Editorial

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From dengue to chikungunya: Guangdong as a sentinel for arboviral threats in East Asia

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SUMMARY: Chikungunya virus (CHIKV), an emerging mosquito-borne alphavirus, poses an escalating global public health threat due to its rapid geographic expansion and increasing outbreak frequency. While most infections present with acute fever and severe polyarthralgia, a significant proportion of patients develop chronic, disabling joint symptoms. Recent local transmission in subtropical urban regions of China, and particularly Guangdong Province, where over 4,800 cases were reported in Foshan alone by July 2025, highlights the virus's adaptability to new environments. Globally, over 220,000 cases and 80 deaths were reported in the first half of 2025 across 14 countries, with Brazil accounting for the majority of the reported cases. Climate factors, viral evolution, and human mobility are major drivers of the virus' spread. Despite the growing threat, no specific antiviral treatment or licensed vaccine is currently available. An effective response requires integrated strategies combining vaccine development, vector control, early warning systems, and climate-adaptive public health planning to mitigate further transmission and its health and socioeconomic impact.

Keywords: chikungunya virus (CHIKV), mosquito-borne disease, Guangdong outbreak, climate change, public health response

1. Introduction

Chikungunya virus (CHIKV) is a mosquito-borne alphavirus from the Togaviridae family, which causes chikungunya fever (CHIKF) and poses a growing global public health threat. CHIKF typically presents as acute fever accompanied by severe polyarthritis and myalgia (*1*). Although CHIKF is mostly self-limiting, chronic arthritis-like symptoms can persist for months or even years in some patients, leading to functional disability and severely affecting quality of life. This is particularly problematic in resource-poor regions, where it causes a significant socio-economic burden (*2*).

In recent years, CHIKV has expanded beyond traditional tropical areas, emerging as a major concern for global health security. Since 2010, multiple local outbreaks have occurred in China, indicating the virus' ability to sustain transmission in subtropical urban environments (*3*). By July 26, 2025, Foshan has reported a total of 4,824 confirmed cases, with the outbreak spreading to other cities in the Pearl River Delta, such as Guangzhou, Zhongshan, and Dongguan (Figure 1) (*4*). The outbreak was triggered by imported cases, with climate factors such as high temperature and humidity after typhoons, which promote mosquito breeding and enhanced viral strain transmissibility, being identified as key driving factors (*5*).

The spread of CHIKV extends far beyond China. In the first half of 2025, 14 countries and regions reported 220,000 cases and 80 deaths globally (*6*). The majority of cases were in the Americas (mainly Brazil, accounting for 64%), followed by Asia with over 33,000 cases, and ongoing outbreaks in Africa. Although Europe has not reported local transmission, its overseas territories, such as Réunion Island (with over 51,000 cases and an ongoing ORSEC Level 4 public health emergency response) and Mayotte Island, have entered an epidemic phase (Figure 2) (*6,7*). The World Health Organization (WHO) has designated CHIKV as a priority pathogen for global vaccine development and control (*8*). On July 4, 2025, WHO issued the "WHO guidelines for clinical management of arboviral diseases: Dengue, Chikungunya, Zika and Yellow Fever," warning of the trends in the widespread transmission of vector-borne diseases (*9*). Despite the growing health threat from CHIKV, there is currently no specific antiviral treatment, and a vaccine is still in clinical development. Since 2017, the Coalition for Epidemic Preparedness Innovations

