

7. VECTOR SURVEILLANCE AND CONTROL

In the absence of an effective CHIKV vaccine, the only tool available to prevent infection is reduction of human-vector contact. The primary vectors of CHIKV are *Ae. aegypti* and *Ae. albopictus*. *Ae. aegypti* is the principal vector in areas of Africa where the virus is considered to be endemic. However, *Ae. albopictus* was incriminated during recent epidemics following introduction of the virus into temperate Europe¹⁷ and some tropical areas of the Indian Ocean^{27, 57}. These outbreaks were associated with adaptation of CHIKV strains to *Ae. albopictus*^{58, 59}. Both *Ae. aegypti* and *Ae. albopictus* are present in the Americas (Figures 4 and 5). *Ae. aegypti* will likely be the most important vector in urban areas, and *Ae. albopictus* will likely play a more significant role in temperate areas and areas where it is well established. Both mosquitoes could support the introduction of CHIKV strains into a variety of geographic areas in the region. Therefore, vector control planning efforts should focus on suppression of both *Ae. aegypti* and *Ae. albopictus* populations to prevent the likelihood of CHIKV establishment, and to lay the foundation for emergency interventions in the event of an outbreak.

Figure 4: Distribution of *Ae. aegypti* in the Americas (adapted from Arias 2002⁶⁰)

