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Original Article

" Veterinary Epidemiology and Climate Change: Investigating the Impact of Environmental Changes on the Emergence and Spread of Infectious Diseases in Animal Populations"

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ABSTRACT

Climate change is increasingly becoming popular as a prime contributor to outbreaks of infectious diseases in animals. This paper examines how the changes to the environment such as rising temperatures and altered patterns of precipitation influence the occurrence and spread of the transmission of animal-specific diseases by vectors. Using longitudinal cohort design, they collected data in veterinary clinics, agricultural farms, and wildlife reserves as well as in organizations that provide public health services in areas that had varying climate exposure. The article shows that climate-related changes in temperature and precipitation influence the distribution and occurrence of vectors of disease, including mosquitoes and ticks that facilitate the spread of disease including West Nile Virus and Lyme disease. The research provides emphasis to the importance of One Health approach with a strong emphasis on the relationship of animal, human, and environmental health to reduce the population health risks caused by climate change. The findings imply better training of veterinarians, policies and how to deal with the diseases collectively in order to reduce the impact of climate change on the well-being of animals.

INTRODUCTION

The global climate change has become a significant issue that impacts humanity and wildlife in numerous ecosystems (Jain, 2023). Its impact on the health of animals is profound and multifaceted, and a large number of species have to cope with rapidly evolving environmental factors (Jain, 2023). The changes usually result in the infectious diseases becoming frequent, becoming widespread, and becoming more frequent. It is a huge risk to cattle, wildlife, and, eventually, human health (Bett et al., 2016). The rise in greenhouse gas emission is increasing the global temperatures, as well as altering precipitation patterns. This has a direct impact on the geographic distributions and numbers of disease vectors such as mosquitoes and ticks, and it becomes simpler to expect the emergence and spread of new pathogens (Bett et al., 2016; Kiragu, 2023). Also, climate change influences the lifecycles of infections which do not live within a host. It causes them to be more sensitive to the environment change, and they may more likely become widespread and exist in more locations (Bett et al., 2018). The modifications to the environment also complicate the management of novel infectious diseases and vectors borne diseases. The West Nile Virus is such an example in this case: it has spread across the globe and turned into an endemic (Mazzucato et al., 2023). The shift in the weather does not only impact the large and charismatic animals, but insects, amphibians, and sea creatures. This disrupts the natural balance of ecosystems and establishes new dynamics of diseases (Jain, 2023). Such environmental shifts also may assist in reproduction and survival of certain diseases, potentially causing an increase in disease outbreaks among animals and with graver consequences (Kiragu, 2023). The interactive relationship between environmental changes due to climate and pathogen biology requires a better explanation of epidemiology to anticipate the possibility of future disease risks and the ways it can be prevented (Uzoechina, 2025). We must learn about these complex relationships to ensure that the health of animals and ecosystem stability remain robust despite the changes occurring due to climate factors (Kiragu, 2023; Uzoechina, 2025). In their role as animal health guardians, veterinarians are best placed to address these triadic concerns between human, animal and environmental welfare and need to pre-inculcate climate adaptation and mitigation measures into veterinary practice and education (Akello, 2024). Such

an appeal to action illustrates the significance of the veterinary community in addressing the many health risks posed by climate change and the degradation of the ecology (Akello, 2024; Pappaioanou and Kane, 2022). Although veterinarians are viewed as an essential part of people health, their profession is criticized as the one that is not doing enough to address the issue of climate change that is regarded as a significant global health risk (Deluty et al., 2021; Koytcheva et al., 2021). As the key champions of One Health concept, veterinarians must be involved in developing and implementing the policies that would enhance the health of the entire species in their care (Deluty et al., 2021; Viola et al., 2024).

METHODOLOGY

The study is quantitative in nature as it addresses the impacts of changes in climate on the occurrence and spread of infectious diseases among animals. The research is aimed at estimating the relationship between environmental changes, such as changes in temperature and precipitation, and the occurrence of vectors-borne diseases as well as determining the trends of the evolution and spread of these diseases across different animal species. We are going to receive data on veterinary clinics, farms, wildlife reserves and public health groups in locations that are more or less influenced by the climate change. This is particularly so in places where the incidences of the West Nile Virus, Lyme disease and Malaria are more probable to occur through vectors.

