Aedes aegypti vector control and prevention measures in the context of Zika, Yellow Fever, Dengue or Chikungunya

Technical Guidance

WASH Regional Group
(West and Central Africa)

The vector
“Know your Enemy”
Understand the Aedes mosquito while in different and moving contexts

Vector control strategy
“Be an epidemi/entomo sniper”
Map the current and/or previous Aedes-related virus incidence rate, overlay with the intra and extra-domiciliary entomological indexes, the typology of the breeding sites, as well as the behavioral practices

Vector control interventions
“No Epicenters”
Engage in a coordinated and multidisciplinary joint fight from the municipal till the household levels to at least stop or prevent the Aedes epicenters

Version: 8 July 2016

From the Interim Technical Note for UNICEF in the context of Zika
“Know your Enemy”

1. The vector

For the purpose of this document, the focus will be on the main vector for Zika, Yellow Fever, Dengue, and Chikungunya based on current evidence: *Aedes aegypti*.

1.1. *Aedes aegypti* mosquito general information

- *Aedes aegypti* is a small, dark mosquito with white lyre shaped markings and banded legs.
- They prefer to bite indoors and primarily bite humans.
- These mosquitoes can use natural locations or habitats (for example tree holes and plant axils) and artificial containers with water to lay their eggs.
- They lay eggs during the day in water containing organic material (e.g., decaying leaves, algae, etc.).
- *Aedes aegypti* do not live through the winter in the egg stage in colder climates. However, eggs will survive mild winters such as those in the southern United States and in Latin America.
- Once laid in containers, many eggs adhere to the side walls of the containers, and if the water dries up, they can survive desiccation for up to one year.
- Generally larvae feed upon small aquatic organisms, algae and particles of plant and animal material in water-filled containers.
- *Aedes aegypti* is adapted to breed around human dwellings and egg production sites are often within or in close proximity to households due to the presence of easy breeding sites (domestic water storage containers, waste products that hold water, etc).
- *Aedes aegypti* is the same mosquito that transmits dengue, chikungunya and yellow fever. *It is not the same mosquito as the one transmitting malaria (females of the Anopheline genus).*

1.2. *Aedes Aegypti* biting behavior

- *Aedes aegypti* bites primarily during the day – only female mosquitoes feed on blood in order to lay eggs. *Aedes* is anthropophilic, they prefer to bite humans over any other species but will also bite dogs and other domestic animals, mostly mammals.
- The mosquito is most active for approximately two hours after sunrise and several hours before sunset, but it can bite at night in well-lit areas. The mosquito attacks generally from below or behind, usually from underneath desks or chairs and mainly at the feet and ankles.
- It feeds indoors and outdoors (endophagic and exophagic).
- The mosquito rests indoors (in closets and other dark places) and outdoors where it is cool and shaded.
- Ae. aegypti females might bite several people before obtaining a full blood meal, potentially creating household clusters of cases with the same date of onset.

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1 Adapted from CDC Dengue and the *Aedes aegypti* mosquito Fact Sheet
2 Adapted from CDC Dengue and the *Aedes aegypti* mosquito Fact Sheet
1.3. **Aedes Aegypti breeding areas**

- Lifetime flight range will typically be less than 100 meters from the site of *Ae. aegypti* and *Ae. albopictus* emergence, therefore timely control within 150 meters of a case should reduce or eliminate transmission.
- *Aedes aegypti* is extremely common in areas lacking piped water systems (i.e. where water is still and not actively running) and where waste management is an issue.
- After taking a blood meal, female *Aedes aegypti* mosquitoes will look for water sources to lay an average of 100 to 200 eggs per batch which are laid separately and often over multiple water sources. The females can produce up to five batches of eggs during a lifetime. The number of eggs is dependent on the size of the blood meal.
- Eggs can still remain viable even if they are in dry conditions or look like they have dried out for up to a year approximately. *Aedes* eggs can therefore easily spread to new locations. The “dry” eggs will produce new mosquitoes within a few days of being immersed in water.
- Very little (only a few inches/centimeters) water is required to serve as a breeding areas.
- Breeding areas include artificial or natural water containers that are within or close to places where humans live, such as:
  - uncovered water storage containers including buckets, water drums and sinks
  - flower pots & the plates under potted plants
  - cemetery vases
  - clogged rain gutters (but not waste drainage systems)
  - ornamental fountains and birdbaths
  - water bowls for pets
  - general refuse such as plastic bags, discarded tires, empty tin cans etc.

This species has also been found in underground collections of water such as:
- open or unsealed septic tanks
- storm drains
- wells
- water meters.

