

Mosquito-borne Virus Strategic Response Plan – Addendum A

Background

The current risk analysis and response actions to Aedes-transmitted diseases (ATDs), such as dengue and Zika, adhere to guidance in the 2023 DEHQ/PHS Mosquito-borne Virus Strategic Response plan where local transmission risk levels of an ATD are based on the number of female Aedes mosquitoes caught in traps on or near the ATD case's residence, currently set at an average of 5 or more female Aedes aegypti per trap-night being categorized as highest risk level for local transmission, prompting adulticide response at a 150 meter radius around the patient's residence.

This threshold of 5 Aedes was based on a genomic epidemiology paper about the 2016 Zika outbreak in Miami-Dade, FL, where an average of 10 Aedes caught per trap-night correlated with an increase in locally-acquired Zika cases ([Grubaugh, 2017](#)). Furthermore, responses to control a dengue outbreak in the Florida Keys in 2020 set an adulticide action threshold at >10 invasive aedes per trap/night to bring the outbreak under control ([Boehmler, 2023](#)). In 2018, a conservative threshold of 5 Aedes (rather than 10 aedes) caught per trap-night was adopted since invasive Aedes were new to the county and information regarding the actual risk of local transmission was limited at the time. Since that time, invasive Aedes have continued to increase throughout the county and from 2022-2023, with the average background level of invasive Aedes caught per trap/night now at 3.4 with a standard deviation of 5.4.

In 2023, Pasadena, CA experienced the first locally-transmitted case of dengue in California. Based upon discussions with the vector agency, average trap counts of invasive Aedes were greater than 80 when local transmission was detected, which were rapidly brought down to an average of 30/trap-night seven days later after vector control interventions. Despite these elevated numbers of invasive Aedes, there was only a single known locally-acquired dengue case in Pasadena. In comparison with the San Diego region, Pasadena also has a generally higher risk of local transmission due to climate and environmental factors (per analysis of VectorSurv's dengue transmission risk tool).

When considering previous and more recent data from Florida, in addition to data from the local transmission of dengue in Pasadena, the threshold of 5 invasive Aedes per trap night is a conservative threshold for adulticide response. As the number of travel-associated ATD

investigations increase, and in recognition of the better data available at this time, it is proposed that the DEHQ/PHS ATD procedure be updated by adding a response threshold for 5-10 invasive Aedes per trap night, which would prompt an adulticide event for the patient's residence rather than a 150-meter radius (allowing VCP to knock down the highest-risk mosquitoes near the patient). The expanded adulticide of 150-meters would instead be triggered by capturing more than 10 invasive Aedes per trap night (instead of the current threshold of 5). This additional tier would allow VCP to proportionally protect against local transmission using conservative thresholds and would simultaneously allow for more efficient use of resources (e.g., adulticide equipment), which is increasingly important to ensure timely adulticide response as the number of travel-associated ATD investigations increase.

Recommendations

1. Set high risk threshold at average >10 Aedes/trap/night - response includes adulticide up to 150 m radius
2. Set medium risk threshold at 5-10 Aedes/trap/night – response includes adulticide at case residence

Revised section:

possible. ATD transmission risk levels are set according to the following:

- a. Low risk
 - i. average 0-4 *Aedes* caught per trap, or
 - ii. 0-4 adult *Aedes* observed² by the VCT on site.
- b. Medium risk
 - i. average 5-10 *Aedes* caught per trap, or
 - ii. 5-10 adult *Aedes* observed by the VCT on site.
- c. High risk
 - i. average >10 *Aedes* caught per trap,³ or
 - ii. >10 adult *Aedes* observed by the VCT on site, or
 - iii. *Aedes* test positively for an ATD.

2. Response Matrix: According to the transmission risk, the following response actions are taken (Table 3).

 **Table 3. *Aedes* response matrix.**

RISK LEVEL	PUBLIC EDUCATION	SOURCE REDUCTION	LARVICIDE	ADULTICIDE
LOW	+	+	+	
MEDIUM	+	+	+	±
HIGH	+	+	+	+

These actions will be applied to different sized areas based on risk level as shown in Table 4. If necessary, the VCP will obtain warrants before entering properties.

Table 4. *Aedes* property access matrix.

RISK LEVEL	PROPERTY	ADJOINING PROPERTIES	RADIUS
LOW	+		
MEDIUM	+	±	
HIGH	+	+	up to 150 m

Modifiers: The Response Matrix above assumes that the case is in an urban or suburban area.

- If the case is in an area with low population density (e.g., rural or industrial area), the risk level may be reduced one category and the corresponding responses taken.
- Likewise, if weather conditions are predicted to negatively influence the ability of *Aedes* to fly or survive (e.g., rain, daytime high temperature ≤60 degrees Fahrenheit, sustained wind ≥10 miles per hour), the risk level may be reduced one level.

² Confirmed by Ecologist (specimens or photos).

³ Modified from Grubaugh et al. 2017.

The time when the public’s health may be at risk is dependent on the incubation periods of ATD in people (i.e., called the intrinsic incubation period) and mosquitoes (i.e., called the extrinsic incubation period). These incubation periods create a window of opportunity when vector control interventions will be most effective in reducing the potential for ATD spread (i.e., before infective mosquitoes are circulating). Exact incubation periods vary depending on multiple conditions including host factors and temperature. The following incubation periods are based on published studies^{4, 5, 6} and are listed here as guidelines (Table 5).

Table 5. Intrinsic and extrinsic incubation periods of Aedes-transmitted diseases (ATDs).

VIRUS	VIREMIA POST-SYMP TOM ONSET (FROM PHS)	EXTRINSIC INCUBATION PERIOD (MOSQUITO)
ZIKA	Up to 7 days	10 days (Boorman, 1956) ²
CHIKUNGUNYA	Up to 7 days	2 days (Dubrulle, 2009) ³
DENGUE	2-12 days	7 days (Chan, 2012) ⁴

Figure 4 below gives one possible Zika transmission timeline with vector control intervention to prevent Zika virus transmission. The timeline could change depending on the timing of infection, travel, mosquito exposure, temperature, and the virus of concern.

⁴ Boorman JP, Porterfield JS. 1956. A simple technique for infection of mosquitoes with viruses; transmission of Zika virus. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 50:238-242

⁵ Chan M, Johansson MA. 2012. The incubation periods of dengue viruses. *PLoS One*, doi.org/10.1371/journal.pone.0050972

⁶ Dubrulle M, Mousson L, Moutailler S, Vazeille M, Failloux AB. 2009. Chikungunya virus and *Aedes* mosquitoes: saliva is infectious as soon as two days after oral infection. *PLoS One*, doi.org/10.1371/journal.pone.0005895

Selected References

Threshold in FL:

<https://meridian.allenpress.com/jamca/article/39/4/251/497756/Response-to-An-Outbreak-of-Locally-Transmitted>

Vector control and other impact for *Aedes* breeding:

<https://resjournals.onlinelibrary.wiley.com/doi/10.1111/mve.12338>

Coachella Valley response plan:

https://www.cvmosquito.org/files/65c83a1ac/invasive_mosquito_species_response_plan.2023.pdf