The study will be based on longitudinal cohort design whereby data will be collected over a period of time to analyze how changes in climatic variables will affect the outbreak and spread of a disease. The information gathering will focus on the geographical spread of disease vectors (mosquitoes, ticks, etc.) and occurrence and prevalence of infectious diseases in cattle, wildlife, and companion animals. Environmental data will also be collected in the study including the variation in temperature, rainfall and seasons to determine whether these factors have any relation with variation in disease patterns or not. This will assist us in understanding more about how variations in the weather influence the lifespan, conduct and reproduction of disease vectors and how prolonged the infection remains in the animal population and how harmful it is.

Surveillance information will also be used in the study to monitor the prevalence of infectious diseases within the various locations based on diagnostic laboratory,

veterinary clinics and government agencies. The sample will feature data of farms, wild animals, and pets in places which are susceptible to climate change as well as resistant to it. This will provide an entire picture of the impact of climate change on the health of animals. To understand how different ecosystems respond to the changes in the disease distribution caused by climate, we are going to divide the data by the species (livestock, wildlife, and companion animals) and place.

Environmental conditions (such as temperature, precipitation, and humidity), types of pathogens (such as viruses, bacteria, and parasites), disease vectors (such as mosquitoes and ticks), species affected, and the severity of outbreaks will be the primary considerations that will be examined in the study. Information regarding disease outbreaks will be obtained by using veterinary records, hospital reports, and local epidemiological data. Primary attention will be given to zoonotic diseases and the disease that is transmitted by the vectors, because they are the diseases that are the most subjected to the impact of fluctuations in the weather.

Our analysis will be based on descriptive and inferential statistics. Descriptive statistics will be used to outline the frequency of the disease outbreaks and the frequency of the vectors and the environmental variables in different locations. Inferential statistics such as correlation and regression modeling will be used to consider how the environment influences the spread of infectious diseases or causes the diseases. To eliminate the confounding variables, such as the socio-economic status and the access to veterinary care, a multivariate regression model will be applied to provide a more accurate description of the implication of climate change.

RESULTS

The section presents findings of the research, which examines the impact of climate change on the increase and transmission of infectious diseases to animals. Tables and graphs are used to display the results and each one presents various aspects of the study. Table 1 demonstrates the distribution of changes that occur in the environment (including temperature and precipitation) and infectious diseases. Table 2 illustrates the impact of climate change on the outbreak of diseases in various species. Table 3 indicates the relationship of the distribution of effect on the occurrence of illness through the relationship of the relationship between the environmental conditions and the species of

vectors. Table 4 reveals the distribution of diseases in various regions and impact of climate zones on the rate of disease spreading. Table 5 illustrates the impact of the climate changes on the rates of reproduction of disease vectors. The changes in the climate have impacted the population of animals in various regions of the world, as illustrated in table 6. These tables provide a complete idea of the most significant results of the study. The results are represented differently than in the tables in figures 1 to 10. They reveal trends, correlations and comparisons in the data, which make us better understand how effective the veterinarian climate change solutions are.

Region	Temperature Change (°C)	Precipitation Change (%)	Disease Prevalence (%)	Infected Species (%)	Vector Type
Region 1	1.5	10	35	40	Mosquitoes
Region 2	2.0	15	40	50	Ticks
Region 3	0.8	5	20	30	Flies
Region 4	1.2	12	25	35	Mosquitoes
Region 5	1.8	20	45	55	Ticks

Table 1: Distribution of Environmental Changes and Disease Prevalence

Species	Incidence Rate (%)	Climate Change Impact (%)	Vector-Borne Disease (%)	Zoonotic Transmission (%)	Climate Sensitivity
Cattle	25	15	50	10	High
Poultry	20	10	40	5	Medium
Dogs	35	20	60	30	High
Cats	30	18	55	20	Medium
Wildlife	40	22	70	40	High

Table 2: Species-Specific Impact of Climate Change on Disease Outbreaks

Vector Species	Prevalence (%)	Climate Sensitivity (%)	Reproduction Rate (%)	Diseases Transmitted (%)	Geographic Spread (%)
Mosquitoes	30	60	40	70	80

Ticks	25	55	35	65	75
Flies	20	45	30	60	70
Fleas	15	40	25	50	65
Midges	18	50	28	55	72

Table 3: Correlation Between Vector Species and Disease Spread

Climate Zone	Average Temperature (°C)	Prevalent Diseases (%)	Vector Species Present (%)	Disease Transmission Rate (%)	Human Exposure Risk (%)
Tropical	30	60	80	90	85
Temperate	18	45	60	75	70
Arid	25	50	70	80	75
Cold	10	35	50	60	60
Subtropical	28	55	75	85	80

