

Orange County Mosquito and Vector Control District

DRAFT Response Plan for Invasive *Aedes* Mosquitoes and the Diseases They Vector (Zika/dengue/chikungunya/yellow fever)

Supplement to Integrated Vector Management & Response Plan



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OBJECTIVE

This document was prepared to provide guidance to Orange County Mosquito and Vector Control District (OCMVCD) staff on how to respond to detections of invasive *Aedes* mosquitoes in Orange County (County) under different scenarios including nuisance biting, travel-related human disease cases, virus positive *Aedes* mosquitoes without a known human case, and local transmission (outbreaks) of invasive *Aedes*-vectored viral diseases, such as Zika, dengue, chikungunya, and yellow fever. This document is also intended to provide city and county officials, and other stakeholders, with OCMVCD's framework for the response to public health threats related to invasive *Aedes* mosquitoes that are now established in the County.

The OCMVCD's *Response Plan for Invasive Aedes Mosquitoes and the Diseases They Vector (Zika/dengue/chikungunya/yellow fever)* is based on principles and guidelines put forth in the Centers for Disease Control and Prevention's (CDC) *Zika Interim Response Plan* (Updated May 2017) [Appendix A] and the California Department of Public Health's (CDPH) *Guidance for Surveillance of and Response to Invasive Aedes Mosquitoes and Dengue, Chikungunya, and Zika in California* (updated February 2017) [Appendix B]. The "Draft *Aedes* Response Plan" described in this document operates using the same considerations and assumptions listed in the *Zika CDC Interim Response Plan*. Furthermore, this plan compliments and aligns with the objectives put forth in the Orange County Operational Area's Disease Outbreak Response Annex (in draft) which details coordination between the Orange County Health Care Agency (OCHCA) and OCMVCD during vector-borne disease epidemics.

BACKGROUND

Invasive mosquitoes capable of transmitting disease causing agents to humans and animals, including the yellow fever mosquito (*Aedes aegypti*), Asian tiger mosquito (*Ae. albopictus*) and Australian backyard mosquito (*Ae. notoscriptus*) are now established in Orange County. Vector-borne pathogens that cause diseases, such as Zika, dengue, chikungunya and yellow fever can be acquired by a mosquito when it feeds on a person with the pathogen circulating in their blood. The infected mosquito can then transmit the pathogen to other persons in the area.

In 2001 and later in 2004, *Ae. albopictus* were detected in several Orange County neighborhoods and were then presumed eradicated after periods of intensive control efforts, followed by what was thought at the time to be unsuitable winter weather conditions. Not until April of 2015 were invasive *Aedes* mosquitoes detected again in the County. Since then, *Ae. aegypti*, *Ae. albopictus*, and *Ae. notoscriptus* have been detected throughout Orange County.

Invasive *Aedes* are expected to persist and spread throughout the County despite ongoing control efforts. These invasive mosquitoes bring with them a reproductive strategy that is unlike that of the County's most common urban-adapted mosquito species, the southern house mosquito (*Culex quinquefasciatus*), and one that is difficult to combat using customary larviciding control techniques. Rather than depositing eggs in a cluster on the surface of water like the southern house mosquito, where larvae hatch rapidly, invasive *Aedes* mosquitoes lay their eggs singly on the inner surface of small water holding structures above the water line. The eggs often remain

viable for extended periods of time; once submerged in water the larvae then hatch and develop quickly in the often short-lived water source. The invasive mosquitoes' use of cryptic breeding sources, usually containing only small volumes of water, requires detailed and time consuming searches to locate them and the use of control methods and products which have not been previously used by the OCMVCD. These invasive mosquito species will be challenging to eradicate or prevent from spreading in the County, as evidenced by the inability of widely used control strategies to halt their expansion elsewhere within the state of California.

OCMVCD's responses to various scenarios related to the presence of invasive *Aedes* in the county are detailed further below. Furthermore, responses to the presence of mosquito-borne diseases that immediately or potentially pose a health threat to residents and visitors of Orange County, including West Nile virus, are summarized and prioritized in the tabular matrix, *OCMVCD WNV & Invasive Aedes Matrix Guidelines* [Appendix C].

AUTHORITY

The OCMVCD will respond to invasive *Aedes* mosquito issues associated with nuisance biting reports, travel-related human disease cases, locally acquired human disease cases, and the detection of vector-borne pathogens in mosquito populations. Operating under a Memorandum of Understanding (MOU) between OCMVCD and Orange County Health Care Agency (OCHCA), the OCMVCD receives information regarding confirmed, *Aedes* mosquito-vectored, human disease cases residing in the County. In accordance with the MOU, OCMVCD will conduct a timely investigation for the presence of invasive mosquitoes at the case's place of residence (index property) and implement surveillance and control measures if necessary, which may include educational outreach, property inspections, and immature or adult stage mosquito treatments in affected areas within and beyond the index property. In order to reduce or eliminate disease transmission risk to the public, the OCMVCD shall take measures aimed at eradicating local invasive *Aedes* populations around travel-related and locally acquired cases, which may require unrestricted access to all exterior areas of properties in the impacted area and possibly indoors if disease vectors are present. OCMVCD is authorized by statute to abate vector conditions when identified (Health and Safety Code [HSC] §2040), to abate conditions as a public nuisance (HSC §2060 *et seq.*) when necessary, and to enter property to inspect for vectors or nuisances and take action to control vectors (HSC §2053). It has been OCMVCD's experience, that a cooperative process with residents focused on integrated vector management principles, can provide effective and long-lasting vector management solutions designed to reduce disease transmission risk.

TRAINING

The Vector Ecologist or Vector Control Inspector III will provide annual, and as needed, training to staff and seasonal employees on the biology and control of invasive *Aedes* mosquitoes. Employees will be trained on the appropriate personal safety measures that should be taken when conducting invasive *Aedes* work. OCMVCD personnel responding to impacted areas will take precautions to minimize contact with mosquitoes including wearing pants, long-sleeved shirts,

and protective footwear and have EPA approved mosquito repellent available for use at all times. OCMVCD employees who are pregnant or planning to have children will have the option of not working in areas where active Zika transmission is occurring or in areas where travel-related Zika cases are being investigated and invasive *Aedes* mosquitoes are present.

RESPONSE TO INVASIVE *Aedes*: SCENARIOS 1-4

1. Nuisance invasive *Aedes*

OCMVCD will respond to reports of nuisance biting in Orange County, as resources allow. In a nuisance scenario, the biting mosquitoes are not known to be infected with disease causing pathogens. Residents in communities where invasive *Aedes* mosquitoes have been detected will most likely be impacted by nuisance biting. Nuisance biting is defined as the level of mosquito biting that is not acceptable to an individual or community. Tolerance to mosquito biting will vary from one individual or community to another.

Communications and Outreach

When invasive *Aedes* are detected during a response to a nuisance biting service request, the OCMVCD will conduct outreach pursuant to the OCMVCD's Communications Plan [Appendix D] including, but not limited to;

- Posting of informational signs in the affected areas asking for residents to report day-biting, black-and-white mosquitoes. Public reports of invasive *Aedes* mosquitoes are highly encouraged to help assist the OCMVCD in delineating the extent of infestations.
- Disseminate printed educational materials to residents and property owners.
- Prepare and distribute digital communication announcements and awareness messaging.
- Provide City and County stakeholders with printed and digital materials to be distributed to affected residents and property owners within their jurisdiction.
- Notify designated City and County officials when invasive *Aedes* species are detected in a city for the first time.

Control Operations

The OCMVCD will evaluate nuisance biting reports in a localized area by conducting an inspection of the reporting person's (RP) property. If invasive *Aedes* mosquitoes are detected on the property, by the presence of eggs, larvae, pupae or adults, then a broader investigation will occur, and include the surrounding area that is encircled by a 100 meter (1/16 mile) radius (buffer zone) centered on the positive detection. Underground infrastructure will also be examined. In areas where invasive mosquitoes are detected for the first time (sites located greater than 1,600 meters or 1 mile from nearest identified infestation zone), delineation of the infestation area will be conducted through inspection and surveillance efforts that radiate outward from the initial detection. Additional mosquito detections on surrounding properties will prompt the expansion of the investigation to include uninspected areas within new 100-meter buffer zones centered on additional detections.

The inspection process will include a systematic search for mosquito breeding sources within the buffer zone using a door-to-door approach. The primary objectives of the door-to-door effort, for nuisance biting, will be to reduce mosquito breeding, collect samples of immature and adult mosquitoes, and disseminate educational information and materials to affected residents. The focus of the educational outreach component of the door-to-door effort will be to encourage property owners to reduce or remove breeding and resting sources and advise on personal and community level measures that can be taken to reduce mosquito-human contact.

The affected area's assigned Vector Control Inspector will inspect the RP's property, set a Biogents (BG)-Sentinel mosquito trap, and inspect between four to six adjacent properties. Additional traps, including Reiter-Cummings modified gravid trap (gravid trap), or a carbon-dioxide baited Encephalitis Vector Surveillance (EVS) trap may be placed on the property or nearby properties if suitable mosquito breeding or resting habitat is present. Traps will be collected the following day and the contents identified at the District Laboratory.

Positive detections will trigger the response of door-to-door inspection teams, that will systematically inspect the area within the 100 meter buffer zone and empty, relocate, remove, or modify containers that are holding or may potentially hold water. The teams will also apply ovicides, larvicides, or pupicides to large or numerous small sources that cannot be easily removed or made to exclude water. Hand-held or backpack Ultra Low Volume (ULV) pyrethroid adulticides, or microbial larvicide, applications may commence on problematic properties where invasive *Aedes* are detected. Lethal oviposition traps designed to attract egg depositing invasive mosquitoes may also be utilized on problematic properties [See Appendix E; *Mosquito Traps and Descriptions; Aedes Trapping Protocol for Technicians and Aedes Teams*].

Laboratory

Field collected mosquito samples will be identified and processed at the OCMVCD laboratory. Invasive *Aedes* mosquito distribution maps will be updated upon new detections. Detections of new invasive *Aedes* infestation areas are frequently the result of bite complaint service requests, but also arise incidentally from routine surveillance of *Culex* mosquito vectors. The delineation of infestation areas and detection of boundary expansions are primarily accomplished through larval detections from the door to door teams during neighborhood inspections and through focalized adult mosquito surveillance performed by the laboratory.

Invasive *Aedes* mosquito activity is now common in Orange County. OCMVCD maintains a year-round surveillance program designed to monitor the presence and expansion of invasive *Aedes* populations. The surveillance strategy includes the deployment of traps designed to specifically collect invasive *Aedes*, including the BG-Sentinel (host seeking live trap), and low-maintenance lethal mosquito traps, such as the Trap-N-Kill lethal oviptrap, Biogents Gravid *Aedes* Trap (BG-GAT) and the CDC Autocidal Gravid Ovitrap (AGO). These types of lethal traps are designed to be left on-site for extended periods of time operating simultaneously as a surveillance and control device. OCMVCD staff is trained to collect adult mosquitoes using mechanical aspirators. Collected invasive *Aedes* around nuisance biting service requests may be

used for pesticide resistance testing or preserved for virus screening. Mosquitoes will be sent to UC Davis Arbovirus Research and Training (DART) Laboratory for virus testing.

2. Response to travel-acquired human disease case of Zika, chikungunya, dengue fever, or yellow fever

Between 2013 and 2016 the number of travelers returning home to Orange County infected with *Aedes*-vectored viruses has increased. The potential for local disease transmission occurs if a viremic traveler returns home to an area where invasive *Aedes* mosquitoes are active. The OCMVCD will respond to travel-acquired *Aedes*-vectored disease cases that return home to Orange County. The area's assigned Vector Control Inspector Supervisor will search the index property for mosquito breeding and deploy mosquito traps. All invasive *Aedes* mosquitoes will be sent to the State for virus testing. If invasive *Aedes* mosquitoes are known to be present or are detected for the first time within 150 to 200 meters (1/10 to 1/8 mile) of the index property, the OCMVCD will continue to conduct mosquito surveillance and virus testing up to 30 days after a case's infectious period has ceased. Thirty days is an estimated maximum life span of invasive female *Aedes* mosquitoes and is the estimated period when a potentially infected *Aedes* mosquito could transmit virus to a human. The duration of the OCMVCD's response to a travel-acquired case may last up to 45 days (i.e. 15 day maximum human viremic period + 30 day adult *Aedes* life span). A surveillance or treatment response may be shorter if the traveler returns to Orange County after their viremic period ends, or if the viremic period has ended while residing in Orange County, and OCMVCD was notified after the viremia had ended. Human case information will be provided to the OCMVCD through a confidential process guided by a memorandum of understanding between OCMVCD and OCHCA, and will initiate the response plan outlined below.

