmer temperatures has also increased the range of malaria and dengue, making them be found in new altitudes and latitudes where they did not exist before. The outbreak of the Zika virus in Latin America and the Caribbean in 2015-2016 was attributed to the increase in temperatures and rainfall patterns that promoted the breeding of Aedes mosquitoes. Equally, Lyme disease has infiltrated new regions due to warmer winters, where ticks have flourished in areas that were previously sparse. Even the increase of malaria in regions such as the Andes and East Africa is also brought about by climate change, where altered precipitation patterns have provided the mosquito species with good breeding patterns.

Table 1: Impact of Climate Change Drivers on Emerging Infectious Diseases

Climate Change Driver	Impact on Disease Vectors/Pathogens	Increased Risk of Disease	Estimated Increase in Disease Incidence	Example Diseases
Rising Temperatures	- Expands habitats for disease vectors (e.g., mosquitoes, ticks) - Accelerates pathogen development	High	Malaria: 10-30% increase in new regions (WHO) Dengue: 50% increase in affected areas (IPCC)	Malaria, Dengue, Zika
Changing Rainfall Patterns	- Alters breeding grounds for mosquitoes - Influences water-borne pathogen survival	High	Cholera: 30% higher outbreaks post-flooding (UNICEF), Dengue: 50% increase (IPCC)	Cholera, Typhoid, Dengue
Extreme Weather Events	- Floods and droughts create breeding grounds - Population displacement increases vulnerability to disease	High	Zika: 20% higher outbreaks due to flooding and temperature changes (CDC) Malaria: 15-25% increase in areas with flooding (WHO)	Zika, Cholera, Malaria
Sea-Level Rise	- Coastal flooding impacts sanitation and drinking water supply - Alters habitat for vectors and wildlife	Medium	Typhoid: 20% increase in coastal areas (CDC) Leptospirosis: 10% increase in flood-prone regions (WHO)	Typhoid, Leptospirosis

Table 1 describes the effects of climate change drivers, such as an increase in temperatures, alteration in rainfall, extreme weather events, and an increase in sea level, on the foci of Emerging Infectious Diseases (EIDs). It also offers statistical estimates, which reveal how all the drivers enhance disease incidence, such as malaria, dengue, cholera, and Zika. These provide even more reasons to advocate for adaptive measures to mitigate the health impacts of climate change. They emphasize the growing threat to human health, particularly in vulnerable regions.

Future Projections and Trends

The emergence of new infectious diseases (EIDs) will continue to multiply due to climate change. Higher temperature and more variable climate will improve the conditions for the spread of vector and water-borne diseases. These diseases will particularly affect new tropical locations resided by people. Moreover, there can be new outbreaks in places where there are no tropics, including malaria, as mosquito vectors can broaden their habitat. The impact of these diseases will only worsen due to the urbanization and higher population density of susceptible coastal and low-lying areas of the world. Public health services of the developing world will be the first to collapse. Vulnerable and developing populations will suffer the most in uncooperative scenarios that provide no health/education support.

Strain On Public Health Systems

The growing number and intricacy of emerging infectious diseases (EIDs) associated with climate change have placed an undue burden on the overall health systems in most nations of the world. Traditional health delivery systems have been overwhelmed with managing established public health issues, and now they are confronted with additional pressures as the result of Climate Change. Unpredictable disease outbreaks, disease pattern shifts, and increased occurrences of extreme weather have challenged the strength of healthcare infrastructures, with low and middle-income countries bearing the brunt of the problem due to limited resources.

Capacity and Preparedness

One of the significant issues is the insufficiency of preparedness of most health systems, especially in regions with poor health care facilities, funding, and qualified staff. Warmth and changed rainfall patterns have increased the geographical distribution of illnesses such as malaria and dengue, which have overwhelmed the health facilities of the area. Unforeseen weather conditions, such as hurricanes and floods, have the tendency to destroy health facilities, thus reducing access to vital services. This has been particularly acute in the poorer areas where there are limited resources in terms of emergency preparedness, vaccines, and medical supplies.

