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A review on potential influence of Climate Change on Vector born and Zoonotic diseases: Prevalence and Recommended action for earlier Disease detection in Humans and Animal.

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Abstract:

Climate change is causing a slew of challenges for the world .COVID-19, a newly developing zoonotic illness with likely bat origins that has infected millions of people and had severe global repercussions, was highlighted. For successful prevention and control of probable zoonosis, it is highly advised that One Health procedures be used. With a focus on the potential influence of climate change on natural animal and human systems, greater predictions and mitigations for how such consequences would vector born and zoonotic illnesses in humans and animals will be possible. Climate change has a number of negative consequences for agriculture, water resources, forests and biodiversity, health, coastal management, and temperature rise. Many helminthic, bacterial, viral, and protozoan parasitic diseases, as well as insect and ectoparasitic vectors that impact both animals and people, are affected by climate and weather.

Key word: Climate change, vector born, zoonotic diseases, etiology

Introduction:

Interactions between animals and humans are increasingly being recognised as potential origins of epidemics and the production of "novel pathogens." Sixty per cent of new pathogens are zoonotic, according to estimates. Warmer temperatures may allow a parasite to survive in the environment for longer periods of time, increase an insect replication cycle, allow an infected host animal species to survive winter in large numbers, increase in population, and expand their range of habitation, all of which increase the chance of infection transmission to humans. Climate change is expected to have a wide range of effects on human health, many of which have already been well investigated (Confalonieri et al. 2007; Ebi et al. 2006, 2008; Frumkin et al. 2008; Patz and Olson 2006). The fundamental theme is that global climate change is a severe threat to the world, capable of causing social unrest, population displacement, economic problems, and environmental damage, among other things. Mitigation of global climate change should be a priority for society and its governments in order to achieve a greener, less anthropogenic ally damaged world, according to new ecological trends in society. This rising menace poses a huge challenge for humanity in the twenty-first century. Its consequences cover a wide range of topics that haven't been thoroughly investigated by society at various levels. Human activities are changing the world's climate, and this trend is expected to accelerate in the future decades.

If global temperature rises are not to surpass 2°C—the International Energy Authority warns that "the door to 2°C is closing"—urgent action is now required to reduce carbon dioxide (International Energy Agency, 2011). Indeed, emissions must be drastically reduced within the next two decades, with zero net emissions attained by the end of the century, aided by increasing carbon dioxide bio sequestration from the atmosphere (Friedlingstein et al, 2011). Emissions, on the other hand, have continued to rise, having increased by 49 percent since 1990 and by a faster-than-average annual pace of 5.9% in 2010. Growing evidence includes direct and indirect consequences on human health in the context of the numerous impacts that climate change can have on the world and civilization. The delicate balance or interaction of ecological, physical, and socio economical systems of the biospheres is crucial to the population's health (WHO, 2003). This is one of the numerous areas that multiple studies have lately highlighted in relation to the implications of climatic change for global public health. It is critical to comprehend this relationship since it will exacerbate the already large burden of diseases on national economies and public health, even if some of them, such as zoonotic diseases, are often confined. Authorities must be able to analyse, anticipate, and track human health vulnerabilities as a result of climate change in order to plan for or take action to mitigate these risks (Hambling et al, 2011).

Brucellosis, Japanese encephalitis, Leptospirosis, Cutaneous leishmaniasis, Kyasanur forest diseases, Nipha virus, Scrub typhus are some of the world's zoonotic diseases, as well as Malaria, Dengue fever, and other vector-borne diseases. An emerging zoonosis is defined by the World Health Organization as one that is newly recognised or evolved, or one that has previously occurred but has shown an increase in incidence and geographic, host, or vector range extension. The degree of climate sensitivity influences the distribution and prevalence of zoonotic illnesses. Many people will be displaced as sea levels rise, or will be severely impacted by droughts and famines, a decrease in suitable agricultural lands, an increase in food-borne diseases, water-borne diseases, vector-borne diseases, as well as an increase in premature deaths and diseases linked to air pollution in some parts of the world (Mills, 2009; PAHO, 2008; United Nations, 2006; Diaz, 2006). Although adjustments in the distribution and behaviour of vectors and animal species are likely to worsen these emerging situations, indicating that biologic systems are already responding to ecological changes, more research is needed to fully understand their interacting functions and how to control them.

Infections transmitted from animal to man are known as zoonotic infections. They can be transmitted directly (via direct touch or contact with animal products) or indirectly (through an intermediary vector such as an arthropod or an insect) (Pappas, 2011). Despite the fact that zoonotic infections have a significant global burden, both in terms of immediate and long-term morbidity and mortality, as well as emergence and socioeconomic, ecological, and political correlations, scientific and public health interest in, and funding for, these diseases remains low. (Christou, 2011; Akritidis, 2011), Different statistical analyses, most of them based on linear regressions, have linked extreme climatic anomalies with significant alterations in the epidemiological patterns of diseases, sometimes coupled directly and indirectly on time and space, in an attempt to understand these complex climate changes impact on biological and ecological systems in the context of and their implications for human health. Geographic information systems (GIS) and remote sensing (spatial epidemiology) have also supported these observations and are actively assisting in the development of systems for the prediction and forecasting of such diseases based on climate variability and change described(Rodriguez-Morales et al, 2010; Rodriguez-Morales, 2011).

Geo climatic variation

Changes in land and ocean temperatures, sea level and acidity, precipitation patterns, wind patterns, land characteristics and use, soil conditions, and extreme weather events can all be used to explain geoclimatic variations (torrential rains, floods, extreme wind events, heat waves, and droughts). Global warming is the unprecedented rapid increase in the Earth's average surface temperature over the last century, owing primarily to anthropogenic greenhouse gas (GHG) emissions (Baede et al., 2001). In comparison to the 1850–1900 (preindustrial) period, the global mean surface temperature increased by 0.99 C (0.84–1.10 C) in the 2001–2020 period and 1.09 C (0.95–1.20 C) in the 2011–2020 period, according to the Intergovernmental Panel on Climate Change (IPCC), with larger increments over land (1.59 [1.34–1.83] C) than over the ocean (0.88 [0.68–1.01] ◦C) for the 2011–2020 period (Intergovernmental Panel on Climate Change, 2021).

