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Climate change its impact on vector borne diseases

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ABSTRACT

Over the ages mankind have depleted natural resources and degraded their local environments. Populations have also modified their local climates by cutting down trees or building cities. It is now apparent that human activities are perturbing the climate system at the global scale. Climate change is likely to have wide-ranging and potentially serious health consequences. Some health impacts will result from direct-acting effects like heat wave-related deaths, weather disasters, changes in patterns of infectious disease, and in food production[1]. To assess the potential impacts of climate change on health, it is necessary to consider both the sensitivity and vulnerability of populations for specific health outcomes to changes in temperature, rainfall, humidity, storminess, and so on. All human societies, from primitive to advanced, have had to adapt to the challenges posed by climate. Deeply embedded in this fundamental relationship between climate and human life are the many ways in which climate has always played a role in human health. Climate defines health concerns such as the direct effects of excess heat or cold, the lack of sufficient water during drought seasons or perennially in certain parts of the world, and the risk of various water-borne or vector-borne diseases based on conditions favorable to their spread[2]. Climate change may alter the distribution of important vector species, and this may increase the risk of introducing diseases into new areas. Temperature can also influence the reproduction and survival of the infective agent within the vector, thereby further influencing disease transmission in areas where the vector is already present[3]. However, the ecology and transmission dynamics of vector- borne diseases are complex. The climate factors that could critically influence transmission need to be identified before the potential impact of a changing climate can be assessed. Climate change impact models suggest that the largest changes in the potential for disease transmission will occur at the fringes in terms of both latitude and altitude.

KEYWORDS

Cannabis;
Marijuana;
Toxic;
Hallucinogen;
Hemp.

INTRODUCTION

Climate change is the ever-increasing human-induced progression of changes in our global environment, including rising sea levels, global warming, loss of biodiversity and increases in the incidence of natural disasters. These changes result from human activities such as burning of fossil fuels, deforestation,

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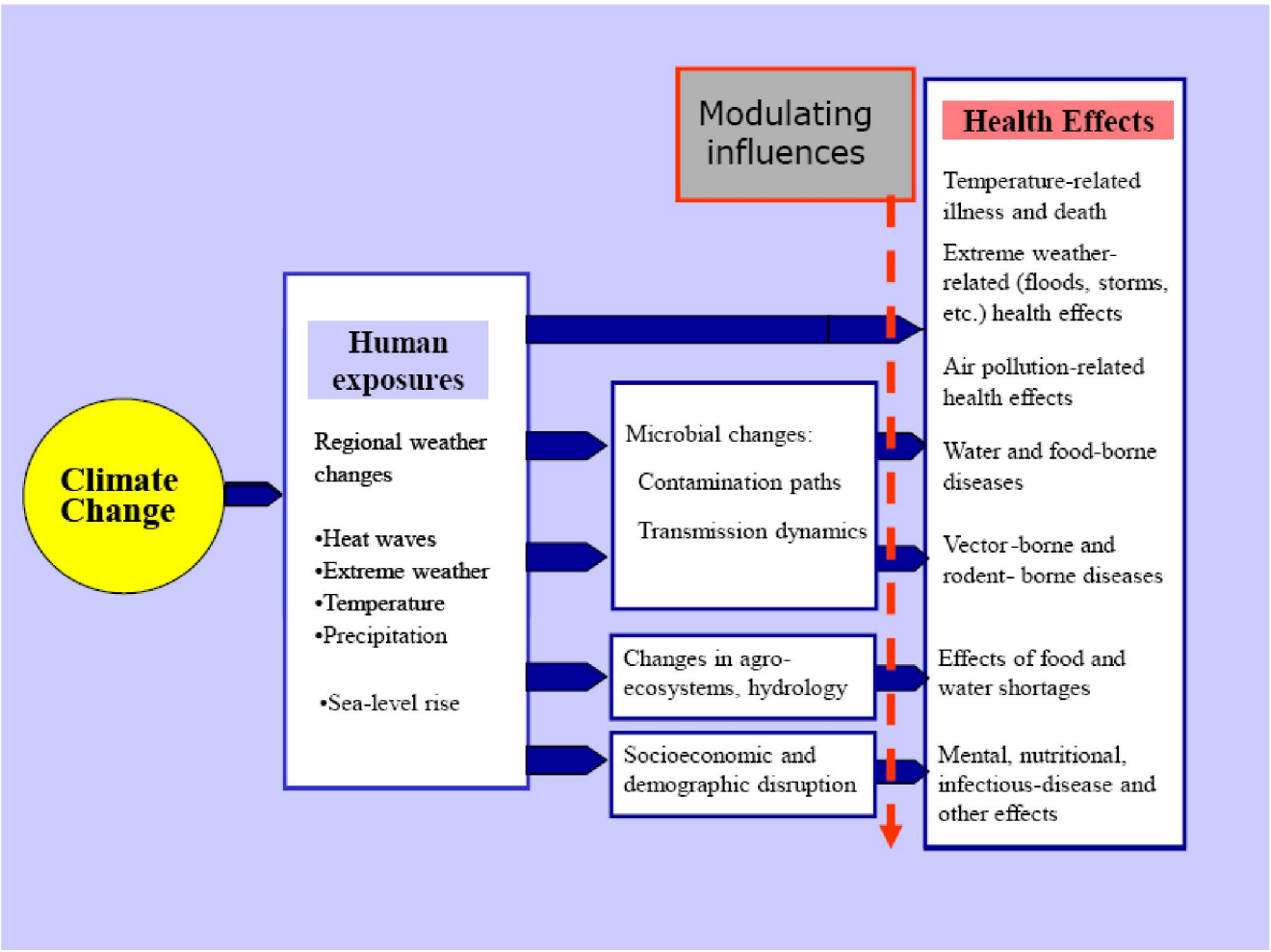
pollution, and urbanization[4]. We have already experienced some of the devastating effects of climate change including floods, heat waves, numerous landslides, hurricanes and the gradual disappearance of Pacific islands due to rising sea levels[5]. Climate change will inevitably affect the global patterns of vector borne diseases, if greenhouse gas emissions are not reduced. As well as increasing the burden of infectious disease it can possibly lead to epidemics in near immune populations.

