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Review Article

Trend of emerging vector borne diseases in India: way forward

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ABSTRACT

There has been a drastic change in climate patterns in the recent past, the impact of which can be observed in the rapidly changing trend of many diseases particularly vector borne diseases. India has been endemic for many vector borne diseases namely malaria, filaria and kala azar. Implementation of strict public health measures and calculated strategies under the vector borne disease control program has been successful in controlling these diseases. However, the country is witnessing an emergence and increasing threat of new vector borne diseases in the form of Chikungunya, Nipah virus, Zika virus and others. This article discusses the epidemiological aspects of some important emerging vector borne diseases in the context of changing ecology and transmission pattern along with the public health implications, and way forward for preparedness to combat their further spread.

Keywords: Emerging, Vector, Diseases

INTRODUCTION

The earth's climate is continuously changing. Most of the climate change is due to man-made activities. One of the major indirect effects of climate change is emergence of many new vector borne diseases. The socioeconomic development leading to clearing of forests, reclaiming wasteland for urbanization, and intrusion into forest fringes are resulting in ecological change leading to altered epidemiology of diseases. The changes in habitats of wild animals lead to increased man–vector contact, thus posing a risk to public health. In last two to three decades, many diseases, which were either forgotten or were restricted to a few foci, have re-emerged with vast spatial distribution.[1]

India has been endemic for many vector borne diseases (VBDs), malaria being predominant in this list. India achieved a reduction of 83.34% in malaria morbidity and 92% in malaria mortality between the year 2000 (20,31,790 cases, 932 deaths) and 2019 (3,38,494 cases, 77 deaths), thereby achieving goal 6 of the millennium development goals (50-75% decrease in case incidence between 2000 and 2019).[2] Though the incidence of malaria has shown a declining trend, there is rising concern regarding the emergence of many new VBDs which were previously not present. Also, a resurgence of VBDs once controlled has come as a burning issue. This paper tries to discuss the epidemiology of some important emerging VBDs in India in the context of climate change.

The details of epidemiological aspects of some important vector borne diseases in the context of changing ecology and transmission pattern are discussed in the present review so as to highlight the importance of eco-epidemiology, public health implications, and way forward for preparedness to combat their further spread.

DENGUE

Dengue, presently one of the most common VBDs in the world was unknown before the mid-20th century. Dengue fever was first reported in India in 1946. No significant dengue activity was reported from anywhere in the country until 1963-1964 when an epidemic was reported from the Eastern coast of India which further spread its wings to Delhi and Kanpur and then to the southern part gradually engulfing the whole of the country followed by endemic prevalence of all the four serotypes of dengue virus (DV).[3] The pathogenesis of severe dengue disease is not known, no vaccine is yet available for protection and the vector control measures are inadequate. The challenges in control of this disease needs to be addressed but scientific evidence is lacking in many of these aspects. Many studies have reported changing spatial patterns in dengue transmission. There could be several reasons for this: changes in human behaviour, increased national and international travel propagating spread of factors and most of all climatic changes pertaining to temperature and precipitation which highly influence the disease transmission dynamics. According to the intergovernmental panel on climate change, the global average temperature has increased by ~0.6 °C over the past 35 years, and the variation in precipitation has increased. Warm temperatures and high humidity have a favourable effect on the longevity of the vector mosquitoes, which facilitates rapid multiplication of virus with increase in transmission. Some studies have reported that an epidemiological shift in DVs and climate change might be responsible for the observed increase in dengue burden across India.[4] Dengue continues to remain an important public health problem in India, as evidenced by the onset of epidemics each year with high proportion of dengue cases along with high case fatality rates. Also, there is co-circulation of multiple DV serotypes. There is a need to initiate well planned community-based cohort studies representing different geographic regions of the country in order to generate reliable estimates of age-specific incidence of dengue fever in India.