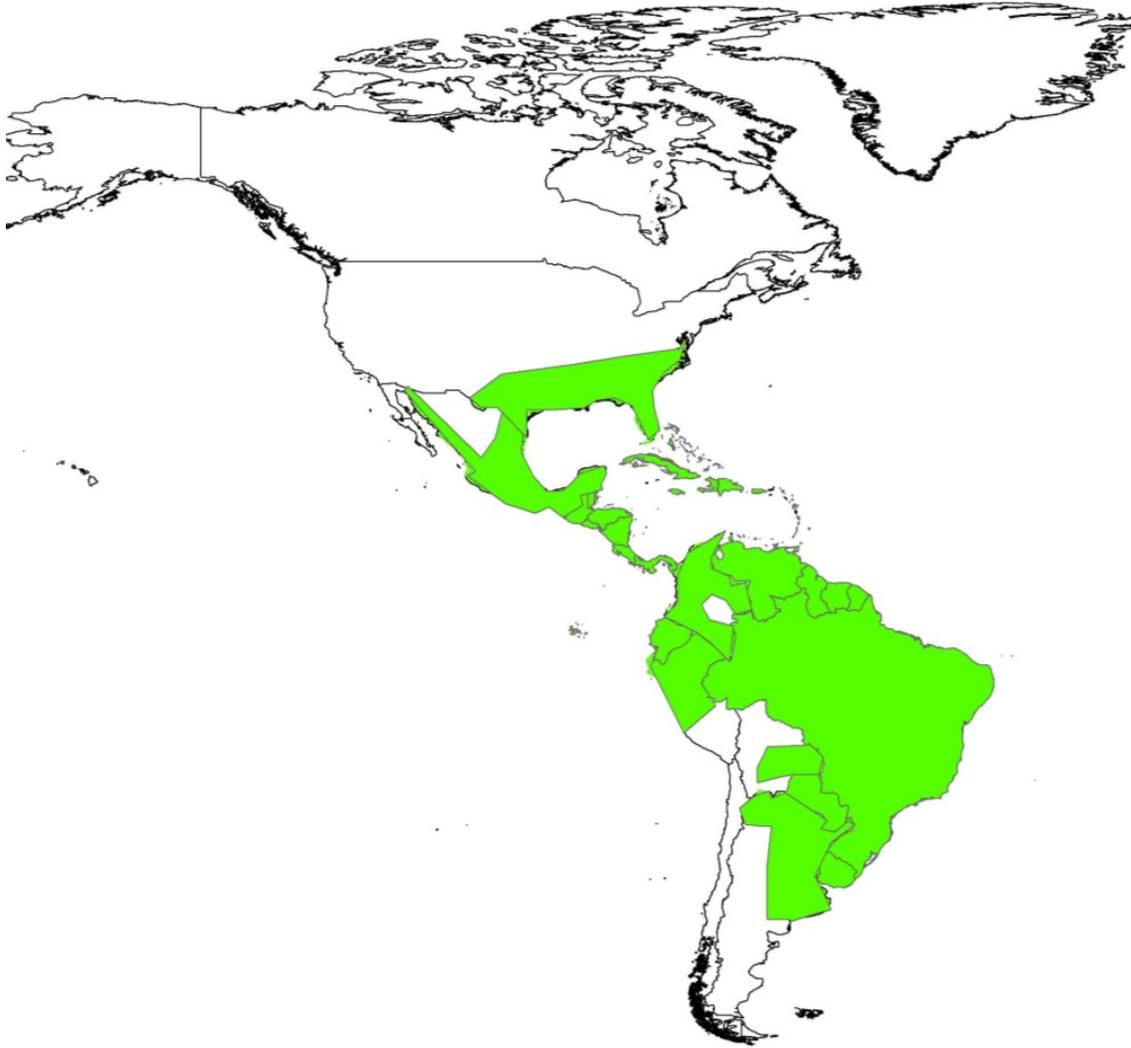
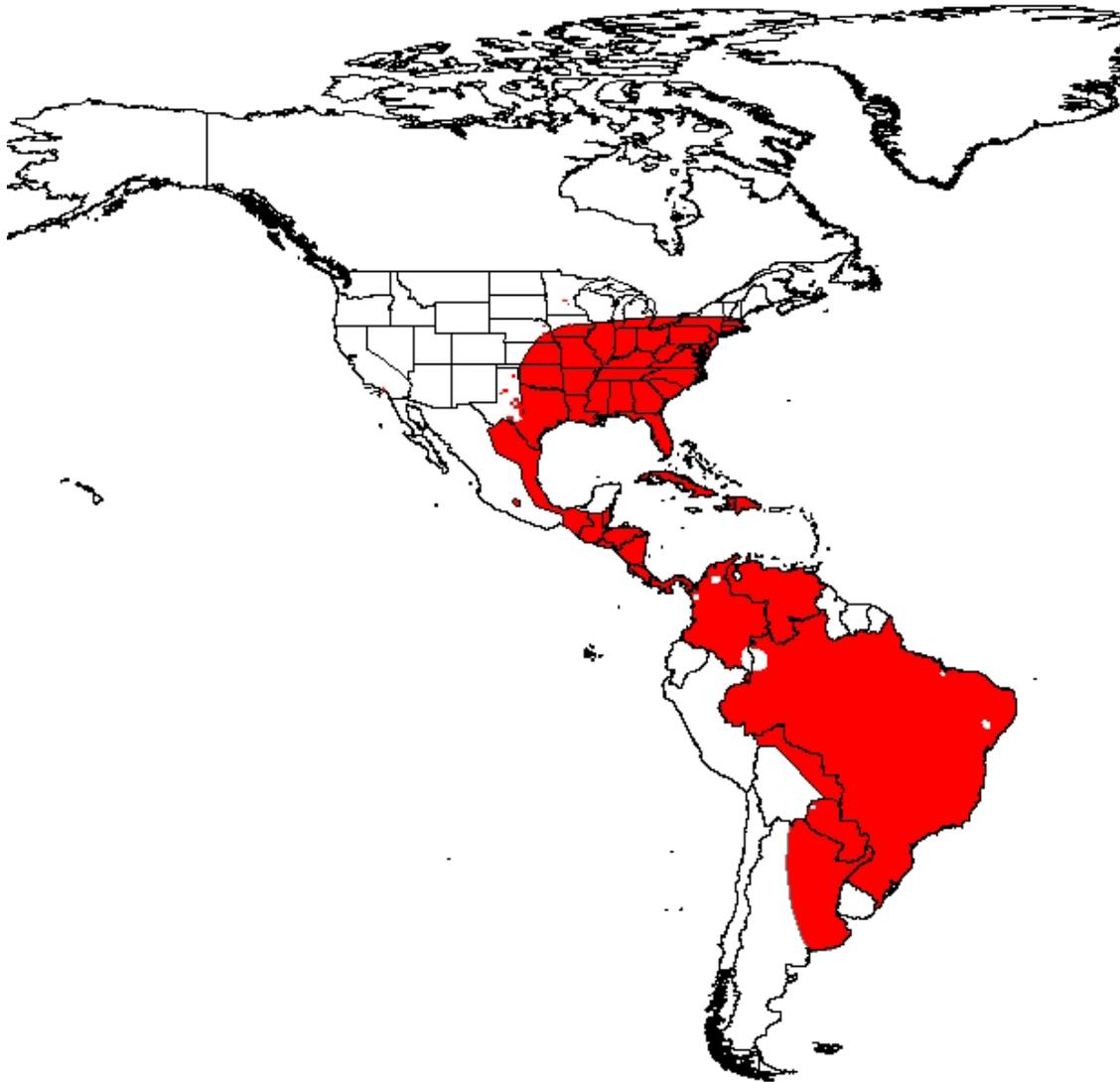


