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CLIMATE CHANGE AND VECTOR BORNE DISEASES: A GLOBAL AGENDA

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ABSTRACT

Vector-borne diseases are illnesses caused by pathogens and parasites transmitted by vectors, which are living organisms that can transmit infectious diseases between humans or from animals to humans. Common vectors include mosquitoes, ticks, flies, sandflies, fleas, and aquatic snails. Prevention and control strategies for vector-borne diseases often include vector control measures (e.g., insecticide-treated bed nets, indoor residual spraying, environmental management), vaccination (where available), public health education, and personal protective measures (e.g., use of insect repellent, wearing long-sleeved clothing).

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INTRODUCTION

The survival of the world is seriously threatened by climate change. Goal 13 of the Sustainable Development agenda, which addresses poverty and health care, calls for immediate action against climate change. This relationship intensifies the spread of vector-borne illnesses like malaria, which primarily affects sub-Saharan Africa. Climate change also affects other neglected tropical diseases, such as leishmaniasis and infections spread by bloodsucking insects (Tambe et al., 2024). Heatwaves and other extreme weather conditions put human health at risk and put a pressure on healthcare systems. Research focusing on community-driven strategies to increase resilience to climate impacts on health is currently given priority.

Community centric research driven hypothesis:
In order to successfully address health issues, this involves doing biomedical research with a local focus, drawing inspiration from successful community-engagedstudies such as those pioneered in urban geography.

Using techniques from Bunge, Warren, and other sources, we present five strategies to improve community-beneficial research on the effects of climate change on vector-borne illnesses:

a) Recognize the localized circumstances of illness transmission, give knowledge a practical application, b) think about variables impacting vectors besides climate, c) extend the reach of knowledge derived from research, d) give communities the power to take back theirresources (Chaves et al., 2024).

By encouraging efficient information translation, these strategies support the improvement of community health and the decrease of disease. They

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can be widely used to address a variety of health issues, combining statistical data and community insights for thorough comprehension and action.

Vector-borne disease:

Infections known as vector-borne diseases are brought to people by pathogens that are carried from afflicted animals by insects like ticks or mosquitoes. Yellow fever, dengue, Zika, malaria, and Chikungunya are common examples. Together, these illnesses account for more than 17% of all infectious diseases and cause over 700,000 fatalities annually (George et al., 2024).

Here are some examples of vector-borne diseases:

Malaria: Transmitted by Anopheles mosquitoes, caused by Plasmodium parasites.

Dengue: Caused by the dengue virus, transmitted by Aedes mosquitoes.

Zika Virus: Transmitted primarily by Aedes mosquitoes.

Chikungunya: Transmitted by Aedes mosquitoes.

West Nile Virus: Spread by Culex mosquitoes.

Lyme Disease: Caused by the bacterium Borrelia burgdorferi, transmitted by Ixodes ticks.

Yellow Fever: Transmitted by Aedes and Haemagogus mosquitoes.

Japanese Encephalitis: Transmitted by Culex mosquitoes.

Leishmaniasis: Caused by Leishmania parasites, transmitted by sandflies.

Chagas Disease: Caused by Trypanosoma cruzi, transmitted by triatomine bugs.

Table 1: Vector-borne diseases and their causative organisms and other general information.

Disease	Vector	Causative organism	Host	Symptoms	Area	Treatment
African horse sickness	**Culicoid midge**	***Orbivirus* (virus)**	**Equids**	**Fever, lung, heart or mucous membrane symptoms.**	**Europe, Africa**	**Vaccination**
Babesiosis	Tick	Babesia *(protozoan)*	Humans, rodents, dogs, cattle	Fever, hemolytic anemia, chills, sweating, thrombocy-topenia	South Europe, Central United States	Antibiotics
Bluetongue disease	Culicoid midge	Orbivirus (virus)	Cattle, sheep	Fever, salivation, swelling of face and tongue	Europe, Africa	Vaccination
Chagas disease (American trypano-somiasis)	Various assassin bugs of subfamily Triatominae	*Trypano-somacruzi* (protozoan)		Mild symptoms, then chronic heart or brain inflammation	Central and South America	Antiparasitic drugs; treat-ment of symptoms
Chikungunya	Mosquito	Chikungunya virus	Human	Abdomen pain, eye pain, joint pain, muscle pain, fever, chills, fatigue, headache, skin rash	Asia	Antibiotics
Dengue fever	Mosquito	Flavivirus (virus)		Fever then arthritis	(Sub) tropics and South Europe	Observation/ supportive treatment