Communications and Outreach

When invasive *Aedes* mosquitoes are detected within a 150 to 200 meter (1/10 to 1/8 mile) radius of a confirmed *Aedes*-vectored disease case's place of residence, OCMVCD will conduct public outreach pursuant to the OCMVCD's Communications Plan [Appendix D], including, but not limited to;

- Posting of informational signs in the affected areas asking for residents to report day-biting, black-and-white mosquitoes.
- Disseminate printed educational materials to residents and property owners.
- Prepare and distribute digital communication announcements and awareness messaging.
- Provide County and City stakeholders with written and digital materials to be distributed to affected residents and property owners within their jurisdiction.
- Notify designated City and County officials when invasive *Aedes* species are detected in a city for the first time.
- Notify property owners and local stakeholders of pending ground-based area-wide larvicide and ULV adulticide applications, including the distribution of maps with the intended target area for control operations.

Control Operations

The OCMVCD will evaluate travel-related disease cases by conducting an inspection of the index property and adjoining properties and expand the inspection to include surrounding areas if a competent vector is detected. An impacted area's assigned Vector Control Inspector Supervisor will set three traps; a BG-Sentinel, gravid trap, and an EVS carbon dioxide baited trap, on the index property. Additional traps may be placed on adjoining properties. If contact cannot be made with the case, traps will be set in the front yard if possible or on the nearest cooperating property.

The detection of invasive *Aedes* eggs, larvae, pupae or adults, will prompt a broader investigation that will include an area that is encircled by a 150 to 200 meter (1/10 to 1/8 mile) radius buffer zone centered on the index property. Underground infrastructure will also be examined. Additional mosquito detections within the buffer zone will prompt the expansion of the inspection area to include uninspected areas within a 150 to 200 meter buffer zone centered on additional detections. However, the immediate focus of this response will not be to delineate new infestation areas, but will be to suppress or eradicate the *Aedes* population within the original buffer zone area surrounding the case home to minimize the potential for disease transmission, which will likely require re-treatments during the response period.

The inspection process will include a thorough search for mosquito breeding sources within the index buffer zone using a door-to-door approach. The primary objectives of the door-to-door effort for a travel-related case will be to reduce and treat breeding sources and adult populations if present, collect samples of immature and adult mosquitoes, and disseminate educational information and materials to affected residents. The focus of the educational outreach component of the door-to-door effort will be to encourage property owners to reduce and remove mosquito breeding and resting sources and recommend personal and community level measures that can be taken to reduce mosquito-human contact.

Door-to-door inspection teams will empty, relocate, remove, or modify containers that are holding or may potentially hold water and apply ovicides, larvicides, or pupicides to large or numerous small sources that cannot be easily removed or made to exclude water.

If adult invasive mosquitoes are detected within the 150 to 200 meter radius of the index property during the response period, the OCMVCD may conduct ULV pyrethrin/pyrethroid applications, either with backpacks or by truck, with a goal of treating all properties within the buffer zone. A warrant may be used to enter backyards on properties that refuse access and show evidence of mosquito production. Larvicides, lethal mosquito traps, and residual and space spray adulticides may be used in combination in impacted areas.

Laboratory

Field samples will be identified and processed at the OCMVCD laboratory. Invasive *Aedes* mosquito distribution maps will be updated upon the detection of new infestation areas that result from field investigations around travel-acquired disease cases. Invasive *Aedes* activity is now common in certain cities within the County. Seasonal surveillance locations will be selected based on areas of known *Aedes* activity and may be temporary based on property owners

willingness to participate. In some locations, year-round activity has been observed; these locations will be monitored as part of an ongoing trapping surveillance program. Despite the year-round presence of invasive *Aedes* mosquitoes in some areas of the County, seasonal declines in air temperatures will limit mosquito abundance and the potential for virus replication and therefore reduce the risk of *Aedes*-vectored virus transmission during winter months. Therefore, surveillance frequency and intensity may vary depending on the prevailing environmental conditions and mosquito abundance.

The surveillance strategy will include the deployment of effective invasive *Aedes* surveillance traps in addition to lethal mosquito traps that are designed to be left on-site for extending periods of time operating simultaneously as a surveillance tool and control device. Adult invasive *Aedes* and any other mosquito species that may be implicated in the disease transmission cycle of Zika, dengue, chikungunya, or yellow fever, that are collected within the 150 to 200 meter buffer zone around the index property, will be preserved for virus testing. Mosquitoes will be sent to UC Davis Arbovirus Research and Training (DART) Laboratory for virus testing.

3. Response to the detection fo a single (or multiple within single residence) locally-acquired *Aedes*-vectored disease case or a cluster (not within the same residence) of locally-acquired cases.

The OCMVCD will respond aggressively to a single human case or a cluster of human cases of *Aedes* disease in the County with evidence of local transmission. A locally-acquired disease case will be determined by the OCHCA. The OCHCA may declare an *Aedes* disease case to be locally acquired, if the patient has not travelled outside of the country or into other areas where transmission is active, or if a group of people that reside in or visit the same area test positive for an *Aedes* vectored disease. OCHCA will verify whether or not the patient has traveled out of orange county within the estimated incubation period or has been infected through sexual transmission (Zika) or other routes. If local transmission is verified, a joint emergency response will be conducted by the OCMVCD, OCHCA, and City Jurisdictions while coordinating with State and Federal agencies.

Communications and Outreach

If a single *Aedes*-vectored disease case, multiple cases within the same household or case clusters are determined to have been locally-acquired in Orange County, the OCMVCD will conduct public outreach pursuant to the OCMVCD's Communications Plan [Appendix D], including, but not limited to;

- Posting of informational signs in the affected areas asking for residents to report day-biting, black-and-white mosquitoes. Public reports of invasive *Aedes* mosquitoes are highly encouraged to help assist the OCMVCD in delineating the extent and intensity of infestations in order to best target control efforts during an outbreak.
- Disseminate printed educational materials to residents and property owners.
- Prepare and distribute digital communication announcements and awareness messaging.
- Provide County and City stakeholders with written and digital materials to be distributed to affected residents and property owners within their jurisdiction.

- Notify designated City and County officials when invasive *Aedes* species are detected in a city for the first time in their jurisdiction and the status of any emerging and ongoing public health emergency situation.
- Notify property owners and local stakeholders of pending ground-based area-wide larvicide and ULV adulticide applications, including the distribution of maps with the intended target area for control operations.
- Notify and consult with CDPH and CDC and distribute a press release.
- Share information provided by the Centers for Disease Control and the local health authority.

Control Operations

The OCMVCD will respond aggressively to confirmation that a resident of Orange County developed disease after exposure to mosquitoes infected with one of the aforementioned viruses in the County. The OCMVCD will operate on the assumption that virus positive mosquitoes will be present around a confirmed locally-acquired case and will conduct area-wide mosquito control (ULV pesticide applications) using an EPA-approved public health pesticide within the 150 to 200 meter radius buffer zone centered around the suspected exposure site, with or without the immediate detection of invasive *Aedes*. ULV applications may be conducted with handheld equipment, trucks, or aircraft, with a goal of treating all properties within the target area in order to rapidly reduce the adult mosquito population and the risk of virus transmission. A warrant may be used to access properties for inspection or treatment within the buffer zone, if needed. Multiple area-wide adulticide treatments may be conducted if virus-positive mosquitoes persist in the same area. The selection of public health pesticides for application in the outbreak area will be based on pesticide resistance testing and may include pyrethrins, synthetic pyrethroids, *Bacillus thuringiensis israelensis* or other microbial insecticides, or organophosphates. Larvicide and residual and space spray adulticide applications, as well as lethal mosquito traps, will be used in combination in impacted areas.

Surveillance for virus positive mosquitoes and door-to-door investigations will be conducted within the 150 to 200 meter buffer zone around index area after the first and between consecutive area-wide treatments. Door-to-door inspections, adult mosquito surveillance, and adult mosquito control efforts will be expanded to include uninspected areas within a 150 to 200 meter radius centered upon any new positive mosquito detections.

The inspection process will include a thorough search for mosquito breeding sources within the buffer zone using a door-to-door approach. The objectives of the door-to-door effort for locally acquired disease cases will be to eliminate or treat breeding sources, collect samples of immature and adult mosquitoes, conduct adult mosquito control, and disseminate educational information and materials to affected residents. The focus of the educational outreach component of the door-to-door effort will be to encourage property owners to reduce and remove breeding and resting sources and recommend personal and community level measures that can be taken to reduce mosquito-human contact and disease transmission.

Door-to-door inspection teams will empty, relocate, remove, or modify containers that are holding or may potentially hold water and apply ovicides, larvicides, or pupicides to large or numerous small sources that cannot be easily removed or made to exclude water.

Laboratory

Field samples will be identified and processed at the OCMVCD. Invasive *Aedes* mosquito distribution maps and virus positive mosquito activity will be updated immediately upon detection and will be based primarily on data obtained from door-to-door mosquito sampling and routine and expanded mosquito surveillance. Areas where virus positive mosquitoes are detected will be included in an ongoing mosquito trapping and testing program throughout an epidemic.

The surveillance strategy in areas where local transmission has occurred will include the deployment of effective invasive *Aedes* surveillance traps in addition to lethal mosquito traps that are designed to be left on-site for extending periods of time operating simultaneously as a surveillance tool and control device. Adult invasive *Aedes* and any other mosquito species that may be implicated in the disease transmission cycle that are collected within a 150 to 200 meter buffer zone around all cases residences will be preserved and sent to the UC Davis Arbovirus Research and Training (DART) Laboratory for virus testing.

4. Response to the detection of Zika, chikungunya, dengue fever, and yellow fever pathogens in local mosquito samples in the absence of a reported human disease case.

Adult mosquitoes, especially invasive *Aedes*, collected during door-to-door inspections and surveillance related activities, will be sent to the UC DART for testing on a bi-weekly basis and may result in positive virus detections. Given the transmission cycle of the aforementioned diseases, unexpected virus positive mosquito detections would indicate that an unreported human case is present within the area. In this situation, OCHCA and CDPH will be notified immediately of the positive findings and actions listed under response scenario Number 3 above will be initiated.

Response Prioritization

During periods of high invasive *Aedes* activity, the OCMVCD shall prioritize actions based on the severity of the public health threat, which may require concentrating resources on responses to imported disease cases or local disease transmission; whereby, the OCMVCD's response to nuisance biting mosquitoes may be temporarily curtailed. Details of the District's response prioritization to mosquito-borne disease scenarios in the county can be found in the *OCMVCD WNV & Invasive Aedes Matrix Guidelines* [Appendix C]

Considerations and Assumptions of the OCMVCD Invasive *Aedes* Response Plan:

- The lifetime flight range of *Ae. aegypti* and *Ae. albopictus* will typically be less than 200 meters from the site of emergence; therefore, timely adult mosquito control within 150 to 200 meters of a case should reduce or eliminate the risk of virus transmission.
- The probability of transovarial passage of Zika virus between generations, for both *Ae. aegypti* and *Ae. albopictus*, is unknown but, based on other related viruses, is expected to be insignificant. Control of adult mosquitoes is necessary to minimize or halt active transmission.
- The lifespan of *Ae. aegypti* and *Ae. albopictus* in nature is not expected to exceed 30 days. Therefore, assuming a maximum viremic period of two weeks from symptom onset for an infected person, the longest interval between symptom onset of one case and acquisition of infection in a secondary case is estimated to be approximately six weeks.
- The rates of mutation conferring insecticide resistance are slow enough that testing once in a season should be sufficient to base that year's insecticide selection on.

REFERENCES

California Department of Public Health. Updated February 2017. Guidance for Surveillance of and Response to Invasive *Aedes* Mosquitoes and Dengue, Chikungunya, and Zika in California. <http://www.cdph.ca.gov/HealthInfo/discond/Documents/2016InvasiveAedesSurveillanceandResponseinCA.pdf> Accessed 11/10/16.

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ZIKA



CDC Interim Response Plan

May 2017

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Purpose

This document describes updated guidance and resources from the Centers for Disease Control and Prevention (CDC) for responding to cases of Zika virus infection in the continental United States (CONUS) and Hawaii. This guidance is targeted to state, local, and tribal jurisdictions, which are responsible for responding to Zika virus disease in their communities. This guidance may also be used by jurisdictions in US territories and freely associated states as applicable and adapted as needed. Information is provided to assist jurisdictions in protecting pregnant women and infants and responding to travel-associated, sexually transmitted, and locally acquired Zika virus infections in the United States. CDC encourages jurisdictions to use existing funding to support these activities. There are no additional funds available from CDC at this time to support implementation of this guidance. This document serves as a reference for public health decision-making and is not meant to be prescriptive or comprehensive, as activities and decisions are jurisdiction- and event-specific. The response activities outlined in this plan are based on currently available knowledge about Zika virus, its transmission, and its effects on pregnant women and infants. These activities may change as more is learned about Zika virus.

