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Review Paper

The Introduction and Establishment of Dengue Disease in A New Area: A Mini Review

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ABSTRACT

Dengue fever virus is a mosquito-borne virus that poses a significant public health threat worldwide. Dengue virus is primarily transmitted by the *Aedes* mosquitoes, which develop in small man-made containers in urban environments. Climate change and urbanization have contributed to the spread of the *Aedes* mosquitoes, increasing the risk of dengue virus transmission in densely populated areas. Increasing the transmission of virus by *Aedes* mosquitoes increases the dengue infection. Additionally, factors such as poor sanitation, low community immunity levels, inadequate waste management and a lack of access to healthcare can also impact the establishment and spread of dengue fever. Globalization, international travel and tourism can introduce the virus to new regions and contribute to its establishment. These factors create ideal conditions for the *Aedes* mosquitoes to develop and for the dengue virus to establish and spread, posing a significant public health challenge.

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Introduction

Dengue fever, caused by the dengue virus, is a mosquito-borne virus that poses a significant public health threat worldwide. Dengue is the most important mosquito-borne viral disease in humans [1]. Dengue virus belongs to the genus *Flavivirus* of the family Flaviviridae with four serotypes, including DENV-1, DENV-2, DENV-3 and DENV-4, causing human infection [2]. Dengue has two human and sylvatic transmission cycles. The human transmission cycle occurs between humans in urban areas in 128 countries, where the main vectors are *Aedes aegypti* and *Aedes albopictus*. In contrast, the sylvatic transmission cycle occurs between non-human primates with occasional spillover into humans in the sylvan environments, which are forested areas in Southeast Asia and West Africa where the main vectors are *Aedes furcifer*, *Aedes luteocephalus* and *Aedes taylori* [3].

Today, dengue outbreaks occur at an increasing frequency and intensity in affected communities worldwide [1]. A wide range of clinical manifestations, from mild dengue fever to potentially fatal disease, such as dengue hemorrhagic fever or dengue shock syndrome, can occur [4]. Understanding the modes of transmission and spread is crucial for effective prevention and control strategies. The primary mode of transmission of dengue fever virus is through the bite of infected female *Aedes* mosquitoes, particularly *Ae. aegypti*. These mosquitoes are highly adaptive to urban environments and develop in small man-made containers commonly found in residential areas [5-10]. Their preference for biting humans during the daytime increases the risk of dengue virus transmission. Once an individual has been bitten by an infected mosquito, they become a potential carrier and can transmit the virus to other uninfected mosquitoes during subsequent bites. This process, known as vertical transmission or transovarial transmission, allows infected mosquitoes to pass on the virus to their offspring, perpetuating its spread [11, 12]. Moreover, dengue virus can also be transmitted by direct route through blood transfusions or organ transplants from infected donors. While rare, this mode poses additional challenges in preventing the introduction and establishment of dengue fever in new areas [9, 13].

The introduction and establishment of proven invasive vectors in a new area

The introduction and establishment of the dengue virus in a new area can be influenced by several key factors. Firstly, the presence of the main invasive vectors, including *Ae. aegypti* and *Ae. albopictus*, is crucial for the transmission of dengue virus. These mosquitoes develop in warm and humid environments, which are often found in tropical and subtropical regions. Additionally, stagnant water sources, such as discarded containers or improperly managed water storage systems, provide larval habitats for these mosquitoes. The proliferation of this mosquito species has been significantly influenced by climate change and urbanization, contributing to the increased risk of dengue in densely populated areas [14-18].

Factors affecting the import of dengue cases in a new area

Human factors also play a significant role in the establishment of the dengue virus. One of the key factors that affect importing dengue cases is the movement of people, especially in areas with a high population density. As people travel and relocate, they can inadvertently transport the *Aedes* mosquitoes and the dengue virus to new locations, facilitating the spread of the disease. Global trade and transportation can also contribute to the introduction of dengue virus to new regions, further complicating efforts to control its establishment. International travel and trade facilitate the movement of infected individuals and vectors across borders, increasing the risk of introducing the disease to new areas. Urbanization and population growth contribute to the expansion of suitable habitats for mosquitoes, as well as increased human-mosquito interactions. Furthermore, socioeconomic factors such as poverty and inadequate sanitation can exacerbate dengue transmission. These interconnected factors highlight the need for comprehensive and coordinated strategies to address the spread of dengue [12, 19-22].