Various zoonoses, such as vector-borne diseases (e.g., RVF), parasite infections (e.g., fascioliasis), water/foodborne diseases, and rodent-borne diseases, may become more common and have a greater impact in the future, as anticipated by climatic change models. Tick growth phases are influenced by soil conditions such as moisture and composition, as well as the survival and dissemination of pathogens such as *Bacillus anthracis* spores, which require an ideal soil component for survival (Hugh-Jones and Blackburn, 2009). Tick mortality and the emergence of fungal illnesses such as Valley Fever (coccidioidomycosis) (Park et al., 2005), which has zoonotic potential, can be caused by dry soil conditions and soil evaporation (Gaidici and Saubolle, 2009). Warmer, drier summers are expected, which will enhance soil evaporation and accelerate dust release into the atmosphere. Pathogens such as bacteria, fungi, and bacterial spores (e.g., *Escherichia coli*, *Salmonella*, and *Coccicdioides*) are also transported through the air by soil dust (Boxall et al., 2009). Wind has the potential to transmit viruses in the air (wind and dust) to far-flung locations. The pathogen's ability to disperse in the air is determined by surface and air temperatures, as well as wind speed (Boxall et al., 2009). According to Chen et al. (2010), the H1N1 influenza virus concentration in the air was much greater during Asian Dust Storms (ADS) than on regular days. Furthermore, high winds can reduce biting rates while also increasing the spatial spread of vectors such as Dipterans (e.g., *Aedes* species and sand flies), potentially increasing disease transmission in new areas (Khan et al., 2019).

Table 1: List of Zoonotic Diseases, etiological agents, animal hosts, symptoms in humans and ecological conditions.

Zoonotic Disease	Etiological agents	Animal host	Symptoms in humans	Ecological conditions
Antrax	*Bacillus anthracis*	Cattle, horses, sheep, pigs, dogs, bison, elks, white-tailed deer, goats, and mink	Skin, respiratory organs, or GI tract	Wild life , high temperature, precipitation, and vegetation
Tuberculosis	*Mycobacterium bovis*, *Mycobacterium caprae*, *Mycobacterium microti*	Cattle, sheep, swine, deer, wild boars, camels, and bison	Respiratory organs bone marrow	Soil and aquatic environments, Population displacement
Brucellosis	*Brucella abortus* *Brucella melitensis*, *Brucella suis*, *Brucella canis*,	Cattle, goats, sheep, pigs, and dogs	Fever, usually high in the afternoon, back pain, joint pain, poor appetite, and weight loss	Cool most condition
Bubonic plague	*Yersinia pestis*	Rock squirrels, wood rats, ground squirrels, prairie dogs, mice, voles, chipmunks, and rabbits	Fever, chills, abdominal pain, diarrhea, vomiting, and bleeding from natural opening	Semiarid upland forest and grasslands where rodent species can be involved
Glanders	*Burkholderia mallei*	Horses, donkeys, and mules	Fever, sweating, muscle aches, chest pain, muscle tightness, and headache	Not fully understood
Leprosy	*Mycobacterium*	Monkeys,	Skin lesions	Open water

	leprae	rats, mice, and Cats		bodies, river, creek
Leptospirosis	*Leptospira interrogans*	Wild and domestic animals including pet dogs	Fever, abdominal pain, jaundice, and red eye	Moist or wet environments
Tularemia	*Francisella tularensis*	Rabbits, squirrels, muskrats, deer, sheep, bull snakes, wild rodents, beavers, cats, and dogs	Joint pain, diarrhea, and dry cough	Cold,moist environments including water, soil,hay,straw
Arcobacter infections	*Arcobacter butzleri, Arcobacter cryaerophilus, Arcobacter skirrowii*	Cattle, sheep, pigs, and chickens	Abdominal pain, fever, and vomiting	Streams and rivers
Actinomycosis	*Actinomyces bovis*	Cattle, sheep, horses, pigs, dogs, and other mammals	Swelling of lymph nodes, soft tissues, skin, and abscess	Fresh water, sea-water,cold and wram blooded animal,soil
Bordetellosis	*Bordetella bronchiseptica*	Cats and dogs	Respiratory problem	Ecological niches,ranging from soil,water and plant
Lyme disease	*Borrelia burgdorferi*	Cats, dogs, and horses	Fever, headache, skin rash, and erythema migrans	Forest fragmentation and reforestation
Campylobacter enteritis	*Campylobacter jejuni, Campylobacter coli*	Cattle, sheep, chickens, turkeys, dogs, cats, mink, ferrets, and pigs	Enteric disorder	Sensetive environmental condition such as temperature, availability of water and oxygen.
Campylobacter fetus infection	*Campylobacter fetus subsp. fetus, Campylobacter fetus subsp. testudinum*	Cattle, sheep, and goats	Enteric disorder	Sensetive environmental condition
Clostridioides difficile Infection	*Clostridioides difficile*	Cattle, horses, and birds	Pseudomembranous colitis, and diarrhea	moist soil and aquatic
Corynebacterium ulcerans and Corynebacterium pseudotuberculosis	*Corynobacterium ulcerans, Corynobacterium pseudotuberculosis*	Cattle, dogs, and cats	Diphtheria	Low temperature and acidic pH conditions area