Human health and the environment are intimately connected, and a disruption in the stability of climatic variables and parameters are expected to have a broad range of health impacts.

Climate plays an important role in the seasonal pattern or temporal distribution of diseases that are carried and transmitted through vectors because the vector animals often thrive in particular climate conditions[6]. For example, warm and wet environments are excellent places for mosquitoes to breed. If those breeding mosquitoes happen to be a species that can transmit disease and if there is an infected population in the region, then the disease is more likely to spread in that area. Because they are sensitive to climate, the distribution and number of vectors is also affected by climate Change.

HOW IS CLIMATE CHANGE OCCURRING?

Climate change is occurring as a result of an imbalance between incoming and outgoing radiation in the atmosphere. As solar radiation enters the atmosphere, some of it is absorbed by the earth's surface and reemitted as infrared radiation, which is then absorbed by greenhouse gases primarily carbon dioxide, methane, and nitrous oxide which result from the combustion of fossil fuels and which cannot be effectively removed from the atmosphere because of deforestation. This process generates heat. As the concentrations of greenhouse gases in the atmosphere have reached record levels, global temperatures have risen at a faster rate than at any time since records began to be kept in



the 1850s, and temperatures are expected to increase by another 1.8 to 5.8°C by the end of this century[8]. The hydrologic cycle will be altered, since warmer air can retain more moisture than cooler air. Some geographic areas will have more rainfall, and some more drought, and severe weather events including heat waves and storms are expected to become more common.

