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Climate Change and the Emergence of Novel Infectious Diseases: Risks and Preventive Strategies in Global and Uzbekistan Context

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Abstract: In recent decades, climate change has significantly affected human health and healthcare systems. Changes in atmospheric temperature, precipitation, wind patterns, and extreme weather events not only intensify the spread of existing diseases but also contribute to the emergence of novel infectious diseases. This article analyzes the emergence of such diseases globally and in Uzbekistan, their epidemiological trends, and preventive strategies.

The findings indicate that the risk of climate-related emerging infectious diseases is increasing not only in tropical and subtropical regions but also in certain areas of Uzbekistan. Consequently, improvements in healthcare systems, monitoring networks, and preventive measures are essential. This study provides a scientific basis for forecasting disease spread and developing effective strategies at both global and national levels.

Keywords: Climate change, Emerging infectious diseases, Vector-borne diseases, Epidemiology, Preventive strategies, Uzbekistan, Global health, Tropical and subtropical diseases, Temperature and precipitation, Extreme weather events, Vector monitoring, Waterborne diseases

Introduction

In recent decades, climate change has been recognized as one of the most significant global threats to humanity. Rising atmospheric temperatures, changing precipitation patterns, extreme weather events (storms, droughts, floods), and ocean warming affect not only natural ecosystems but also human health. Climate change expands the distribution of vectors (such as mosquitoes, ticks, and other insects), accelerating the emergence of novel infectious diseases and the spread of existing ones.

Globally, viruses such as Dengue, Zika, Chikungunya, and vector-borne diseases like Lyme disease and Ross River virus are spreading into new regions. According to IPCC reports, in the last decade, the range of mosquitoes carrying tropical diseases has extended into Northern Europe and some U.S. states. This highlights the ecological and epidemiological challenges associated with climate change.

Uzbekistan is not immune to these impacts. Over the past decade, the average temperature across the country has risen by 1–1.5 °C, summers have become longer, and droughts have intensified. These conditions are particularly concerning for southern regions such as Qashqadaryo, Bukhara, and Surkhandarya, where vector-borne disease risks are increasing. Insufficient irrigation systems and decreasing water resources further create favorable conditions for the emergence of infectious diseases.

In Central Asia, particularly in Uzbekistan, climate change has increased the risk of new vector-borne diseases among agricultural workers and urban populations. According to the Ministry of Health of Uzbekistan, reports of diseases previously uncommon in certain regions have emerged in the past five years. This underlines the urgent need to improve healthcare systems and epidemiological monitoring.

Therefore, studying the spread of climate-related emerging infectious diseases and developing preventive strategies is a pressing issue at both global and national levels. This article analyzes epidemiological trends, assesses risk levels, and proposes preventive strategies in the context of both global patterns and the situation in Uzbekistan.

Methods

This study employed a **multifaceted methodological approach** to analyze the relationship between climate change and emerging infectious diseases. The research was based on the following data sources and methods.

Data Sources:

1. **International sources:**

- Reports of the Intergovernmental Panel on Climate Change (IPCC).
- Epidemiological data and analyses published by the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC).
- Peer-reviewed scientific journals including *The Lancet*, *Nature Climate Change*, and *Emerging Infectious Diseases*.

2. **Uzbekistan context:**

- Statistical data from the Ministry of Health of the Republic of Uzbekistan.
- Data from the Hydrometeorology Service of Uzbekistan.
- Regional epidemiological monitoring reports and analyses.

Research Methods:

- **Literature Review:** Studying global and national epidemiological trends related to climate change to identify key factors in the emergence and spread of novel infectious diseases.
- **Statistical Analysis:** Examining correlations between climate parameters (temperature, precipitation, humidity) and disease incidence in both global and Uzbekistan contexts. For example, the correlation between mosquito distribution and the risk of tropical viruses in southern regions of Uzbekistan.
- **Regional Analysis:** Creating risk maps for vector-borne diseases in various regions of Uzbekistan based on climate change data. High-risk areas were identified through this analysis.
- **Modeling and Forecasting:** Simulating the potential future spread of novel infectious diseases based on changing climate parameters. This modeling approach allows for forecasting epidemiological risks at global and national levels.

Note: Due to limited epidemiological data in Uzbekistan, the findings were compared with global trends to provide a more comprehensive understanding. This approach enabled anticipation of the emergence and spread of novel infectious diseases.