infections				
Enterohemorrhagic Escherichia coli infections	*E coli O157:H7*	Cattle, sheep, pigs, deer, dogs, and poultry	Enteritis and Hemolytic–uremic syndrome	Temperature in natural environment is low <30
Helicobacter infection	*Helicobacter pullorum, Helicobacter suis*	Poultry and pigs	Peptic ulcer	Not fully understood
Vibriosis	*Vibrio parahaemolyticus*	Farm animals	Enteritis	Aquatic environment in warm and low salinity water
Salmonellosis	*Salmonella enterica, Salmonella bongor*	Domestic animals, birds, and dogs	Enteritis	Wet environments shielded from the sun
Ehrlichiosis	*Anaplasma phagocytophilum, Ehrlichia ewingii, Ehrlichia chaffeensis, Ehrlichia canis, Neorickettsia sennetsu*	Sheep, cattle, deer, dogs, and cats	Fever, headache, fatigue, muscle aches, and occasionally rash	Domestic environment
Pasteurellosis	*Pasteurella multocida*	Poultry, pigs, cattle, buffaloes, sheep, goats, deer, cats, dogs, and antelope	Fever, vomiting, diarrhea, and gangrene	Water pH, sodium chloride, clays
Japanese Encephalitis	*Genus-Culex Family-triteaniorhynchus*	Pig, Cattle	Brain swelling, headache, high fever, disorientation	Agricultural area
Rabies	Rabies virus, Genus—*Lyssavirus* Family—*Rhabdoviridae*	Cattle, horses, cats, dogs, bats, monkeys, wolves, skunks, rabbits, and coyotes	Nervous system	Diverse ecological communities,land scap effect
Newcastle disease	Paramyxovirus, Genus—*Avulavirus* Family—*Paramyxoviridae*	Poultry and wild birds	Conjunctivitis	Domestic poultry under non-experimental conditions
Avian influenza	Influenza A virus Genus—*Alphainfluenzavirus* Family—*Orthomyxoviridae*	Ducks, chickens, turkeys, dogs, cats, pigs, whales, horses, seals, and wild birds	Flu like symptoms, diarrhea, and pneumonia	Open access to watering and feeing areas by wild migratory birds

Rift Valley fever	Rift Valley fever virus Genus—*Phlebovirus* Family—*Bunyaviridae*	Buffaloes, camels, cattle, goats, and sheep	Influenza- like fever, muscle pain, joint pain, and headache	RVF outbreaks are triggered by a favourable environment and flooding
Ebola virus disease (Ebola Hemorrhagic Fever)	Ebola virus Genus—*Ebolavirus* Family—*Flaviviridae*	Monkeys, gorillas, chimpanzees, apes, and wild antelopes	Fever, intense weakness, muscle pain, headache, sore throat, hemorrhage, vomiting, diarrhea, kidney, and liver failure	Vegetation index
Marburg viral hemorrhagic fever	Marburg virus Genus—*Marburgvirus* Family—*Flaviviridae*	Fruit bats and monkeys	Hemorrhage, fever, muscle pains, watery diarrhea, abdominal pain, and non-itchy rash	Vegetation index, rural environment in vicinity of livestock
Chikungunya fever	Chikungunya virus Genus—*Alphavirus* Family—*Togaviridae*	Monkeys, birds, and rodents	High fever, severe joint pain, muscle pain, and skin rash	Not fully understood
Dengue fever	Dengue virus Genus—*Flavivirus* Family—*Flaviviridae*	Monkeys and dogs	High fever, skin rash, skin hemorrhage, and shock	Not fully understood
Hantavirus infection (Hantavirus Pulmonary Syndrome)	Hantavirus Genus—*Orthohantavirus* Family—*Hantaviridae*	Deer mice, cotton rats, rice rats, white-footed mice, shrews, and moles	Respiratory problem, high fever, dizziness, chills, and abdominal problems	Mild winters and summer rainfall may cause dramatic increases in rodent population
Zika fever	Zika virus Genus—*Flavivirus* *Family—Flaviviridae*	Apes and monkeys	Fever, pain, and conjunctivitis	Warm climatic environment
West Nile fever	West Nile virus Genus—*Flavivirus* Family—*Flaviviridae*	Horses, birds, and reptiles	Headache, skin rash, swollen lymph nodes, stiff neck, disorientation, coma, tremors, convulsions, and paralysis	River fields
AIDS	HIV Genus—*Lentivirus* Family—*Retroviridae*	Monkeys and chimpanzees	Immunosuppression, influenza-like symptoms, fever, chills, rash, night sweats, muscle aches,	Environmental consequences like erosive coping strategies, changes in livehoods and

			fatigue, swollen lymph nodes	increased reliance on natural resources
Severe acute respiratory syndrome (SARS)	SARS coronavirus (SARS-CoV) Genus—*Coronavirus* Family—*Coronaviridae*	Bats, dogs, cats, ferrets, minks, tigers, and lions	influenza-like symptoms, fever, muscle pain, severe cases progress to a respiratory disease and pneumonia	Wild environment
Monkey pox	Monkeypox virus Genus—*Orthopoxvirus* Family—*Poxviridae*	Squirrels, Gambian poached rats, dormice, different species of monkeys, and others.	Fever, pox lesions on skin	Not fully understood
Trichinellosis	*Trichinella spp.*	Pigs, dogs, cats, rats, and other wild species	Gastrointestinal, e.g., nausea, vomiting, diarrhea, and abdominal pain	Domestic environment
Visceral larva migrans	*Baylisascaris procyonis, Toxocara canis, Toxocara cati, and Ascaris suum*	Birds, emus, cats, chinchillas, porcupines, prairie dogs, rabbits, weasels, woodchucks, and woodrats	Gastrointestinal, e.g., coughing, shortness of breath, fever, and abdominal pain	Domestic environment
Cutaneous larval Migrans	*Ancylostoma braziliense*	Dogs and cats	Subcutaneous tissue	Domestic environment
Hydatidosis	*Echinococcus granulosus*	Buffaloes, sheep, goats and adult stray or shepherd dogs	Hydatid cysts in liver, lungs, bones, kidneys, spleen, abdominal pain, and respiratory problem	Low air temperature, high humidity of soil, high rainfall
Cryptococcosis	*Cryptococcus neoformans*	Dogs, cattle, horses, sheep, goats, birds, and wild animals	Respiratory problems, fever, nausea, and vomiting	Diverse ecological niches
Cryptosporidiosis	*Cryptosporidium parvum*	Cattle, sheep, pigs, goats, horses, and deer	Diarrhea lasting 3–14 days. Abdominal pain, nausea and malaise are frequent. Some patients have a slight fever	Aquatic environment
Fascioliasis	*Fasciola hepatica,*	Cattle, sheep,	Intense internal	Rainfall, high