Poor housing conditions with limited access to proper waste management systems and a lack of access to healthcare lead to an accumulation of potential mosquito larval habitats. Lack of awareness about preventive measures among communities may also hinder effective control efforts. Lastly, climate change can impact dengue establishment in new areas by altering temperature patterns and precipitation levels. These factors collectively create ideal conditions for the *Aedes* mosquitoes to develop and for the dengue virus to establish and spread, posing a significant public health challenge [12, 23-25].

Impact of environmental factors on the transmission of dengue virus

The transmission of dengue virus is greatly influenced by various environmental factors. One key factor is temperature, as the *Aedes* mosquitoes which transmit the virus responsible for dengue, develop in warm climates. Higher temperatures accelerate the mosquito life cycle and increase its biting rate, thus enhancing viral transmission. Additionally, temperature influences the incubation period of the virus within mosquitoes and affects its replication rate [12, 20, 26, 27].

Another crucial environmental factor is rainfall. Mosquitoes require water to breed, and heavy rainfall provides ideal larval habitats for them. Stagnant water accumulates in containers or natural depressions, serving as perfect breeding grounds for *Aedes* mosquitoes. Consequently, increased rainfall leads to a surge in mosquito populations and, subsequently, higher rates of dengue virus transmission. Urbanization also plays a significant role in dengue virus transmission [9, 24, 28-30].

Rapid urban growth results in increased human population density and changes in land use patterns. These alterations provide more favorable conditions for *Aedes* mosquitoes to breed and come into contact with humans. Urban areas often lack proper waste management systems, leading to an accumulation of discarded containers that serve as potential larval habitats. Furthermore, deforestation can contribute to the spread of dengue virus by disrupting natural ecosystems and increasing human-mosquito interactions [12, 26, 31].

Efforts to prevent and control the establishment of dengue

Efforts to control the establishment of dengue must also consider the role of socioeconomic factors. Poverty and overcrowding in urban areas can create environments that are conducive to the proliferation of the *Aedes* mosquitoes and the transmission of the dengue virus [32]. Inadequate housing and a lack of access to basic amenities can exacerbate the risk of dengue, making it essential to address these social determinants of health in prevention and control efforts. Furthermore, education and community engagement are crucial in raising awareness about the prevention of dengue as well as promoting behavior changes that can help reduce the risk of transmission [33]. In addition to these factors, the presence of other diseases can also impact the establishment of dengue. Coinfections with other mosquito-borne pathogens, such as Zika or chikungunya viruses, can complicate the clinical presentation of dengue and pose challenges for diagnosis and treatment [34]. Furthermore, the emergence of drug-resistant strains of the dengue virus can hinder efforts to control the disease, emphasizing the need for ongoing research and surveillance [35]. Addressing these multifaceted factors is essential for effectively managing the establishment and spread of dengue.

Efforts to control the establishment and spread of dengue must also take into account the impact of climate change [36]. Rising temperatures and changing precipitation patterns can create more favorable conditions for the *Aedes* mosquitoes to develop, expanding the geographic range of dengue [37]. Additionally, deforestation and urbanization can alter ecosystems, creating new habitats for mosquitoes and increasing the risk of disease transmission. Therefore, adaptation strategies that address the environmental drivers of dengue are crucial for long-term prevention and control. Furthermore, international collaboration is essential in addressing the global spread of dengue [38]. Sharing knowledge, resources and best practices across countries can help strengthen surveillance and response efforts, ultimately reducing the burden of the disease on a global scale. Additionally, investment in research and development of vaccines and innovative control measures is critical to mitigating the impact of dengue. By working together on a global scale, the international community can make significant strides in combating this public health threat.

Efforts to control dengue should also prioritize community-based interventions, such as clean-up campaigns and the use of insecticide-treated bed nets. These measures can help reduce mosquito larval habitats and minimize human-mosquito contact, ultimately lowering the risk of transmission. Additionally, public health campaigns that emphasize the importance of early detection and seeking medical care can lead to timely treatment and better outcomes for patients. Collaboration with local healthcare providers and community leaders is essential for the successful implementation of these interventions. Efforts to control dengue should also focus on educating the public about the importance of personal protection measures, such as wearing long-sleeved clothing and using insect repellents [39]. Empowering individuals to take proactive steps to reduce their risk of exposure can complement broader public health interventions and contribute to overall disease prevention. Additionally, leveraging technology and data-driven approaches for early detection and monitoring of dengue outbreaks can enhance response efforts and facilitate targeted interventions in high-risk areas. By integrating these strategies into comprehensive control programs, we can work towards reducing the global burden of dengue.

Ethical Considerations

Compliance with ethical guidelines

This article is a narrative mini-review with no human or animal sample.

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Conflict of interest

The author declared no conflict of interest.

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