Impact of climate change on human health

- Climate change is expected to have a substantial effect on the burden of infectious diseases that are transmitted by insect vectors and through contaminated water because of rising temperatures and changing rainfall patterns. Insect vectors tend to be more active at higher temperatures. For example, tropical mosquitoes such as anopheles species, which transmit malaria, require temperatures above 16°C to complete their life cycles. Some vector borne diseases such as malaria are also thought of as water-vectored diseases, since mosquitoes typically thrive in aquatic habitats, where they lay their eggs in water-filled containers. Thus, epidemics of malaria tend to occur during rainy seasons in the tropics. In contrast, epidemics of the mosquito-borne West Nile virus infection can occur during times of drought. This happens because mosquitoes and birds (the primary hosts of the virus) are brought into proximity at scarce water sources, enhancing the transmission of the virus. In addition, the populations of the natural predators of mosquitoes are greatly reduced during times of drought, as wetlands dry up.
- Waterborne infectious diseases are also strongly affected by climate. During times of drought, water scarcity results in poor sanitation and much of the population can be exposed to potentially contaminated water. Like drought, excess rainfall and flooding can also contribute to epidemics of waterborne infectious diseases, in this case due to poor sanitation resulting from runoff from overwhelmed sewage lines or the contamination of water by livestock. An example is the 1993 epidemic of diarrheal disease due to cryptosporidium in Milwaukee after heavy spring rains or the typical seasonality of bacterial and protozoal diarrheal illnesses.

There are some widely cited examples suggesting that climate change has already resulted in the introduction of certain infectious diseases into previously unaffected geographic areas. One such example is the spread of malaria into highland regions of East Africa, where this disease previously did not exist. This spread occurred in the setting of weather that was much warmer and wetter than usual; it resulted in high rates of illness and death, because the disease was introduced into a largely non immune population.

According to World Health Organization (WHO) it is estimated that effects on human health as of the year 2000 in developing regions of the world have been disproportionately affected by climate change relative to developed regions. This imbalance stands in stark contrast to the imbalance in greenhouse-gas emissions, which are almost entirely attributable to developed countries, such as the United States, and countries with rapidly developing economies, such as China and India.

The WHO report also includes estimates of the future global burden of disease that will result from climate change It is predicted that by 2030 there will be 10% more diarrheal disease than there would have been with no climate change and that it will primarily affect the health of young children; indeed, the impact on children might well be amplified by the effects of such diseases on malnutrition, development, and cognition. If global temperatures increase by 2 to 3°C, as expected, it is estimated that the population at risk for malaria will increase by 3 to 5%, which means that millions of additional people would probably become infected with malaria each year.

Impact of climate change on VBDs

Vector-borne diseases are transmitted typically by the bite of an infected arthropod. The arthropod could be something rather familiar like a mosquito, tick, or black fly. Or it might be a less familiar species such as an African Tsetse fly or copepod. These arthropods that carry and transmit diseases are known as vectors. Other non-arthropod vectors can include rodents such as rats, certain bats, a species of aquatic snail, and several species of wild birds. Different vectors carry different diseases such as malaria, dengue, encephalitis, African sleeping sickness, and yellow fever.

The role of climatic factors has been studied extensively in the epidemiology of malaria due to its