	Fasciola gigantica	goats, and other ruminants	bleeding, fever, nausea, swollen liver, skin rashes, and extreme abdominal pain	humidity, adequate temperature
Tinea/ringworm infection	*Microsporum spp.*, *Trichophyton spp.*	All animals like cattle, sheep, goats, cats, and dogs	Skin lesions	Warm , moist environment
Aspergillosis	*Aspergillus spp.*	All domestic animals and birds	Respiratory problems	Warm , moist environment
Blastomycosis	*Blastomyces dermatitidis*	Mostly dogs, cats, and less common in horses, ferrets, deer, wolves, African lions, bottle-nosed dolphins, and sea lions	Fever, malaise, pneumonia, verrucous skin lesions, subacute meningitis, gait abnormalities, and seizures	Droughts environment
Coccidioidomycosis	*Coccidioides immitis*, *Coccidioides posadasii*	Dogs, horses, pigs, and ruminants	Hypersensitivity reaction, fever, erythema nodosum, erythema multiform, arthralgia, pleuritic chest pain, and dry cough	Drought environment
Cryptococcosis	*Cryptococcus neoformis*	Cats, dogs, cattle, horses, sheep, goats, birds, and wild animals	Meningitis, fever, malaise, headache, neck stiffness, photophobia, cough, nausea, and vomiting	Lower environmental conditions
Sporotrichosis	*Sporothrix schenckii*	Dogs, cats, horses, cows, camels, dolphins, goats, mules, birds, pigs, rats, and armadillos	Erythematous papulonodular lesions, cough, low-grade fever, weight loss, pulmonary dysfunction, and lung abscess	Fluctuated temperature and humidity
Malassezia infection	*Malassezia spp.*	Dogs and cats	Pityriasis versicolor, seborrheic dermatitis, atopic eczema, folliculitis, and dandruff	Domestic environment
Histoplasmosis	*Histoplasma*	Cats, dogs,	Often asymptomatic,	Environment

	capsulatum var. capsulatum	rabbits, and rats	fever, productive cough, chest pain, weight loss, hepatosplenomegaly, and hematologic disturbances	disruption due to floods, storms
Q-Fever	*Coxiella burnetti*	Cattle, sheep, goats, dogs, cats, chickens, and wild animals	Fever, and skin rash	Warm weather with dry soil
Epidemic typhus	*Rickettsia prowazekii*	Dogs, lambs, goat kids, calves, donkeys, and young camels	High fever, headache, malaise, myalgia, arthralgias, rashes, CNS manifestations, petechiae, and cough	Moist, scrubby vegetation
Rocky mountain spotted fever	*Rickettsia rickettsii*	Rodents and dogs	Fever, headache, rash, malaise, myalgia, anorexia, nausea, vomiting, abdominal pain, and photophobia	Wildfires, longer droughts and tropical strom
Queensland tick typhus	*Rickettsia australis*	Bandicoots, rodents, cattle, wombats, and companion animals	Mild fever, macular, papular, or maculo-papular rash, rigors, myalgia, arthralgia, acute renal failure, headache, and lymphadenopathy	Plenty of moisture and scrub vegetation
Scrub typhus	*Orientia tsutsugamushi*	Rodents	Fever, rash, myalgia, diffuses lymphadenopathy, necrotic eschar, cough, and headache, diarrhea	Moist, scrubby vegetation
Enzootic abortion	*Chlamydia abortus*	Cattle, horses, sheep, pigs, cats, and rabbits	Abortion	Veld grazing environment
Psittacosis	*Chlamydia psittaci*	Parrots, parakeets, lories, cockatoos, cattle, sheep, and goats	Cough, dyspnea, pleuritic chest pain, epistaxis, sore throat, hemoptysis, fever, malaise, anorexia, chills,	Agriculture land

			nausea, vomiting, myalgias, arthralgias, headache, and abdominal pain	
Chlamydiosis	*Chlamydia felis, Chlamydia trachomatis*	Cats and mice	Conjunctivitis, urethritis, cervicitis, pelvic inflammatory disease, ectopic pregnancy, tubal factor infertility, epididymitis, proctitis, and reactive arthritis (sequelae)	Biotic and abiotic stress
Trypanosomiasis	*Trypanosoma brucei*	Antelopes, cattle, camels, and horses	chronic and intermittent fever, headache, pruritus, lymphadenopathy, hepatosplenomegaly, and sleep disturbance	Wild life conservation area
Leishmaniasis	*Leishmania infantum*	Cats, dogs, horses, and bats	Skin lesions, hepatosplenomegaly, and wasting	Agricultural environment
African sleeping sickness	*Trypanosoma brucei*	Antelopes, cattle, camels, and horses	High fever, headache, nausea, vomiting, and erythematous plaque formation	Humidity, wildlife distribution, change to human livestock
Chagas disease	*Trypanosoma cruzi*	Domestic pigs and cats, opossums, armadillos, raccoons, and woodrats	severe myocarditis, meningoencephalitis, swelling or redness of skin, fever, swollen lymph nodes, head or body aches, fatigue, nausea, vomiting, and diarrhea	High temperature environment
Giardiasis	*Giardia lamblia*	Dogs, cats, ruminants, and pigs	Diarrhea, abdominal cramping, bloating, flatulence, malaise, nausea, and anorexia	Aquatic environment
Toxocariasis	*Toxocara canis, Toxocara cati*	Dogs and cats	Fever, anorexia, hepatosplenomegaly, rash, pneumonitis, asthma, and visual impairment	Tropical and sub-tropical environment

Toxoplasmosis	*Toxoplasma gondii*	Pigs, sheep, goats, poultry, and rabbits	Lymphadenopathy, fever, malaise, night sweats, myalgia, sore throat, and maculopapular rash	Wild field
Balantidiasis	*Balantidium coli*	Ruminants, pigs, guinea pigs and rats	Chronic diarrhea, occasional dysentery, nausea, foul breath, colitis, abdominal pain, weight loss, and deep intestinal ulcerations	Urban agriculture