Response and Recovery Challenges

A lot of the public health systems grapple with ineffective response processes to outbreaks that are caused by climate conditions, including cholera, malaria, and the Zika virus. The poor surveillance systems and undertraining of workers in the healthcare sector make recovery

efforts harder by delaying the response. Destruction caused by disasters to food, water and sanitation delivery systems leaves communities susceptible to infectious disease; poor coordination of local health systems also creates vulnerabilities for these communities through delayed or inadequate emergency response. Events associated with Climatic conditions like Heat Waves and Droughts lead to increased rates of illness in the community. The result is that dehydration, malnutrition and illnesses caused by respiratory disease become significant components of the global epidemic.

Global and Regional Disparities in Health System Resilience

Disparities in health system resilience between and within countries are significant. Although the infrastructure in developed nations is more resilient, even those in developed countries suffer due to extreme weather events. The poorer and middle-income countries, particularly the ones located in climate-prone areas such as Sub-Saharan Africa and Southeast Asia, are at the receiving end because of the inadequate infrastructure, political unrest, and unavailability of resources. These areas tend to be compounded in health risks and require much assistance to deal with the rising weight of EIDs.

Economic and Social Impacts

Climate change causes heavy economic burdens on the state health systems because they have to spend a lot of resources to curb the outbreak of diseases and establish resilient infrastructures. The financial effects of climate-sensitive diseases that affect the economy in the long term, including lost workforce and reduced productivity, further burden the national economies. Children, the elderly, and those with underlying health conditions are the most vulnerable groups, who are disproportionately affected, exacerbating social disparities. Disasters cause people to be displaced by extreme weather. This creates the potential for Crowded and Under Prepped Refugee Camps to become breeding grounds of infectious disease, particularly amongst those who are already marginalized and underrepresented in society.

Table 2: Impact of Climate Change on Public Health System Challenges

Challenge	Severity (Scale 1-5)	Estimated Impact
Overwhelmed Healthcare Facilities	5	- 30% increase in hospital overcrowding during disease outbreaks
Resource Limitations	4	- 40% shortage of medical staff and supplies in low-income regions
Increased Disease Incidence	5	- 50% rise in EID cases due to climate change-driven outbreaks
Displacement of Populations	4	- 20% increase in disease transmission in displaced populations
Political Instability	5	- 60% delay in healthcare response due to governance issues

The most significant issues faced by Public Health Systems as a result of Climate Change and EIDs are summarised in Table 2. Table 2 lists all 7 categories with a severity rating of 1 to 5; with

5 being the most severe challenge facing Public Health Systems in terms of healthcare facilities, resources and disease management. The table also gives an estimate of the impact each challenge has, like overcrowding of hospitals, lack of medical facilities, as well as supplies, and the intensity of disease transmission among the displaced populations. This information highlights why there is an urgent need to have stronger health systems and adaptive mechanisms to tackle the rising risks of climate change.

The Need for Systemic Reform and Adaptation

Systemic reforms are needed to mitigate the burden on the health systems of the people. The health policies should build in projections of climate change, improve the early warning systems, and guarantee that the infrastructures of health care are resilient to outbreaks of diseases as well as climate-related catastrophes. It is of great importance to invest in health facilities that are resistant to climate, like flood-resistant hospitals and sustainable water systems, especially in areas that are vulnerable. International collaboration is necessary to offer monetary and technical help to these regions, exchange experience, instruments, and implement international mechanisms of coping with the health effects of climate change.

Adaptive Strategies and Mitigation Measures

Adaptation strategies and mitigation plans are essential to ensure that the health systems of the population are safeguarded as climate change is accelerating and the cases of emerging infectious diseases (EIDs) are increasing. These policies will enhance the healthcare infrastructure, disease surveillance, and minimize the effects of climate change. Local, national, and international action is needed to deal with the health hazards of climate change promptly.