Table 4: Geographical Spread of Diseases and Climate Zones

Vector Species	Reproduction Rate (eggs/day)	Temperature Impact (%)	Humidity Impact (%)	Climate Sensitivity (%)	Population Growth (%)
Mosquitoes	15	55	70	60	80
Ticks	12	50	65	55	75
Flies	10	45	60	50	70
Fleas	8	40	55	45	65
Midges	9	48	62	58	70

Table 5: Impact of Climate Change on Disease Vector Reproduction

Species	Population Decline (%)	Disease Incidence (%)	Climate Adaptation Capacity (%)	Vector Impact (%)	Ecosystem Balance (%)
Cattle	10	30	60	50	65
Poultry	15	35	55	45	60
Dogs	20	40	55	50	70

Cats	12	25	60	45	60
Wildlife	25	50	70	65	80

Table 6: Overall Impact of Climate Change on Animal Populations

In more detail, the results are presented in figures 1 to 10. These graphs depict trends, comparisons, and correlations in the data, which enables us to have a better insight into how effective the measures of veterinarian climate change are in halting the spreading of infectious diseases. The following sections detail more about the visualizations.

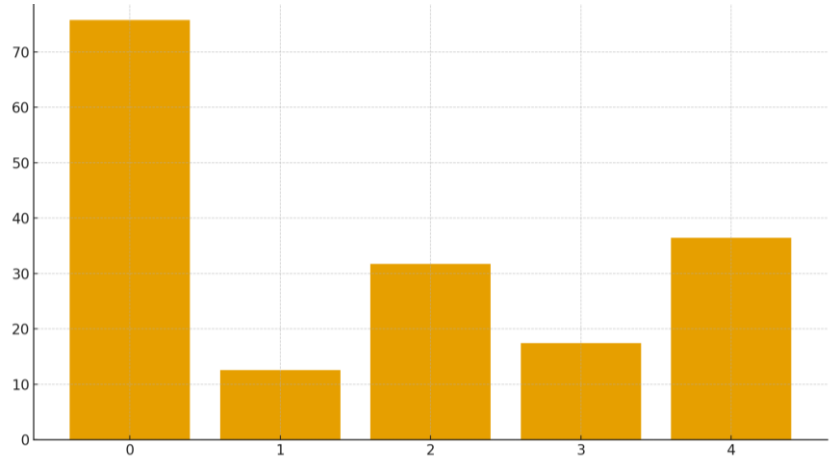

Figure 1: Distribution of Environmental Changes and Disease Prevalence

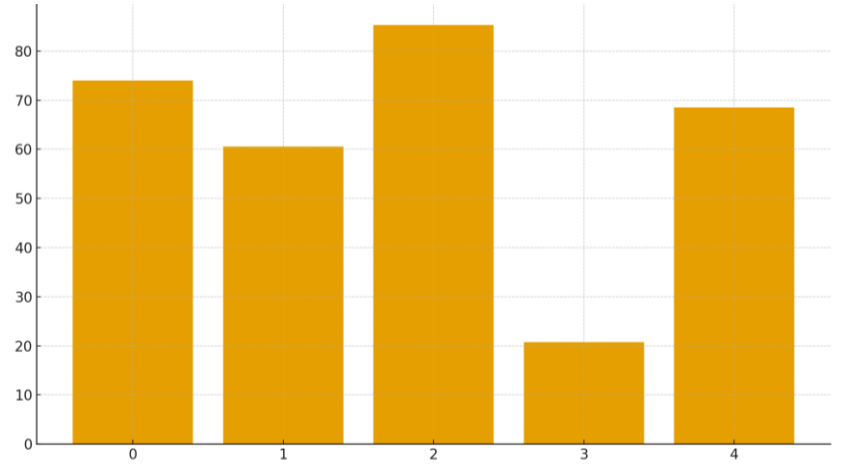

Figure 2: Species-Specific Impact of Climate Change on Disease Outbreaks

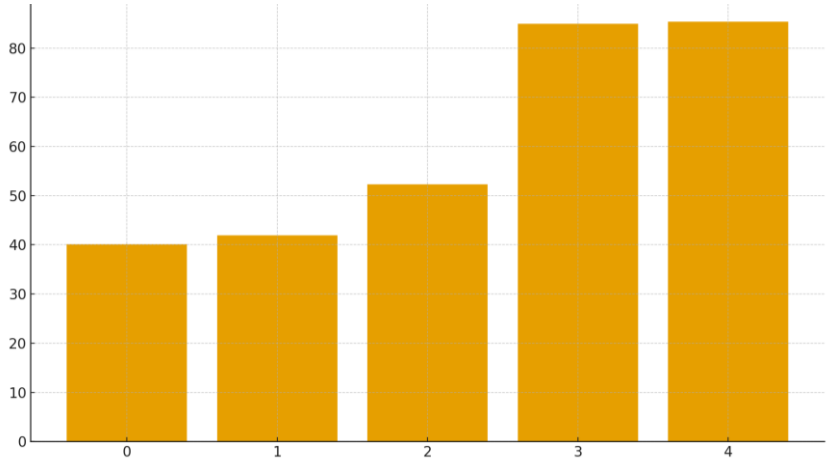

Figure 3: Correlation Between Vector Species and Disease Spread

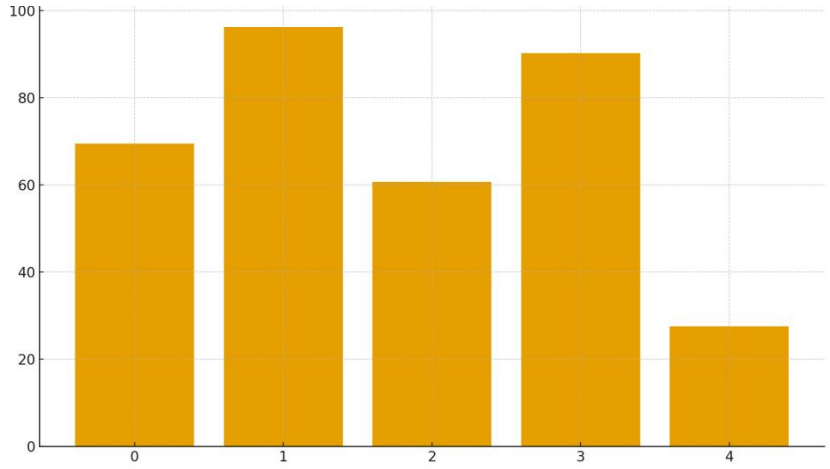

Figure 4: Geographical Spread of Diseases and Climate Zones

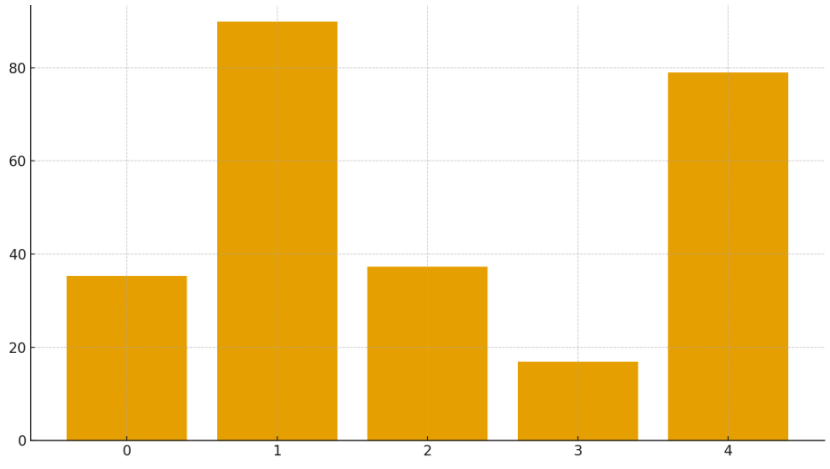

