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Anthropogenic Drives of Emerging Infectious Diseases and Possible Mitigation Approaches

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ABSTRACT

The last decade has seen a surge of emergence of zoonotic diseases leading to disastrous consequences. The out break of these zoonoses are due to immense human pressure leading to biodiversity loss, change of human dietary pattern and illegal wildlife trade to name a few. Globally scientists, politicians and economists are trying to tackle the problem, but more unified efforts are required. Keeping these efforts confined to the elite community will be of no use unless the common people, who account for the greater part of the population, are made aware of the global scenario.

Key words: *Zoonoses, Anthropogenic drives, Biodiversity loss, Mitigation approaches*

Introduction

Emerging infectious diseases (EID) are those which appear for the first time in a certain population, or that are already present but a record rapid increase in number or geographical spread. So an emerging disease may be a known infectious disease appearing in a new species or in a new geographical area or, an unknown infectious disease identified for the first time. About 70% of all EIDs are zoonotic (Morse *et al.*, 2012). Zoonotic diseases are shared between humans and animals i.e., they are transmitted from other animals to humans. The causative agent can be various viruses, bacteria, fungi, other organisms or even abnormal protein agents known as prions. There are over 200 zoonoses recorded by World Health Organization (WHO). These pose maximum threat to humankind causing billions to be infected and millions of death and irrepairable damage to economy.

Transmission of zoonoses to humans

The transmission of pathogens from one species to a new one is scientifically called a spillover (Kreuder *et al.*, 2015). This can occur in many ways.

It may be direct contact, like coming in contact with saliva, urine, feces, mucous, blood of an infected animal. Petting, touching animals, their bites, and scratches may be example of direct contact.

Indirect contact with areas where animals live (pet habitats, chicken coops, aquariums, barns), roam and surfaces or objects contaminated by them may also cause transmission.

Transmission may be vector borne like being bitten by a tick or insect like mosquito or flea, which has bitten an infected animal. The mode of transmission is often food and water borne. Consuming undercooked food from animal and plant source that has been contaminated by infected animals may cause transmission.

Anthropogenic drives for spread of Zoonoses

We have been using the planet's resources since our inception and she has been forever obliging. The growing human load and the associated increase in consumption has lead to cataclysmic changes to our planet affecting land and water cover, the biogeochemical cycle, the climate and the way our ecosystems function.

Our mindless activities have modified significantly three fourth of the planet's land and two thirds of the oceans and sea environment and brought nearly one million animal and plant species at risk of extinction. According to WWFs Living Planet report (WWF, 2018) a 60% average decline in vertebrate population abundance has been observed in just more that 40 years. Average global temperatures are on the rise due to excessive greenhouse gas emissions. These human activity triggered changes are having profound effect not only on the biosphere but also on human health. What have we done to push our planet in this trajectory of global change having so severely dramatic and irreversible effect on environment and its natural ability to sustain our lives? These anthropogenic drives need to be scrutinized so that we can avoid such zoonoses and related pandemics.

To handle increasing food demand (due to rise of population) (U.S. Energy Information Agency,2013 and*Tilman et al.*, 2014), cropland expansion is being done at the cost of deforestation. Such land use change brings about biodiversity loss due to habitat loss, which is definitely responsible for spread of zoonoses. High diversity of host species can reduce disease risk (dilution effect). When some of the hosts are removed and we move towards creating a monoculture of animals then they are very likely to be transmitters of a disease. In the last century a rapid collapse in the vulture population in India (due to use of diclofenac on livestock) led to an upsurge in rabies cases as livestock carcasses were no more being fed on by vultures instead an increased population of wild dogs was observed. These wild dogs are main vectors for rabies in humans. Destruction of habitats obviously reduces plant diversity in an area, which in turn affects the presence, abundance and distribution of mosquitoes increasing the risk of malaria transmission. The deforested areas of Peruvian amazon have much higher density of the local mosquitoes, which spread malaria than the tracts where forests are intact.

Increased consumption of bush meat is another major cause of spread of zoonoses. With time bushmeat consumption has been thrown out of bounds, as it is an important source of nutrition for the poor food insecure households and a delicacy for the affluent. Everything ranging from ants, bats, reptiles, pangolins, antelopes, apes like chimpanzees and gorillas and even hippopotamus and sharks are hunted for our plates. Eating anything and everything available and that too raw or half-cooked is dangerous as is evident from the current pandemic situation. Bush meat is even trafficked to distant countries through illegal trade routes. Direct contact with animal parts and unregulated trade of wild animals exposes humans to pathogens that are hosted by those species. Trafficking of wild animals by commercial routes connecting continents increases the spread of pathogens. Wildlife trade being the fourth most profitable trade in the world can be underlined as cause of risk of pandemics.

Wild animals are even captured and bred in captivity for easy availability of meat and other parts. When these animals are packed together they transmit pathogens as they defecate, urinate, sneeze, cough or even scratch. In animal markets close proximity of animals of different species pose risk of genetic recombination of different viruses and its spillage into new species.

Intensification of livestock production to keep pace with population increase and dietary shift towards higher consumption of animal products is another potential cause for spread of zoonoses. Not only does these expose humans to livestock who may be carriers of disease but also exposes these livestock to infection from other wild species if the area of production is close to forest land. This was how Nipah virus had spread from intensified pig production at the edge of tropical forests, which are fruit bat reservoirs. As humans and domesticated animals invade wildlife habitats, tick borne pathogens are increasing at an alarmimg rate. Tick borne encephalitis (TBE), Colorado tick fever and Lyme disease are few to name.

Addressing the crisis

The dramatic surge in zoonotic diseases in the past few years is obviously a crisis that evolves from massive increase in human exploitation of natural resources, their dietary shifts and greed to fill pockets by trying to be the master of nature. It must be realized that sustainable development goals be it con-

servation of biodiversity, food production or climate change mitigation, all needs to be planned in unison. The launch of 2030 agenda for sustainable development that addresses the crisis of human pressure leading to catastrophic consequences and involvement of 60 plus countries in Global Health Security Agenda for finalizing a strategy for the next five years known as GHSA 2024 roadmap are positive steps that are being taken internationally (Marco *et al.*, 2020).

Inter-disciplinary research approach is required for sustainable development. It must be realized that disease emergence does not involve pathogen dynamics and biological aspects of humans alone. It also involves looking deep into behavioral aspects of humans, life stocks, wildlife and even socioeconomic changes that are taking place. More research is required for resolving the complex relation between EID and biodiversity (Keesing *et al.*, 2010, Allen *et al.*, 2017 and Jones *et al.*, 2008). It is very much essential to strike a balance between technological advances provoking more exploitation of nature and shift towards less resource intensive lifestyles. That control of EIDs is an integral part of socioeconomic planning needs to be realized. Public awareness programs that highlight biodiversity as national wealth must be conducted regularly. The three main dimensions of sustainable development: economic, environmental and social – all require involvement of masses. The government alone cannot be the bearer of the cross for securing our futures.

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Conflict of interest

Both the authors have no conflict of interest.

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