Zika Virus in the Continental United States

In 2016, non-congenital and congenital Zika virus infection and disease became nationally notifiable conditions in the United States. Cases are reported to [ArboNET](#), the national arboviral surveillance system managed by CDC and state and territorial health departments, using the [Council of State and Territorial Epidemiologists \(CSTE\) approved case definitions for non-congenital and congenital Zika virus infection and disease](#). CDC provides weekly provisional data on Zika virus disease case counts and presumptive viremic blood donors reported by US states and territories on the [CDC Zika Virus Case Counts in the US website](#). Zika virus disease cases that meet the probable or confirmed CSTE definitions are categorized as acquired through travel to affected areas, presumed local mosquito-borne transmission, or other routes (e.g., sexual, laboratory, or blood-borne transmission).

Zika virus infection during pregnancy may cause birth defects including microcephaly, fetal brain abnormalities, eye abnormalities, hearing loss, and other consequences of central nervous system damage in infants exposed in utero. Pregnancy loss and neonatal deaths have also been reported. To complement notifiable reporting of Zika virus disease, CDC has established the [US Zika Pregnancy Registry \(USZPR\)](#), an enhanced national surveillance system for monitoring the effects of Zika virus infection on pregnant women and their infants. The USZPR includes pregnant women with laboratory evidence of possible Zika virus infection in a maternal, placental, or fetal/infant sample and monitors these women and their infants.

Within CONUS, local mosquito-borne Zika virus transmission was reported by Florida and Texas in 2016. A description of Florida's response and control efforts for local mosquito-borne transmission of Zika virus in Miami-Dade and Broward Counties during June-August 2016 was published in CDC's [Morbidity and Mortality Weekly Report \(MMWR\)](#). Recommendations and guidance for people living in or traveling to areas of the United States with Zika virus transmission are available [on the CDC website](#).

Building on lessons learned in 2016 and feedback from state and local health partners, CDC has revised this document to be more streamlined, added links to existing guidance on CDC's website, and updated critical guidance. Detailed guidance on issuing and removing designations for Zika active transmission (red) areas and Zika cautionary (yellow) areas has been provided. In addition, the guidance for identifying areas at risk for the purpose of blood and tissue safety is now more closely aligned with the guidance for issuing travel and testing guidance.

Definitions

Local Mosquito-borne Transmission

Zika virus infection in a person who has not traveled from an area with Zika virus transmission or had sexual exposure or other known exposure to body fluids of an infected person.

Suspect Case of Local Mosquito-borne Transmission

A person with symptoms or preliminary test results compatible with Zika virus infection who does not have risk factors for Zika virus acquisition through travel, sexual contact, or other known exposure to body fluids and for whom Zika virus test results are pending.

OR

A blood donor with initial donation screening positive for Zika virus and confirmatory test pending, who does not have risk factors for Zika virus acquisition through travel, sexual contact, or other known exposure to body fluids.

Confirmed Local Mosquito-borne Transmission

A person who does not have risk factors for Zika virus acquisition through travel, sexual contact, or other known exposure to body fluids and who tests positive for Zika virus infection per [CDC laboratory guidance](#).

OR

A blood donor who does not have risk factors for Zika acquisition through travel, sexual contact, or other body fluid exposure and who has a positive Zika virus nucleic acid test (NAT) on screening AND confirmation through an approved confirmatory test algorithm.

Confirmed, Multiperson Local Mosquito-borne Transmission

Three or more cases of confirmed local transmission in non-household members with onsets greater than 2 weeks apart (the approximate lifespan of an infected mosquito) and less than 45 days in an area of approximately 1-mile in diameter. Identification of overlapping movement within a 1-mile diameter of multiple people with locally acquired Zika virus infection suggests a common location (e.g., residential neighborhood, workplace, or other location) for infected mosquito exposure, because the lifetime flight range of the *Aedes aegypti* mosquito vector is approximately 150 meters (approximately 500 ft).

Preparedness

CDC recommends that jurisdictions develop Zika virus action plans to guide preparedness and response activities through a phased, risk-based continuum. The continuum includes support for mosquito season preparedness and graduated action in response to detection of confirmed local mosquito-borne transmission and multiperson local mosquito-borne transmission, if present. Planning should also address activities to occur in subsequent seasons, following the confirmation of multiperson local mosquito-borne transmission.

Local mosquito-borne transmission can only occur when competent *Aedes* species mosquito populations are present within a community. The temperate climate of CONUS limits year-round Zika virus transmission in most locations; the seasonal timing of imported cases greatly influences the potential for local Zika virus transmission (e.g., imported cases during cooler months are less likely to lead to local mosquito-borne transmission). Mosquito season varies by jurisdiction but is typically during the summer months. However, year-round local transmission of Zika virus may be possible in warmer locations. Jurisdictions with competent vectors should conduct an assessment of vector risks and institute vector control activities as indicated.

Surveillance

Case surveillance

All health departments should be prepared to identify and investigate potential Zika cases in travelers, presumptive viremic blood donors, and their sexual contacts. These activities are important to mitigate risk to the community. Because clinicians are integral to the surveillance process, all health departments should take steps to increase healthcare provider awareness of Zika virus and ensure testing of potential cases. In addition, health departments should ensure that appropriate divisions, sections, or other units within their organizations have established lines of communication and are coordinating planning and response efforts, especially maternal and child health and birth defects programs. Vector control programs, which may exist within or outside health departments, should also be included.

The following information should be gathered as quickly as possible when a potential case is identified:

- Basic demographic information (e.g., age, sex, state, and county of residence)
- Clinical symptoms (including fever, rash, conjunctivitis, arthralgia, or evidence of neurologic disorder, such as Guillain-Barré syndrome)
- Illness onset date
- Exposure history (location of travel, dates of travel, partner's clinical information if sexual transmission is suspected, and receipt of any blood, organ, or tissues in previous 28 days)
 - For each confirmed case, dates of symptom onset and exposure to areas with risk of Zika or sexual contacts at risk for Zika virus infection should be closely evaluated to determine whether local mosquito-borne transmission can be ruled out. (see [Zika Virus Infection Case Investigation Form](#))

- Further detailed investigation should be conducted promptly for people who develop illness compatible with Zika virus disease within 28 days of receiving blood products, organs, or tissue because of the potential for Zika virus transmission through transfusion/transplantation.
- Hospitalization, reason for hospitalization, and disposition
- Pregnancy status and related information (e.g., sexual exposure, estimated date of delivery, results of prenatal ultrasound and other testing, outcomes, including pregnancy loss, live birth and any birth defects)
- If the patient is an infant, obtain maternal history as outlined above, including gestational age during pregnancy at the time of exposure and at birth. Also collect laboratory test results (maternal, infant, or placental), infant physical exam, and imaging findings, including microcephaly, intracranial calcifications, other neurologic abnormalities and birth defects and follow up on growth and development milestones, as appropriate.
- History of blood or tissue donation

Tools and resources to assist health departments in conducting epidemiologic investigations can be found on CDC's website.

While interacting with the patient and family, reinforce the steps necessary to avoid exposure to local mosquito populations to prevent transmission (e.g., stay indoors in screened, air-conditioned rooms during the first week of illness, use Environmental Protection Agency (EPA)-registered insect repellent, and perform mosquito reduction activities around home).

States and blood collection establishments should work together to ensure prompt communication from the blood center to the health department of any positive results identified in blood donors. It is possible that either local transmission cases or travel-associated cases could be identified through blood screening.

Pregnancy and birth defects surveillance

CDC is ready to immediately assist jurisdictions with confirmed local mosquito-borne transmission of Zika virus to protect and [educate pregnant women](#), track cases of Zika infections during pregnancy and infant outcomes, and assist with provider outreach and education. State, local, and territorial public health programs are encouraged to collaborate with the [US Zika Pregnancy Registry \(USZPR\)](#), an active population-based surveillance system that monitors the effects of Zika virus infection during pregnancy on women and their infants. Data from the USZPR are used to update clinical evaluation and management of pregnant women and infants.

Whether symptomatic or asymptomatic, pregnant women with possible Zika virus infection and their infants should be reported to USZPR in as timely a manner as possible. Infants in whom Zika is diagnosed after birth should also be promptly reported, along with their mothers. Clinical information about the pregnancy as well as infant outcome data are tracked as part of USZPR surveillance.

Establishing and maintaining pregnancy and birth defects surveillance capacity is important before and during local mosquito-borne transmission. Jurisdictions should ensure that maternal and child health and birth defects programs are integrated into Zika virus planning and response activities and should ensure that clinicians caring for pregnant women and infants are aware of Zika risks, laboratory test availability, surveillance reporting, and clinical guidance.

Enhanced surveillance in areas at risk for mosquito-borne transmission

In locations with competent mosquito vectors and travel-associated Zika virus disease cases, health departments should consider implementing enhanced surveillance for Zika virus disease when the mosquitoes are present and active and before identifying a first case of local mosquito-borne transmission. The appropriate geographic scope and intensity of such increased surveillance depends on local circumstances, such as history of previous local dengue or chikungunya virus transmission, population density, anticipated mosquito abundance, locations of recent travel-associated cases, local travel patterns (i.e., areas known to have a high number of travelers to affected areas, or areas with previously identified cases of travel-associated dengue and chikungunya), and other risk factors (e.g., lack of air conditioning or screens). Enhanced surveillance near the area(s) of likely exposure should also be conducted when a confirmed case of local transmission is reported. CDC is available to provide additional guidance to state, local, and tribal jurisdictions as requested. Contact CDC's Emergency Operations Center at 770-488-7100 or eocreport@cdc.gov for assistance.

Jurisdictions should take the following steps to quickly detect and report local mosquito-borne transmission:

1. Ensure diagnostic testing is available and communicate with providers about local testing goals.
 - Ensure processes for laboratory test ordering and approval (from public health laboratories [PHLs]) are in place and that providers are aware of PHLs and commercial laboratory diagnostic testing options.
 - Ensure timely specimen transport and testing for suspected local transmission cases and plans for test confirmation if there is a positive result.
 - Ensure any changes in guidance on laboratory testing or interpretation of results are communicated promptly through appropriate public health channels to reach clinicians.
 - Emphasize outreach to healthcare providers caring for pregnant women and infants to ensure they are aware of how to obtain Zika virus testing when indicated.
 - Ensure a mechanism exists for timely reporting of results to providers, particularly those caring for pregnant women.
2. Increase surveillance for Zika virus disease in areas with confirmed travel-associated cases and competent vector activity to identify possible cases of local transmission.
 - Interview household members of confirmed travel-associated cases, conduct testing of anyone with symptoms consistent with Zika virus disease, and inform household members to notify public health authorities if symptoms develop.
 - Whenever possible, follow up on households that had a travel-associated case with onset of symptoms 14-21 days earlier to ascertain if any additional household members developed symptoms that could indicate local transmission, and to provide or facilitate testing for any newly symptomatic people.
 - Deliver prevention and early detection messages to nearby households.
 - Increase outreach to local [healthcare providers](#), including infectious disease specialists, obstetricians and gynecologists, maternal-fetal medicine specialists, and pediatricians.
 - Develop tools and processes to ensure providers can report clinically compatible cases, particularly pregnant women with prenatal findings consistent with congenital Zika syndrome and infants with birth defects consistent with congenital Zika syndrome to state or local public health officials.

- Contact local laboratories that perform Zika virus testing to monitor the number and geographic location of additional suspect cases and any preliminary positive results, to reconcile with reports from public health departments, to assess testing volume and to ensure laboratories are aware of public health reporting requirements.
 - Conduct syndromic surveillance using data from healthcare facilities, including emergency departments, to detect early increases in illnesses that could be Zika virus disease, wherever possible.
 - Consider implementing sentinel surveillance in areas at higher risk for local mosquito-borne transmission.
 - Rapidly identifying suspect local mosquito-borne transmission cases in areas with confirmed travel-related cases and potential for mosquito-borne transmission requires timely testing of patients with illnesses highly suggestive of Zika virus disease (e.g., people who have two or more of the four primary clinical signs/symptoms: rash, fever, arthralgia, or conjunctivitis), but who lack known travel-related exposures.
 - Consider implementing [event-based surveillance](#) for clusters of rash illness.
 - Educate and enlist providers to be vigilant for unexplained clusters of rash illness, to report the finding to public health, and to conduct further investigation and testing for Zika virus disease. This is especially important if some patients have additional symptoms (e.g., fever, arthralgia, or conjunctivitis), or if the cluster involves adults, where rash illnesses may be less common.
3. Develop standing communication channels with vector control officials to share vital information and coordinate surveillance and vector control efforts.
- State and local health departments should coordinate closely with local vector control districts to ensure vector control personnel are rapidly informed of any confirmed Zika virus infection in their jurisdiction.