Changes in reservoir and vector as a result of manic climatic fluctuation generate new ecological niches for vectors, impacting disease dissemination in both time and space. One of six basic mechanisms is likely to be implicated if climate change influences the prevalence of zoonotic and vector-borne diseases by influencing non-human hosts, vectors, and pathogens:

a) Range shifts: Altitudinal temperature gradients are around 1,000 times steeper than latitudinal temperature gradients (Colwell et al. 2008), making altitudinal transects more useful models for evaluating the effects of climate change on plant and animal populations. Range shifts aren't always limited to latitude and height. Several host and vector species have environment preferences. The frequency with which hosts, vectors, or pathogens appear in certain habitat categories aids in determining the relative risk of disease to humans linked with these habitats (Mills and Childs 1998). Climate change's impact on plant and animal communities' species composition is poorly known. Because there is a lack of current and historical data on the distributions of many species and populations, it is difficult to establish geographic changes in the distributions of animal species as a result of climate change (Jannett et al. 2007; Thomas et al. 2006). Nonetheless, a variety of taxa, including important mammalian hosts and arthropod vectors, have seen range changes. These range shifts have tended to be poleward and upward (Hickling et al. 2006; Rosenzweig et al. 2007), with overall expansions, reductions, or no change in the total area occupied by a population or species. In Europe, Ixodes ricinus, the vector of Lyme disease and tick-borne encephalitis, has seen altitudinal and latitudinal range alterations (Gage et al. 2008). Climate-change-induced range shifts are unlikely to affect entire groups or assemblages at the same time (Root and Schneider 2002). Species migrate at varying rates and under different conditions, depending on their motility, tolerances, and physiological limitations. As a result, assemblages of species are likely to shift: Some species will experience increased population densities and competitive release in new areas, allowing them to colonise habitats from which they were previously excluded, whereas others will face increased pressures and decreased population densities as new competitors or predators move into their ranges, or they will be unable to migrate as a result of climate change, leaving them stranded on a diminishing islands with suitable habitat.

b) Land temperature:

Temperatures around the world are rising at an unprecedented rate, and this is primarily due to anthropogenic emissions of GHGs are greenhouse gases. Temperature rises of 0.2 degrees Celsius per decade (The Intergovernmental Panel on Climate Change 2007) has predicted Change, with a mean temperature rise ranging from 1.8°C to 4°C by the end of the twenty-first century. The distribution of vectors, and thus the risk of disease, is expected to increase. Arthropod vectors are the most sensitive to temperature shifts in the environment, resulting in an increase in vector-borne zoonotic diseases.Mosquitoes, ticks, and sandflies are ectothermic and live in warm environments, have cyclical processes that are temperature dependent. Temperature changes at the extremes are likely to cause transmission. (Githeko AK et al., 2000). Mosquitoes are directly affected by temperature. It causes increased activity, increased reproduction, and thus increased frequency of blood meals and faster blood digestion. (Martine V et al., 2008.) Pathogens carried by mosquitoes mature at a faster rate as well. When the temperature of the water rises, mosquito larvae develop faster, increasing the overall vector capacity. (Reiter P et al. 2008.) The abundance of the competent vector *Aedes albopictus* in Italy aided in the first outbreak of Chikungunya infection in a temperate climate. (Rezza G et al. 2007.) Ticks can survive at higher latitudes and altitudes in warmer climates. The ideal climate-driven model of a disease system would use a biological method that explicitly models the dynamics of both the vector and the pathogen. An precise evaluation of the correlations between climatic conditions and disease cycle parameters is required for successful deployment of such a model (Rogers and Randolph et al 2000). Ticks' development rate and overwinter survival rate are both accelerated by higher temperatures. The impact of global warming on leishmaniasis transmission using sandflies as vectors can also be seen. Sandflies are more active and take more blood meals at higher temperatures, which promote transmission. The development of leishmania parasites is also accelerated by rising temperatures. (Ready PD et al., 2010) As seen by the possible development of leishmaniasis in North America as a result of vector dissemination and expansion, the vectors spread into surrounding regions. (Gonzalez C et al., 2010.) Hantavirus infections are spread primarily by rodents. Warmer weather and lower snowfall decrease the protective environment given by snow, causing rodents to seek shelter in human homes, increasing hanta virus transmission, as witnessed in Scandinavia. (Evander M et al. 2009.)

c) Rain fall patterns: Precipitation has an indirect effect on vectors. More mosquito breeding grounds are created as a result of increased precipitation. After heavy rains, the foliage becomes dense, providing refuge and resting sites for vectors. (Githeko AK et al. 2000.) Rift Valley fever outbreaks have been linked to periods of high rainfall. *Aedes spp*. are the most common mosquito vectors, and they transmit virus by transovarial transfer. They are floodwater breeders, and their eggs are laid during periods of heavy rain. Even during droughts, these eggs remain viable and hatch when the conditions are favorable again. If vertebrate reservoirs are present, heavy rainfall and larval development boost vector capacity, and epidemics ensue. *Culex* and *Anopheles spp*. can then act as secondary vectors in the outbreak's spread. Inter-epizootic intervals can range anywhere between 5 and 35 years. (Martine V et al. 2008.) East Africa is expected to see heavy rains, resulting in further Rift valley fever outbreaks. Climate change will have less of an impact on Rift valley fever in West Africa, and disease onset may be attributed to a reduction in herd immunity. (Chevalier V, et al 2004.) Increased rainfall generally results in more crops and food, which may contribute to a rise in rodent populations and rodent-borne zoonosis. Flooding raises the possibility of zoonosis spread by water. The cryptosporidium outbreak in Milwaukee, Wisconsin, may have been exacerbated by heavy rainfall upstream of water treatment plants (Mac Kenzie WR et al.1994). Chikungunya and West Nile virus epidemics have been linked to severe rains and even droughts. Droughts reduce mosquito predators, resulting in an increase in vector abundance after the drought ends, and the concentration of reservoir hosts around watering holes makes disease transmission easier (Wang G et al.,2010.).

d) Soil condition:

Tick development is influenced by soil moisture, with mortality linked to dry weather and soil evaporation. Hyalomma ticks, which transmit Crimean-Congo haemorrhagic disease, are, on the other hand, better adapted to surviving in dry conditions than other ticks.(Randolph SE et.,al 2008.) *Bacillus anthracis* spore distribution is determined by soil composition. For spore survival, humus-rich soils with high calcium and alkaline (pH>6.1) conditions are ideal. (Hugh-Jones et.,al 2009.) The presence of disease also necessitates the presence of susceptible vertebrate hosts as well as human variables.

e) Ocean temperature, sea level and acidity:

Sea level rise is also a worry as a result of rising sea temperatures and melting polar ice caps and glaciers. Coastal flooding and the risk of water-borne zoonoses will be exacerbated by rising sea levels. Carbon uptake by the oceans causes a drop in pH, putting marine ecosystems at risk. (Intergovernmental Panel on Climate Change 2007.)

f) Pathogen load:

The growth of infections and disease burdens in arthropod vectors can be influenced significantly by temperature. (Gage et al. 2008; Sutherst 2004). Malaria parasites can only develop in mosquito vectors when temperatures are in a particular range. (Patz and Olson 2006). Similarly, the etiological agent of plague, *Y. pestis*, can only form and produce biofilm at temperatures below 28°C. Biofilm aids *Y. pestis* transmission by prompting infected fleas to increase their feeding attempts and vomit *Y. pestis* back into their hosts during eating. (Gage and Kosoy 2005; Jarrett et al. 2004). Temperature has an effect on the survival of *Y. pestis*, with many fleas clearing the infection when temperatures rise over 28°C. (Gage and Kosoy 2005; Hinnebusch et al. 1998). Recurrence of viral replication has been shown in human viral infections, and it is expected to occur in zoonotic host populations as well. (Halford et al. 1996; Mehta et al. 2004). Sin Nombre virus replication and shedding are occasionally identified in infected North American deer mice (Botten et al. 2003; Kuenzi et al. 2005). Although the mechanisms for viral replication reactivation remain unknown, stress-related immunosuppression has been proposed (Botten et al. 2002; Kuenzi et al. 2005). In hosts and vectors, the link between stress and pathogen transmission, replication, persistence, and shedding is poorly understood. A better knowledge of this link would allow for more precise forecasts of the consequences of climate change on the risk of vector born zoonotic disease infection in humans.

g) Climate change with anthropogenic factor:

Changes in reservoir and vector due to manic climatic variance provide novel ecological niches for vectors, affecting disease spread temporally and spatially. If climate change affects the prevalence of zoonotic and vector-borne diseases by affecting non-human hosts, vectors, and pathogens, one of four basic processes is likely to be involved: Interaction effects between various components of climate change (e.g., temperature and precipitation) must be examined, just as interactions between climate change and other anthropogenic and natural factors must be studied to accurately forecast the influence of climate on vector born zoonotic diseases (Benedict et al. 2007). Human activities encourage host or vector range shifts by transferring hosts or vectors to new geographic areas, including new continents, as was the case in the United States with plague vectors and West Nile virus hosts. As a result of human migrations in reaction to climate change, some vector born zoonotic disease may become more vulnerable. Drought-related clustering of individuals near water supplies where sand fly vectors were concentrated, for example, was linked to an increase in leishmaniasis. Although *Aedes aegypti*, the major vector of Dengue virus, is anticipated to attain northward range expansions in the United States as winter temperatures become warmer, this may not result in dengue epidemics in the United States (Reiter et al. 2003). Many species' responses to climate change will be influenced by anthropogenic ecological disturbance. As previously stated, as the temperature warms, many wildlife species and vectors' distributional ranges are expected to migrate pole ward and toward higher altitudes, potentially bringing hosts, vectors, and diseases now restricted to the tropics into the range of temperate population centers. During the transition from the last ice age to the current interglacial period, similar species movements occurred. However, not all species and populations will be able to relocate (Wright et al. 1993). Nonviolent creatures living on mountain tops or other habitat islands will be stranded. Similarly, localized foci of some vector borne diseases that rely on the continuing presence of specific hosts and vectors may vanish if both are restricted in their travel. Changing climate factors are connected with host and vector "responses," but this does not prove causation and effect. When movement of either is restricted, potential confounding variables like as behavioral changes, interspecific interactions, intrinsic population phenomena, anthropogenic causes, and evolutionary changes should be examined. (National Research Council 2001).

h) Other extreme weather events: The El Nio-Southern Oscillation (ENSO) cycle is a global climatic phenomenon that alternates between hot and warm periods, contributing to more extreme weather events. (Kovats RS et al.2003.) Heavy rains and Rift Valley disease outbreaks have been linked to the ENSO in East Africa. (Gould EA et al. 2009.) In the Andes, fascioliasis is likely to be influenced by ENSO and global warming. (Mas-Coma S et al. 2009.)The impact of global warming on the ENSO, on the other hand, is still uncertain. (McPhaden MJ et al. 2006.)

Figure1. Potential impact of global warming:

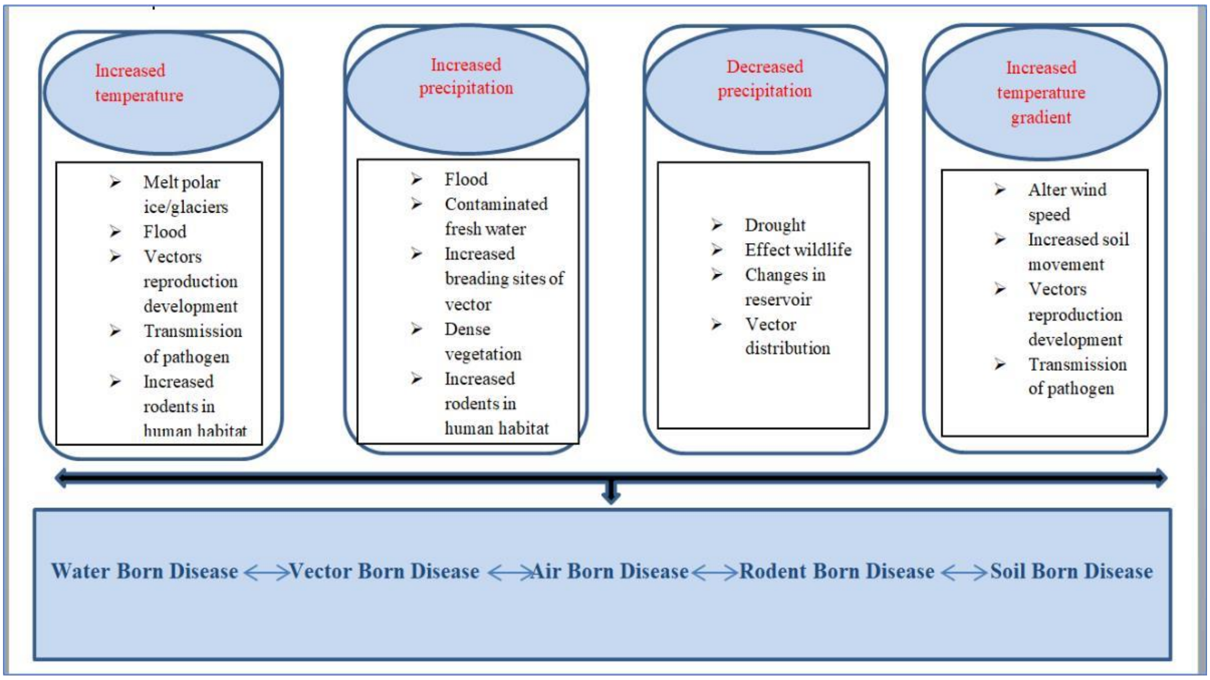

Table 2: Some of the predicted climate change effects on these various forms of zoonosis.

Disease Mosquito-borne	Some predicted changes	Reference
West Nile virus infection	A higher probability of infection in 2025 and further expansion in 2050	Semenza et al., 2016
Zoonoses transmitted by Aedes aegypti and Aedes albopictus (e.g., Dengue, Chikungunya, WNV, Zika, Yellow fever)	Northward range expansion of suitable niches for Aedes aegypti and Aedes albopictus by 2100	Khan et al., 2020
	Increase climatically favorable niches of Aedes albopictus throughout the 21st century	Fischer et al., 2011
	Decrease climatic suitability of Aedes albopictus during the 21st century	Fischer et al., 2011
Dengue fever	Increase the proportion of the global human population at risk of dengue transmission in 2085 50–60% of the estimated global population in 2085 will be at risk of dengue transmission compared to 35% of the population if climate change did not ensue	Global Hales et al., 2002
	Dengue fever Increase the intensity and duration of dengue transmission during the 21st century and increase of dengue epidemic potential by 2100	Liu-Helmersson et al., 2016
Malaria	A rise in the number of days per year fit for malaria transmission by 2050 and 2100	Casimiro et al., 2006
	Malaria 8–14% increased risk of local malaria transmission by 2050	Kuhn et al., 2003
	Malaria Net increase in climate suitability, population at risk, and annual person-months at risk from the 2050s to the 2080s	Caminade et al., 2014
	Malaria Become climatically suitable for *Plasmodium vivax* malaria transmission for 2 months per year by 2030	Lindsay et al., 2010

	Become climatically suitable for Plasmodium vivax malaria transmission for 4 months per year by 2030	Lindsay et al., 2010 ,Thomas, 2001
Sand fly-borne		
Leishmaniasis	Northward expansion of areas with favorable climatic conditions (in Central and Northern Europe) for most vector species in 2061–2080	Koch et al., 2017
	Leishmaniasis A 15% growth in the annual number of hospital admissions with the highest relative growth in the south regions by the end of the 21st century	Mendes et al., 2016
Tick-borne		
Lyme disease	Expansion of vector Ixodes scapularis north into Canada with an upsurge of 213% suitable habitat by the 2080s Shift the vector from the Southern United States into the Central	Brownstein et al., 2005
	Lyme disease Begin disease season 0.4–0.5 weeks earlier in 2025–2040 and Lyme disease Northward shift of the habitats of the white-footed mouse (a reservoir host) by 3◦ latitude by 2050	Roy-Dufresne et al., 2013
Tick-borne encephalitis	Move to higher altitudes and latitudes along with the 3.8% overall habitat expansion for Ixodes ricinus by 2040–2060	Boeckmann and Joyner et al., 2014
Blackfly-borne		
Onchocerciasis	13–41% decrease of forest fly and savannah fly numbers by 2040	Cheke et al., 2015
Triatomine-borne		
Chagas disease Distributional shifts of vectors:	Triatoma gerstaeckeri (north) and Triatoma sanguisuga (north and south) from its current range in 2050	Garza et al., 2014
Tsetse-borne		
African trypanosomiasis	Decrease habitable range for vectors by up to 23.1% , 12.9% , and 22.8% of current habitable area by 2050	Nnko et al., 2021
Mite-borne		

Scrub typhus	Increase maximum disease incidence rate by 8%, areas of the high potential of incidence rate by 9%, and disease occurrence duration by 2 months	Kim et al., 2020
Waterborne		
Cryptosporidiosis and Giardiasis	Increase the combined incidence of cryptosporidiosis and giardiasis in the wet season by 5.9% in the 2020s, 8.4% in the 2040s, 12.1% in the 2060s, and 16.3% in the 2080s, compared to 1970–2000 period	Chhetri et al., 2019
Campylobacteriosis	Increase the annual rates of reported cases with children most at risk and the highest expects in summer (e.g., an 8.4% increase in 2040 and a 19.5% increase in 2090 in children)	McBride et al., 2014
Schistosomiasis	Increase infection risk by up to 20% over the next 20–50 years East Africa (Higher in Rwanda, Burundi	Creesh et al., 2015
	Spread the disease farther north no endemic areas of China by 2050	Zhou et al., 2008
Foodborne		
Campylobacteriosis	Doubling of campylobacter cases by the end of 2080s with an additional 6000 cases per year caused only by climate changes	Kuhn et al., 2020
Salmonellosis	Increase of the mean annual number of temperature-related cases by ~20,000 by the 2020s in addition to increases by population changes 50% more temperature-related cases than based on population change alone by 2071–2100	Watkiss and Hunt et al., 2012

Rodent-borne		
Plague	1 ◦C degree increase in spring temperatures may result in a >50% increase in Y. pestis prevalence in its reservoir host	Stenseth et al., 2006
	Plague Increase risk along the northern coast and Sierras while lower the risk in the southern regions by 2050	Holt et al., 2009
	Plague Reduce periods of high plague activity in the Western United States and move to higher latitude and altitudes in coming decades	Ari et al., 2008
	Plague Geographical shift of the disease with possible northward movement by 2055.	Nakazawa et al., 2007
Hantavirus infection (Nephropathia epidemica)	Increase risk of infection	Tersago et al., 2009
	Hantavirus pulmonary syndrome Increase incidence in coming decades	Hjelle and Glass, 2000
Airborne		
Highly pathogenic avian influenza	Increase the risk of outbreaks in January and February months by the end of 2030	Tian et al., 2015
	Increase the risk of outbreaks from April to June by the end of 2030 Northern Africa and Southern and Western Asia	Tian et al., 2015
	Highly pathogenic avian influenza Higher risk of outbreaks in northern regions Global	Herrick et al., 2013