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3 Adapted from CDC *Dengue and the Aedes aegypti mosquito Fact Sheet*
Examples of breeding sites
1.4. **Key differences between Aedes Aegypti and Aedes Albopictus**

<table>
<thead>
<tr>
<th>Aedes Aegypti</th>
<th>Aedes Albopictus</th>
</tr>
</thead>
<tbody>
<tr>
<td>An important vector in urban areas, with or without vegetation</td>
<td>Associated with thickets and arboreal vegetation</td>
</tr>
<tr>
<td>High preference for taking blood meals from humans and to lesser extent from domestic mammals, which makes it a very capable vector of dengue/chikungunya/zika/yellow fever viruses</td>
<td>Bites humans but also a variety of available domestic and wild vertebrates, which lowers its capacity to transmit dengue/chikungunya/zika/yellow fever viruses</td>
</tr>
<tr>
<td>Adult mosquitoes are commonly found indoors, but can also be found outdoors</td>
<td>Biting adults are found both indoors and outdoors, but are most commonly found outdoors</td>
</tr>
<tr>
<td>Larval habitats are typically containers on the household premises</td>
<td>Larvae occur in peridomestic habitats as well as surrounding natural habitats</td>
</tr>
<tr>
<td>Most containers with water used for immature development are within or in close proximity to households</td>
<td>Utilizes water-filled containers around or further away from households</td>
</tr>
<tr>
<td>Sneaky biter</td>
<td>Aggressive biter</td>
</tr>
</tbody>
</table>

**Areas infested with Aedes Aegypti**
![Map of Aedes Aegypti infested areas](image)

**Areas infested with Aedes Albopictus**
![Map of Aedes Albopictus infested areas](image)
“Be an epidemi/entomo sniper”

2. Vector control strategy

Controlling Aedes aegypti and interrupting human–vector contact plays a primary role in preventing or reducing Zika/Yellow Fever/Dengue/Chikungunya virus transmission.

Effective vector control requires strong entomological surveillance and integrated approaches that tackle all life stages of the mosquito and fully engage communities. In selecting the most appropriate vector control method, or combination of methods, consideration should be given to the local ecology and behaviour of the target species, the resources available for implementation, the cultural context in which control interventions are carried out, the perception and behaviors of the affected population, the feasibility of applying them in a timely manner, and the adequacy of coverage.

2.1. Characteristics of a vector control strategy for containment of Zika, Yellow Fever, Dengue and Chikungunya (adapted from WHO Dengue guidelines)

WHO’s dengue guidelines for diagnosis, treatment, prevention and control presents a model for vector control called Integrated Vector Management (IVM). Defined as “a rational decision-making process for the optimal use of resources for vector control”, IVM considers five key elements in the management process, namely:

- **Advocacy, risk communication and community engagement and legislation** – the promotion of these principles in development policies of all relevant agencies, organizations and civil society; the establishment or strengthening of regulatory and legislative controls for public health; and the empowerment of communities;
- **Collaboration within the health sector and with other sectors** – the consideration of all options for collaboration within and between public and private sectors; planning and decision-making delegated to the lowest possible administrative level; and strengthening communication among policy-makers, managers of programmes for the control of vector-borne diseases, and other key partners;
- **Integrated approach to disease control** – ensuring the rational use of available resources through the application of a multi-disease control approach; integration of non-chemical and chemical vector control methods; and integration with other disease control measures;
- **Evidence-based decision-making** – adaptation of strategies and interventions to local vector ecology, epidemiology and resources, guided by operational research and subject to routine monitoring and evaluation;
- **Capacity-building** – the development of essential infrastructure, financial resources and adequate human resources at national and local levels to manage IVM programmes, based on a situation analysis.

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4 Such as: health, water management, education, military (if relevant), meteorological, including at the ministerial level.
5 As presented in section 1.2.2, while the WASH sector will not take the responsibility to design chemical control activities, the WASH sector may participate in governmental-led initiatives using chemical control methods. Should that be the case, a ‘do no harm’ check should be conducted prior to the launch of these initiatives (see Annexe 3 for example).
2.2. Implementation of a vector control strategy during an outbreak

Vector management during an outbreak response can include:

- Coordination and intersectoral collaboration within health and other sectors and ministries
- Conducting a situational analysis (epidemiological, entomological, insecticide resistance status, pesticide management, policy frameworks), identifying risk factors and locations at most risk to target interventions\(^6\)
- Conducting a vector control needs assessment, in this context for preparedness and outbreak response
- Developing a response strategy for vector control setting goals and objectives, activities and indicators
- Based on situation analysis and needs assessment, choosing appropriate vector control methods: during an epidemic this will require mixed methods using environmental management, chemical and possibly other control methods such as biologic
- Prioritizing and integrating communication and community engagement into all vector control activities
- Identifying, training and mobilizing partners and community groups from all sectors and services to improve vector control knowledge and engage in control activities
- Identifying necessary supplies and equipment required for implementation of the vector control strategy
- Linking to the epidemiologic services and monitoring breeding sites
- Monitoring implementation and making adjustments in programs as needed, including monitoring of insecticide resistance\(^7\)
- Advocacy and fund raising