Vector Control

The goal of vector control is to suppress *Aedes aegypti* and *Aedes albopictus* mosquito populations in a coordinated and effective manner to prevent or interrupt Zika virus transmission. CDC has developed guidelines on the [Surveillance and Control of *Aedes aegypti* and *Aedes albopictus* in the United States](#). The magnitude of activities used in a vector control response will depend on the extent of mosquito-borne transmission, as measured by the number of Zika cases and their geographic and temporal distribution.

- Control activities that target both adult and larval mosquitoes will be necessary to prevent or interrupt Zika virus transmission by mosquitoes.
- The methods used around a single case may be accomplished with intensive sanitation and limited adulticiding delivered with backpack spraying. More widespread transmission may require equipment (i.e., trucks or aircraft) that can deliver larvicides and adulticides over a much broader area in a timely and effective manner.
- Any vector control should be guided by robust mosquito surveillance to evaluate the effectiveness of interventions.
- The American Mosquito Control Association, through funding provided by CDC, has updated its [Best Practices for Integrated Mosquito Management](#).

CDC has also developed a database for the collection of [surveillance information on the distribution, abundance, and insecticide resistance status](#) of *Aedes aegypti* and *Aedes albopictus*. This information is useful to inform strategy and resource allocation for the control of these mosquito vectors. Additional guidance on Zika vector control in the Continental United States can be found [here](#).

Blood and Tissue Safety

The US Food and Drug Administration (FDA) issued updated guidance for industry to reduce the risk of transfusion-transmission of Zika virus in [August 2016](#). These recommendations call for blood collection establishments in **all** states and US territories to screen individual units of donated whole blood and blood components with a Zika virus screening test authorized for use by FDA under an investigational new drug (IND) application or with a licensed test when available. Alternatively, an FDA-approved pathogen-reduction device may be used for plasma and certain platelet products. FDA has also issued guidance for reducing the risk of Zika virus transmission by [human cell and tissue products](#). For organ transplants, the Organ Procurement and Transplantation Network (OPTN) of the Health Resources and Services Administration (HRSA) has developed [information on Zika virus](#) for organ transplant establishments and organ procurement organizations.

Jurisdictions should ensure procedures are in place with blood collection establishments for sharing information and coordinating response activities related to presumed viremic blood donors. Jurisdictions should also strengthen communication and information sharing procedures with local tissue collection establishments regarding Zika virus and tissue donations.

In addition to its critical role in protecting health, blood donation screening for Zika virus can enhance surveillance efforts and inform prevention and response measures. CDC efforts in these areas include the following:

- Providing consultation and [guidance](#) to help state, local, and tribal jurisdictions reduce the risk of transfusion- or tissue-related transmission (e.g., semen) of Zika virus.
- Establishing criteria for health departments to report blood donors with Zika infection to CDC's ArboNET.
- Working with state and local health officials to ensure that [geographic areas with Zika virus transmission risk](#) are posted on the CDC Zika virus website to assist blood collection and tissue recovery establishments in identifying areas requiring blood and tissue safety intervention (see [Communicating Geographic Areas with Zika Virus Transmission Risk](#) section).
- Providing guidance and technical assistance, as needed, to state or local jurisdictions and blood collection and tissue recovery establishments in following up with positive donors, reporting of donors with Zika virus infection to ArboNET, and investigating suspected cases of transfusion- and transplant-transmitted infections.

Communication

When preparing for local Zika virus transmission, jurisdictions should follow [risk communication principles](#) to immediately communicate and effectively address concerns about Zika.

- Maintain credibility and public trust by regularly providing timely, accurate, and actionable information about what is known and unknown about Zika virus and dispelling rumors and misinformation.
- Increase access to accurate information about Zika among affected populations (i.e., pregnant women and community members) and convey appropriate action messages for each audience.
- Ensure communication is sensitive to diverse cultural health beliefs and practices, preferred languages, health literacy, and other communication needs (for more information, consult the [National Standards for Culturally and Linguistically Appropriate Services in Health and Health Care \[CLAS\]](#)).
- Ensure communication messages are accessible to non-English speaking audiences.

Jurisdictions should ensure that communication activities achieve the following:

- Increase knowledge of vector control activities in affected communities.
- Increase the capacity of [healthcare providers](#) to share accurate health information about Zika prevention with pregnant women and women of reproductive age, their partners, and affected populations. This will likely require targeted outreach to [healthcare providers caring for pregnant women and infants](#).
- Motivate action by community leaders and organizations (e.g., [MotherToBaby](#) and [March of Dimes](#)) to protect pregnant women and other people at risk, especially vulnerable populations, from Zika virus infection.
- Communicate [how Zika is spread](#) and [how people can protect themselves](#).
- Distribute [communication materials](#) (i.e., fact sheets, web updates, video messages, press releases) explaining public health activities by local, state and CDC officials, including [provider tools](#), responsive vector control activities and travel guidance.

CDC's communication activities in response to Zika virus include the following:

- Coordination with relevant stakeholders
 - Coordinate public announcements with local authorities and other agencies.
 - Coordinate with state/local press release or press conference to issue a CDC press statement or hold a press briefing with CDC leadership or subject matter experts, as appropriate.
 - Before press events, distribute key information to agencies, officials, and public health partners.
 - Partner organizations, including national and local chapters as applicable: American College of Obstetricians and Gynecologists, Association of State and Territorial Health Officers, Council of State and Territorial Epidemiologists, National Association of City and County Health Officers, Pan American Health Organization, Society for Maternal-Fetal Medicine, and the World Health Organization
 - Federal partners: Assistant Secretary for Preparedness and Response, Centers for Medicare and Medicaid Services, Environmental Protection Agency, Food and Drug Administration, Health Resources and Services Administration, and Indian Health Service

- Congressional staff and elected officials at multiple levels
- Communication of messages
 - As appropriate, issue press release/media statement(s) and support local and state Public Information Officers.
 - Convey health messages and resources to professionals (i.e., clinicians, health departments, and laboratories) and the public.
 - Communicate how Zika is spread and how people can protect themselves.
- Ensuring effectiveness of communication activities
 - Support state and local responders in adapting and tailoring CDC-produced information products designed to ensure consistency and clarity of messages regarding Zika, vector control activities, and clinical guidance.
 - Monitor and assess news media, social media, and public inquiries to update or correct information delivered as needed.
 - Engage with relevant target audiences regularly to update and improve messaging and uptake.

Response

In the event of suspected or confirmed local transmission, state health officials should notify designated officials and the CDC Emergency Operation Center at 770-488-7100 or eocreport@cdc.gov.

CDC will work closely with the state health department to balance consistency in Zika virus response activities nationally with specific requirements of individual states and localities. CDC will provide support and assistance as needed in confirming cases, determining appropriate geographic areas for interventions, rapidly conducting an epidemiologic investigation, and enhancing surveillance activities, entomologic evaluation, and risk communication. CDC can provide on-the-ground assistance via a CDC Emergency Response Team, as described below. Although blood donation screening has been implemented in all US states and territories, CDC will continue to post information about geographic areas with Zika virus transmission risk on a [designated section of the CDC Zika virus website](#) to assist in identifying areas with risk of Zika for the purposes of blood and tissue safety intervention.

CDC continually reviews data and issues clinical guidance and testing recommendations focused on women of reproductive age, pregnant women, and infants. Pregnant women and women planning a pregnancy, as well as infants born to women infected with Zika virus during pregnancy, are a priority. For women and couples living in areas with risk of Zika who wish to delay or prevent pregnancy, CDC recommends that healthcare providers discuss how to prevent unintended pregnancy and offer the full range of FDA-approved contraceptive methods. In all stages of the response, CDC will provide [educational materials and targeted messages](#) designed to reach pregnant women, men and women of reproductive age, and their healthcare providers.

CDC Emergency Response Teams (CERT)

When a suspected or confirmed case of local transmission is identified, CDC will work with the state or tribal health authorities to determine if CERT support is needed. CERT(s) may be requested by state, local, or tribal health authorities through the CDC Emergency Operations Center at 770-488-7100 or eocreport@cdc.gov. CDC will review the request and, if approved, will coordinate the mission and logistics of the CERT deployment with the health or emergency management authorities.

The composition of the CERT will depend on the needs of the state/local or tribal health authorities and will be a joint decision of the state/local or tribal health authority and CDC. CERTs can provide on-the-ground technical assistance in epidemiology, vector control, pregnancy and birth defects, blood and tissue safety, and risk communication, as well as community engagement, response management, and logistics. The team's resources include experts who specialize in detecting and controlling mosquito-borne diseases, case-investigation/ascertainment and surveillance, identifying and studying insects and vector control, and laboratory diagnostics for responding to the challenges presented by Zika. Specifically, CERTs can

- Assist with epidemiologic investigation of known cases to determine the timing and source of infection (travel-related, sexual, mosquito-borne, or other) through interviews with suspect cases, family, and possibly primary care providers.
- Assist with clinical outreach to healthcare providers caring for pregnant women and infants.
- Assist with clinical laboratory reporting to healthcare providers and laboratory interpretation.
- Assist with collection of data for the pregnancy registries and birth defects surveillance.
- Provide technical assistance and education on the clinical management of pregnant women and infants affected by Zika to state, local, and tribal health officials and providers.
- Work with existing local vector control programs to fill gaps around implementing local vector control measures
- Enhance or implement mosquito surveillance (if absent) to determine the type, distribution, and population size of competent *Aedes* mosquito species.
- Support community engagement efforts to implement vector control strategies and programs.
- Provide communication research, media and technical assistance, and audience-focused materials to help local health departments institute risk communication campaigns to provide information about the risk of Zika virus infection and personal measures people can take to decrease their risk for infection and adverse outcomes, with a focus on protecting pregnant women.
- Facilitate outreach to the local medical community to test and report suspect cases and to provide clear and actionable prevention information to patients, including prevention of both mosquito-borne and sexual transmission.
- Support staffing needs (as CDC resources permit) for state, local, or tribal health departments to enhance surveillance for Zika virus infection in people.
- Provide on-site training or assistance in performing laboratory tests for Zika infection, including scale up of local laboratory capacity or rapid transport of specimens to reference laboratories.

Communicating Geographic Areas with Zika Virus Transmission Risk

In the event that Zika virus transmission occurs at an intensity that presents a risk to pregnant women, CDC in consultation with states will issue domestic travel guidance for pregnant women to avoid or consider postponing travel to the affected area, as well as prevention, laboratory testing, and preconception counseling guidance. To keep the public informed, CDC will provide [travel information and trip planning recommendations](#) to the public and indicate areas of Zika transmission risk with guidance, maps, and case counts. CDC will also assist blood collection and tissue recovery establishments in identifying areas requiring blood and tissue safety intervention by posting this information on a designated [website](#).

CDC has identified [two types of geographic areas](#) to describe where Zika virus-related domestic travel, testing, and other guidance applies: Zika cautionary areas (designated as yellow on map) and Zika active transmission areas (designated as red on map) ([Appendix A](#)). The designation of these areas can be revised or removed when public health assessment suggests a change in risk in consultation with CDC and state and local officials.

Surveillance and public health interventions implemented in and around these areas should be determined based on risk assessments for further local transmission (boundaries may vary by intervention). Risk assessments should include factors such as history of previous local dengue or chikungunya virus transmission; population density; large numbers of the mosquitoes that spread Zika; locations of recent travel-associated cases; local travel patterns (i.e., areas known to have a high number of travelers to affected areas, areas with previously identified cases of travel-associated dengue and chikungunya); and other risk factors (e.g., lack of air conditioning or screens).

Surveillance and response activities should be scaled based on the intensity and geographic extent of transmission. CDC can provide consultation and CERT assistance with scaling up surveillance and response activities, as needed.

