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Threat of Mosquito-Borne Human Viral Diseases

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Mosquitoes, with its annoying behavior, are the worst enemy in human societies worldwide. To complicate matters, there are more than 3,500 species of mosquitoes existing globally [1], among those, the members of three genera of mosquito, *Anopheles, Aedes and Culex*, are the leading causes of mortality and morbidity in humans [2]. Over one million people worldwide die from mosquito-borne diseases annually. Mosquito-borne viral infection is the editorial focus, even though malaria is the most serious disease to humans, transmitted by the anophelene mosquito and readers should access information relating to malaria prevention addressed in WHO guidelines [3].

The mosquito is a tiny creature since the average body weighs is approximately 2.5 mg. The lifespan of most adult female mosquitoes, depending on the species, lives for two to three weeks. Nectar is important food for both male and female mosquitoes, but the female mosquitoes also feed on blood for the ovary development. It is this behavior that allows the transmission of viruses to induce diseases in human beings. The density of mosquitoes is the critical factor in a disease outbreak.

Mosquito-borne viral infections are mainly in the Flaviviridae, Togaviridae and Bunyaviridae families [4]. The Flaviviridae family includes Dengue fever, Yellow fever, Japanese encephalitis, West Nile virus, Kunjin virus, Murray Valley encephalitis virus, St Louis encephalitis virus, and the more recent Zika virus. The Togaviridae family covers Ross River virus, Barmah Forest virus, Chikungunya virus, Eastern equine encephalitis, Western equine encephalitis, and Venezuelan equine encephalitis. The Bunyaviridae family contains Ťahyňa.

The initial clinical manifestations are very similar among mosquito-borne viral diseases; with a short incubation period, symptoms that may begin three to six days after infection, and fever, arthralgia, headache, shivers, anorexia,nausea and vomiting during acute phase. Majority of inflicting patients recover within a week of illness, while few percentages of subjects may progress to severe conditions, such as encephalitis, liver damage, bleeding and shock which may lead to death, varying dependent upon viruses. The case mortality rates also vary among viruses, ranging from without death to 50% of death.

Mosquito-borne human viral diseases not only are a public health and society burden but also are a potential threat to be utilized as biological weapons. As such, researches on the prevention and anti-viral modality have been intensively investigated. Mosquitoes imbibe blood to transmit the viruses to the host. Although with many years of intensive investigations, the process of the mosquito proboscis penetrating in human skin, the morphology of the deposited viruses, and the skin cells response to the bite and the invading viruses remain at large.

Traditionally, an instant effective strategy to mitigate a disease transmission is mosquito control with chemicals which is a standard practice. In addition to issue of resistant mosquitoes emerging, the cost and the effectiveness hardly meet the expectations. Many modernized approaches, such as altering the mating behaviors or artificial made mosquitoes competing and perhaps replacing specific species of mosquitoes in open field have been developed and are in the process of field trials. The concept may be workable, but the behaviors of mosquitoes upon harvesting viruses appear to be altered. The challenge on how do the man-made mosquitoes react and behave in nature remains a major and critical task to be resolved.

As of today, some of mosquito-borne human viral diseases have vaccines to prevent it, while others have limited efficacy in field trials and are a work in progress. Vast majority of mosquito-borne viruses are originated from animals or birds, and humans are an accidental host. Vaccines to prevent these viruses appear to achieve the expectation. In contrast, for those viruses staying in human populations are less successful by vaccination. One of the good examples is dengue; human plays an important role in its life-cycle. Although many human viruses can cause damage in human immune system, the dengue virus appears to be equipped with a specific strategy to demise the human immune system. As such, the most difficult task in dengue vaccine development is to identify protective parameters that can use as a protective index in vaccine clinical trials.

Another aspect in prevention and treatment of mosquito-borne viral disease is effective therapeutic drug administration. With the nature of the mosquito-borne viruses, the strategy in developing effective anti-viral drug seems to be far more difficult than initial thoughts. As such, anti-viral modality to treat the mosquito-borne diseases is still within tunnel and the light at the other side of the tunnel is a long way to be seen.

With climate change and mosquito-borne human viruses potentially being modified and utilized as biological weapons, researches on the interactions of mosquitoes and human beings with viruses transmitted by the tiny creatures are urgently needed. Hope this scientific information can be further communicated in the Journal of Bioterrorism and Biosafety (JBBS).

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