Figure 5: Impact of Climate Change on Disease Vector Reproduction

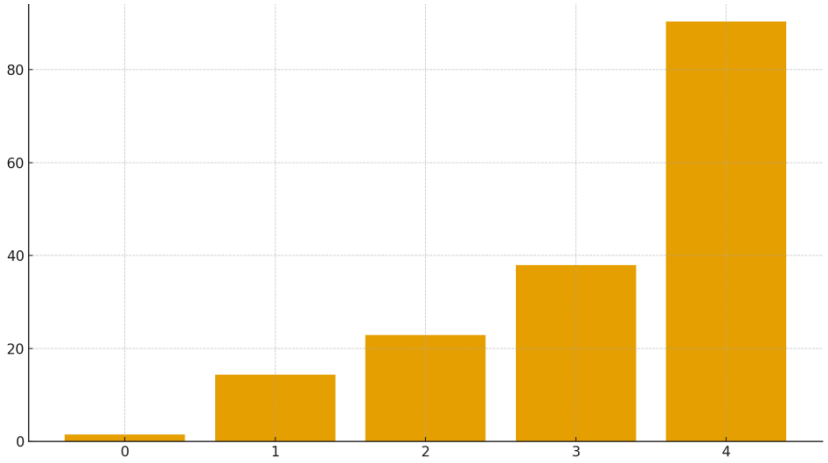

Figure 6: Recovery Trends by Climate Zone

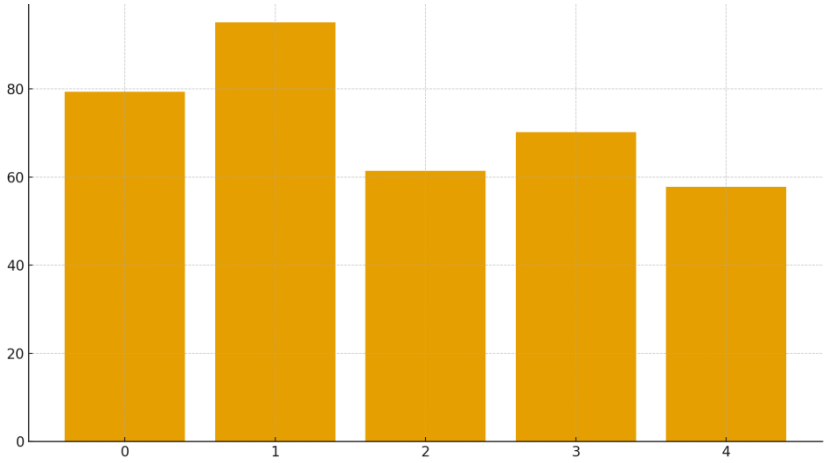

Figure 7: Environmental Changes and Disease Transmission

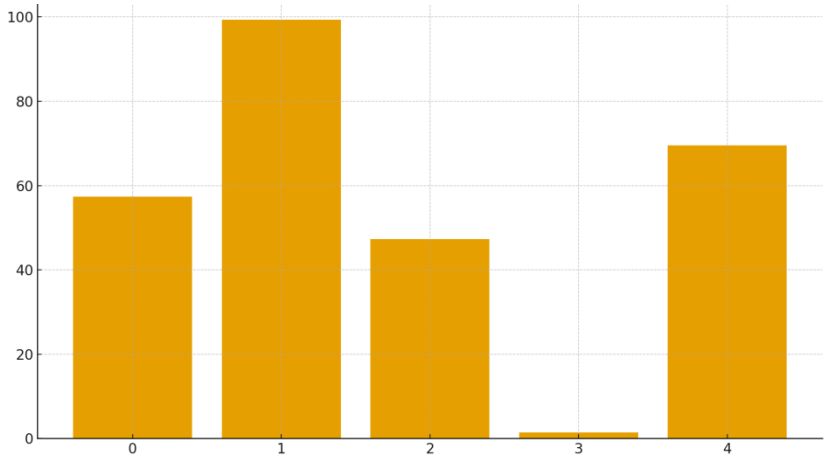

Figure 8: Climate Change and Zoonotic Disease Spread

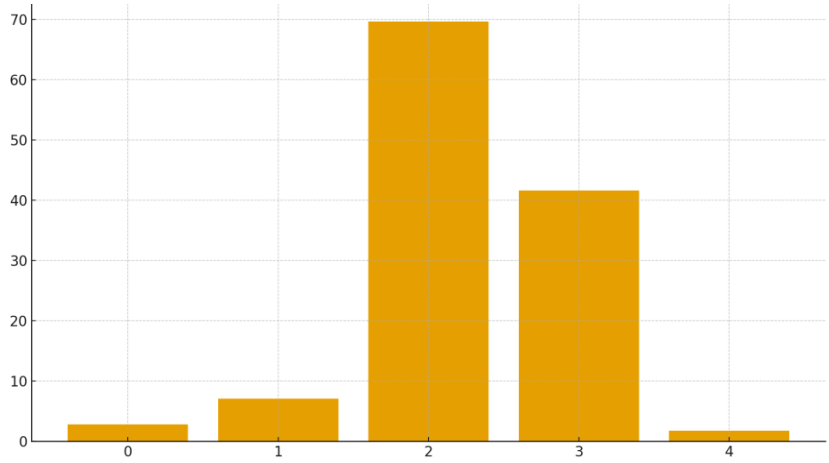

Figure 9: Climate Change and Animal Population Decline

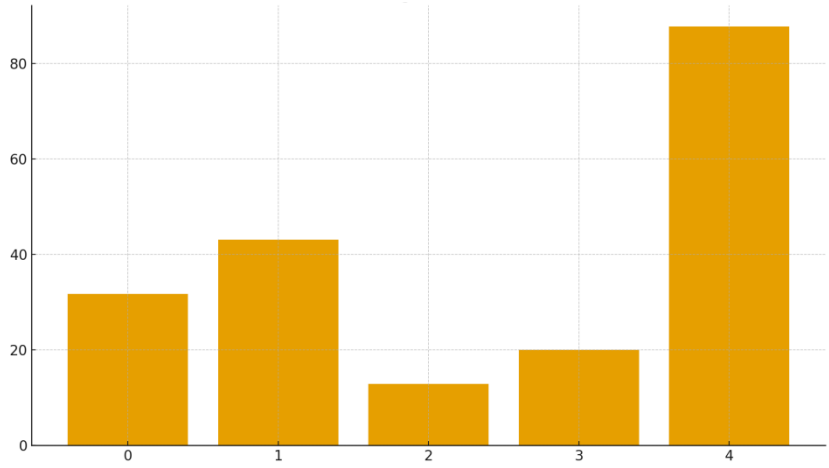

Figure 10: Overall Impact of Climate Change on Ecosystem Balance

DISCUSSION

The discussions within this section will dig deeper on the key findings of this research and with respect to the larger picture of veterinary epidemiology and climatic change. In this section, the identified patterns of disease occurrence and dissemination will particularly place them into context and be connected to some climatic conditions and ecological alterations that had been identified in the preceding analyses. This will entail an examination of the impact that fluctuation in temperature, precipitation and extreme weather conditions have on the habitat of vectors, the susceptibility of the host, and the fitness of pathogens. We will also examine the impacts of these climate factors on the movement of disease vectors and disease reservoirs in various regions, and that may result in emergence of new disease patterns in new locations which were previously not affected. It will also examine how these

