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A REVIEW ON GLOBAL ENVIRONMENTAL CHANGE AND INFECTIOUS DISEASES

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Abstract
Global environmental change has the potential to influence the earth systems of biology; however, its effects on human health are not well defined. Developing countries having limited resources are expected to face a host of health effects due to environmental changes, including vector-borne, water-borne diseases and contact diseases such as malaria, cholera, and dengue and corona virus. Awareness campaign drives to discuss preventive health care strategies as the recent lockdown done by the Govt. of India to combat the menace of pandemic disease spread through corona virus. With drug and insecticide resistance on the rise, significant funding and research efforts must to be maintained to continue the battle against existing and emerging diseases. This article reviews common and prevalent infectious diseases in India, their links to environmental change, The aim of the present work is to suggest ways to overcome newly spread infectious diseases by controlling environmental changes at human level by devising new medicines and diagnostic kits .

Keywords: Environmental Change, Human Health, Vector-Borne Disease, Water-Borne Disease and Pandemic Disease.

Introduction

Environmental change is one of the greatest threats to human health in the 21st century. Environment directly impacts health through climatic extremes, air quality, and multifaceted influences on food production and water resources. It also affects infectious diseases, which have played a significant role in impacting the rise and fall of civilizations.

Global environmental change brings major changes to the epidemiology of infectious diseases through changes in microbial and vector geographic range. Human defenses against microbial diseases rely mainly on immunity developed and a thermal restriction zone for most of the microbes. Given that microbes can adapt to higher temperatures, there is concern that global warming will select for microbes with higher heat tolerance that can defeat our endothermy defenses and bring new infectious disease.

The purpose of the study was to link environmental changes to spurt of infectious diseases and to analyze the factors involved in the linkage.Notable contributions in this field have been made by Altizer *et al* 2013, Casadevall 2020, Bajracharya 2006, Baylis & Morse 2012, Bhattacharya et al 2006, Caminade *et al* 2017, , Epstein,.2005, Gill *et* al 2009, Hess 2009,Jaden *et al* 2018. Keesing *et al* 2010, Majra and Gur 2009, Mavalankar *et al* 2007, Michael 2012,Reiter, 2001, Rotz *et al* 2002, Tjaden *et al* 2017, Tong, *et al* 2018.

Global environmental change and health in India

The effect of environmental change on human health in India is a broad topic, covering areas from extreme weather events to shifts in vector-borne diseases. In South Asia, scientists predict an increased frequency of floods due to greater intensity of rainfall events and to glacier lake outburst floods (GLOFs) in mountainous regions.

Floods create conducive environments for numerous health consequences resulting from disease transmission. Faecal-oral transmission of diseases is of particular concern in regions such as South Asia because of limited access to clean water and sanitation. In developed countries, flood control efforts, sanitation infrastructure, and surveillance activities to detect and control outbreaks minimize disease risks caused from flooding. Flooding can also contribute to increased vector-and rodent-borne and other infectious diseases. Rising sea-surface temperatures are expected to increase tropical cyclone intensity and the height of storm surge. Public health effects of cyclones include diseases and illnesses associated with the loss of clean water, hygiene, and sanitation, loss of shelter and belongings, population displacement, toxic exposures, and hunger and malnutrition risk due to food scarcity