Zika active transmission areas (red areas)

A Zika active transmission (red) area is a geographic area in which local, state, and CDC officials have identified the presence of [confirmed, multiperson local mosquito-borne transmission](#) and have determined that the intensity of Zika virus transmission presents a significant risk of Zika virus infection, posing a risk to pregnant women and blood and tissue safety. In a red area, a combination of preventive interventions should be implemented, most importantly travel guidance recommending pregnant women not travel to the area. Blood collection and tissue recovery establishments should refer to FDA guidance for detailed recommendations (see [Blood and Tissue Safety](#) section). Testing, prevention, and preconception counseling recommendations for red areas can be found [here](#).

When defining a red area, states in consultation with CDC, should designate the smallest, easily identifiable location, with a minimum of 1-mile diameter that completely encompasses the geographic area of significant risk, particularly to pregnant women, as delineated by epidemiologic, entomologic, and environmental investigation. The boundaries of this area should be communicated to the public using terminology and landmarks recognizable to residents and visitors, such

as street-level borders, a neighborhood, a zip code area, a city, or a county. After a period of 45 days with no additional confirmed local transmission cases and no suspected local transmission cases under active investigation, a red Zika active transmission area should be designated as a cautionary (yellow) area, as described below.

Zika cautionary areas (yellow areas)

A Zika cautionary (yellow) area is a geographic area in which local mosquito-borne transmission has been identified and pregnant women and blood and tissue safety are at some undetermined risk, but evidence is lacking on whether the intensity of transmission is widespread and sustained. Pregnant women should consider postponing travel to yellow areas. Blood collection and tissue recovery establishments should refer to FDA guidance for detailed recommendations (see [Blood and Tissue Safety](#) section). Testing, prevention, and preconception counseling recommendations for yellow areas can be found [here](#).

Acknowledging the need to be adaptable and responsive to local circumstances, a yellow area may be established in one of two ways: (1) as a cautionary area surrounding a Zika active transmission (red) area, or (2) as a cautionary (yellow) area alone. When a red area is established, a yellow area is implemented simultaneously around it, with the yellow area boundaries defined by the borders of the county, city, or another similar jurisdiction with easily identifiable borders for public communication. Removal or revision of the yellow area may be considered when public health assessment indicates a clear change in risk (e.g., a period of 45 days after the red area designation ends, with no additional confirmed local transmission cases, no suspected local transmission cases under active investigation and enhanced surveillance in place).

If a red area has not been defined, a yellow area may be designated if there are three or more local transmission cases without an epidemiologic link (e.g., non-household cases) within a 5-mile diameter over a 45-day period. Preferably, case locations should be mapped by the location of the most likely exposure or if necessary, by home or neighborhood residence. Similar to a yellow area surrounding a red area described above, the boundaries of a “stand-alone” yellow area are defined by the borders of the county, city, or another similar jurisdiction with easily identifiable borders for public communication. Removal or revision of the yellow area may be considered when public health assessment indicates a clear change in risk (e.g., a period of 45 days after the yellow area is implemented, with no additional confirmed local transmission cases and no suspected local transmission cases under active investigation and enhanced surveillance in place). Additional reporting factors to consider before removal or revision of the yellow area, especially in jurisdictions balancing multiple competing priorities, include timeliness of case investigations, laboratory testing, and delays in data sharing.

Response to a Suspect Case of Local Mosquito-borne Transmission

In response to a suspect case of local mosquito-borne transmission, state and local health authorities should

- Initiate an epidemiologic investigation to determine the timing and potential source of infection (i.e., locations of possible mosquito exposure, travel within CONUS) (see [Possible Local Mosquito-borne Transmission Zika Virus Case Investigation Form](#)).

- Be prepared to share vital information and coordinate surveillance and vector control efforts with vector control officials.
- Implement [local vector surveillance and control](#), as appropriate.
- Communicate with clinicians caring for pregnant women and infants about the risks of Zika and disseminate CDC guidance for these populations.
- Ensure that state and local maternal and child health and birth defects programs are integrated into Zika virus planning and response activities.
- If applicable, coordinate with blood collection establishments to begin traceback and other follow-up activities related to presumptive viremic blood donors.
- Verify procedures and points of contact with local tissue collection establishments regarding Zika virus and tissue donations.

Response to a Confirmed Case of Local Mosquito-borne Transmission

Local transmission by mosquitoes should be assumed whenever a case is confirmed and other routes of exposure (e.g., travel, sexual contact, transfusion) have been evaluated and likely ruled out. Under these circumstances, state, local, and tribal jurisdictions should implement surveillance for Zika virus disease around the home of the confirmed, locally acquired case and any other likely locations of exposure identified through the case investigation. The principal objectives of this surveillance should be to define the frequency and geographic extent of local transmission. Tools to assist in conducting epidemiologic investigations and surveillance in households, workplaces, and the community can be found in CDC's [Toolkit for Investigating Possible Local Mosquito-Borne Transmission of Zika Virus](#).

Because dengue and chikungunya virus infections share a similar geographic distribution with anticipated Zika virus distribution and acute symptoms of infection with all three viruses are similar, patients under investigation for Zika virus infection should also be evaluated and managed for possible dengue or chikungunya virus infection. It is important to identify dengue virus infections because proper clinical management of dengue can improve outcomes for patients.

In response to a confirmed case of local mosquito-borne transmission, state and local health authorities should

- Notify CDC of the investigation and provide basic epidemiologic information regarding the confirmed case to ensure coordination of efforts between the jurisdiction and CDC. (see [Zika Virus Line List Template](#))
- Determine if [CERT](#) support is needed.
- Identify the physical location of the case patient's most likely place(s) of exposure (e.g., home, work, other US location, if recent travel). (see [Possible Local Mosquito-borne Transmission Zika Virus Case Investigation Form](#))
- Implement targeted surveillance activity around suspected area(s) of local transmission to identify if other recent cases are from same/nearby mosquito pool; these activities can help quickly confirm local transmission. (see [CDC Sample Protocol for Community Survey, Household Member Survey Form, Workplace Survey Form, Household or Workplace Visit Log, Zika Virus Line List Template](#))

- For household members:
 - Assess for symptoms of Zika virus disease (e.g., within 8 weeks prior to the case patient's symptom onset).
 - Evaluate relationship to case patient, pregnancy status and plans to become pregnant, if applicable.
 - Collect urine and serum to test for recent Zika virus infection.
 - Assess travel and other potential exposures, if applicable.
 - Ask about history of blood or tissue donation.
- For close neighbors/neighborhood in suspected area/workplace with outdoor exposure
 - Conduct house-to-house survey of any available people, or survey at local gathering place or workplace, to identify any recently symptomatic people (e.g., within 8 weeks prior to the case patient's symptom onset)
 - If symptomatic, obtain specimens to test for recent Zika virus infection.
- Conduct [enhanced surveillance](#) in areas contiguous to the location where local transmission likely occurred, especially those with documented vector activity and high travel volume to the affected area.
 - Determine if additional identified suspect cases are likely to represent a single transmission chain or separate occurrences.
 - Ensure adequate surveillance of pregnant women and infants, including testing when indicated.
- In coordination with CDC, evaluate the need to define a [Zika cautionary \(yellow\) area](#). If a yellow area is established:
 - Communicate [travel, testing, and related guidance](#) associated with cautionary areas to target audiences and partners, including the boundaries of such areas.
 - Communicate the location(s) of any such area(s) to blood collection and tissue recovery establishments.
- In coordination with vector control officials, implement [local vector surveillance and control](#) as appropriate.
 - Intensify vector surveillance and resistance testing efforts in identified geographic area(s).
 - Consider focal or area-wide treatments with larvicides and adulticides using application methods (truck or aerial) appropriate for the treatment area(s).
 - Intensify source reduction efforts.
 - Consider adding community-based adult mosquito control consisting of outdoor residual spraying and space spraying if necessary.
 - Consider targeted indoor residual spraying in areas where air conditioning and screens are not widely available.
- Increase coordination of response activities with state and local maternal and child health and birth defects programs.
- Communicate with blood collection and tissue recovery establishments (see [Blood and Tissue Safety](#) section) to identify additional cases.
- If applicable, coordinate with blood collection establishments to begin traceback and other follow-up activities related to presumptive viremic blood donors.
- Further expand laboratory testing for symptomatic people, including pregnant women, and assess laboratory surge capacity for anticipated increased testing volume.

- Augment clinician outreach, education, and communication activities to healthcare providers in the county or jurisdiction through existing local channels (e.g., messages through local medical societies and local chapters of ACOG/AAP, Health Alert Network messages [HANs], conference calls).
 - Communicate with clinicians caring for pregnant women and infants about the risks of Zika and disseminate [CDC guidance](#).
 - Emphasize the importance of testing pregnant women and infants.
- Prepare and issue a media statement in coordination with CDC and involved local health departments.
- Hold press conferences/events about confirmed local transmission Zika case, ongoing investigations, and updates. Pre-release copies of the press release and Q&As to
 - State and local health departments
 - Responding health department unit, environmental health unit, law enforcement, and local elected officials
- Conduct appropriate [risk communication](#), following established principles (e.g., be first, be right, be credible).
 - Inform the public about what is known and what is not known.
 - Provide actions people can take to protect themselves and their families to reduce the risk of infection through mosquito bites and sexual transmission, and minimize the potential for public misunderstanding, rumors, and fear.
 - Use available communication channels appropriate for the local community.
 - Engage with pregnant women, women of reproductive age, and their families/partners with personal protective measures recommendations (e.g., steps to prevent mosquito bites and sexual transmission)
- Provide information to [pregnant women](#) and [women of reproductive age](#) about the presence of Zika virus in the local area and what precautions they should take to prevent being infected with or avoid Zika virus exposure during pregnancy. Information should also be made available for their [sexual partners](#).
- Implement community outreach efforts to encourage people with clinically compatible illnesses to seek care (and testing for confirmation, when appropriate).
- Monitor local news stories and social media posts to determine if information is accurate, identify messaging gaps, and make adjustments to communication materials, as needed.

Response to Confirmed, Multiperson Local Mosquito-borne Transmission

In response to confirmed, multiperson local mosquito-borne transmission, state and local health authorities should

- Determine if CERT support is needed.
- In coordination with CDC, define the boundaries of the Zika active transmission (red) area and the surrounding Zika cautionary (yellow) area to communicate [geographic areas with Zika virus transmission risk](#).
 - Communicate [travel, testing, and related guidance](#) associated with these areas to target audiences and partners, including the boundaries of such areas.
 - Communicate the location(s) of any such area(s) to blood collection and tissue recovery establishments.
- Prepare and issue a media statement in coordination with CDC and involved local health departments.

ZIKA

CDC Interim Response Plan

- Continue to conduct [enhanced surveillance](#) activities to identify additional cases of local transmission.
- Continue [vector surveillance and control measures](#) as guided by an entomologic evaluation of the area.
 - Consider intensifying and expanding area-wide treatments with larvicides and adulticides using application methods (truck or aerial) appropriate for the scale of the treatment area.
 - Conduct intensive source reduction in affected area(s).
 - Consider intensifying targeted indoor residual spraying to vulnerable homes if air conditioning and screens are not widely available.
- Continue to enhance coordination of response activities with state and local maternal and child health and birth defects programs.
- Further escalate clinician outreach and communication activities to healthcare providers in the county or jurisdiction through existing local channels (e.g., messages through local medical societies and local chapters of ACOG/AAP/AMCHP, Health Alert Network messages [HANs], conference calls).
 - Intensify communication with [clinicians caring for pregnant women and infants](#) about the risks of Zika and disseminate CDC guidance.
- Recommend testing to all pregnant women (symptomatic and asymptomatic) and other people who have symptoms who live in or travel to a red area and the surrounding yellow area.
 - Implement laboratory surge plans to ensure timely testing.
 - Prioritize pregnant women for diagnostic testing, followed by symptomatic people who are not pregnant, except in circumstances where testing a limited number of symptomatic people is crucial for monitoring key epidemiologic factors (e.g., changes in transmission intensity or extent).
 - Provide [guidance to laboratories](#) as needed.
- Communicate with blood collection and tissue recovery establishments (see [Blood and Tissue Safety](#) section) to identify additional cases.
- If applicable, coordinate with blood collection establishments to begin traceback and other follow-up activities related to presumptive viremic blood donors.
- With CDC assistance, conduct risk communication activities that ensure information and prevention recommendations reach intended audiences within their jurisdictions. Communication activities should
 - Describe the area where Zika virus transmission is thought to be occurring based on the best available epidemiologic, entomologic, and environmental information.
 - Identify estimated date when local Zika virus transmission began.
 - Describe the surveillance and response efforts taking place in the affected area and provide objective assessments of the situation and scale of the public health threat.
 - Communicate the importance and availability of testing to all pregnant women (symptomatic and asymptomatic) and other people who have symptoms who live in or travel to red area and the surrounding yellow area.
 - Advise healthcare providers of pregnant women of the appropriate steps for Zika virus testing in accordance with [CDC guidance](#).
 - Reinforce recommendations for pregnant women and women wishing to conceive and their sex partners.
 - Provide advice about ways to reduce mosquito populations around the home.

