

Appendix G: Vector Control for CHIKV Containment

Virus containment efforts should be initiated upon discovery of a CHIKV case or cluster (introduced or autochthonous transmission), simultaneous with activating the local emergency response capacity. The purpose of containment is to eliminate the newly introduced CHIKV and to prevent its spread using intensive vector control measures. This concept has been applied to contain the invasion and spread of dengue viruses in non-endemic areas⁸⁴. Even if CHIKV spreads into an urban area of a country, containment should be considered a primary strategy to avoid its spread elsewhere in the country and into neighboring countries. Application of vector control measures should start at homes of detected CHIKV cases (or suspected site of infection) and be applied to the entire neighborhood. Because of delays in case detection and notification, it is likely that CHIKV may have already spread to other parts of the neighborhood⁸⁵. Request the involvement of local authorities to gain access to closed or abandoned properties. The entire emergency containment operation needs to be conducted rapidly, so human and other resources devoted to this effort should be matched to the size of the containment area. Malaria control personnel and others with suitable training may be utilized to accomplish goals of the containment effort.

The following actions are recommended to contain an introduction of CHIKV:

1. In addition to participating in a national communication effort, inform the community (residents, schools, churches, businesses, etc.) immediately of the CHIKV introduction. Topics should include mode of spread,

- symptoms, advice to consult a physician if symptoms appear, and community involvement to eliminate standing water from containers and to allow health inspectors into homes for application of anti-mosquito measures. Prepare the community so that CHIKV containment operations can be conducted more efficiently and rapidly in residential and commercial properties as well as public spaces and parks.
2. Conduct indoor and outdoor insecticide applications to eliminate adult mosquitoes. Details on insecticides, dosages, and precautions can be found in Table F3 and WHO publications^{66, 77, 86}.
 3. Simultaneously, conduct container elimination/protection and larviciding to eliminate the production of new mosquitoes. Special attention should be given to cryptic or subterranean bodies of water that can produce *Aedes* mosquitoes such as roof gutters, drains, wells, elevated water tanks, water meters, and even septic tanks⁸⁷. Water storage containers and animal drinking pans should be cleaned (scrubbing and rinsing) and protected with tight covers. Some containers, such as useful implements (paint trays, buckets) and bottles should be stored upside-down under a roof. Large objects that accumulate rain water (boats, cars) should be properly covered. Containers that cannot be managed for any reason should be treated with a larvicide. For example, containers holding water for animal or human consumption require the application of larvicides that have been licensed in the country for that particular purpose. WHO's approved larvicides used to treat potable water-storage containers are provided in

Appendix F, in the section - Chemical control of larval habitats. All pesticides should always be used following their label specifications. Other larvicides that can be applied to containers holding non-potable water, see Table F2^{66, 77, 86, 88}.

4. Alternatively or concurrently with source reduction/management, residual insecticides can be applied to containers holding non-potable water (inner/outer walls) to kill the larvae and pupae and to nearby outdoor surfaces to kill landing or resting adult mosquitoes. This type of insecticide application is done with hand-held compression sprayers and much care has to be placed to avoid spraying near unprotected water-storage containers or pets^{66, 77}.
5. Monitor houses and buildings in the neighborhoods that are being treated and implement special control rounds after working hours, weekends, and holidays to assure that nearly 100% of homes and businesses are treated.

Outbreak Intervention

Controlling an epidemic of CHIKV or a series of outbreaks over a larger geographic scale requires:

1. Activation of a command center (Emergency Operations Center), either physical or virtual, where epidemiologists, entomologists and vector control specialists, educators, media communicators, etc., can jointly plan, work, and evaluate progress throughout the epidemic. Epidemiological services need to be organized in a way that daily, detailed reports are sent

- to all authorized personnel in the affected areas (states, municipalities). To be successful, it will be necessary to establish an efficient system of communications, allowing feed-back reports and receipt acknowledgements (e-mail, fax, phones, etc.).
2. Orienting the population at large through the media on the possibility of resulting infection with CHIKV and on how families and communities can contribute to the abatement of the epidemic. Educational materials on specific actions to prevent or control CHIKV transmission should be elaborated and distributed by various media (TV, radio, newspapers, local organizations, schools, clinics, etc.). It would be important to report daily (press) what communities or neighborhoods are being affected by CHIKV, so that the residents and local authorities are aware of imminent risk of infection and can take appropriate actions (e.g., proper use of repellents, elimination of all standing water, organizing clean-up campaigns, etc.). Dissemination of this information needs to be done in a way that no personal information or identifiers are released to the public at any time.
 3. Ensure that infected and febrile persons are protected from mosquito bites by using bednets at home and in hospitals.
 4. Orienting vector control operations by real-time epidemiological and entomological assessments of CHIKV transmission, indicating the specific areas that need to be treated. In areas where dengue is endemic, knowledge from a retrospective analysis of DEN virus transmission or

previous experience with DEN viruses should be used to guide vector control operations.

5. Applying effective vector control measures. An epidemic is generally a series of smaller outbreaks occurring simultaneously in several different places within a country (neighborhoods, cities, municipalities, states), where the number of disease cases is unusually large. This means that epidemic control measures may need to be applied concurrently in several locations. Large area control of mosquito populations over short periods of time by spraying insecticides from truck- or aircraft-mounted equipment has not proven effective in reducing dengue transmission when used alone. Large scale outdoor application of pesticides may provide a benefit when used in conjunction with other control measures as part of an integrated mosquito control program⁷⁶. Therefore, effective vector control measures to be applied during an epidemic are similar to those recommended for area-wide CHIKV containment (above) and DEN virus outbreaks⁶⁶; the main difference is that they should be simultaneously applied in many areas to abate individual outbreaks.

- a. Geo-reference each CHIKV case to the level of operational control areas. In the case of endemic areas, conduct the retrospective epidemiological study at this level so that stratification serves operational purposes. Use of Geographical Information System (GIS) to map operational units, make and distribute maps of disease incidence, and spatially monitor the epidemic.

- b. Divide the target area (e.g., state, municipality) into relatively uniform areas (operational control areas) that will be treated using an area-wide approach (neighborhoods with 2,000 – 5,000 persons; census areas, zip-codes, etc.). All premises, businesses and other areas (parks, cemeteries, abandoned lots, areas along creeks, illegal dumps, etc.) will be simultaneously treated within a few days. This operational division of the space should be conducted well in advance of an eventual introduction of CHIKV.
- c. Area-wide vector control measures imply having sufficient trained personnel, equipment, and supplies to treat the environment where *Aedes* mosquitoes are being produced. By significantly reducing mosquito adults (using adulticides) and the production of new adult mosquitoes (source reduction and elimination, larvicides) in a particular area, the transmission cycle could be interrupted and CHIKV driven to extinction. This scenario is possible only if the number of biting mosquitoes is dramatically reduced for the length of time it takes for humans and vectors to become clear of CHIKV. For this reason, vector control measures need to achieve a very high efficiency as measured by the elimination of a very large proportion of vector mosquitoes.

Limitations of Vector Control

Vector population reduction and the associated reduction of vector-human contact should be correlated with reduced virus transmission and reduced human disease. However in order to interrupt an outbreak, vector population reduction must be immediate, substantial, and sustained. Adult mosquitoes will continue to emerge and replace adult mosquitoes killed by adulticides. Therefore, it is essential to maintain IVM programs, with complete coverage and repeated treatments. In addition to the presence of mosquito control professionals and an active IVM program, it is important to maintain the support and cooperation of all members of society⁶⁷.