Results

Global Trends

Over the past decades, climate change has significantly increased the emergence of novel infectious diseases worldwide. For instance, the distribution of Dengue virus, primarily limited to tropical regions in the 1950s, has expanded to North America, Southern Europe, and even Central Europe by the 2020s. Zika and Chikungunya viruses have also emerged in new regions, including Brazil, the southeastern United States, and Southeast Asia, particularly after 2010.

Global trends in vector-borne diseases indicate that a 1–2 °C increase in temperature accelerates mosquito and vector life cycles, enhances reproductive efficiency, and facilitates expansion into new areas. Changes in precipitation patterns and uneven water distribution increase the risk of waterborne diseases, such as cholera and other gastrointestinal infections.

Uzbekistan Context

In Uzbekistan's southern and central regions, the average temperature increased by 1–1.5 °C over the last decade. Droughts and extreme weather events have intensified. According to regional epidemiological monitoring, between 2015 and 2025, the risk of mosquito proliferation and tropical viruses increased in Surkhandarya, Qashqadaryo, and Bukhara. These regions face high vector-borne disease risk, placing additional pressure on the healthcare system.

Furthermore, northern regions of Uzbekistan (Sirdarya, Jizzakh) may witness the emergence of new vector species due to climate change. Insufficient irrigation systems and water reservoirs in these areas may trigger local epidemics of vector-borne diseases.

Graphs and Analysis

1. **Global Graph:** Expansion of mosquito distribution carrying tropical diseases from 1950 to 2020.
2. **Uzbekistan Graph:** Vector-borne disease risk index in southern regions of Uzbekistan from 2015 to 2025.
3. **Analysis:** Comparing global and national trends demonstrates the significant impact of climate change on epidemiology.

The results clearly indicate that climate change increases the risk of emerging infectious diseases at both global and national levels, posing a critical challenge not only for healthcare systems but also for social and economic stability.

Discussion

The global spread of climate-related emerging infectious diseases demonstrates that even small changes in climate parameters can significantly affect epidemiological outcomes. For instance, a 1–2 °C increase in temperature accelerates the life cycle of mosquitoes and other vectors, expanding their geographic distribution. Extreme precipitation or drought events further increase the risk of waterborne diseases.

In the context of Uzbekistan, this risk is particularly pronounced in southern regions. Recent climatic changes have led to an increase in mosquito populations and the spread of tropical viruses. Regional monitoring indicates that Surkhandarya, Qashqadaryo, and Bukhara face high vector-borne disease risks, necessitating enhanced preventive measures within the healthcare system.

Global experiences suggest that the following strategies are effective in reducing climate-related infectious disease risks:

1. Strengthening vector monitoring and biological control systems.
2. Educating populations on epidemiological risks and preventive measures.
3. Adapting healthcare systems to climate change and preparing for epidemic emergencies.
4. Implementing integrated monitoring systems for continuous analysis of climate and health data.

Similar strategies can be implemented in Uzbekistan, including controlling mosquito populations in southern regions, maintaining clean water resources, educating local populations on preventive measures, and improving epidemiological monitoring. Training healthcare professionals to understand the epidemiological risks of climate change is also critical.

The discussion demonstrates that climate change is a major factor in the emergence and spread of novel infectious diseases at both global and national levels. Consequently, integrating global and national strategies and implementing evidence-based preventive measures is essential.

Conclusion

This article analyzed the relationship between climate change and the emergence of novel infectious diseases in both global and Uzbekistan contexts. The results indicate that rising global temperatures,

extreme precipitation, and droughts significantly increase the risk of vector-borne disease spread. Diseases common in tropical and subtropical regions are expanding into new areas, posing challenges for healthcare systems and social stability.

In Uzbekistan, southern and central regions have experienced increased mosquito populations and rising risks of tropical viruses due to climate change. Northern regions may also face emerging vector species and disease risks. These conditions necessitate enhanced regional monitoring, adaptation of healthcare systems, and strengthened preventive measures.

Based on the findings, the following recommendations are essential:

1. Improve vector monitoring and control systems.
2. Educate and raise awareness among local populations about preventive measures.
3. Adapt healthcare systems to climate change and prepare for epidemic emergencies.
4. Establish integrated monitoring systems for continuous analysis of climate and health data.

This study provides a scientific basis for understanding climate-related infectious disease risks and developing preventive strategies at both global and national levels.

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