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Dengue fever	Mosquito	Flavivirus (virus)		Fever then arthritis	(Sub) tropics and South Europe	Observation/ supportive treatment
Dirofilariasis	Mosquito	*Dirofilaria*	Dogs, wolves, coyotes, foxes, jackals, cats, seals, sea lions, muskrats, bears, rabbits, raccoons, reptiles, beavers, ferrets, monkeys,	Chest pain, fever, pleural effusion, cough, nodules under the skin or lung granulomas	Worldwide	Heartworm medicine
Tick-borne encephalitis	Tick	Tick-borne encephalitis virus		Ill with flu then meningitis	Central and North Europe	Prevention and vaccination
Heartland virus disease	Tick	Heartland virus		Fever, lethargy, headache, myalgia, diarrhea, nausea, loss of appetite, anorexia, thrombocy-topenia, leukopenia, arthralgia	Missouri and Tennessee, USA	Supportive treatment

Leishmaniasis	Sandfly	*Leishmania* (protozoan)		Fever, damage to the spleen and liver, and anaemia	South hemisphere and Mediterranean Countries	Treatment of infected
Lyme disease	Tick	*Borrelia burgdorferi* (bacterium)	Deer, human	Bull's-eye pattern skin rash around bite, fever, chills, fatigue, body aches, headache, joint pain. Some-times neuro-logical problems.	Europe, North Africa, and North America	Prevention and antibiotics
Malaria	Mosquito	*Plasmodium* (protist)	Human	Headache then heavy fever	(Sub) tropics	Prevention and anti-malaria
Plague	Flea		Rats, Human	Fever, weakness and headache. In the bubonic form there is also swelling of lymph nodes, while in the septicemic form tissues may turn black and die, and in the pneumonic form shortness of breath, cough and chest pain may occur	Central Asia, India, US, Africa, Peru, Brazil	Antibiotics
Pogosta disease Synonyms: Karelian fever Ockelbo disease Sindbis fever	Mosquito	Sindbis virus		Skin rash, fever, in severe cases - arthritis	Scandinavia, France, Russia	unknown
Rickettsial diseases: Typhus rickettsialpox Boutonneuse fever African tick bite fever Rocky Mountain spotted fever etc.	Tick, mite, lice	*Rickettsia species* (bacteria)		Fever with bleeding around the bite	Global	Prevention and antibiotics
Tularemia	Deer flies, ticks	*Francisella tularensis* (bacterium)	Birds, lagomorphs, rodents	Skin ulcer, swollen and painful lymph glands, fever, chills headache, exhaustion	North America	Streptomycin, gentamicin, doxycycline, ciprofloxacin