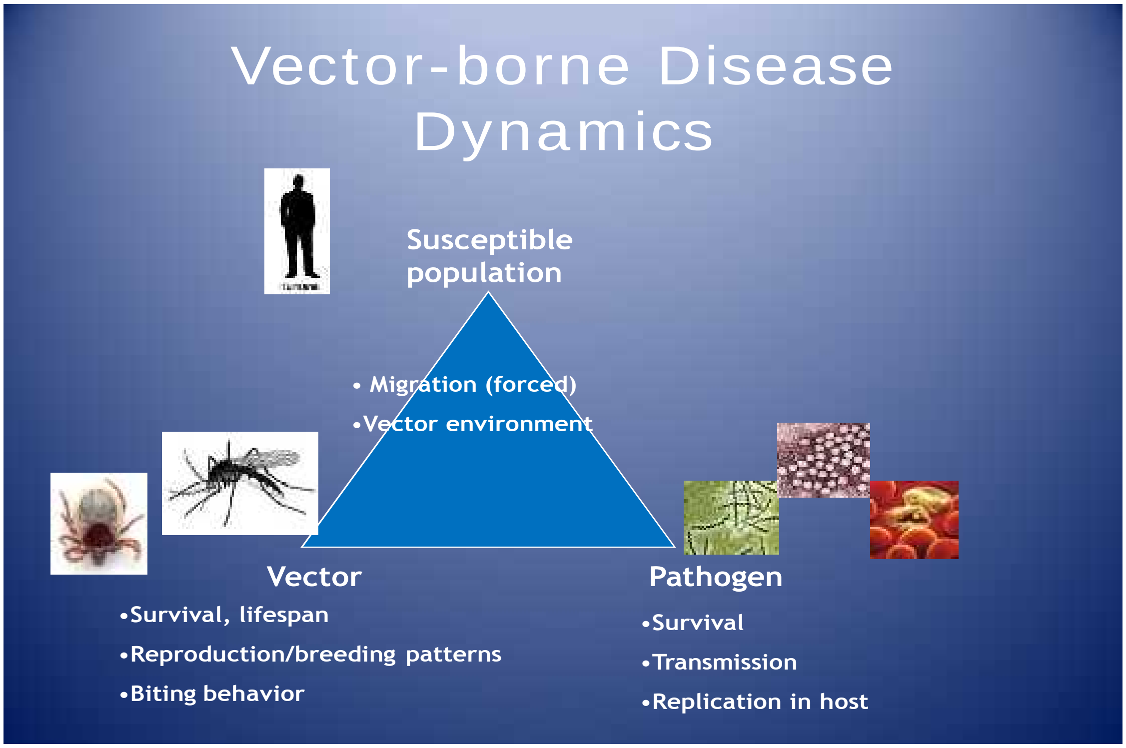

Fig 1 Vector borne disease dynamics
Source slideserve.com

Water-borne diseases
A warmer climate (Fig 1) could cause water-borne diseases to become more frequent, including cholera and diarrhoeal diseases such as giardiasis, salmonellosis. Diarrhoeal diseases are already a major cause of morbidity and mortality in South Asia. As rising ambient temperatures increase, bacterial survival time and proliferation and thus the incidence of diarrheal diseases might further increase.

Diarrhoeal diseases are largely attributable to unsafe drinking water and lack of basic sanitation; thus, reductions in the availability of freshwater are likely to increase the incidence of such diseases. Rapid urbanization and industrialization, population growth, and inefficient water use are already causing water shortages.

Cholera is a well-known water-borne diarrheal disease that has afflicted humankind since ancient times. Molecular techniques have shown that bacteria are now recognized as naturally occurring in aquatic environments, with bacterial population peaks in spring and fall in association with plankton bloom.
Several factors have caused the global resurgence of malaria, including the emergence of insecticide and drug resistance, human population growth and movement, land-use change, and deteriorating public health infrastructure. All these factors can interact to affect adult mosquito densities and the development of the Plasmodium parasite within the mosquito. Both the parasite and the mosquito that houses the parasite are susceptible to temperature changes. Deforestation, vegetation clearance, and irrigation can form open grounds preferred by malaria vectors and thus increase transmission.

The first operationally early warning system for epidemic malaria was implemented in India. The system combined human and meteorological factors to provide about a month's lead-time of epidemic risk. By the 2050s, the geographic range of malaria vectors is projected to shift away from central regions toward southwestern and northern States.

Other vector-borne diseases
Environmental changes might affect other diseases like dengue, leishmaniasis, lymphatic filariasis and on chocerciasis, and tick-borne diseases, which may exhibit changes in transmission intensity or shifts in their geographical ranges due to the impact of climate on the relevant vector populations. Climatic factors might also influence human plague, a bacterial disease carried by rodents and transmitted by fleas. .

Pandemic diseases
The recent pandemic field of infectious diseases has the unenviable distinction of being the only sub discipline of medicine that routinely has to deal with new diseases and where therapies lose their potency and value from drug resistance. New infectious diseases caused by pathogenic microbes not previously known to medicine emerge from acquisition from another species (e.g., species jump), as occurred with HIV, and from increased susceptibility in humans who become immune suppressed, who are often the source of so-called opportunistic pathogens.

Structure of COVID 19 .The Mutated RNA of virus spreads via contact and is a life threatening disease as the vaccine development for it is in infant stage and drug hydroxychlrouine is found to be effective in curing it .The immune system is unable to defend itself from this antigen. (Anthony *et al* 2015) .Coronaviruses (CoVs) are the largest group of viruses belonging to the Nidovirales order. The most prominent feature of coronaviruses is the club-shape spike projections emanating from the surface of the virion (Chen *et al* 2020). These spikes are a defining feature of the virion and give them the appearance of a solar corona, prompting the name, coronaviruses. Within the envelope of the virion is the nucleocapsid. Coronaviruses have helically symmetrical nucleocapsids, which is uncommon among positive-sense RNA viruses, but far more common for negative-sense RNA viruses. (Fig 2).