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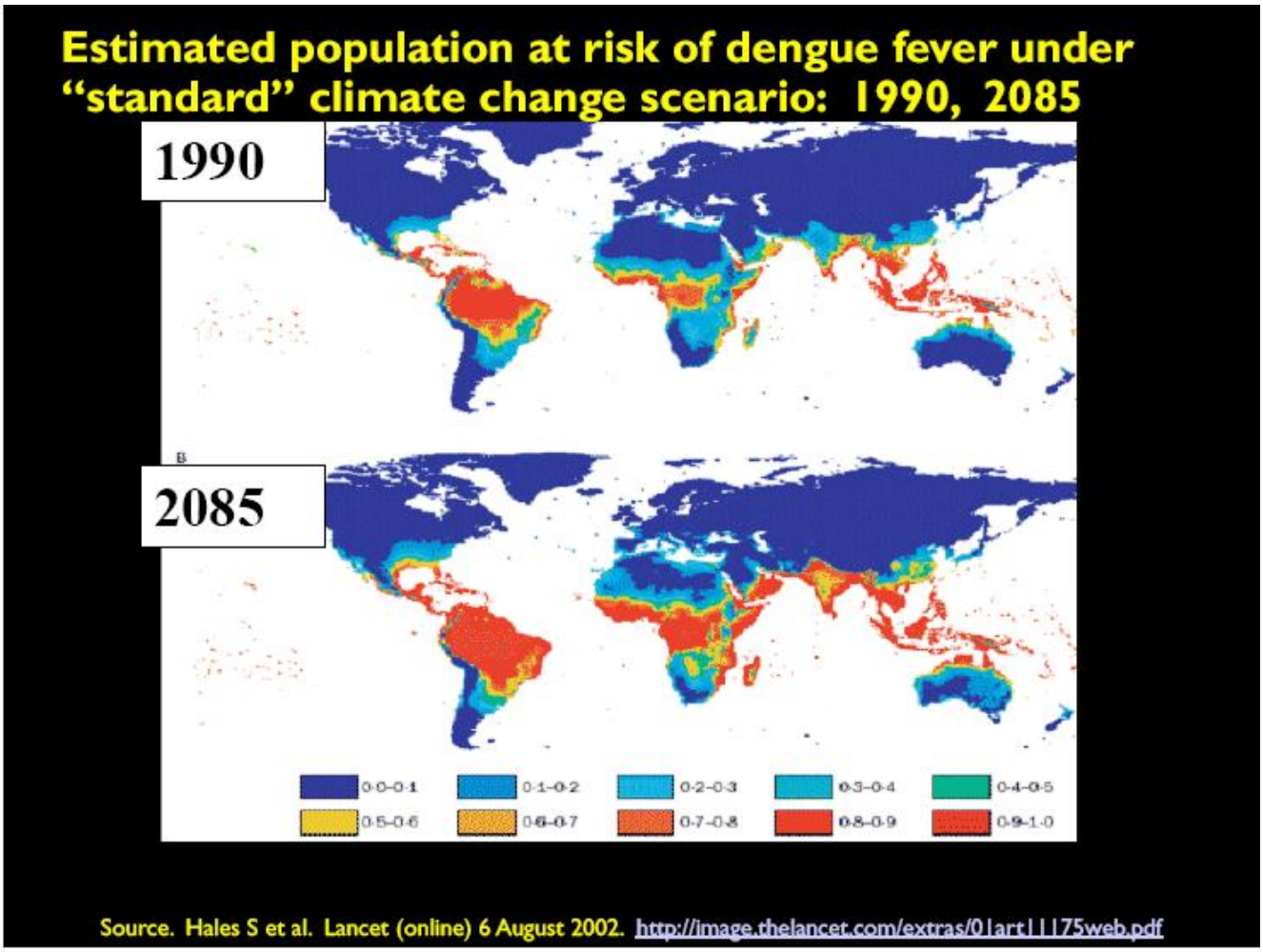
Environmental changes	Example diseases	Pathway of effect
Dams, canals, irrigation	Schistosomiasis	▲ Snail host habitat, human contact
	Malaria	▲ Breeding sites for mosquitoes
	Helminthiasies	▲ Larval contact due to moist soil
	River blindness	▼ Blackfly breeding, ▼ disease
Agricultural intensification	Malaria	Crop insecticides and ▲ vector resistance
	Venezuelan haemorraghic fever	▲ rodent abundance, contact
Urbanization, urban crowding	Cholera	▼ sanitation, hygiene; ▲ water contamination
	Dengue	Water-collecting trash, ▲ *Aedes aegypti* mosquito breeding sites
	Cutaneous leishmaniasis	▲ proximity, sandfly vectors
Deforestation and new habitation	Malaria	▲ Breeding sites and vectors, immigration of susceptible people
	Oropouche	▲ contact, breeding of vectors
	Visceral leishmaniasis	▲ contact with sandfly vectors
Reforestation	Lyme disease	▲ tick hosts, outdoor exposure
Ocean warming	Red tide	▲ Toxic algal blooms
Elevated precipitation	Rift valley fever	▲ Pools for mosquito breeding
	Hantavirus pulmonary syndrome	▲ Rodent food, habitat, abundance