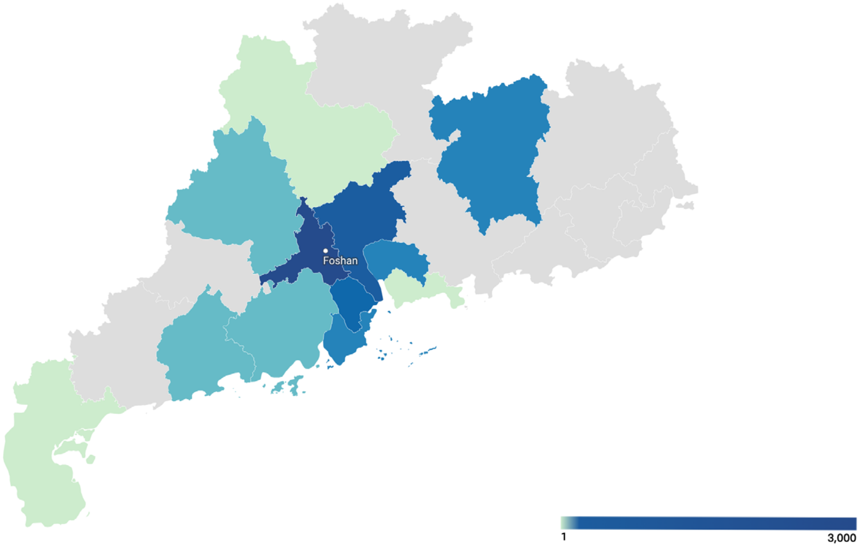

Figure 1. Locally acquired Chikungunya cases reported in Guangdong Province from July 20 to July 26, 2025.

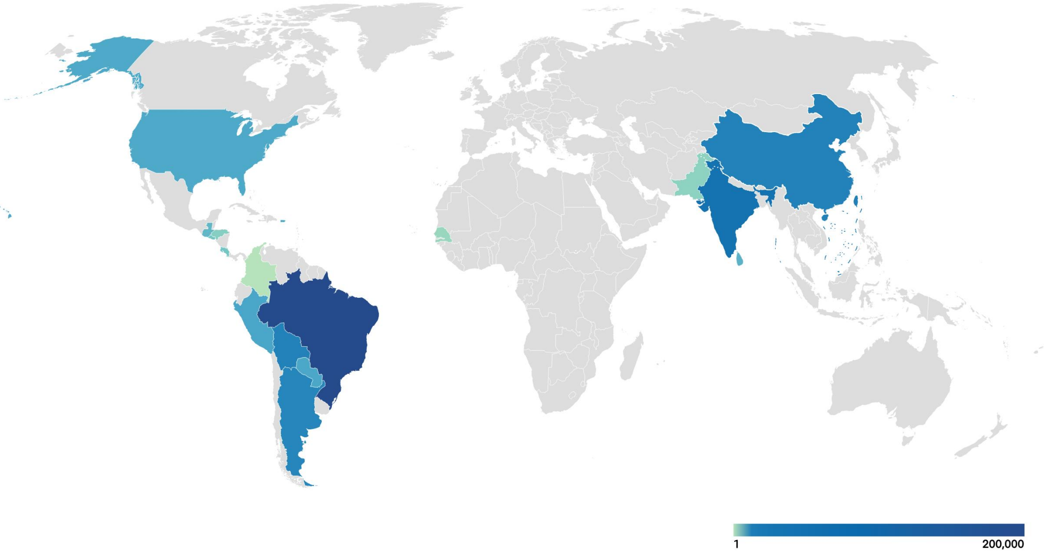

Figure 2. CHIKV disease case notification rate per 200,000 population, March 2025 - July 2025. The data represent reported cases of CHIKV infection from March to July 2025. Case counts were compiled from both official public health authorities and non-official sources, including news media. Depending on the data source, both autochthonous (locally acquired) and non-autochthonous (imported) cases may be included.

(CEPI) has included CHIKV in its list of priority pathogens for vaccine development, but a vaccine is still some years away. Therefore, vector control remains the main line of defense (*10*). A multi-layered response strategy integrating vaccine development, precise vector control, and community engagement is essential to addressing the spread of CHIKV (*11,12*).

Global warming not only expands the geographical range and prolongs the season suitable for mosquito breeding but it also increases the efficiency of virus transmission. Additionally, dense human populations act as "high-speed pathways" for cross-regional virus spread. Previous prevention and control strategies face significant challenges. The urgent need is for vector surveillance, early warning systems, cross-border collaborative defense mechanisms, and climate-adaptive public health strategies to be at the heart of health defense systems in the future.

