Impact of Human Activities on Emergence of Viral Infections

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Abstract

Humans have always been on the other edge of the rope in the tug-of-war for his survival from numerous biotic and abiotic challenges. In past two three decades human beings without the conscious awareness are creating situations resulting in frequent recurring infectious diseases as evident by global outbreak of civid-19.

In this paper various such anthropogenic factors have been discussed. Knowledge of such activities may develop some insight into the understanding of human induced frequent viral manifestations, so that we can switch to wise and sustainable practices for our own existence before it is too late.

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Introduction

Human race from its very origin is fighting with many challenges imposed by biotic factors (microbes, vectors and other animal species etc.) and abiotic factors (natural calamities) for its survival, one of them is viral infections. Humans have afflicted by viruses throughout their evolutionary history. Phylogenetic studies reveal that some of the viruses show intimate relationship with human race, while other are acquired time to time from other species including domestic animals, rodents, monkeys, apes and now bats.

Past 2-3 decades have evidenced the emergence of many viral outbreaks which have recently evolved and are impacting a large population over a large geographical range. Some of the notorious viruses are Ebola virus, Lyssa virus, Sars virus, Hanta virus and most recently COVID-19 and then monkey pox disease .

Outbreak of COVID-19, has imposed a medical emergency in 128 countries of the world, infected more than 554 billions people and nearly caused 6.4 billions deaths worldwide within 2-3 years of its emergence in Wuhan city of China, declared as pandemic by WHO. Worldwide lockdown imposed to control this highly contagious viral disease has crippled the world's economy and had brought life to an abrupt halt. It is this halt that gave us an opportunity to think and re-think that despite the tremendous progress that we have made in science, technology and medicines, we are still finding ourselves helpless in saving our lives from rapidly growing tentacles of one or other viral infections.. Yet and again it leaves us introspecting ourselves, if it is our deeds and acts that have led us to such a miserable condition. For our own existence we have to think deeply and to take serious actions for a safer and happier world.

Emerging Viral Manifestation

An emerging infection can be defined as infection that is newly appeared in population or has existed earlier in the past but now, is rapidly increasing in incidence or geographical distribution. Most recent example of an emerging viral infection is COVID-19, becoming one of the largest pandemics in human history.

Operationally disease emergence can be viewed as a two-stepprocess:-

1) Introduction of the agent into a new host population (whether the pathogen originated in the environment, in another species, or as variant of an existing infectious agent).
2) Establishment and further spread within the new population.

Factors that promote one or both of these steps will speed up the emergence of disease. Because humans are important agents of ecological and environmental change, many of these factors are anthropogenic.

Emergence and spread of viral infections are more frequent and deadly than other microbial infections due to two major reasons:

1) High mutation rate due to simple genetic composition
2) Intracellular existence in the host cell that makes the preparation of anti-viral drugs very difficult because any chemical that may kill the virus, will kill the host cell first. Hence we have very few anti-viral drugs to control viral epidemics.

Major Factors Responsible for Viral Manifestation

Emergence and spread of viral infections depends on four major factors discussed briefly below:-

1. **Pathogen characteristic –** It includes selection pressure, scope of high mutation, drug resistance, etc.
2. **Host characteristics –** Host population, immune responses, culture and habits, etc.
3. **Environmental factors –** Climate changes due to global warming, Al-Nino effect, heavy rainfall etc.
4. **Vector characteristics –** Increase in vector population and vector range, competencies of vector in adapting itself, migration and change in behaviour of vector.

But the last few decades and evidenced the over-exploitation of the nature by human beings to fulfil their greed and not need, have become the fifth determinant in an emerging vial epidemic.