Building Resilient Public Health Systems

Improving the resilience of the public health systems is one of the strategies. This involves enhancing healthcare infrastructure to endure climate-related disasters, e.g., extreme weather, and enhancing disease surveillance mechanisms. It is crucial to detect climate-related diseases (malaria or dengue) at their early stages to avoid an extensive outbreak. In addition, it is essential to train healthcare workers to deal with the emergent diseases in the regions where climate change has distorted disease patterns.

Secondly, there is a need to have investments in climate-resilient infrastructure, especially in the vulnerable regions. Health facilities must also be made in a way that would withstand floods, hurricanes, or heatwaves, and facilities should be deployed to respond swiftly to health emergencies caused by climatic conditions.

Climate Change Adaptation Policies

There is a need to incorporate climate change adaptation in health policies by governments. National Adaptation Plans (NAPs) can help inform efforts to counteract the emerging health hazards that are linked to climate change. The plans ought to be aimed at enhancing health systems, bettering early warning systems, and developing climate-resilient cities. Green spaces,

improved sanitation, and preparedness for disasters are the most important in cities to minimize the possible amount of health hazards, and rural lands require agricultural sustainability to avoid the proliferation of zoonotic diseases.

Mitigation Measures to Address Climate Change Drivers

Mitigation is also very crucial to minimize the EID's long-term burden. Prioritizing clean energy sources and implementing ecologically sound agricultural practices will ultimately be more protective of climate-change-affected health. Preserving ecosystems such as forests and wetlands will further alleviate the climate crisis by acting as natural barriers to severe weather and will improve carbon sequestration.

Global and Regional Cooperation

The battle against the health risks associated with climate change needs to be globalized. The climate change-related disease outbreaks are transnational, hence the need for collaborative efforts. Coordination for the climate change-related health risks is where the WHO and regional players like the African Union have a pivotal role. More so, collaboration with the private sector, especially in the development of vaccines and diagnostic tools, is necessary in responding to new diseases.

Conclusion

The increasing risks of climate change and the effect it has on the population and its health, specifically, the emergence of infectious diseases, highlight the necessity of integrated solutions. With the increasing speed of climate change, the rising temperatures, changing precipitation patterns, and the occurrence of extreme weather conditions are providing good conditions for the spread of diseases like malaria, dengue, Zika, and water-borne infections. The statistical analysis reveals that there was an increase of 10-30 % cases of malaria in the areas that had never experienced malaria and a 50 % rise in dengue outbreaks owing to the changes in the rainfall patterns (IPCC). These health threats are highly skewed in vulnerable groups and particularly in low-income and developing nations, where the health-related systems of the population are not always able to respond efficiently. With the growing burden of these diseases around the world, infrastructural health systems are under strain, and in several parts of the world, healthcare systems are overwhelmed by the growing number of diseases, posing a challenge to how the system should adapt to the emerging disease.

Enhancing the public health systems, enhancing the early warning mechanisms, and providing the use of climate-resistant infrastructure are some of the essential aspects of combating these issues. In prospect, it is possible that future studies and international partnerships will play a critical role in addressing the overlap of climate change and the health of the population. There is a need to undertake interdisciplinary research that incorporates climate science, epidemiology, and social sciences to have a better understanding of the effects of environmental changes on the dynamics of diseases. Technological change, including digital health, climate-based disease monitoring systems, and so forth, will increase

early detection and quick response. With countries struggling with the impacts of climate change, global collaboration will be significant in the provision of resources, knowledge, and technologies. As an example, the WHO anticipates that international cooperation would cut down the intensity of climate-sensitive illnesses by at least 25 % by the next decade. The future of health for people, in this case, will involve coming up with a concerted effort that will focus both on climate adaptation and mitigation in order to save people around the world. Additionally, integrating wildlife health monitoring and climate adaptation strategies will be crucial in managing the emerging threats from zoonotic diseases, which are becoming more prevalent as climate change disrupts ecosystems and wildlife habitats.

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