2. Environmental and epidemiological context

Guangdong is located in a subtropical monsoon climate zone with an average annual temperature of 22-25°C and annual precipitation exceeding 1,800 mm. High temperature and humidity provide ideal breeding conditions for Aedes aegypti and Ae. albopictus. Studies show that the larvae of these two mosquito species develop most rapidly at water temperatures between 25-30°C, and higher humidity increases the frequency of blood-feeding in adult mosquitoes, which in turn enhances virus transmission efficiency (*13,14*). Guangdong's hot and humid climate is a key ecological factor driver of local mosquito-borne viruses transmission.

At the same time, rapid urbanization, increased population density, and complex infrastructure further amplify the risk of mosquito-borne disease transmission. In the core area of the Pearl River Delta, the population density exceeds 7,000 people per square kilometer, leading to "frequent human–mosquito interactions" that significantly increase individual exposure risk (*15*). During urban development, artificial water sources such as puddles at construction sites, flowerpot trays, discarded containers, and poorly maintained urban water systems become major breeding grounds for mosquitoes, allowing mosquito populations to breed on a large scale (*16*). As a key national transportation hub and a major destination for migrant workers, Guangdong receives about 23% of the country's incoming travelers annually (*17*), and the frequent international movement of people significantly increases the likelihood of imported cases triggering local transmission.

An important point worth noting is that CHIKV, like dengue virus (DENV) and Zika virus (ZIKV), has adapted from a forest transmission cycle to an urban transmission cycle, no longer requiring non-human primates to maintain its transmission chain. In densely populated urban areas where mosquitos are active, CHIKV can sustain low-level transmission in the population, and once conditions are favorable, it can lead to large-scale outbreaks (*11*).

According to an epidemiological study of dengue fever released by the Chinese Center for Disease Control and Prevention (CCDC) on October 11, 2024, a total of 117,892 dengue cases were reported nationwide from 2005 to 2023, with Guangdong accounting for over half of the cases, totaling 68,070 (57.74% of the total cases) (*18*). In 2024, Guangdong experienced another dengue outbreak, with more than 10,000 reported cases by the time of the report (*19*). This outbreak provides important empirical data on the local transmission risk of mosquito-borne viruses. The outbreak not only demonstrates that densely populated urban areas with high mosquito densities provide an ideal platform for virus transmission but also underscores the importance of a rapid response and effective vector control in reducing the risk of virus spread.

Of particular note, CHIKV shares the same mosquito hosts — Ae. albopictus and Ae. aegypti — with DENV. This biological similarity means that prevention and control measures for CHIKV can directly draw on those used for dengue, particularly in addressing the "imported cases + high mosquito density + delayed response" risk framework in the early stages of an outbreak. This framework underscores the fact that timely and effective vector control is crucial to interrupting the virus transmission chain. In fact, past dengue outbreaks have shown that failure to take timely control measures after imported cases often leads to uncontrolled local transmission, resulting in large-scale outbreaks.

Based on current trends and historical data, priority must thus be given to early vector surveillance, rapid identification of sources of viral importation, and the swift initiation of response mechanisms in CHIKV prevention. This is not only a necessary measure for dealing with CHIKV outbreaks but also an important safeguard to enhance overall mosquito-borne virus control capacity.

3. Public health challenges exposed

The recent CHIKV outbreak in Foshan, Guangdong, has highlighted the significant challenges faced by the grassroots epidemic monitoring system. As an example, there was a 7-day delay between the discovery of the first case (July 8) and the initial report (July 15), far exceeding the typical CHIKV transmission cycle of 3–4 days (*20,21*). This delay highlights deficiencies in timely detection within the early warning system. In the absence of effective preventive interventions, epidemic control relies entirely on passive monitoring and vector control. This dual disadvantage — delayed monitoring and a lack of population immunity — significantly lowers the outbreak threshold.