Risk Factors to consider when developing a vector control strategy during an outbreak (this does not look at virus behavior or human susceptibility)\(^8\):

- **Presence of *Aedes aegypti***: All areas with the presence of *Aedes aegypti* are at risk of having related virus transmission.
- **Climatic (seasonal) and geographic variables**: Climatic variables including rainfall, temperature, and relative humidity are predictors of *Aedes aegypti* presence. The level of altitude also thought to play a role, with locations of higher altitudes at lower risk (rare above 1,700 meters).
- **Urban setting**: The urban environment has become the dominant habitat for the *Aedes aegypti* mosquito although the vector remains prevalent in rural areas as well.
- **Urban population living in slums**: Within urban environments, slum areas have a lower probability of having pipes domestic water supplies, and are therefore more likely to use open containers for water storage. Slums are also likely to have poor clean water drainage systems, and poor waste management systems. For these reasons, they may harbour most of the *Aedes aegypti* mosquitos in urban areas.
- **Water storage practices**: Communities that store domestic water supplies in drums or containers outside or inside their homes are at higher risk of related virus transmission.
- **Capacities**: Lack of overall capacity and available resources to support *Aedes* vector control programs is a risk factor for related virus transmission.
- **Insecticide-resistance**: Resistance to insecticides can derail efforts, therefore local information on the vector’s characteristics and entomological data including their resistance profile is vital to inform vector control methods. Insecticide resistance should be carefully monitored over time so that timely decisions can be made to use alternative insecticides or control strategies, if the vector becomes resistance to insecticides that are being used.

\(^6\) GIS technology can be used to risk-stratify and map environmental and other risk factors in order to identify priority areas for planning vector control interventions and risk communication for personal protection.

\(^7\) Monitoring and managing insecticide resistance in *Aedes mosquito populations*- Interim guidance for entomologists. WHO.

\(^8\) Adapted from Zika Virus Risk Assessment in the WHO African Region
Examples of Aedes aegypti surveillance methods – Adapted from WHO Dengue vector surveillance and control\textsuperscript{9,10}

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>METHOD</th>
<th>Larval survey</th>
<th>Collection on humans</th>
<th>Collection of resting mosquitoes</th>
<th>Ovitrap</th>
<th>Tyre larvitraps</th>
<th>Insecticide susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline infestation surveys</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Control programme monitoring low infestation levels (&lt;5% house index\textsuperscript{*})</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control programme monitoring ≥ 5% house index</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surveillance against reinfection</td>
<td></td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Verification of eradication</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of control methods</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{*}House index: % of houses positive for mosquito breeding = \(\frac{\text{Infested houses}}{\text{Houses inspected}}\) \times 100

Further details regarding surveillance including sampling and survey methods can be found in the WHO Interim guidance on Entomological surveillance for Aedes spp. in the context of related virus\textsuperscript{11}.

Operational priorities for surveillance\textsuperscript{12}: The following operational priorities may be considered by Government authorities, in the context of Zika/Yellow Fever/Dengue/Chikungunya virus.

- Countries without \textit{Aedes}
  - Enhance surveillance of mosquitoes at border areas.
  - Monitor imported goods (e.g. used tyres, plants) from countries endemic with or receptive to \textit{Aedes}, by quarantine measures using ovitraps.


\textsuperscript{12} Ibid.
• Implement vector surveillance and control at points of entry in accordance with International Health Regulations (IHR), emphasizing non-chemical interventions such as source reduction.

• **Countries with Aedes, but no evidence of Zika/Yellow Fever/Dengue/Chikungunya virus transmission**
  
  • Establish sentinel surveillance of *Aedes* and collect data regularly. If any increase in *Aedes* density is detected, promptly target breeding sites with source reduction in a radius of 400 metres, and community awareness activities.
  
  • Ensure placement of contingency stocks of nationally approved insecticides and equipment to respond to potential outbreaks of arboviruses.
  
  • Develop adequate capacity, skills and equipment for control, and ensure availability of funds to respond to potential outbreaks of arboviruses.
  
  • Identify local areas with high densities of *Aedes*.
  
  • Prioritize the most productive sites and target control measures. (*Note: also taking into consideration results of needs / vulnerability assessment*)
  
  • Aim for zero breeding sites in low-density areas and prevent expansion of the vectors to other areas by rapid control activities in the vicinity.
  
  • Maintain constant monitoring of vector density through surveillance programs. Make all efforts to maintain vector density at a low level.

• **Countries with Aedes and evidence of Zika/Yellow Fever/Dengue/Chikungunya virus transmission**
  
  • Establish sentinel surveillance of *Aedes* and collect data regularly. Surveillance data should reflect trends and impact of control measures.
  
  • Develop adequate capacity, skills and equipment for control, and ensure availability of funds to manage the outbreak.
  
  • Identify local areas with high density of *Aedes*.
  