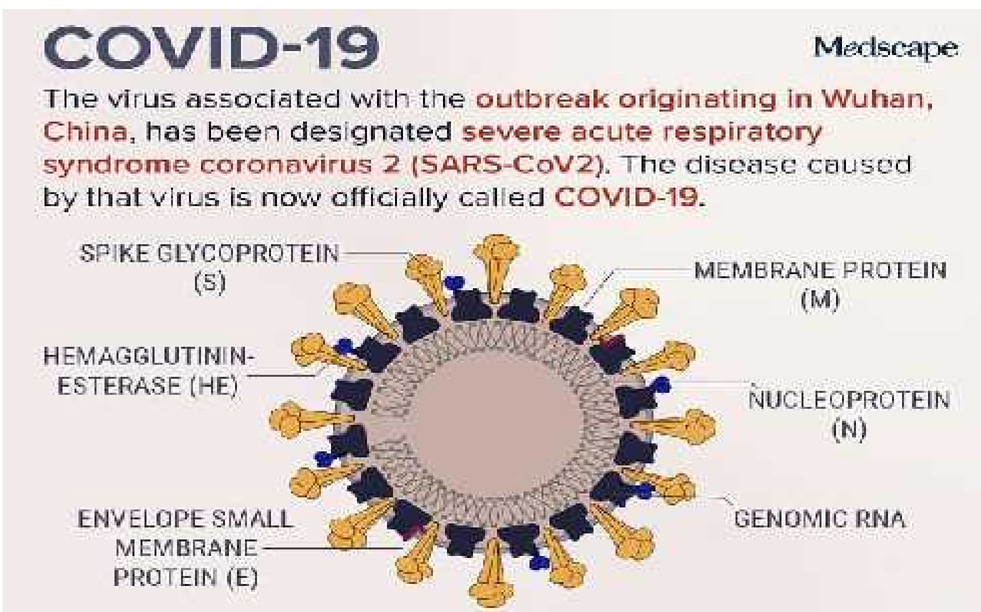

FIG 2 Structure of Corona Virus ***Source Medscape.Com***

The corona virus is an enveloped particle containing the spike (S), membrane (M), and envelope (E) proteins. In addition, some strains of corona viruses, but not SCoV, express a hemagglutinin protein (HE) that is also incorporated in the virion. The genome of coronaviruses is a linear, single-stranded RNA molecule of positive (mRNA) polarity, and from 28 to 32 kb in length (Drosten *et a.*, 2003). Within the virion, the genome is encapsidated by multiple copies of the nucleocapsid protein (N), and has the conformation of a helical RNA/nucleocapsid structure. The S protein has been a focus of pathogenesis studies in mice because it appears to be the critical determinant of cell tropism, species specificity, host selection, cell tropism, and disease. Increases in extreme weather events will also have health consequences(Chan *et al* 2013).

Implications for health care systems

As a developing country with high population of nearly 130 crores,, India might experience myriad human health effects because of environmental change. Monitoring the spread of infectious diseases will require early warning systems, which have both health and economic benefits. As the recent spread of COVID 19 was regularly monitored from the first stage itself..Increases in extreme weather events will also have health consequences.

There will likely be a rise in demand for emergency medicine services such as urgent and ambulatory care.(FIG 3) Expanded surveillance activities could detect shifting patterns of disease distribution so that emergency department personnel would be aware of emerging threats.