Clinically, primary healthcare facilities face diagnostic challenges when identifying CHIKV's non-specific acute symptoms (such as fever and rash), leading to a high rate of misdiagnosis and confusion with dengue fever in particular (*22*). Vector control also suffers from systemic flaws, with chemical insecticide spraying mostly occurring only after an outbreak has occurred. Seasonal mosquito control efforts are inconsistent and insufficient. The extent of breeding site elimination remains inadequate, and especially in areas with limited environmental management, such as ponds and wetlands. Additionally, mosquitoes have developed a high level of resistance to commonly used pyrethroid insecticides (*23,24*). The compounded errors of inaccurate clinical diagnosis and delayed control measures have caused critical windows for interrupting the transmission chain to be repeatedly missed.

At the community level, confusion over the recognition of CHIKV is a major obstacle to effective prevention. Residents often misinterpret the disease's characteristic joint pain as strain or ordinary arthritis, leading to delays in seeking medical attention and missing the intervention window during the viremia phase. Moreover, the difficulty in distinguishing between

CHIKV and DENV results in significantly lower protective behavior among the public (*22*). Gaps persist in the existing health education and communication systems, and standardized prevention information does not adequately reach areas with highly fluid populations. Furthermore, the current one-way communication model has failed to translate into practical protective behaviors, leading to a disconnect between knowledge dissemination and action. The "cognitive gap — behavioral inertia — failed intervention" feedback loop continues to weaken the community-level protective barrier (*25*).

4. Strategic recommendations

To overcome the current bottlenecks in mosquito-borne disease control, the urgent necessity is to formulate a multi-layered, enhanced prevention and control strategy. First, a comprehensive digital mosquito-borne disease monitoring network should be established, integrating pathogen screening at sentinel hospitals, dynamic vector density assessments, and real-time meteorological data analysis to establish a multidimensional early warning system capable of detecting emerging risks (*26*). This network would not only allow for real-time monitoring of virus transmission dynamics but also enable adjustments to control strategies based on real-time data, significantly improving the efficiency and accuracy of emergency responses.

Additionally, the rapid development of tropical virus laboratory capabilities is crucial, and especially the capacity for high-throughput testing and genotyping of multiple pathogens, including CHIKV, DENV, and ZIKV (*27*). Building such laboratories will facilitate accurate tracing and provide scientific data with which to predict viral mutations and epidemic trends.

Building on that step, a key task is to create a routine provincial-level response mechanism, incorporating mosquito control threshold-based responses into routine public health operations. When, for example, the Breteau Index remains above 10, emergency insecticide measures should be implemented (*28*). Moreover, community mobilization plans should be formulated to normalize prevention and control efforts, shifting from a reactive approach during outbreaks to a proactive defense model. This mechanism would enable year-round surveillance and vector control, preventing epidemic spread due to a delayed response.

At the regional cooperation level, a real-time cross-border case information reporting platform needs to be created under the Guangdong-Hong Kong-Macao Greater Bay Area health integration framework. This platform would cross administrative boundaries, enabling real-time sharing and coordinated control of case data throughout the region, significantly enhancing coordinated response capacity (*29*). At the same time, unified vector control technical standards should be devised and joint emergency drill mechanisms should be created to address fragmented cross-regional prevention and control.

Finally, a widely available vaccine does not yet exist, so accelerating local vaccine clinical trials should be prioritized in light of the current vaccine gap (*30*). Additionally, exploring vaccine pre-purchase agreements and reserve pathways would provide strategic reserves for future vaccine interventions. This strategy aims to ensure a quick response in the event of an outbreak and achieve effective vaccination coverage. By integrating multiple dimensions such as early warning systems, standardized response mechanisms, regional collaboration, and technical reserves, this framework should create a resilient and responsive mosquito-borne disease prevention and control ecosystem (Figure 3).