  • Prioritize the most productive breeding sites and target control measures. (*Note: also taking into consideration results of needs / vulnerability assessment*)
  
  • Encourage community engagement to target smaller breeding sites in and around houses once a week.
  
  • In the event of a large outbreak, enhance control to include targeted adult *Aedes* control measures such as fogging, along with larval control measures.
  
  • Develop key messages for communication to the community. Target messages for schools and other community groups and organizations to support the campaign.

### 2.3. Vector control methods

Control methods can be divided into several categories:\(^\text{13}\):

1. **Environmental management:**
   - Source reduction
   - Personal protection
2. **Chemical control:** insect growth regulators and larvicides
3. **Biological:** based on the introduction of organisms that prey upon, parasitize, compete with or otherwise reduce populations of the target species. (e.g. copepods, *Bacillus thuringiensis* var. *israelensis*, Wolbachia)
4. **Genetic:** sterile insect technique and genetically modified mosquitoes

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For the purpose of this document, focus will be on the primary methods that the WASH sector will engage in according its capacity and country context.

A specific comment on chemical and biologic control methods: while the WASH sector will not take the responsibility to design and supervise chemical or biologic control activities, The WASH sector may participate in governmental-led initiatives using these methods. Should that be the case, a ‘do no harm’ check should be conducted prior to the launch of these initiatives. More details on the ‘do no harm’ check is included in Annex 3.

Larviciding/growth inhibitors or “focal” control of Ae. aegypti is usually limited to domestic-use containers that cannot be destroyed, eliminated or otherwise managed. It is difficult and expensive to apply chemical larvicides on a long-term basis. Therefore, chemical larvicides are best used in situations where the disease and vector surveillance indicate the existence of certain periods of high risk and in localities where outbreaks might occur (WHO/SEARO Dengue control guidelines). Larvicides used at the community level in conjunction with environmental manipulation is an integral component of vector control during an epidemic. Although The WASH sector if engaging in larvicide (and/or adulticide) use activities, above all if through community organizations, should conduct these chemical vector control intervention under the clear supervision of the MoH and WHO.

Larvicides (Mentor webinar):
- Easy to apply, little training, no special equipment needed.
- Must be repeated every 6-8 weeks for large water containers.
- Larviciding may not be sustainable in endemic settings but can be highly effective in epidemic settings.
- Sand or granules formulation is ideal for community based programmes; spraying requires strong community sensitization as sprayers must wear personal protective equipment.

Application of any chemical methods should be strictly guided by the recommendations from the WHO Pesticide Evaluation Scheme in line with local entomological information: http://www.who.int/whopes/Mosquito_larvicides_Feb_2016.pdf?ua=1

2.3.1. Vector control method 1: Environmental management - Source control\(^\text{14}\)

Aedes aegypti uses a wide range of confined larval habitats, both man-made and natural. For best results, environmental vector control efforts should target all breeding sites. However, when there are resource constraints, it may not be feasible or cost-effective to attempt to control the immature stages (eggs, larvae and pupae) in all such habitats in a community. Some man-made container habitats produce large numbers of adult mosquitoes, whereas others are less productive. Consequently, when resource constraints force a choice, control efforts should prioritize habitats that are most productive and hence epidemiologically more important. Such targeted strategies require a thorough understanding of the local vector ecology and the attitudes and habits of residents pertaining to potential breeding sites (e.g. water storage containers, flower pots, etc. as outlined in section 1.1.3).

\(^{14}\) Extract from WHO Dengue Guidelines
Environmental management seeks to change the environment in order to prevent or minimize vector propagation and human contact with the vector-pathogen by destroying, altering, removing or recycling non-essential containers that provide larval habitats. Such actions should be the mainstay of vector control.

**Environmental management includes (see WHO dengue guidelines for expanded activities):**

- **Environmental modification** – long-lasting physical transformations to reduce vector larval habitats, such as installation of a reliable piped water supply to communities, including household connections.

- **Environmental manipulation** – temporary changes to vector habitats involving the management of "essential" containers, such as:
  - Weekly emptying and cleaning by scrubbing of water-storage vessels, flower vases and desert room coolers. (Scrubbing inner container surfaces, is critical as the eggs are sticky, virtually gluing themselves to the insides of containers, and survive dry conditions.)
  - Cleaning of gutters; sheltering stored tyres from rainfall.
  - Recycling or proper disposal of discarded containers and tyres such that they do not collect water.
  - Management or removal from the vicinity of homes of plants such as ornamental or wild bromeliads that collect water in the leaf axils.
  - After cleaning and emptying, ensuring water containers are fully covered (ie. with a tight fitting or insecticide treated lid) to prevent landing and breeding by mosquitoes.
  - Solid waste management including as part of community clean up, directed against discarded or non-essential containers, particularly if they have been identified in the community as breeding sites.

- **Changes to human habitation or behaviour** – actions to reduce human–vector contact, such as installing mosquito screening on windows, doors and other entry points, and using mosquito nets while sleeping during daytime.