Figure 5: Approximate Distribution of *Ae. albopictus* in the Americas (adapted from Benedict et al. 2007⁶¹)



There are some significant differences between *Ae. aegypti* and *Ae. albopictus* that must be accommodated in developing surveillance and control procedures. *Ae. aegypti* is more closely associated with humans and their homes and feed preferentially on humans. Adult *Ae. aegypti* rest indoors and

larval habitats are most frequently containers on the household premises. *Ae. albopictus* feeds readily on humans but also utilizes a broader range of bloodmeal hosts⁶², and larvae occur in peridomestic habitats as well as surrounding natural habitats. *Ae. albopictus* can overwinter in the egg stage and therefore occupy more temperate climates⁶³ than *Ae. aegypti*. These species have distinct morphological features and identification of specimens collected during surveillance and control programs in the Americas can be readily accomplished^{64, 65}.

An effective, operational dengue control program provides the basis for CHIKV preparedness because the biology and control procedures for *Ae. aegypti* are similar to those of *Ae. albopictus*. Surveillance and control recommendations developed for dengue management⁶⁶ as a component of the Integrated Management Strategy for Dengue Prevention and Control (EGI-Dengue) may be utilized and intensified in order to respond to a CHIKV introduction. Successful control programs require well trained professional and technical staff and sufficient funding. In addition, an independent quality assurance program should be incorporated into the integrated vector management (IVM) scheme.

To be successful, the CHIKV IVM program must include intersectoral participation (collaboration) at all levels of government and between health, education, environment, social development, and tourism agencies. IVM programs also benefit from participation of NGOs and private organizations. CHIKV control program must communicate with and mobilize the entire

community⁶⁷. Community participation is an essential component of IVM⁶⁸. An IVM strategy must be developed and in place before CHIKV is introduced to be effective.

7A. Reducing the Risk of CHIKV

Components of an IVM program to reduce CHIKV risk include:

1. Vector Surveillance and Identification of High Risk Areas

In areas where dengue is endemic, a retrospective analysis of DEN virus transmission during previous years should be conducted during the CHIKV planning phase to provide an indication of the areas where CHIKV is expected to circulate (given the similarity in transmission cycles of these viruses). Areas can be stratified in terms of risk of transmission⁶⁹. Stratification is then used to assign resources and priorities. For example, controlling or preventing CHIKV transmission in neighborhoods that traditionally have produced many cases of dengue should inhibit virus amplification and virus spread to nearby neighborhoods.

The program must have the ability to systematically collect surveillance data on relative densities of *Ae. aegypti* and *Ae. albopictus*. Surveillance methods for *Ae. aegypti* and *Ae. albopictus* are varied and include methods to monitor egg production, larval sites, pupal abundance, and adult abundance. These methods are reviewed in Chapter 5 of the WHO Dengue Guidelines⁶⁶. New traps and sampling methods are being developed that may provide more accurate surveillance data^{70, 71}. Programs must be able to detect and identify

hidden and difficult to control larval sites (e.g., cryptic locations such as septic tanks, storm drains, sump pumps, vacant lots) and other productive sites as well as the readily identified and commonly found larval habitats.