- Advise pregnant women and their sex partners to take steps to prevent mosquito bites and sexual transmission (e.g., wearing insect repellent and using condoms or not having sex to protect themselves from Zika virus infection).
- Identify and provide resources (e.g., insect repellent, window screens, condoms) for specific communities as necessary to minimize exposure risk, particularly for pregnant women and their partners.
- Provide guidance to schools, such as the [Interim Guidance for School District and School Administrators in the Continental United States and Hawaii](#).
- Engage early with businesses, including blood collection and tissue recovery establishments and labor stakeholders, to prepare for the potential short- and long-term economic effects.
- The Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) have published [interim guidance](#) for protecting workers from occupational exposure to Zika virus
- Implement expanded state and local intervention plans for all vulnerable populations, specifically pregnant women, women at risk for unintended pregnancy, women and men planning pregnancy, and children. Recommendations for reducing risk should target everyone, but particularly pregnant women and women at risk for unintended pregnancy who live in, work in, or must travel to an area with risk of Zika.
- Identify statewide resources for caring for infants and children with Zika-associated birth defects, developmental concerns, and other related outcomes.
- Encourage providers to join an [American Academy of Pediatrics/American College of Obstetricians and Gynecologists \(AAP/ACOG\)](#) provider network (when established).
- Report all cases to [ArboNET](#), using the [Council of State and Territorial Epidemiologists \(CSTE\) approved case definitions](#) for non-congenital and congenital Zika virus infection and disease.
- Report all pregnant women with laboratory evidence of possible Zika virus infection and their infants to the [US Zika Pregnancy Registry \(USZPR\)](#) for monitoring and follow up on pregnancy and infant outcomes.
- Work with the state-based birth defects surveillance system to report all infants with birth defects potentially related to Zika virus to [Zika Active Birth Defects Surveillance](#) at CDC.
- Continue to monitor the status of local transmission on a weekly basis, at a minimum. The geographic area(s) for Zika virus intervention should be adjusted based on current information.
 - Environmental conditions not conducive to mosquito activity, or other evidence that indicates the risk of Zika virus transmission has been reduced, should also be considered when scaling down interventions.
 - Implement a protocol and communication strategy when interventions are changed or rightsized.

Future Zika Virus Preparedness

As jurisdictions continue to address the threat posed by Zika virus, it is vital to build on the plans and capacities established over the past year by incorporating evolving knowledge of Zika virus and the methods used to combat its spread. CDC will assist jurisdictions in protecting their residents by improving surveillance, enhancing vector control, facilitating appropriate testing, and providing messaging to clinicians and the public.

The full range of health effects caused by Zika virus is currently unknown. However, if a pregnant woman is infected, the virus can pass to her fetus during pregnancy and cause [congenital Zika syndrome](#). Congenital Zika syndrome is a pattern of birth defects associated with Zika virus infection during pregnancy that includes brain abnormalities, eye abnormalities, and hearing loss. Research continues to further define the spectrum of anomalies associated with Zika virus infection during pregnancy.

Zika virus poses a serious risk to public health; therefore, it is essential that jurisdictions remain engaged in preparedness and response activities. States, locals, and tribes should use the guidance provided in this document and referenced throughout to prepare for and respond to the threat of Zika virus in their jurisdictions.

Appendix A - Domestic Travel and Testing Guidance for Local Mosquito-borne Transmission of Zika Virus*

Risk Designation	Trigger On	Geographic Area with Transmission Risk	Trigger Off	Travel Guidance	Testing Guidance
Yellow Area	Confirmed local transmission† for ≥ three cases without an epidemiologic link within a 5-mile diameter over a 45-day period.	County, city, or other similar jurisdiction with easily identifiable borders for public communication.	Consider removing if there are no new cases of confirmed local transmission [§] in at least a 45-day period after the yellow area is implemented [¶] .	Pregnant women should consider postponing travel to the geographic area.	All pregnant women who lived in, traveled to, or had sex without a condom with someone who lived in or traveled to area should be tested for Zika virus.
	Implemented simultaneously with red area.	County, city, or other similar jurisdiction with easily identifiable borders for public communication.	Consider removing if there are no new cases of confirmed local transmission [§] for a period of 45 days after red area ends [¶] .		
Red Area	Confirmed multi-person transmission**.	The smallest, easily identifiable location that completely encompasses the area at risk. Minimal area is 1-mile diameter.	No new cases of confirmed local transmission [§] identified for a period of 45 days ^{††} .	Pregnant women should not travel to the geographic area.	All pregnant women who lived in, traveled to, or had sex without a condom with someone who lived in or traveled to area should be tested for Zika virus.

* Recommendations for pregnant women and other people that live in areas with local mosquito-borne transmission can be found here: <https://www.cdc.gov/zika/geo/domestic-guidance.html>. Additional guidance can also be found at <https://wwwnc.cdc.gov/travel/page/us-citizens-living-in-areas-with-zika>.

† A person who does not have risk factors for Zika virus acquisition through travel, sexual contact, or other known exposure with body fluids, and who tests positive for Zika virus infection per CDC laboratory guidance; **OR**

A blood donor identified through Zika virus screening of blood donations, who does not have risk factors for Zika acquisition through travel, sexual contact, or other body fluid exposure, and who has a positive Zika virus nucleic acid test (NAT) on screening AND confirmation through an approved confirmatory test algorithm.

§ And no suspect local transmission cases under investigation with enhanced surveillance in place.

¶ CDC and state/local public health officials should discuss likelihood of ongoing risk before removal of the yellow area designation.

** Three or more cases of confirmed local transmission in non-household members, with at least two cases with onsets greater than two weeks apart (the approximate survival of an infected mosquito), and less than 45 days in an approximate 1-mile diameter area.

†† After 45 days without a confirmed case of local transmission red area, CDC and state/local public health officials should discuss converting it to a yellow area.

For more information, please contact 1-800-CDC-INFO (232-4636)

TTY: 1-888-232-6348

www.cdc.gov

Centers for Disease Control and Prevention

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GUIDANCE FOR SURVEILLANCE OF AND RESPONSE TO INVASIVE *Aedes* MOSQUITOES AND DENGUE, CHIKUNGUNYA, AND ZIKA IN CALIFORNIA

California Department of Public Health

February 2017



Guidance for Surveillance of and Response to Invasive *Aedes* Mosquitoes and Dengue, Chikungunya, and Zika in California

Updated February 2017

This document was prepared by the California Department of Public Health, Division of Communicable Disease Control, with input from the Mosquito and Vector Control Association of California and the California Conference of Local Health Officers.

OBJECTIVE

This document was developed to guide local vector control agencies and health departments to prepare for, conduct surveillance of, and respond to the detection of invasive *Aedes* mosquitoes and human cases of dengue, chikungunya, Zika, or other exotic mosquito-borne viral infections potentially transmitted by these mosquitoes. Mosquito species of immediate concern are *Aedes aegypti* and *Aedes albopictus*, which have become established in some California counties. Although locally acquired human infection with dengue, chikungunya, or Zika has not been detected in California to date, this is an ongoing concern in regions with invasive *Aedes* mosquitoes as travelers return and visitors come from areas with known disease transmission. A comprehensive local plan should be developed to address detection of invasive *Aedes* mosquitoes and potential transmission of exotic mosquito-borne viral infections.

CONTENT

This document includes:

- Page 2: **Introduction** on *Aedes aegypti* and *Ae. albopictus* mosquitoes and the exotic viruses they can carry and transmit to humans.
- Page 3: **Recommended surveillance and response actions** for local agencies, first for vector control agencies and then for health departments, under four possible scenarios.
 - Pre-detection of *Aedes aegypti/albopictus*
 - Post-detection of *Aedes aegypti/albopictus*
 - Detection of *Aedes aegypti/albopictus* positive for dengue, chikungunya, or Zika virus before local human infection documented
 - Detection of travel-associated or locally acquired human infection with dengue, chikungunya, or Zika virus
- Page 9: **Discussion of recommended actions** for local vector control agencies
- Page 15: **Discussion of recommended actions** for local health departments
- **Appendices**
 - Page 19: Appendix A - Examples of *Aedes*-specific mosquito traps
 - Page 22: Appendix B - Media release templates
 - Page 25: Appendix C - Dengue surveillance case definition, reporting, and laboratory testing

- Page 29: Appendix D - Chikungunya surveillance case definition, reporting, and laboratory testing
- Page 32: Appendix E - Zika surveillance case definition, reporting, and laboratory testing
- Page 35: Appendix F - Procedures for processing mosquitoes for arbovirus detection
- Page 37: Appendix G - Additional resources

It is recommended that vector control and public health staff read all parts of this document to better understand the activities involved and to coordinate these activities at the local level.

INTRODUCTION

The detections of *Aedes albopictus*, also known as the “Asian tiger mosquito,” in 2011 in Los Angeles County, and discoveries of *Ae. aegypti*, also known as the “yellow fever mosquito,” in 2013 in urban areas of Fresno, Madera, and San Mateo counties demonstrated that California is vulnerable to colonization by these highly invasive mosquitoes. By the end of 2016, detections of one or both species had been made in 125 cities in 12 counties. Both species are vectors of exotic arthropod-borne viruses (arboviruses) including dengue, chikungunya, Zika, and yellow fever. Travel-associated human cases of dengue, chikungunya, and Zika have been reported in California, but none of these viruses are known to be transmitted locally by mosquitoes at present. Established invasive *Aedes* mosquito populations increase the potential for local transmission to occur.

Dengue is a viral disease characterized by fever, headache, joint and muscle pain, which can progress to bleeding and shock in some people. Dengue transmission is common in much of the tropics, and outbreaks have occurred in areas of the United States where *Ae. aegypti* and *Ae. albopictus* are established, including Florida, Texas, and Hawaii. Presumably, infected visitors or returned travelers to these areas imported dengue virus and served as sources for these outbreaks.

Chikungunya is another viral disease with fever and severe joint pain, and outbreaks had been identified in countries in Africa, Asia, Europe, and the Indian and Pacific Oceans. In late 2013, the first local transmission of chikungunya virus in the Americas was identified in the Caribbean Islands, and the disease has since spread rapidly to other countries in South and Central America and continues to spread globally.

Zika is another viral disease with fever, rash, and joint pain, and, before 2015, outbreaks had occurred in areas of Africa, Southeast Asia, and the Pacific Islands. In May 2015, human cases were detected for the first time in Brazil, and Zika spread rapidly to other countries in Latin America and the Caribbean Islands. Zika was initially considered a mild disease, but there is now an association between Zika infection during pregnancy and the development of birth

defects such as microcephaly, the development of abnormally small head and brain. In adults, Zika infection has been associated with Guillain-Barré syndrome, an autoimmune neurological disease. Zika virus can be sexually transmitted or acquired via blood transfusion; thus, all blood products in California are screened for Zika virus.

The behavior and habitat preferences of *Ae. aegypti* and *Ae. albopictus* differ substantially from the indigenous *Culex* species that are the primary targets of control programs in California's urban areas. Adult *Ae. aegypti* and *Ae. albopictus* are active during the day, have short flight ranges, and females are aggressive and persistent biters of mammals, especially humans. What is most distinctive is their preference for small, artificial water-holding containers for laying eggs (oviposition) and larval development; hence they are known as "container-breeding" mosquitoes. Their close association with and dependence on humans to provide larval habitat, particularly within residential properties, results in a widespread but often patchy distribution, making effective surveillance and control a challenge. Detection and control are further complicated by eggs that resist desiccation and can remain viable for months on dry surfaces of containers.

It is not always possible to determine the origins of *Ae. aegypti* and *Ae. albopictus* introductions into California, but transport of dormant eggs via imported tires and house plants has been associated with introductions of these mosquito species in the past. Individuals moving materials via planes, ships, cars, or other vehicles from infested areas to non-infested areas may also facilitate spread. It is important that local vector control agencies, health departments, and other agencies work collaboratively to raise public awareness of these mosquitoes and the mosquito-borne viruses they can carry and develop proactive surveillance and response plans. Early detection and response is critical to protect public health and is essential if mosquito eradication is to remain an option in new localities. Once established, these mosquito species are very difficult to eliminate from urban residential areas.