**Examples of activities for Environmental management** to be carried out for each type of container (larval habitats may vary by country, this table should be reviewed accordingly).

<table>
<thead>
<tr>
<th>Larval habitat</th>
<th>Empty, clean and scrub weekly</th>
<th>Mosquito-proof cover</th>
<th>Store under roof</th>
<th>Modify design, and/or repair and clean</th>
<th>Use expanded polystyrene beads</th>
<th>Fill (with sand, soil or concrete)</th>
<th>Collect, recycle &amp; dispose of</th>
<th>Puncture or drain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-storage tank or cistern</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drums (150-200 litres)</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Flower vase filled with water</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Potted plants with saucers</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Roof gutter</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Animal water container</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
2.3.2. Vector control method 2: Environmental management - Personal protection

The objective of personal protection methods is to limit the contact between mosquitoes and individuals. Personal protection measures effective against Aedes mosquitoes include:

**Clothing**
- Clothing that minimizes skin exposure (i.e. long sleeved shirts/ tops and long pants) during daylight hours when mosquitoes are most active affords some protection from the bites of vectors and is encouraged - particularly during outbreaks.
- Wear light-colored clothing, since mosquitoes are thought to be more attracted to darker colors.

**Repellent applied to skin**
- Repellents may be applied to exposed skin.
- Repellents should contain DEET (N, N-diethyl-3-methylbenzamide), IR3535 (3-[Nacetyl-N-butyl]-aminopropionic acid ethyl ester) or Icaridin (1-piperidinecarboxylic acid, 2-(2-hydroxyethyl)-1-methylpropylester).
- The use of repellents must be in strict accordance with label instructions.
- The following repellents are considered safe for use during pregnancy\(^{15}\): DEET, IR3535 and KBR3023 (icaridin, also known as picaridin)\(^{16}\) when instructions are followed closely and carefully.
- DEET: the duration of effect depends on the formulation and concentration as well on environment of use. Concentrations below 20% would generally require frequent applications during the day.
- Appropriate advice on instructions for use must be provided to ensure safety, especially for populations that do not commonly use repellents routinely.
- International and national safety protocols need to be followed for safety, especially for children and pregnant women.

**Repellent applied to clothing** (e.g. school uniforms and clothing worn when working)
- Studies\(^ {17}\) have shown that long-lasting permethrin-impregnated clothing can provide protection against mosquito bites.

\(^{15}\) Plant-based repellents such as oil of lemon eucalyptus (OLE) and its synthetic analogue PMD are recommended by the CDC but have not undergone rigorous testing and have limited efficacy due to rapid evaporation.

\(^{16}\) http://www.cdc.gov/ncbddd/disasters/environmental.html

• Permethrin is the most commonly used active ingredient, but others, including bifenthrin, deltamethrin, cyfluthrin, DEET (N,N-diethyl-3-methylbenz-amide) and KBR3023 (icaridin), have also been trialed in terms of application to protective clothing and have been shown to have some effect depending on susceptibility of the locally present vector.
• DEET can be applied to clothes but may damage synthetic fabrics such as rayon or plastics.
• Permethrin, DEET and KBR3023 (icaridin) can be used by pregnant women and therefore should be encouraged to use these repellents applied to clothing.

**Long Lasting Insecticidal Nets (LLIN)**

• LLIN afford good protection for those who sleep during the day (e.g. infants, the bedridden and night-shift workers).
• The average wing length of female Aedes varies from 1.67-3.83 mm therefore standard size LLINs and screens are sufficient to keep them out of homes if used consistently.

**Aerosol products**

Where indoor biting occurs, household insecticide aerosol products, mosquito coils or other insecticide vaporizers may also reduce biting activity.

**Household fixtures**

Household fixtures that reduce access to the mosquito can reduce biting. Fixtures include:

• Window and door screens
• Air-conditioning
• Insecticide treated curtains

Countries affected by Zika/Yellow Fever/Dengue/Chikungunya (especially if microcephaly is confirmed to be associated with this virus) should explore proactive special care for pregnant women, such as giving adequate repellent lotion and treated mosquito nets to pregnant women. Personal protection measures should also be targeted to women of child bearing age given the possibility of simultaneous ZKV infection and pregnancy.

### 2.4. Community Engagement

As community mobilization is a key activity for vector control this guide should be used in conjunction with *Risk communication and community engagement for Zika virus prevention and control: A guidance and resource package for country offices for coordination, planning, key messages and actions, UNICEF, PAHO/WHO, IFRC, March 2016.*

• Effective source reduction, especially for *Aedes* requires scrupulous and repeated cleaning or treatment of containers for everyday use and thus relies extensively on homeowner collaboration. Public education campaigns to help people identify and eliminate small water containers from their property are key mosquito control intervention in areas where *Aedes* is the main vector.
• Another approach is to support community programmes using paid specialists (technicians) who can be directly involved in surveillance, education and vector control strategy and who interact with and educate the public. Such an approach would be at the discretion of the government.