▲ increase ▼ reduction

global public health importance. The minimum temperature required for development of P. vivax parasite in anopheline mosquitoes is 14.5–16.5°C while for P. falciparum it is 16.5–18°C. At 16°C it will take 55 days for completion of sporogony of P. vivax while at 28°C, the process can be completed in seven days and at 18°C it will take 29 days. The duration of sporogony in Anopheles mosquitoes decreases with increase in temperature from 20 to 25°C. From 32 to 39°C temperature, there is high mortality in mosquitoes and at 40°C, their daily survival becomes zero. At increased temperatures, the rate of digestion of blood meal increases which in turn accelerates the ovarian development, egg laying, reduction in duration of the gonotrophic cycle and more frequency of feeding on hosts, thus, increasing the probability of transmission. Thus, climatic conditions play important role in the distribution, degree of endemicity and epidemicity of diseases in an area. Some areas, which have most favourable conditions of temperature and rainfall, experience transmission of disease throughout the year, while in areas experiencing colder months, transmission is seasonal and does not take place throughout the year.

Dengue fever

Dengue fever, which comes in four strains, is also spread by mosquitoes. However, unlike malaria, dengue fever is spread by mosquitoes that thrive in urban areas (Nelson, 2009). An infection by one of four strains will create immunity to only that strain, and will unfortunately



increase the chances of infection by another strain (Ibid). The most deadly strain causes Dengue Hemorrhagic Fever (DHF), and although it is rarely fatal if diagnosed early, it severely damages the circulatory system and internal organs (Nelson, 2009).

Dengue fever originated in Africa and is transmitted by more than 130 species of mosquitoes in tropical and subtropical regions (Tseng et al., 2008). Cases have been recorded in every season and are widely distributed in many countries in South and Southeast Asia, Central America, and the Western Pacific (Tseng et al., 2008). The number of months with average temperatures higher than 18C and the degree of urbanization were found to correlate with increasing risk of dengue fever (Wu et al, 2009). Temperature affects insect survival time and habitats as well as maturation and infective periods, and higher temperatures shorten the incubation period and viral development rate (Ibid). *Ae. Aegypti*, the mosquito responsible for dengue, used to breed in small natural water bodies like tree holes or rock pools (Phillips, 2008). Now, it also breeds in water that has accumulated in trash (bottles, plastics, tires) (Ibid). Furthermore, *Ae. Aegypti* prefer to live inside buildings rather than outside, and prefer to feed on humans instead of animals (Ibid). Therefore, these mosquitoes are considered to have adapted to the urban environment (Ibid).

Examples of other vector-borne diseases

- Cholera: its transmission occurs through the process of ingesting contaminated water or food. The last outbreak was reported in Iraq (August 2007)
- Chikungunya: Discovered in India in 1963, the virus caused the death of 237 people in la Reunion island where 1/3 of the island's population were infected
- Urban yellow fever: Found only in part of Africa and South America.

Work plan on climate change

In 2009, the world health assembly endorsed

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a new who work plan on climate change and health. This includes

- Advocacy: to raise awareness that climate change is a fundamental threat to human health.
- Partnerships: to coordinate with partner agencies within the UN system, and ensure that health is properly represented in the climate change agenda.
- Science and evidence: to coordinate reviews of the scientific evidence on the links between climate change and health, and develop a global research agenda.
- Health system strengthening: to assist countries to assess their health vulnerabilities and build capacity to reduce health vulnerability to climate change.

CONCLUSION

Climate change is our responsibility as members of the health care community so we must focus our efforts on mitigating the effects of climate change, including its potential impact on the global burden of infectious diseases. Additional research is needed on the ecology and epidemiology of infectious diseases that will probably be affected by climate change. The best means for accomplishing this aim would be to incorporate research on the effect of climate change into existing infrastructures, such as the ambitious malaria-eradication program recently launched by the Bill and Melinda Gates Foundation. One of the goals of research on climate change should be the development of early warning systems to help populations prepare for impending epidemics. As we move forward, it is imperative that organizations such as the WHO continue their missions of treating and preventing otherwise neglected infectious diseases, as part of a multifaceted approach to improving global health. Effective treatments and vaccines will go a long way in preventing human suffering that could otherwise occur as a result of climate change.

"Health is Wealth" so let us take measures to protect our health from the impacts of Climate change.

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