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Advancing Dengue Virus Detection in Aedes Larvae: An Alternative Approach for Dengue Active Surveillance

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Abstract

Dengue fever remains a significant public health concern in many parts of the world, particularly in tropical and subtropical regions. Traditional methods of dengue surveillance primarily focus on monitoring human cases, which often results in delayed responses to outbreaks. This literature review explores the potential of utilizing Aedes larvae as an alternative means for dengue virus detection, providing insights into the development of effective strategies for dengue active surveillance. Through an analysis of existing research, this article highlights the advantages, challenges, and future prospects of this approach.

Keywords: Dengue • Virus • Aedes larvae

Introduction

Dengue fever, caused by the dengue virus transmitted primarily by Aedes mosquitoes, is a major global health issue. Current methods of dengue surveillance heavily rely on monitoring human cases, which often leads to delayed responses to outbreaks and limits the effectiveness of control measures. Detecting the presence of dengue virus in Aedes larvae presents a promising alternative approach for active surveillance, offering the potential for early detection and proactive management of dengue outbreaks. This literature review aims to explore the feasibility and implications of utilizing Aedes larvae for dengue virus detection, providing valuable insights for public health practitioners and researchers [1].

Literature Review

A comprehensive search of electronic databases, including PubMed, Web of Science, and Google Scholar, was conducted to identify relevant studies on dengue virus detection in Aedes larvae. Keywords such as "dengue virus," "Aedes larvae," "detection," and "surveillance" were used to retrieve relevant articles published in peer-reviewed journals. Studies that investigated methods, techniques, and challenges associated with dengue virus detection in Aedes larvae were included in this review [2].

Monitoring Aedes larvae for the presence of dengue virus can serve as an early warning system for potential outbreaks, enabling timely intervention measures. Identifying infected larvae allows for targeted vector control strategies, such as larviciding, to reduce mosquito populations and prevent the spread of dengue. Surveillance of Aedes larvae provides valuable information on the presence and distribution of dengue virus in the environment, aiding in risk assessment and management. Compared to traditional human-based surveillance methods, monitoring Aedes larvae for dengue virus can be a cost-effective approach, especially in resource-limited settings. Larval surveillance offers the advantage of continuous monitoring throughout the year, regardless of seasonal variations in dengue transmission [3].

Polymerase Chain Reaction (PCR) and quantitative PCR (qPCR) are sensitive molecular techniques used for detecting dengue virus RNA in Aedes larvae. Enzyme-Linked Immunosorbent Assay (ELISA) and Immunofluorescence Assays (IFA) can be employed to detect dengue virus antigens in Aedes larvae. Virus isolation techniques involve inoculating Aedes larvae with dengue virus and subsequently culturing the virus in suitable cell lines for detection. NGS technologies enable comprehensive analysis of viral genomes present in Aedes larvae, allowing for strain identification and evolutionary studies [4].

Discussion

Obtaining an adequate number of Aedes larvae samples for surveillance can be challenging, particularly in urban or densely populated areas. Sensitivity of detection methods may vary, impacting the reliability of results obtained from Aedes larvae surveillance. Not all Aedes larvae may become infected with dengue virus, affecting the accuracy of surveillance data. Environmental conditions such as temperature and humidity can influence the presence and viability of dengue virus in Aedes larvae, affecting detection outcomes. Implementing larval surveillance programs requires financial resources, trained personnel, and infrastructure, which may not be readily available in some settings [5].

Continued research is needed to improve the sensitivity and specificity of detection methods for dengue virus in Aedes larvae, including the development of novel molecular and serological assays. Integrating larval surveillance with existing human-based surveillance systems can enhance the overall effectiveness of dengue control efforts. Utilizing Geographic Information Systems (GIS) and temporal analysis techniques can provide valuable insights into the spatial and temporal dynamics of dengue transmission based on larval surveillance data. Engaging local communities in larval surveillance activities can foster community participation and support for dengue control initiatives. Adopting a One Health approach that considers the interconnectedness of human, animal, and environmental health can facilitate a holistic approach to dengue surveillance and control [6].

Conclusion

Dengue virus detection in Aedes larvae offers a promising alternative approach for active surveillance, providing early warning of potential outbreaks and targeted vector control measures. Despite challenges and limitations, advancements in detection methods and research efforts hold great potential for enhancing the effectiveness of dengue control programs. By integrating

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larval surveillance with existing surveillance systems and adopting a multidisciplinary approach, public health authorities can mitigate the impact of dengue fever and contribute to global efforts to combat vector-borne diseases.

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Conflict of Interest

None.

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