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“No Epicenters”

3. Vector control interventions

3.1. Response – all areas with active Zika/Yellow Fever/Dengue/Chikungunya transmission

The list below contains a number of suggested activities and interventions where the WASH sector can be most active and play a role in vector control. It is not exhaustive and will continue to be updated and evolve as more information is known about Zika/Yellow Fever/Dengue/Chikungunya transmission and possible impact on communities.

This table looks primarily at the prevention of the transmission of the Zika/Yellow Fever/Dengue/Chikungunya virus.

<table>
<thead>
<tr>
<th>Level</th>
<th>Municipal</th>
<th>Community (neighbourhoods, schools, health centres, religious institutions)</th>
<th>Household</th>
</tr>
</thead>
</table>
| Coordination           | • Engage in inter-sectoral coordination mechanism for vector control, including MoH, MoE, Min of public works / water & waste management, Min of environment, Min of communication  
                         • Support the MoH for 4Ws mapping for vector control                      | • Strengthen linkages between community-based vector control programs and health centre administrators, school administrators, community leaders, religious leaders, in accordance with local needs  
                         • Engage school administrators in Zika/Yellow Fever/Dengue/Chikungunya control activities  
                         • Provide logistical support as needed to enable coordination of community-based vector control activities among partners | N/A       |
| Risk / needs assessment| • Participate in the municipal-level risk assessment, including providing support for vector surveillance as appropriate  
                          • Participate in the municipal-level needs assessment                      | • Conduct community-based risk and needs assessments for vector control through WASH sector-supported community mobilization programmes |           |
<p>| Development of vector  | • Support the MoH in the development of a                                  | • Support the MoH and MoE in the development of a                           | • Develop and provide messaging to families |</p>
<table>
<thead>
<tr>
<th><strong>control strategy</strong></th>
<th>municipal-level vector control strategy</th>
<th>school-based vector control strategy</th>
<th>to develop a household plan for vector control</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Support the MoH and Min of public works / water &amp; waste management to develop a municipal-level vector control strategy for the municipal water system</td>
<td>• Support local authorities and community leaders to adapt the municipal-level vector control strategy and develop a community-based strategy according to the local context</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Identification of implementing partners</strong></th>
<th>Engage with MoH, Min of public works / water &amp; waste management, MoE</th>
<th>Engage with local NGOs, Red Cross, community leaders, community mobilizers, women and youth groups, teachers, school administrators, religious leaders</th>
<th>Engage with Red Cross and community outreach groups conducting household visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engage with MoH, Min of public works / water &amp; waste management, MoE</td>
<td>• Sign PCAs with partners</td>
<td>• Engage with Red Cross and community outreach groups conducting household visits</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Identification of supply needs</strong></th>
<th>Based on the needs assessment and vector control strategy, support relevant ministries in the identification and/or procurement of supplies</th>
<th>Based on the community-based vector control strategy, support the identification and/or local procurement of supplies as needed</th>
<th>Provide messages to households for identification of necessary supplies for vector control</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Support the MoH, Min of public works / water &amp; waste management in the identification of supply needs for the municipal water system</td>
<td>• Support the MoH, Min of public works / water &amp; waste management, MoE in conducting training for vector control at all levels, including through the development of training programs and educational materials as needed</td>
<td>• Empower households with knowledge to implement appropriate household-level vector control and personal protection</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Capacity development and training</strong></th>
<th>Support MoH, Min of public works / water &amp; waste management, MoE in conducting training for vector control at all levels, including through the development of training programs and educational materials as needed</th>
<th>Support local authorities to train community organizations, community leaders, teachers, religious leaders, etc. in vector control</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Support MoH to conduct multi-stakeholder Aedes breeding site surveys</td>
<td></td>
<td>• Empower households with knowledge to implement appropriate household-level vector control and personal protection</td>
<td></td>
</tr>
<tr>
<td>• Support breeding site surveys for the municipal water system</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Monitoring</strong></th>
<th>Support local authorities and community organizations to conduct Aedes breeding site surveys at schools, health centres, parks, markets, etc.</th>
<th>Support multi-stakeholder KAP surveys to assess the impact of messaging on behavioural change for effective vector control</th>
<th>Through WASH sector-supported outreach programs, conduct Aedes breeding site surveys at the household level</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Support MoH to conduct multi-stakeholder Aedes breeding site surveys</td>
<td></td>
<td></td>
<td>• Support multi-stakeholder KAP surveys to assess the impact of messaging on behavioural change for effective vector control</td>
</tr>
</tbody>
</table>
### Indicators