2. Personal protection

Individuals may reduce the likelihood of infection by the use of personal repellents on skin or clothing. DEET and picaridin (also known as KBR3023 or Bayrepel™) are effective repellents widely available in the Americas. Infants and others sleeping or resting during the day should use bednets to avoid infection from *Ae. aegypti* and *Ae. albopictus*, both of which are day biting mosquitoes. It is of particular importance that individuals who are potentially infected with CHIKV during an outbreak rest beneath an IT bednet to avoid mosquito bites and further spread of infection. Use of IT bednets has the additional benefit of killing mosquitoes that come into contact with the net, which may reduce vector-human contact for other household members⁷². A number of pesticide products may be used to safely treat bednets (Table 6), or long-lasting pretreated nets can be obtained commercially.

Table 6. WHO recommended insecticide products for treatment of mosquito nets^a

1. Conventional Treatment:		
Insecticide	Formulation^b	Dosage^c
Alpha-cypermethrin	SC 10%	20-40
Cyfluthrin	EW 5%	50
Deltamethrin	SC 1%; WT 25%; and WT 25% + Binder ^d	15-25
Etofenprox	EW 10%	200
Lambda-cyhalothrin	CS 2.5%	10-15
Permethrin	EC 10%	200-500

2. Long-Lasting Treatment:		
Product Name	Product Type	Status of WHO Recommendation
ICON® MAXX	Lambda-cyhalothrin 10% CS + Binder Target dose of 50 mg/m ²	Interim

^aAdapted from http://www.who.int/whopes/Insecticides_ITN_Malaria_ok3.pdf

^bEC = emulsifiable concentrate; EW= emulsion, oil in water; CS = capsule suspension; SC= suspension concentrate; WT=water dispersible tablet

^cMilligrams of active ingredient per square meter of netting.

^dK-O TAB 1-2-3

3. Household Prevention

The use of intact screens on windows and doors will reduce entry of vectors into the home, and mosquito proofing water storage vessels will reduce oviposition sites and local production. Within a household, use of IT bednets⁷² and IT curtains⁷³ also reduce vector-human contact.

The number of adult mosquitoes in a home may be reduced by use of commercially available pyrethroid-based aerosol sprays and other products designed for the home such as mosquito coils and electronic mat vaporizers. Aerosol sprays may be applied throughout the home, but areas where adult mosquitoes rest (dark, cooler areas) should be targeted including bedrooms,

closets, clothing hampers, etc. Care should be taken to emphasize proper use of these products when advocating to the public in order to reduce unnecessary exposure to pesticides.

4. Neighborhood and Community Prevention

Neighborhood and community prevention for a CHIKV introduction in the Americas should be based on methods developed for dengue control utilizing effective strategies to reduce the densities of vector mosquitoes⁶⁶. A fully operational dengue control program will reduce the probability that a viremic human arriving in the Americas will be fed upon by *Ae. aegypti* or *Ae. albopictus* mosquitoes leading to secondary transmission and potential establishment of the virus.

Dengue programs for controlling *Ae. aegypti* have traditionally focused on control of immature mosquitoes, often via community involvement in environmental management and source reduction. It is essential that community involvement be incorporated into an IVM program^{74, 75}.

Vector Control Procedures

The WHO Dengue Guidelines⁶⁶ provide information on the main methods of vector control and should be consulted to establish or improve existing programs. The program should be managed by experienced professional vector control biologists to assure that the program uses current pesticide recommendations, incorporates new methods of vector control and includes

resistance testing. Prevention programs should utilize the methods of vector control found in Appendix F, as appropriate^{66, 74}.

7B. Response to CHIKV Introduction

Immediately after confirmation of the first autochthonous CHIKV case, the health department should provide information regarding the onset data and location of the case to the IVM program. Vector control procedures must be intensified to effectively reduce the abundance of infected vectors in order to halt transmission in the areas of the case(s). Simultaneously, emergency response committees at local and national levels should be informed of the situation and activated. Initial effort should focus on containing virus transmission and preventing expansion (Appendix G). If virus containment fails, or if cases are not detected until the outbreak has spread over a large geographic area, intensive vector control efforts will need to be expanded to a larger scale program.

Summary of Vector Surveillance and Control Section

- Early detection of disease will increase the likelihood of containing transmission of CHIKV in the area
- Successful Integrated Vector Management for CHIKV requires trained experts in medical entomology and vector control, sufficient resources and a sustained commitment
- Current dengue control programs in the region should be utilized and improved to prevent CHIKV transmission
- Vector surveillance and control activities and methodologies must be validated and continually evaluated to measure efficacy