African trypanosomiasis (sleeping sickness)	Tsetse fly	*Trypanosoma brucei* (protozoan)	Wild mammals, cattle, human	Fever, joint pain, swollen lymph nodes, sleep disturbances	Sub-Saharan Africa	Various drugs
Lymphatic filariasis	Mosquito	*Wuchereria bancrofti*	Human	Fever, swelling of limbs, breasts, or genitalia	Africa, Asia.	Various drugs
West Nile fever	Mosquito	West Nile virus	Birds, human	Fever, headaches, skin rash, body aches.	Africa, Asia, North America, South and East Europe	None
Yellow fever	Mosquito	Yellow fever virus	Human	Muscle pain, abdomen pain, loss of appetite, fatigue, jaundice, fever, chills, head-ache, nausea, vomiting, bleeding, delirium	South America, Africa	Yellow fever vaccine
Zika fever	Mosquito	Zika virus	Monkeys, human	Fever, eye pain, conjunctivitis, rash, headache, vomiting, joint pain, muscle pain, fatigue, chills, sweating, loss of appetite	South America, Mexico, Asia, Africa	Decreasing mosquito bites, condoms
Crimean Congo hemorrhagic fever	Tick	CrimeanCongo hemorrhagic fever	Human Dog Cat	Fever, muscle ache, dizziness, neck pain, backache, headache, sore eyes and photophobia (sensitivity to light)		

Climate change impacting vector-borne diseases: Almost all diseases spread by vectors have a climatic component. The hosts, vectors, and pathogens that cause these illnesses are extremely sensitive to their surroundings.

Because of this sensitivity, variations in precipitation and temperature brought on by climate change can have a big impact on the spread of diseases carried by vectors.

There are three main ways that climate change affects vector-borne illnesses:

1. Increased appropriateness of habitat for vectors: Higher temperatures have the potential to increase the geographic range in which vectors such as ticks and mosquitoes can thrive and proliferate. Droughts can also produce breeding pools from previously flowing water, while increased rains can increase the number of breeding sites by creating more standing water.
2. Extended seasons of disease transmission: Temperatures that are warmer are more likely to provide an environment that is favorable for the spread of disease, which could lead to longer seasons of disease transmission.
3. Modification of vector behavior: Variations in temperature have the ability to alter the ways that vectors bite. For example, warmer temperatures

have the potential to alter mosquito biting habits, decreasing the efficacy of protective measures like bed nets (Carnaghi *et al.*, 2024).

It is difficult to fully attribute these effects to climate change, though, because human mobility, control efforts, and changes in land use all have a big impact on how diseases spread and where vectors are distributed.

Risking factors:
According to a 2022 study published in The Lancet Planetary Health, by 2070, an additional 4.7 billion individuals may be more susceptible to dengue and malaria as a result of climate change (El-Ansary, 2024). Human migration has been the main factor in dengue's global spread since the 1990s, but by 2030, climate change is expected to overtake human migration as the main cause. By the end of the century, dengue fever is predicted by the Intergovernmental Panel on Climate Change to have longer seasons and a wider geographic distribution, potentially infecting billions more people across Asia, Europe, Central and South America, and sub-Saharan Africa (Paul, 2024).

Similarly, as favorable habitats for disease transmission grow due to rising climates, approximately 1.3 billion additional individuals may be exposed to Zika, another vector-borne illness, by 2050(Michaud *et al.,* 2024). But certain areas might get too hot for mosquitoes, which are necessary for the spread of Zika and other various illnesses. The tick-borne encephalitis and Lyme disease carriers, ticks, are multiplying as a result of warmer winters brought on by global warming (Pustijanac*et al.,* 2024). Ticks that spread tropical diseases have even survived German winters, suggesting that they may continue to go northward into uncharted territory.

Probable preventive measures:
Prompt action is necessary to limit the danger of vector-borne diseases that are made worse by climate change (Githeko, 2024). Making the switch to clean, renewable energy is essential to reducing climate impacts. But adaptive strategies are also required:

1. Make sure that everyone has access to medical treatment and illness management.
2. Improve disease surveillance by community monitoring and health education to identify outbreaks early.
3. Reduce your exposure to vectors by utilizing techniques including pesticides, window and door screens, protective clothes, and habitat alteration.
4. Utilize cutting-edge technologies to hasten the development of vaccines.
5. Give management of wetlands first priority, and get rid of vector breeding grounds close to populated areas.
6. Investigate novel vector control tactics, such as using mosquitoes contaminated with Wolbachia.

These actions are essential for protecting public health in the face of rising vector-borne disease threats associated with climate change.

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