- Number and % of districts with active vector control programmes
- Number and % of districts with vector surveillance
- Number and % of cisterns in abandoned houses on which tight fitting lids are added
- Number and % of tires protected or destroyed
- Community acceptance of interventions\(^\text{19}\)
- Community perception of programme effectiveness
- Number and % of schools with vector control mechanisms in place
- Number and % of water-holding containers (outside of the home) on which tight fitting lids are added
- Community acceptance of interventions
- Community perception of programme effectiveness
- Number and % of schools with vector control mechanisms in place
- Number and % of water-holding containers (outside of the home) on which tight fitting lids are added
- House index (% houses positive for mosquito breeding)\(^\text{20}\)
- Container index (% of water-holding containers positive for mosquito breeding)\(^\text{21}\)
- Number and % of water-holding containers (inside the home) on which tight fitting lids are added

### 3.2. Preparedness – all areas where Aedes is present without current Zika/Yellow Fever/Dengue/Chikungunya outbreak

**All areas at risk:**
- With Dengue or Chikungunya or Yellow Fever or Zika epidemiologic history

<table>
<thead>
<tr>
<th>Level</th>
<th>Municipal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coordination</strong></td>
<td>Engage in inter-sectoral coordination mechanism for vector control, including MoH, MoE, Min of public works / water &amp; waste management, Min of environment, Min of communication&lt;br&gt;Support the MoH for 4Ws mapping for vector control</td>
</tr>
<tr>
<td><strong>Risk / needs assessment</strong></td>
<td>Participate in the municipal-level risk assessment, including providing support for vector surveillance as appropriate&lt;br&gt;Participate in the municipal-level needs assessment</td>
</tr>
<tr>
<td><strong>Development of vector control strategy</strong></td>
<td>Support the MoH in the development of a municipal-level vector control strategy, based on existing dengue control strategies if available.</td>
</tr>
<tr>
<td><strong>Identification of implementing partners</strong></td>
<td>Engage with MoH, Min of public works / water &amp; waste management, MoE&lt;br&gt;Identify NGOs and community based implementing partners in the event of a local Zika/Yellow Fever/Dengue/Chikungunya outbreak</td>
</tr>
<tr>
<td><strong>Identification of supply needs</strong></td>
<td>Based on the needs assessment and vector control strategy, support relevant ministries in the identification and/or procurement and stockpiling of supplies</td>
</tr>
<tr>
<td><strong>Capacity development and training</strong></td>
<td>Support MoH, Min of public works / water &amp; waste management, MoE in conducting training for vector control at all levels, including through the development of training programs and educational materials as needed</td>
</tr>
<tr>
<td><strong>Monitoring</strong></td>
<td>Support MoH to conduct multi-stakeholder Aedes breeding site surveys</td>
</tr>
<tr>
<td><strong>Indicators</strong></td>
<td>Number and % of districts with vector surveillance</td>
</tr>
</tbody>
</table>

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\(^{19}\) Participatory evaluation is important to enhance community ownership and to generate data on behavioural, social and political changes

\(^{20}\) House Index (HI): percentage of houses infested with larvae or pupae = (number of houses infested with larvae or pupae) / (number of houses inspected) * 100

\(^{21}\) Container Index (CI): percentage of water-holding containers infested with larvae or pupae = (number of infested containers with larvae or pupae) / (number of containers inspected) * 100
### DO NOT DO list

<table>
<thead>
<tr>
<th><strong>DO NOT</strong> disseminate messages that have not been validated by the government</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DO NOT</strong> take over on activities that should be led by others as this disempower them, considering that they may be more proficient than us in conducting the activities in the first place</td>
</tr>
<tr>
<td><strong>DO NOT</strong> base vector control interventions on users “mosquito disturbance” complaints rather than on epidemiologic data</td>
</tr>
<tr>
<td><strong>DO NOT</strong> intervene at community or household level without prior understanding of key behavior determinants</td>
</tr>
</tbody>
</table>
Annex 1: Aedes Aegypti Mosquito development cycle

The Aedes mosquitoes have 4 life stages: egg, larva, pupa and adult. Mosquitoes can live and reproduce inside and outside the home. The entire life cycle, from an egg to an adult, takes approximately 8-10 days.

Life Stages of Aedes Mosquitoes:

The entire immature or aquatic cycle (i.e., from egg to adult) can occur in as little as 7-8 days. The life span for adult mosquitoes is around three weeks.

Eggs (duration: a few days to several months)

- About three days after feeding on blood, adult female mosquitoes lay their eggs on the inner, wet walls of containers with water, above the waterline.
- Mosquitoes generally lay 100-200 eggs at a time.
- The females can produce up to five batches of eggs during a lifetime. The number of eggs is dependent on the size of the blood-meal.
- Eggs are very hardy; they stick to the walls of a container like glue.
- Eggs can survive in dry conditions (i.e. being not immersed in water) for up to 8 months.
- It only takes a very small amount of water to attract a female mosquito. Eggs are laid on damp surfaces in areas likely to temporarily flood, such as tree holes and man-made containers like barrels, drums, jars, pots, buckets, flower vases, plant saucers, tanks, discarded bottles, tins, tyres, water cooler, etc. and a lot more places where rain-water collects or is stored.
- Chlorine (sodium hypochlorite commonly known as bleach and swimming pool chlorine) has ovicidal properties. However the chlorine in chlorinated water diffuses out in a few hours when it is stored in the open. Therefore, simply chlorinating water is not sufficient to ensure elimination of eggs.