CHIKUNGUNYA

Chikungunya virus was first isolated in East Africa in 1952 and established foothold in the 2005 Indian Ocean epidemics.[5] Although not phylogenetically related to dengue, Chikungunya is a similar disease producing flu-like febrile illness often associated with a maculopapular rash and distinctively disabling arthralgias. India was affected with outbreaks of Chikungunya during 1963-1973 where the first outbreak was reported from Kolkata in West Bengal. Chikungunya resurfaced again after 32 years in 2005 in the Indian ocean islands affecting Hyderabad and Ananthapur district of Andhra Pradesh in South India. It eventually affected 1.4 million people in 13 states with huge economic and productivity loss of 391 million rupees.[6,7] Ahmedabad city of Gujarat and Kerala state were the worst affected places. In 2009, the infection expanded to 15 states in India.[6] The number of states which reported Chikungunya fever (CHIKF) increased to 23 by the year 2015, 28 states in 2016, and 30 states/union territories in the year 2019 reporting a total of 12,205 laboratory confirmed cases in 2019. Currently this VBD is endemic in 24 states and 6 union territories in the country. The trend of positivity increases as rainy season sets in and continues to remain high in winter.[8] There is a need to understand about virus biology, virus-vector/virus-host interaction, vector distribution and transmission in context of prevailing environmental conditions. Continuous surveillance has already been advocated by several studies in India and it should be supported for the apparent reasons. A study conducted by the Ministry of environment, forest and climate change wherein researchers analysed data sets from 1948-2016, revealed that from 1982-2016, many states reported a gradual increase in Chikungunya compared to the previous years. The study shows that chikungunya spreads between 20 and 34 °C but the peak transmission occurs at 29 °C.[9] Moreover, a small variation in climatic factors has a huge impact on vector-borne diseases such as malaria, Zika, dengue and Chikungunya.[10]

ZIKA VIRUS

An outbreak had occurred in Brazil in May 2015, and the virus has since been identified throughout the Americas as Zika virus. A major concern related to this virus is that the infection in pregnant women increases the risk of structural brain abnormalities in the fetus, including microcephaly. It was recommended that women who are pregnant or potentially pregnant should avoid travel to areas in which Zika is spreading. In 2017, the first case of Zika virus was reported in India from Gujarat and subsequently from Tamil Nadu. On 15 May 2017, the Ministry of health and family welfare, government of India, reported three laboratory-confirmed cases of Zika virus disease from Ahmedabad, India–confirmed by reverse transcriptase-polymerase chain reaction (RT-PCR) test. Before this declaration, India was in World Health Organization (WHO) category-4 (virus may be present but no notified cases documented), but with these three confirmed cases, India had shifted to WHO category-2.[11] This was followed by large outbreaks in Rajasthan and Madhya Pradesh later in 2018. These outbreaks in India highlighted the spread of this disease beyond geographical barriers owing to the growing globalization, increased travel and ubiquitous presence of its vector, the *Aedes* mosquito.

The identified cases did not reveal any reveal history to Zika virus endemic regions. This suggested that presumably the virus may not be a recent introduction but existing as a vector borne entity in silent form in the country. In India, more than 35,000 serum samples of febrile illness have been tested which yielded only four cases, suggesting a very low level of transmission of the virus within the community. Although there have been a few Zika cases reported in India, there has been no isolation of virus yet.[12]

This scenario reflects that the virus in India is distinct from both the African and Asian strains, so the replication is not much which explains the low transmission of infection in this region.

NIPAH VIRUS

The Nipah virus was first discovered in Malaysia in 1999 during an outbreak among pig farmers. The natural host of the virus are fruit bats of the Pteropodidae family. Since then, there have been multiple outbreaks — all of them in South and Southeast Asia claiming more than 260 lives. On 19 May 2018, a Nipah virus disease (NiV) outbreak was reported from Kozhikode and Mallapuram districts of Kerala, India which was the third reported NiV outbreak in South India, the earlier being in 2001 and 2007 in West Bengal. Those infections were all traced back to fruit bats found dead in the water of a family's well. A total of 17 deaths and 18 confirmed cases were reported as of 01 June 2018. The outbreak of Nipah demonstrated that Kerala and the rest of the country are exposed to the high risk of another outbreak making preparedness vital.[13] Scientists have warned that as the climate warms and humans destroy more natural habitat of species like the fruit bats in Asia, opportunities for new zoonotic variants to emerge increase. Habitat loss and climate change directly results in loss of food resources, causing nutritional stress for the flying foxes, and hence they migrate closer to urban areas. This epidemic also highlighted critical gaps in the health system like our relatively inexperienced cadre of surveillance personnel requiring further training in field epidemiology and data analysis. Also strengthening infection control practices including ensuring availability of medical supplies and adequate stocks of personal protection equipment would be important steps in managing any similar outbreak in the future.[14]