Anthropogenic Factors and Emergence of Viral Infections

Human activities directly or indirectly play major role in speeding up the emergence and spread of viral infections. These can be listed as:

1) Agricultural Development and Deforestation

To fulfil the demands of food and habitation for exponentially growing population, forest and grasslands are being converted to agricultural land and residential areas. This increased the human exposure to natural foci of a viral infection through ticks, rodents, bats, apes and other virus carrying vectors. For example, in 1998, emergence of a highly contagious respiratory and neurological disease of pigs and humans caused by paramixo virus (Nipah virus) was reported. Serological studies revealed that fruit bats were the natural hosts and reservoir of this virus. Due to habitat loss of bats for newly developed fruits orchards, bats entered the farms, infected the fruits and eventually the human population. Similarly, in India high incidences of Japanese Encephalitis can be attributed to adoption of rice contribution and subsequent water logging in fields. Hanta virus, the cause of 1 Lakh cases per year of Korean Haemorrhagic Fever in China is a natural infection of rice field mouse. People during rice harvest came in contact with infected mouse and catch the disease. In Argentina, conversion of grassland to maize cultivation increased the population of a rodent that was the natural host of Junin virus and caused breakout of Argentine Haemorrhagic fever.

2) Human Movement/Migration

Human movement across the nation, as well as across the world has become frequent in modern global society for various purposes like political instability, terrorism, war, trade and commerce, job opportunities, travel and tourism, etc. These movements often come as an important factor in disease emergence and its spread. An infection which in past remain localised in a geographically isolated area, be brought to new place through human movement. History of disease spread is filled with many examples of this. Ships brining slaves (16^{th} and 17^{th} century) from West Africa to New World also brought Yellow Fever and its mosquito vector (Aedes) to the new territories. Bubonic plague is reported to spread in Europe from Asia because of trade between these two continents. History is repeating itself more intensively in today's fast paced mobile world. Corona has travelled to 128 countries from China within 3 months. Rats have carried Hanta virus virtually world-wide.

3) Unplanned Urbanisation and Burden to Healthcare Infrastructure

Industrialisation have encouraged the mass movement of workers from rural areas to cities. According to an estimation of united nation 65% of the world population will migrate to cities by the year 2025. Rural urbanisation allows localised Infection to reach larger population. Once in a city, the infection could also spread further through highways and airways. HIV virus is the best known example of this type of spread.

4) Uncontrolled

Urbanisation exerts pressure on infrastructure of cities. It became difficult to maintain hygienic condition, supply of pure water, garbage disposal, medication and immunisation adequately. The pathogens that usually remains in low counts in reservoirs hosts or in environment, able to take advantage of these deficiencies in public healthcare system to re-emerge. E.g., viral diseases like chicken pox, small pox that were once decreasing but now are increasing rapidly again due to less emphasis on immunisation. Although such situation is more severe in developing countries but sometimes developed countries came in arrest with such breakdowns. The US outbreak of cryptosporidium infection in Wisconsin in1993, infecting 4 lac cases, was partly due to non-functioning water filtration plant.

5) Blood Transfusion and Tissue/ Organ Transplants

Infected blood transfusion may also cause spread of disease. In 1997, Transfusion-Transmitted virus(TTV) was identified as the cause of many cases of hepatitis, transmitted by infected blood donation. Many cases of HIV spread have also been reported in different parts of world due to infected blood transfusion.

Similarly, Xenobiotic transplant, from an infected donor may spread disease to other. Eg – In US, a person bitten by bat, having unidentified rabies, donated organs to 4 people, who later on died due to rabies.

6) Use of Viruses as Bio weapons

From nuclear weapons we move towards chemical weapons and now bio weapons. Use of pathogenic microbes as bioweapons is much easier in this globalised world, hence many countries have developed harmful bacteria and viruses for bio war. In 2001, Anthrax disease was intentionally distributed through coastal system in United States, caused many deaths. Recently it is being said that COVID-19 is developed by China in Wuhan Institute of Virology as Bio weapon.