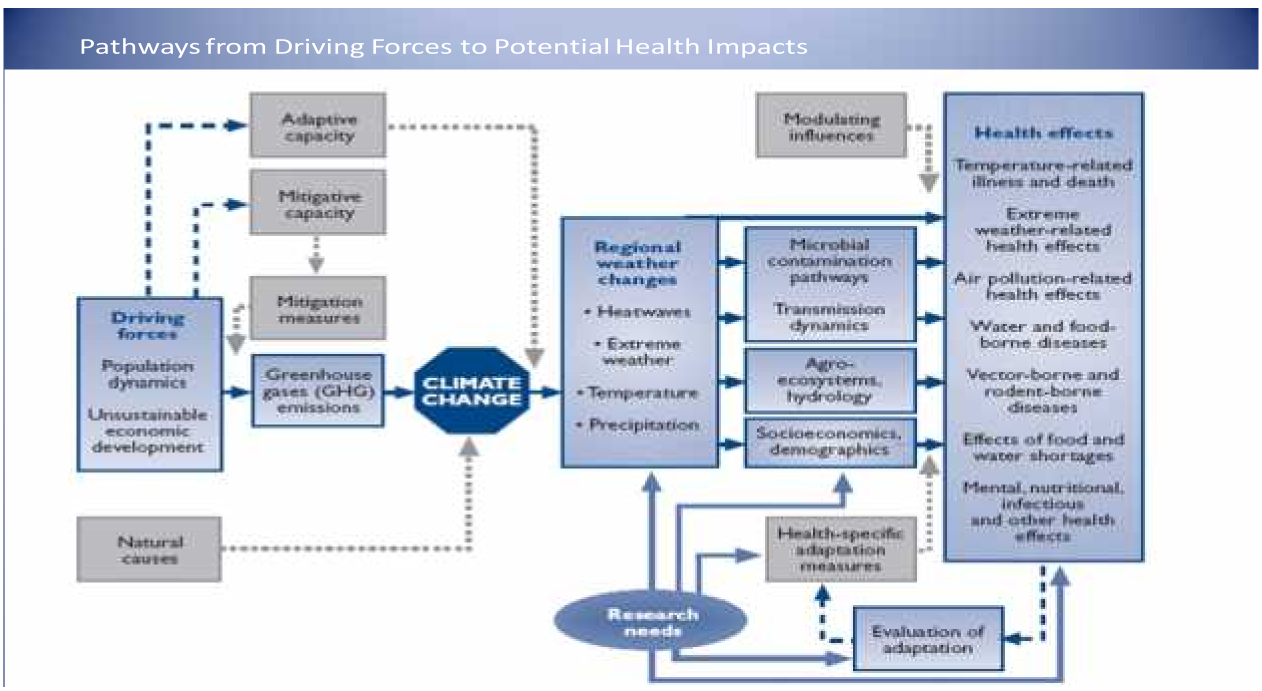

Fig 3 Health Impacts by Environmental changes source WHO.int

Major lines of defense

The human organism is protected from infectious diseases by an advanced immune system that includes innate and adaptive arms and physical defenses. Although physical defenses such as skin are well known to physicians, the role of temperature is often unappreciated. Mammals are remarkable among animals in their endothermy which maintains an elevated body temperature through life. Infectious diseases are acquired from other hosts (e.g., influenza virus) or directly from the environment, usually by inhalation (cryptococcosis and histoplasmosis). Microbes acquired from other humans are already adapted to mammalian temperatures, and these are not inhibited by endothermy.

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Although the experience with Lyme disease, HIV, SARS corona viruses, Zika virus, shows that medicine and science can eventually respond successfully to previously unknown microbes with new diagnostics, control measures, and therapeutics, effective responses take time, and countless lives are lost in the meantime. However, various measures could be taken today to increase preparedness for confronting new infectious diseases.

Measures Taken to combat infectious diseases

Designing enhanced surveillance systems for human and animal diseases would provide early information about new pathogenic microbes. Early warning provides potentially actionable information that can be used to design containment measures and diagnostic tests and to develop new therapies and vaccines.

Promote research into nonhuman host-microbe interactions. New pathogenic microbes may use virulence strategies that are fundamentally different from those of known infectious diseases. For example, when HIV burst onto the scene in the 1980s, medical science had no experience with a virus whose pathogenic strategy crippled the immune system and left the host vulnerable to a variety of other lethal infectious diseases. Microbes that are currently pathogenic in plants and invertebrates may pose fundamentally different virulence strategies if they adapt to the human host. However, it is worth remembering that pioneering work into nonhuman retroviruses in the decades before the HIV epidemic created the knowledge base that allowed rapid progress in developing antiretroviral therapies once HIV was identified as a retrovirus.

To date, there are no anti-viral therapeutics that specifically target human coronaviruses, so treatments are only supportive (Huang *et al* 2020). In vitro, interferons (IFNs) are only partially effective against coronaviruses (Zhang *et al* 2020). IFNs in combination with ribavirin may have increased activity in vitro when compared to IFNs alone against some coronaviruses; however, the effectiveness of this combination in vivo requires further evaluation (Cinatl *et al* 2003). The SARS and MERS outbreaks have stimulated research on these viruses and this research has identified a large number of suitable anti-viral targets, such as viral proteases, polymerases, and entry proteins. Significant work remains, however, to develop drugs that target these processes and are able to inhibit viral replication.

Promote continued development of antimicrobial therapeutics. The majority of existing antimicrobial therapeutics target microorganisms associated with humans and livestock. However, these represent an infinitesimally small proportion of the microbial life in the biosphere, and there is no guarantee that currently available antimicrobial therapies would be effective against new pathogenic microbes.

Develop threat matrices to identify new likely potential threats. Threat matrices are already used to identify the most worrisome pathogenic microbes for biological warfare and bioterrorism, which guide research priorities and expenditures on preparedness measures, such as vaccines. Currently, there is probably not enough information available to construct such threat matrices, but any such exercise would inform on the research needed to obtain the required information. With enhanced information into the types of microbial diseases that affect plants and animals and the temperature tolerance of environmental microbes, it should be possible to develop threat matrices that stratify risk of new infectious diseases.

Conclusion

Environmental change will almost certainly bring new infectious diseases and change the epidemiology of many existing diseases. Previous successes should not be a cause for complacency, and these reflect advances in science and clinical medicine that provide our species with tools to cope with new microbial threats. The best insurance against future threats is continued investment in surveillance, epidemiology, antimicrobial therapeutics, and basic research into mechanisms of microbial pathogenesis.

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