SCRUB TYPHUS

In India, Scrub typhus is present in whole of the Shivalik ranges from Kashmir to Assam, Eastern and Western Ghats, and the Vindhyachal and Satpura ranges in the central part of India. The district of Darjeeling has also been historically considered as one of the scrub typhus-endemic areas in the country. There were reports of scrub typhus outbreaks in Himachal Pradesh, Sikkim, and Darjeeling (West Bengal) during 2003–2004 and 2007. The notable outbreaks reported from India in the last 10 years were Tamil Nadu (28 cases in 2001–2002), Himachal Pradesh (200 cases, 13 fatal in 2011), Nagaland (9 cases, 3 fatal in 2011), Meghalaya (80 cases, 5 fatal in 2010), and Puducherry in 2008. There have been outbreaks in areas located in the sub-Himalayan belt, from Jammu to Nagaland.[15]

Resurgence may be due to changes in the human behaviour, unplanned urbanization, deforestation, and rapid transport leading to displacement of vectors as well rodents from one place to another. Earlier, the habitat of the mite was restricted to the shrubs in hilly and forest terrains. However, recent studies have shown that rodents carrying the mite are transmitting the disease in the urban locales as well. Temperature has a significant influence on the chigger activity whereby a 1ºC increase in mean temperature has been associated with a 3.8% increase in cases. Also, warmer climates foster more outdoor human activities and facilitates increased man vector contact. Relative humidity and rainfall are other significant predictors of scrub typhus activity. A study conducted by Wei et al in Southern China showed that a 10% increase in relative humidity was associated with an 8.5% increase in the odds of scrub typhus cases after a 4-month lag. This may be because a high relative humidity provides a moist condition for the mite to thrive.[16] A study in Chile revealed that chiggers survive and reproduce well at a relative humidity above 50% but decrease in number or activity when relative humidity is below 50%.[17] This disease is also prevalent in areas such as sandy beaches, mountain deserts, and equatorial rain forests. Certain areas such as forest clearings, riverbanks, and grassy regions provide optimal conditions for the infected mites to thrive. These small geographic regions are high-risk areas for humans and have been called scrub typhus islands.[18]

The significant challenges are that the diagnosis is often missed, and tools for confirming diagnosis are often not available in resource-poor setups. Delay in initiating treatment owing to this may lead to untoward fatality. More widespread access to medical care, close suspicion of the disease along with the increased use of affordable and accurate rapid tests, is mandatory to improve diagnosis and treatment of this condition which can be easily treated with antibiotics.

The national vector borne disease control program (NVBDCP) is looking into the prevention and control of six vector borne diseases – malaria, dengue, lymphatic filariasis, kala azar, Japanese encephalitis and chikungunya in India. The directorate of NVBDCP is responsible for framing technical guidelines and policies as to guide the states for implementation of the above mentioned six diseases programme strategies. Monitoring is done through regular reports and returns of MIS. Every state has state VBD control unit under the state directorate of health services with stipulated technical components.[19]

Way forward

Realignment of vector control strategies is the much-needed strategy required as climate changes continue to pose newer challenges to existing vector control strategies.

Increased technical capacity to deal with increasing outbreaks in terms of diagnostics, treatment and efficient reporting systems for early detection and control of outbreaks.

Training of staff on the latest guidelines and updates on diagnosis, management and reporting mechanisms.

Strengthening of monitoring and evaluation mechanisms to track progress of programmatic indicators and capture the true burden of disease. Moving towards electronic health reporting and health information management systems would be critical for managing and responding to acute events.

Integrated vector control strategies which include the environmental management and larval control which is evidence based for efficient control of vectors including evaluation of new approaches for vector control. Requirement of trained entomologists for a better understanding of the vector biology.

Simultaneously, reminding of case definitions, strengthening infection control practices including ensuring prepositioning of medical supplies and adequate stocks of personal protection equipment would be important steps in managing any similar outbreak in the future.

Familiarising hospital staff with standard operating procedures and protocols for disease management, through tabletop exercises will ensure readiness; and maintaining universal precautions and hospital IPC practices regardless of the type of patient handled would be the need of the hour.

Multidisciplinary approach for involvement of sectors outside health for environmental management like water and sanitation, public health engineering.

CONCLUSION

Ongoing research into this field exploring the intricate relationship of climate change with vector control diseases is the need of the hour.

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