Control and measures

Raise awareness of the problem and take steps to prevent and manage it at the source-

Veterinarians' principal responsibility has shifted away from controlling major conventional animal diseases and toward improving management, enhancing laws and regulations, and preventing and controlling animal diseases in order to promote animal and human health and assure food safety. Currently, there are two common misunderstandings. The first is the misconception that animal disease prevention and management is solely the duty of the agricultural department. The agriculture department is largely concerned with animal husbandry safety. However, zoonotic disease prevention has implications for public health, human health, and the global economy.

Strengthen management and improve mechanisms-

The prevention and control of zoonosis is a methodical endeavour that necessitates government-wide coordination and collaboration from a variety of sectors, specialties, and systems. Animal health and animal-derived food safety regulation tasks are dispersed throughout various departments, including the Ministry of Health. To develop an effective general health epidemic prevention system that is integrated with human medicine and veterinary medicine, these institutions must be centrally administered. It is also necessary to improve the training of skilled workers in relevant sectors.

Strengthen regulations and make a legal commitment to preventing and controlling zoonosis-

It is proposed that the appropriate rules and regulations be further studied, developed, supplemented, and improved in order to prevent and control zoonosis at their source. The International Animal Health Code and general international standards, for example, can help strengthen rules and regulations. The Ministry of Health and Agriculture's epidemic reporting mechanism should be enhanced. From a legal standpoint, the prevention and control of zoonosis should be ensured.

Create a baseline of information about the geographic and habitat distribution of identified zoonotic and vector-borne pathogens, as well as their hosts and vectors-

Accurate data on the present distribution of these agents, as well as their hosts and vectors, helps to determine current potential disease endemic areas and estimate relative risk across habitat types. These data are also required for establishing geographical changes in disease distribution as a result of climate change. Because pathogen distributions do not necessarily correspond to host and vector distributions (Mills and Childs 1998), research must include sampling hosts and vectors for pathogen presence in addition to recording host and vector presence or absence. Finally, because different infections are linked to genetically varied populations of hosts or vectors,(Mills and Childs 1998)Keep track of outbreaks of wildlife diseases in people, as well as their geographic spread, severity, and frequency. This is a different form of longitudinal monitoring programme, with a broader spectrum of diseases and hosts and more limited data collection. These data can be used to follow geographic and temporal patterns in the incidence of vector born diseases, identify vulnerable populations, and evaluate forecasting models. The Global Early Warning System for Major Animal Diseases, including Zoonosis, is one of several existing databases that provide valuable forms. Integration of such formats with the WHO networks' monitoring, data gathering, and data dissemination capabilities would result in a strong tool that would make geographic and incidence data immediately available to the public health professional, researchers, and modellers.

E**nhance relevant research in the interests of scientific prevention and control-**

To promote the implementation of advanced and practical scientific and technological achievements, top-level zoonosis research should be done at the national level. Studies of pathogen ecology and warning models should be done as part of fundamental research. Basic scientific challenges such as the source of high virus variability, the processes of cross-species transmission and multiple medication resistance, virus-host interaction, and pathogen traceability should all be investigated. The development of quick and high-throughput diagnostic reagents should be the focus of diagnostic technology research.

Identification and characterisation of pathogens

Although it is evident that understanding the diversity of tropical diseases is important, it has received little attention. Although conducting a comprehensive survey of potential pathogens in nature is a daunting task, a good place to start would be to identify the most likely potential hosts and vectors (e.g., bats and rodents, ticks and mosquitoes) and catalogue those pathogens with a history of causing disease in humans (e.g., viruses, rickettsia, and some bacteria).

Conduct laboratory and field experiments to see how climate change affects hosts and vectors, as well as their ability to retain and transmit infections.

Laboratory and manipulative field experiments (Post et al. 2008) can be used to evaluate mechanisms of climate change effects on hosts, vectors, and diseases, as well as to develop hypotheses for field testing. Laboratory studies will be the best way to examine the impact of precise changes in temperature, humidity, or physiological stress on host, vector, or pathogen populations because specific environmental parameters cannot be isolated and controlled in the field. Increased rates of transmission and viral recrudescence, as well as increases in pathogen burden in hanta virus hosts seen in field experiments, have been linked to stress-related immunosuppression. (Botten et al. 2003; Kuenzi et al. 2005)

Develop prediction models of changes in zoonotic disease risk and the anticipated distribution and abundance of important hosts and vectors using data from laboratory and field investigations, epidemiological studies, and remote sensing. Such predictive models have been shown to be useful. In the south western United States, long-term direct monitoring of host population density and prevalence of hanta virus infection in North American deer mice offered early warning of an increased risk of HPS (Yates et al. 2002). Rainfall and temperature data were utilised in models to identify high-risk locations for plague and HPS in the same geographic area (Eisen et al. 2007; Enscore et al. 2002;)

Conclusion:

Animals are responsible for the bulk of human infectious diseases. Not only do these infections cause sickness in animals, but they also pose a serious threat to human health. Because of growing contact between humans and wild animals, altered eating habits, climate change, and ecologically unfriendly human operations all play a role in the origin and re-emergence of many zoonotic illnesses. The present COVID-19 epidemic demonstrates the terrible impact of zoonosis on the human population. Because animals, humans, and the environment are so intertwined, research concentrating on a single health strategy should be prioritised in order to discover important intervention steps in pathogen transmission. The goals of the actions outlined above are to form the multidisciplinary relationships required to conduct and interpret ecosystem-based studies of various diseases recorded as a result of climate change; identify the hosts, vectors, and pathogens with the greatest potential to affect human populations under climate change scenarios; and conduct studies that will increase our understanding of the potential mechanisms by which climate change occurs. The importance of these studies extends beyond the context of climate change.

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