Larva (duration: 5 days)

- Larvae emerge from mosquito eggs, but only after the water level rises to cover the eggs. This means that rainwater or humans adding water to containers with eggs will trigger the larvae to emerge.

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22 Adapted from CDC Mosquito life cycle Fact Sheet
Version: July 8 2016
• Larvae feed on microorganisms in the water. After molting three times, the larva becomes a pupa.

**Pupa: (duration: 2-3 days)**
- Pupae will develop until the body of the newly formed adult flying mosquito emerges from the pupal skin and leaves the water.

**Adult (duration: 2-4 weeks)**
- After adult mosquitoes emerge: male mosquitoes feed on nectar from flowers and female mosquitoes feed on blood from humans and animals to produce eggs.
- Aedes aegypti mosquitoes prefer to bite people.
- After taking a blood meal, female *Aedes aegypti* mosquitoes will look for water sources to lay an average of 100 to 200 eggs per batch. The females can produce up to five batches of eggs during a lifetime. The number of eggs is dependent on the size of the bloodmeal.
- Aedes aegypti has only a very limited flying range in its lifetime (~a few 100 m).
- Aedes aegypti mosquitoes prefer to live near people. They can be found inside homes, buildings, and businesses where window and door screens are not used or doors are left propped open.
Annex 2: Background on previous eradication efforts of Aedes aegypti

Historically, efforts to control Aedes aegypti in the WHO Region of the Americas resulted in the eradication of Ae. Aegypti populations from much of the neotropics by the 1970s.

Dengue, also transmitted by Aedes aegypti has been successfully prevented via vector control in at least three instances.

- The first was the highly successful, vertically-structured paramilitary hemispheric eradication campaign directed by the Pan American Sanitary Board. Campaigns to eradicate Ae. Aegypti were successful between 1948 and 1972, when complete vector eradication was achieved in 21 countries of the Americas.
- The second was also a rigorous, top-down, military-like vector control operation in Cuba that was based on intensive insecticidal treatment followed by reduction of available larval habitats (source reduction) in 1981.
- The third successful programme was in Singapore.

However, from the 1970s onwards, these results were not maintained and receded notably. Eradication programmes lost political importance and priority in the majority of the countries that had achieved eradication. Once reinestation was detected, government response was very late; high costs were associated with providing materials, equipment, salaries and benefits for the workers that were not kept in their positions, and reinestation was concomitant with the appearance in Ae. Aegypti of resistance to organochlorated insecticides and the fast and rampant growth of suburban centres.²³

²³ Adapted from World Health Organization on behalf of the Special Programme for Research and Training in Tropical Diseases, Delivery Issues Related to Vector Control Operations: A Special Focus On The Americas, 2007
Annex 3: “Do no harm” check

Support from WASH sector regarding chemical vector control WILL ONLY BE within an official and precise request from the MoH and/or the WHO.

See check list examples below:

- If purchase order/transport/delivery or support to field operations using larvicides or insecticides:
  (i) commercial name + chemical composition of product? (Y/N)
  (ii) sealed containers/sachets with expiry date? (Y/N)
  (iii) transport and warehouse conditions? (Y/N)
  (iv) required equipment’s and tools? (Y/N)
  (v) user manual? (Y/N)
  (vi) name(s) of partners/actors receiving product? (Y/N)

- If training on chemical vector control:
  (i) name(s) of staff/partner/targeted communities? (Y/N)
  (ii) name(s) of certified team(s)/trainer(s)? (Y/N)

If there is one “No” in your list, then there is a risk of harm. The WASH sector should only support requests when all “No” are cleared.
Annex 4: Bibliography and for further reference

Vector control documentation


Centers for Disease Control and Prevention, *Dengue and the Aedes Aegypti Mosquito*

Centers for Disease Control and Prevention, *Help Control Mosquitoes That Spread Dengue*, 2014


Centers for Disease Control and Prevention, *Mosquito Life Cycle*

Centers for Disease Control and Prevention, *Comparison between main dengue vectors*

Centers for Disease Control and Prevention, *Dengue and the Aedes Albopictus Mosquito*

Hayes, Edward B., *Zika Virus Outside Africa*, Emerging Infectious Diseases, Vol. 15, No. 9, September 2009


World Health Organization, *Global Strategy For Dengue Prevention And Control*, 2012


Minimum Standards in Water supply, sanitation and hygiene promotion, 5. Vector control, 2011

**Chemical control method**


World Health Organization, *Space spray application of insecticides for vector and public health pest control - A practitioner’s guide*, 2010


**Risk communication and community engagement**