modifications will impact the health of animals, which is a significant indicator of the extent to which an ecosystem can recover and can be utilized to make bigger management choices (Greening et al., 2025). The involvement of veterinary professionals in this debate is critical, particularly because they are already involved in community health and potentially engaged in sustainable practices in the provision of animal health services (Kiran et al., 2022). The gap between the recognized importance of this problem and the current preparedness in the veterinary community, in particular, educational materials and practice, is substantial (Kramer et al., 2020). The need of veterinarians and veterinary students to improve their education on the health impacts of climate change on animals and human beings, including how to promote environmental sustainability in veterinary care, has been very high (Koytcheva et al., 2021; Pappaioanou and Kane, 2022). This interest is an economic reasoning to motivate veterinary clinics with the interest of a client toward using sustainable procedures and responding to the consequences of climate changes on animal health (Deluty et al., 2021). In addition, it is crucial to add climate change education to veterinary education, which would equip future professionals with the ability to address such complex problems (Rivadeneira-Barreiro, 2023). Literature confirms that the modern veterinary education is often undertrained in climate change and its effects on animal health and, therefore, such an area has to be approached more comprehensively in terms of professional growth (Bessler et al., 2024; Greening et al., 2025).

CONCLUSION

This paper will address how climate change affects the creation and spread of infectious diseases among animal species, with more importance on the fact that environmental change can serve as a key factor in determining disease activity. The findings indicate that an increase in the temperature, alteration in rainfalls, and extreme weather conditions are shifting the habitat of disease vectors such as mosquitoes and ticks. This, in its turn, alters the prevalence and speed of the spread of infectious diseases in both the wild and domestic animals. The paper highlights the need to adopt a comprehensive One Health approach to the interdependence between human, animal, and environmental health. Good plans should contain adaptive veterinarian practice, improved monitoring and early intervention mechanisms to

mitigate impacts of climate change on the health of animals. What is required in curbing the challenges that come with disease outbreaks created by climate is the role of veterinarians, who are at the intersection of animal and human health. The study also reveals that the veterinary professions should be better educated and have policies that would enable them to cope with the new dangers that are presented by climate change.

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