5. Broader implications for global health

Guangdong, as a key observation point for the interaction between climate change and emerging infectious diseases in China and East Asia, offers valuable insights for understanding and addressing global climate-sensitive diseases due to its unique geography, climate,

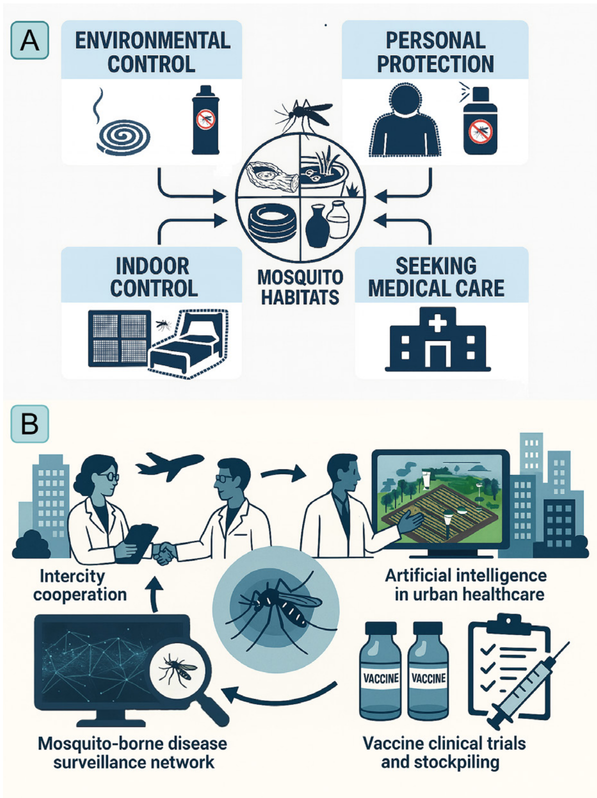

Figure 3. The integrated ecological framework for mosquito-borne disease prevention. (A) Personal and community protection are necessary measures. The first line of defense against mosquito-borne diseases is afforded by personal protection measures such as insect repellents, mosquito nets, and long-sleeved clothing. **(B)** Broader community and environmental interventions have evolved from individual-level protection. The synergy between micro- and macro-level strategies in interrupting transmission cycles and controlling mosquito populations in subtropical urban settings is underscored by this layered framework.

and population characteristics. The region's subtropical hot and humid climate is intensifying due to global warming. When this is combined with the population dynamics of its megacities and its role as an international transportation hub, it means that Guangdong is a natural laboratory for studying how climate change intensifies the transmission dynamics of mosquito-borne viruses (*31*). This combination of ecological and social risks makes Guangdong highly representative in the study and intervention of emerging viruses (such as DENV, CHIKV, and ZIKV) (*32*).

More importantly, Guangdong has established an adaptive comprehensive mosquito-borne virus governance system amidst rapid urbanization. Driven by the recurrent outbreaks of diseases like dengue, the province has gradually built an integrated model of "monitoring–response–community mobilization," which includes AI-driven real-time mosquito risk warnings, cross-border regional defense mechanisms, environmental management in high-risk areas like informal urban settlements (i.e., "urban villages"), and public health education strategies involving community participation (*33,34*). This governance experience not only proves the feasibility of interrupting vector transmission pathways in high-density urban environments but also provides a policy and practice template for developing countries similarly facing the dual pressures of urbanization and infectious diseases.

Therefore, experiences adapting to health risks should be shared among countries in the Global South under the "South-South Cooperation" framework. Against the backdrop of intensifying climate change, developing countries need to jointly create early warning and response networks to deal with climate-sensitive diseases, collaborate to innovate vector control technologies, and enhance disease monitoring and intervention at lower levels. At the same time, climate health risks should be integrated into urban planning, infrastructure development, and social governance systems, shifting from reactive emergency responses to proactive collective resilience (*35,36*). Only by turning regional governance models into collective multinational action can countries in the Global South effectively combat the growing threat from infectious diseases amidst climate change.

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