7) Change In Eating Habits

In some cultures, wild animals like snakes., bats, monkeys, dogs etc, are consumed by people. Many wild animals are reservoirs of dangerous viruses, which sometimes mutate themselves to infect human population that comes in contact with these wild animals or consume these as food. Tourism, migration and international media have increased knowledge and popularity of different kinds of food in different parts of the world but new consumers are not well adapted to these exotic food as compared to native consumers and acquire many infections for example, exposure to Japanese food, Sushi has introduced the use of raw fish in European countries and USA and became the cause of Anisakiosas disease. Bush meat (primate meat and brain) is becoming very popular in urban African world. Several outbreaks of Ebola virus in western Africa found associated with consumption of Chimpanzee, infected with this virus. Similarly, infection of Simian Foamy virus, human T-lymphotropic viruses have been found in people who consumed, hunt or keep monkeys or apes as pets in Cameroon of south Africa.

8) Increased Consumption of Processed Food

Due to busy schedule and cultural changes junk food, ready to eat food frozen food are becoming very popular. This have increased the demand of mass food processing and distribution. This process and frozen food increases the life span of viruses as well as their geographical distribution.

9) Integrated Animal Husbandry

Sometimes putting two or more species in contact provides a natural laboratory for mixing of viruses and origin of new strains. Pandemic influenza appeared to be originated from integrated pig-duck farming in China. The genes of two influenza strains found in duck andpig remix to forma new variant that can infect human to a larger scale.

10) Exotic pet keeping- pets from foreign countries have been a source of infection from endemic regions to new regions. Emergence of Lagos bat Lyssa virus in France in 1999 is a good example of such spread. Rousette bat imported from Belgium and sold to a pet shop in France was infected by this influenza causing Lyssa virus and infected 100s of people later on.

11) Occupational exposure- healthcare workers and scientists related to biological researches experience high exposure to viral infection and its further spread. Especially when hospital and research labs do not have full proof safety measures. in rural north Indian healthcare settings thousands of health workers are found to have blood born viral infections causing hepatitis B, C and even HIV. In Germany (1967), people working with green monkey tissue from Uganda were infected by Marburg virus, present in the tissue and died later on. In 2005, an outbreak of Marburg virus occurred in Angola.

12) Improper Sanitation in Healthcare Settings

Many times, healthcare settings become front line of exposure to new diseases and responsible for emergence of infections. Example, in the outbreak of Ebola viral infection in Africa, many of the secondary cases were hospital acquired, most transmitted to other patients through contaminated apparatus, beds and some to the healthcare staff by contact.

13) Man induced microbial adaptations

Microbes like any other living being are constantly evolving. Uncontrolled and inappropriate use of antibiotic and antiviral drug resulted in resistant strains of microbes. As mutation power is much higher in

viruses, they frequently change their strains and epitopes to dodge the immune system of human beings as well as drugs used to control them.

14) Road and Dam Construction

The construction of new roads, increased the access to new untouched areas which expose the non-immune population such as construction workers, minors, tourists and environmentalists to indigenous vectors and their parasites. This subsequently resulted in the emergence of new infections. Dam construction also damaged the biodiversity of that area and disturbed the ecological balance, which in turn result into emergence of new microbial infections. Moreover, water logging due to these dams promotes breeding of vector insects of the viruses. Outbreak of rift valley fever in villages of Africa have been associated with the dam building near their villages.

15) Wars

Wars especially cross nation wars may also speedup the spread of microbial infections. Outbreak of Dengue virus in year 2000, in 60 countries is partially credited to world war II.During the war, both the viruses and its mosquito vector become widely distributed in urban south east Asia. The war caused a slack in the economic development and negligence towards plant urbanisation and control of vectors.

Conclusions

from the above discussion it is clear that emergence of infection is not new in the history of human existence. Historical processes that have given rise to the emergence of new infections have become more prevalent than ever before due to human interference with nature and destruction of ecological balance. Development and scientific progress is in evitable in modern world but it has also brought negative effects in the form of high population, global warming, loss in bio diversity, life style disorders and emergence of infectious diseases.

War between viruses and human being although seems tough and never ending but humans are not powerless. Owing to his high intellect and strong desire to survive, he have always managed to successfully overcome the virus outbreaks. Knowledge of factors underline disease emergence can help in developing more effective preventive strategies. We have to learn to live with minimal needs and to adopt sustainable developmental practices

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