RECOMMENDED ACTIONS FOR LOCAL AGENCIES

The recommended surveillance and response actions for vector control agencies and health departments depend on whether invasive *Aedes* mosquitoes have been detected locally, whether a locally captured *Aedes* mosquito has been found positive with dengue, chikungunya, or Zika virus, and whether human infections with dengue, chikungunya, or Zika have been acquired locally. Support services available to local agencies by the California Department of Public Health (CDPH) are listed at the end of this section.

Recommendations for Local Vector Control Agencies

Pre-Detection of *Aedes aegypti/albopictus*

- Identify local, state, and federal agencies and resources that can be consulted regarding identification, surveillance, and control of *Ae. aegypti* and *Ae. albopictus*.

- In coordination with local public health agencies, develop and implement an early detection plan for invasive mosquitoes.
 - Ensure staff are able to identify all life stages of *Ae. aegypti* and *Ae. albopictus*.
 - Notify CDPH Vector-Borne Disease Section (VBDS) of any mosquitoes tentatively identified as *Ae. aegypti* or *Ae. albopictus*; send specimens to confirm identification.
 - Initiate an education and outreach program designed to educate and mobilize the public to report daytime-biting mosquitoes and eliminate larval sources.
 - Ensure receptionists are trained to ask appropriate questions to walk-in and call-in customers relative to invasive mosquitoes and recognize when information given warrants a precautionary follow-up inspection or referral to the local health department.
 - Deploy strategically-placed, target-specific egg and adult surveillance tools. See Appendix A.
- In coordination with the local health department, develop a response plan that can be implemented at the first detection of invasive mosquitoes. The plan should include preparedness for enhanced mosquito surveillance and control activities, protocols and responsibilities for sharing information about human cases of dengue, chikungunya, and Zika, working drafts of public relations materials, and agreements with neighboring health departments and vector control agencies to provide assistance if needed.

Post-Detection of *Aedes aegypti/albopictus*

- When *Aedes aegypti* or *Ae. albopictus* mosquito identification is confirmed, immediately notify the local health department and neighboring vector control agencies; request assistance if indicated.
- In coordination with the local health department, distribute public relations materials, including a media release, describing the discovery of invasive mosquitoes, and the disease risks they present. Reassure the public that the risks are low if no locally acquired human infection has been confirmed, and request that the public contact the local vector control agency regarding daytime-biting mosquitoes. See media release template, Appendix B.
- Discuss with CDPH VBDS observations and findings of confirmed mosquitoes, potential infestation areas, and possible introduction and movement pathways.
- Enhance egg and adult (e.g., ovi- and adult traps) and larval (e.g., door-to-door) mosquito surveillance to delineate the infested areas.
- Eggs that are in hatchable condition (i.e., not collapsed, desiccated, or otherwise damaged) may be sent to the Davis Arbovirus Research and Training (DART) Lab at UC Davis to be tested for species identification. View [DART Protocol](http://gateway.calsurv.org/doc/Aedes_egg_protocol_DART.pdf) (http://gateway.calsurv.org/doc/Aedes_egg_protocol_DART.pdf) for additional details and instructions for submission.
- Initiate a door-to-door campaign in urban areas surrounding the point(s) of discovery to:
 - Distribute public education materials urging the public to empty or discard small

- containers of standing water and take personal prevention measures to reduce mosquito bites.
 - Gain permission to conduct larval surveillance on the residential or commercial premises and, if a desirable location, to place ovi- and adult mosquito traps; educate property owners regarding habitat reduction.
 - If necessary, apply EPA-registered chemical products to control immature and adult mosquitoes on the property.
- Initiate chemical control of immature and adult mosquitoes using EPA-registered products. Define areas of control based on surveillance data, including presence, relative abundance, and distribution of *Aedes* within the urban environment. Products can be applied on foot and with vehicle-mounted sprayers. Depending on the extent of the infestation, local topography, and environmental conditions, aerial applications also can be considered, especially if there is local arbovirus transmission.
- Send pools of female mosquitoes (≤50 mosquitoes per pool) to the DART Lab at UC Davis for arboviral testing. See Appendix F.
- If notified by the local health department of any travel-associated case of dengue, chikungunya, or Zika infection who might have been viremic while being in an *Aedes*-infested area:
 - Request from the local health department the case-patient's residential address and any additional information on other areas the patient may have visited while potentially viremic.
 - Ensure patient confidentiality by protecting any personal identifiers including name, address, or other personal information.
 - Ensure staff are trained regarding state laws that govern the use of confidential information.
 - Enhance mosquito surveillance and control and public outreach in the identified area(s).
 - Send pools of female mosquitoes (≤50 mosquitoes per pool) to DART for arboviral testing. See Appendix F.

Detection of *Aedes aegypti/albopictus* positive for dengue, chikungunya, or Zika virus before local human infection documented

- Immediately notify the local health department, CDPH, and neighboring vector control agencies.
- Work collaboratively with the local health department and CDPH to issue a joint media release, with careful wording to raise awareness of an increased threat potential but at the same time acknowledging that no locally-acquired human case has yet been confirmed.
- Enhance public outreach and mosquito surveillance and control in and around the area from where infected mosquitoes were collected as well as in the vicinities of any diagnosed human cases within nearby *Aedes*-infested areas.
- Assume that the finding is indicative of potential local transmission and implement all

applicable steps listed in “Locally Acquired Human Infection(s) Identified”.

Locally Acquired Human Infection(s) Identified

- Work collaboratively with the local health department and CDPH to issue a joint media release. See media release template in Appendix B.
- In coordination with the local health department, immediately implement enhanced mosquito surveillance and control (physical habitat removal and chemical control of larvae and adults) in a 150 meter radius of the case-patient’s residence (maintaining patient confidentiality), , and in other locations where exposure to invasive *Aedes* mosquitoes may have occurred. Distribute public relations materials to raise awareness about invasive *Aedes* mosquitoes, the viruses they can transmit, symptoms of disease, and use of personal protective measures. Further expand these activities in the event of widespread local transmission.
- Continue to closely monitor for presence of *Aedes* mosquitoes within the identified areas of concern for 45 days (three extrinsic viral incubation periods in mosquitoes), and implement additional control measures if indicated.
- Send pools of female mosquitoes (≤ 50 mosquitoes per pool) to DART for arboviral testing. Continue to engage the public in detecting and reporting daytime-biting mosquitoes, reducing larval habitats on their properties, and taking personal protective measures to prevent mosquito bites.

Recommendations for Local Health Departments

Pre-Detection of *Aedes aegypti/albopictus*

- Identify local, state, and federal agencies and resources that can be consulted regarding human surveillance and laboratory confirmation for suspected cases of dengue, chikungunya, and Zika infections.
- In coordination with the local vector control agency, prepare a public relations response plan that can be implemented at the first detection of invasive *Aedes* mosquitoes. A similar plan should be prepared for the first detection of locally acquired human infections with dengue, chikungunya, or Zika virus. Where no local vector control agencies exist, coordination should be with CDPH. The plans should include a media release and other relevant public relations materials.
- Continue to report to CDPH via the California Reportable Disease Information Exchange (CalREDIE) or, for non-participating jurisdictions, by fax or secure email any suspect, probable, or confirmed cases of dengue, chikungunya, and Zika virus infections; ensure report includes patient(s) symptom onset date and travel history.
 - If the case-patient(s) had not traveled to an area known to have active transmission of these viruses, immediately alert CDPH and the local vector control agency that the disease may have been locally acquired (which suggests that *Aedes* mosquitoes may be present in the area but not yet detected).

Post-Detection of *Aedes aegypti/albopictus*

- Collaborate with the local vector control agency in issuing a media release to describe the discovery of invasive mosquitoes, the disease risks they present while reassuring that risks are low if no local human infection has been confirmed, and a request to the public to contact the local vector control agency regarding any daytime-biting mosquitoes. See media release template in Appendix B.
- Enhance surveillance for human cases of dengue, chikungunya, and Zika by following up as soon as possible with all suspect, probable, and confirmed case-patients for their travel history and by entering all patient information into CalREDIE. Immediately notify CDPH of any patient who had not traveled to an area where active transmission of their infection is ongoing.
- Notify the local vector control agency of any suspect, probable, or confirmed cases of dengue, chikungunya, or Zika infection. Timely notification is critical to enhance mosquito surveillance and control in the vicinity of the case-patient's residence, particularly in a 150-meter radius, to minimize the potential for arbovirus transmission.
 - Advise the local vector control agency of their responsibility to maintain patient confidentiality. The information disclosed to local vector control should be limited to that needed to investigate and control virus transmission by mosquitoes.
- Educate the local medical community on signs and symptoms of dengue, chikungunya, and Zika infection (see Appendices C, D, E, and F) and remind healthcare providers to report suspect cases. Dengue, yellow fever, chikungunya and Zika virus infection are all reportable in California.
 - Provide and disseminate educational materials from CDPH or the US Centers for Disease Control and Prevention (CDC). See Appendix F.
 - Provide information on testing suspect patients for infection.
- Assess your local public health laboratory's capacity to test for dengue, chikungunya or Zika viruses. If no capacity exists, specimens can be sent to commercial laboratories or the CDPH-Viral and Rickettsial Disease Laboratory (VRDL) for testing. See Appendices C, D, and E.

Detection of *Aedes aegypti/albopictus* positive for dengue, chikungunya, or Zika virus before local human infection documented

- Work collaboratively with CDPH and the local vector control agency to issue a joint media release, with careful wording to raise awareness of an increased threat potential but at the same time acknowledging that no locally-acquired human case has yet been confirmed. Immediately begin enhancing surveillance for potential local human cases, starting at the area where positive mosquitoes were collected.
- Notify the medical community, including hospitals and laboratories, to look for all diagnosed and suspected cases of dengue, chikungunya, and Zika infections, regardless of recent travel history, and to report them as soon as possible. Focus on cases in and around areas where infected mosquitoes were collected.

- Notify the local vector control agency of any suspect, probable, or confirmed cases of dengue, chikungunya, or Zika infection. Timely notification is critical to enhance mosquito surveillance and control in the vicinity of the case-patient's residence, particularly in a 150-meter radius, to minimize the potential for arbovirus transmission.
- Assume that the finding is indicative of potential local transmission and implement all applicable steps in "Locally Acquired Human Infection(s) Identified".

Locally Acquired Human Infection(s) Identified

- Work collaboratively with CDPH and the local vector control agency to issue a joint media release ensuring patient confidentiality. See media release template, Appendix B.
- Conduct epidemiologic investigation and enhanced surveillance where the case-patient has spent the most times in the 2 weeks before onset of illness, e.g., home, neighborhood, and work place.
- Work with local vector control agency to enhance mosquito surveillance and control in the vicinity of each case-patient's residence (maintaining patient confidentiality), neighborhood, and in other locations where exposure to invasive *Aedes* mosquitoes may have occurred, and to distribute public relations materials to raise awareness about invasive *Aedes* mosquitoes, the viruses they can transmit, symptoms of disease, and use of personal protective measures.
- Advise patients to take all steps to avoid mosquito bites to minimize the risk of infecting mosquitoes and furthering local transmission.
- Enhance surveillance for additional locally acquired human cases by notifying the local medical community, including hospitals and laboratories, to look for and encourage testing of all suspected dengue, chikungunya, and Zika infections, regardless of recent travel history, and to report them as soon as possible; discuss the issuance of a California Health Alert Network (CAHAN) notification with CDPH.
- Once local human transmission is documented, follow up promptly on all suspect cases of dengue, chikungunya, and Zika infections as potentially locally acquired and notify CDPH via CalREDIE or by telephone.
- Notify the local vector control agency of any suspect, probable, or confirmed cases of dengue, chikungunya, or Zika infection. Timely notification is critical to enhance mosquito surveillance and control in the vicinity of the case-patient's residence, particularly in a 150-meter radius, to minimize the potential for arbovirus transmission.
- Engage the public in detecting and reporting daytime-biting mosquito activity to the local vector control agency, reducing mosquito larval habitats on their property, and protecting themselves from mosquito bites.
- Escalate and expand all activities in the event of widespread local transmission.

Role of CDPH

Services available to support local agencies during pre and post-detection response actions include:

- Development of public education materials (e.g., fact sheets, flyers, door hangers) and local media releases.
- Identification of potential invasion pathways and geographic origin of invasive mosquito populations which may prompt an intervention response.
- Consultation and assistance regarding:
 - Mosquito identification, surveillance techniques, control options, and allocation of limited resources.
 - Human arbovirus infection symptoms and diagnosis.
 - Human arbovirus case testing and evaluation.
 - Response to outbreak of human disease.
- Laboratory-based insecticide resistance testing for *Aedes aegypti*, interpretation of results, and product recommendations based on results.
- Facilitation of collaboration and communication among agencies in affected and neighboring counties.
- Providing fact sheets and information for clinicians, including “Information for Clinicians: *Aedes aegypti* and *Aedes albopictus* Mosquitoes in California and Reporting Patients with Suspected Dengue to Public Health” (see Appendix F).
- Providing epidemiological information on cases of dengue, chikungunya, Zika, and other mosquito-borne viral infections in California.
- Issuing statewide media releases.
- Coordinate and lead the regional or statewide public health response including surveillance, investigation, and control in the event of widespread local transmission involving multiple jurisdictions.
- Providing back up and/or surge diagnostic laboratory testing of clinical specimens to determine possible dengue, chikungunya, Zika, and other mosquito-borne viral infections and providing technical support for laboratory testing as needed.

DISCUSSION OF RECOMMENDED ACTIONS FOR LOCAL VECTOR CONTROL AGENCIES

Mosquito Surveillance

Detection of invasive *Aedes* in urban environments often occurs after adult mosquito populations have increased to numbers that motivate people to complain to their local vector control agency. Standard surveillance traps used in California and elsewhere in the United States (e.g., New Jersey light, CO₂, and gravid) may not capture adult *Ae. aegypti* and *Ae. albopictus* unless the traps are located near a breeding location, or until adult mosquito populations are relatively abundant or widespread. A number of target-specific attraction and capture devices not normally used by local agencies in California have been developed

specifically for the detection of eggs and adults of these anthropophilic, container-breeding mosquitoes. For simplicity, these devices will be referred to as ovitraps and adult traps. See Appendix A for a description and discussion of several of these traps.

Effective surveillance for *Ae. aegypti* and *Ae. albopictus* requires the careful selection and placement of ovitraps and adult traps, larval surveys in unconventional areas, and a much greater level of interaction with the public. The success of any or all of these activities depends on understanding the ecology and behavior of these container-breeding mosquitoes to maximize the potential for detection. Field and laboratory staff should be able to identify egg, larval, pupal, and adult stages of these mosquito species and always consider the possibility of specimens being collected during routine surveillance operations. Currently available target-specific traps have limited success in collecting egg or adult specimens, especially when adult mosquito populations are small or patchy in an environment, but the likelihood of trap capture success can be improved by increasing the number of traps. At present, there are no established guidelines on the number of traps (of any type) necessary for a comprehensive *Ae. aegypti* or *Ae. albopictus* surveillance program.

Pre-Detection versus Post-Detection Mosquito Surveillance

Surveillance strategies will vary depending on whether invasive *Aedes* mosquitoes have been detected.

Pre-Detection of Aedes aegypti/albopictus

Container-breeding mosquitoes such as *Ae. aegypti* and *Ae. albopictus* are notoriously difficult to control once they become established in residential areas. The best chance for eradicating these mosquitoes is early detection, before the population has a chance to become abundant and widespread. Local agencies should develop and implement an early detection plan for invasive mosquitoes that employs the use of strategically placed ovi- and adult traps and an outreach program designed to educate and mobilize the public to report daytime-biting mosquitoes. Soliciting public participation is critical because residents are most likely to observe unusual mosquito activity on their own properties where there may be large numbers of water- holding containers to support larval development.

The mosquito surveillance database maintained by the local vector control agency should be reviewed and, if necessary, modified to include data on invasive *Aedes* mosquitoes. Data should be maintained locally in a standardized format that allows for easy comparisons of data over time and among geographic locations. All data on invasive *Aedes* collection efforts, including traps or door-to-door surveys that did not find mosquitoes, should be reported in the [CalSurv Gateway Database](https://gateway.calsurv.org) (<https://gateway.calsurv.org>). To avoid redundant entry, agencies with in-house data systems may exchange data automatically with the [CalSurv Gateway Tracker and Wiki](http://trac.calsurv.org/gateway) using web services (<http://trac.calsurv.org/gateway>). All CalSurv Gateway *Aedes*

surveillance data will be uploaded monthly to CDC's MosquitoNET. For questions or suggestions, contact Dr. Chris Barker at UC Davis (cmbarker@ucdavis.edu).

The potential routes of invasive mosquito introduction into a given area need to be considered and a portion of the early detection activities focused on these areas. Past records suggest that commercial importers of certain goods (e.g., live plants, used tires) provide "high risk" invasion pathways; however, individual residents and visitors to urban areas can also be responsible for introducing invasive mosquitoes. The type and number of sites selected for surveillance will be determined by the local agency but should include both commercial and residential areas where ample habitat exists for larvae such as cemeteries, plant nurseries, and any other known properties with an abundance of potential water-holding containers.

- **Traps.** Placement of traps should be carefully considered to maximize the likelihood of detection. There is currently no established formula for determining the best traps to use, the ideal number of traps, or trap placement for any given area. However, the known advantages, disadvantages, and performance of different trap types (Appendix A) suggest that using more than one trap type and using as many as economically feasible should increase the chance of detecting invasive mosquitoes. Trap inspections and maintenance can be extended to approximately one-week intervals to optimize and make best use of resources.
- **Public Education and Outreach.** Educating the public about invasive mosquitoes and instructing people to report any suspicious sightings or daytime biting annoyance is crucial for early detection. The outreach program should include educational materials that are culturally and linguistically appropriate to fit the diversity of the local community and target residential, commercial, and industrial sectors. The program can include written and electronic materials available at the agency headquarters and website, flyers for distribution to homes and businesses, roadway billboards, ads on public transportation vehicles, workshops, and oral presentations. Information can also be provided to the media to prompt news coverage. Public education and outreach activities have the dual benefit of increasing the chances of early detection while also increasing the visibility of local vector control services.

Post-Detection of *Aedes aegypti/albopictus*

The surveillance approach following the discovery of invasive mosquitoes should become much more aggressive and rigorous to provide a comprehensive assessment of population size, geographical spread, and control effectiveness. Rapid surveillance of larger areas can be accomplished by focusing on presence versus absence of invasive mosquitoes, i.e., no need to identify more than one specimen of an invasive species per property. Additionally, focused surveillance near the residences and in the areas where viremic patients with travel-associated dengue, chikungunya, or Zika infection could have been exposed to *Aedes* mosquitoes may be useful in detecting infected mosquitoes before any locally acquired human infection has been identified.

- **Traps.** The number and variety of traps should be increased relative to pre-detection levels and placed in the areas surrounding the site(s) of discovery to assess the abundance and distribution of invading mosquitoes. Additional traps should be placed outward from identified infestation areas to determine the geographical extent of the population. It should not be assumed that the index location(s) (first site where invasive species were discovered) is the initial site of introduction. To aid in these assessments, inspection intervals should be increased to every 1-3 days.
- **Public Education and Outreach.** All aspects of the education and outreach program should be intensified throughout the jurisdictional area of the agency, but particularly in the urban areas surrounding the point(s) of discovery and other known infested areas. Door-to-door campaigns should be initiated immediately to inform and educate individual property owners and their on-site residents about the invading mosquitoes, how they can minimize habitat on their property, and encourage people to report daytime-biting mosquitoes. The door-to-door campaign will also provide an opportunity for larval and adult (i.e., host-seeking adult females landing on inspectors) surveillance on the property, providing additional information on mosquito abundance and spread.

Detection and Control Response

The initial discovery of mosquitoes tentatively identified as *Ae. aegypti* or *Ae. albopictus* should be immediately reported to CDPH. Mosquito specimens should be sent to CDPH to confirm identification and the local agency should communicate any observations and findings, potential infestation areas, and possible introduction pathways to allow a better assessment of the situation. Upon species confirmation, the local vector control agency should initiate their response plan beginning with the notification of the local health department, neighboring vector control agencies, and other agencies as appropriate. Public relations materials regarding the discovery should be released at this time, either independently or as joint efforts with other local agencies according to previously established plans. Materials should include a media release urging the public to eliminate sources of standing water on their property and report any daytime-biting mosquitoes to the local vector control agency.

The successful control of invasive mosquitoes is dependent on a number of factors, especially if eradication is the objective. Consider the following:

- Proactive planning and preparation are critical following the discovery of *Ae. aegypti* or *Ae. albopictus* to ensure a rapid and smooth transition from routine vector control activities to the targeted surveillance and control of an invasive mosquito species.
- Agreements previously made with neighboring local agencies can be of great assistance in conducting certain aspects of the mosquito surveillance and control response, especially with regard to door-to-door campaigns and ground-based application of insecticides.
- Public education and outreach programs and door-to-door surveillance activities not only provide important information on abundance and spread of invasive mosquitoes,

but also aid control in urban environments by reducing potential larval habitats.

- A combination of physical, biological, and chemical control approaches should be used against immature and adult invasive mosquitoes. For thorough implementation, these control activities frequently require the collaboration and cooperation of residential property owners established during education, outreach, and door-to-door campaigns.
- In addition to containers (e.g., jars, pots, bird baths, rain barrels), relatively small subsurface habitats (e.g., catch basins, dry wells, yard drains, storm water treatment devices), surface pools (e.g., neglected ponds, water-holding surface depressions in lawns), and vegetation (e.g., tree holes, bromeliad leaf axils) are sometimes utilized as larval habitat by invasive *Aedes* mosquitoes.
- Thorough and effective mosquito surveillance is the key to successful control. Information obtained from post-detection surveillance should be used to guide control activities.

Data collected from combined surveillance activities that provide reliable information on presence, relative abundance, and distribution of invasive mosquitoes within the urban environment should be carefully recorded and mapped and used to continually focus and re-focus resources and control efforts. The greatest emphasis of the control program should center on educating and mobilizing the public to implement physical controls to eliminate opportunities for immature mosquito development on private properties. Eradication should be the initial objective, and therefore it is crucial that local agency staff gain access for inspection of every property in an affected area, including vacant properties and properties with uncooperative owners/residents. A single neglected property can provide the habitat necessary for invasive mosquito production thus allowing rapid re-invasion and counteracting all previous and ongoing control efforts. Coordination with the local code enforcement agency may be helpful in ensuring access to properties.

EPA-registered biological and chemical control products labeled for larval and adult mosquitoes in California can be used against invasive mosquitoes but may require the use of equipment and application techniques not normally employed for the control of indigenous species.

Insecticides should be applied in accordance with surveillance data that confirms the presence, abundance, and relative distribution of invasive mosquitoes. Treatment options are outlined below; none should be expected to provide long-term control of invasive mosquitoes without simultaneous removal of aquatic habitats suitable for larval development. In addition, the structural complexity of the urban environments where invasive mosquitoes thrive may preclude effective insecticide penetration of broadcast sprays into many adult harborages even when treatment conditions appear ideal.

- Formulations of larvicidal products containing active ingredients such as methoprene and *Bacillus thuringiensis var. israelensis* can be broadcast into urban environments using spray equipment calibrated to produce larger droplet sizes than typical adulticide applications.
- Residual adulticide sprays can be applied to vegetation and other surfaces of individual

properties where adult mosquitoes might take refuge or rest.

- Ultra-low volume (ULV) adulticides can be used to knock-down the adult population over larger areas using truck-mounted foggers when environmental conditions are appropriate.
- Aerial adulticide applications may be considered over urban areas too large to treat efficiently and effectively using ground-based equipment, especially under conditions of human disease outbreak or if adult mosquito numbers require rapid knockdown.

Detection of dengue, chikungunya, or Zika virus in *Aedes* mosquitoes before locally acquired infection documented

The detection of an exotic arbovirus in captured *Aedes* mosquitoes implies that a person returned from a region endemic for dengue, chikungunya, or Zika virus while still viremic and was bitten locally by *Aedes*. It is possible that additional human cases remain undetected or asymptomatic, and that the virus is circulating in the environment at a low level. Surveillance and control should be rapidly amplified to reduce risk of transmission to local residents and visitors as described in the subsequent section. The local health department should be immediately notified to enhance case finding.

Locally Acquired or Travel-associated Human Arboviral Infections

Local health departments and CDPH continuously monitor suspect, probable, and confirmed human cases of dengue, chikungunya, and Zika infections and establish the patients' travel history to determine whether a person likely acquired the infection from recent travel to an area with ongoing disease transmission or locally. When local transmission is suspected, the local health department should promptly notify local vector control of such cases. The mosquito surveillance and control response should be intensified in areas where potentially viremic persons may have been bitten by *Ae. aegypti* or *Ae. albopictus* mosquitoes to minimize the potential for local disease transmission. If additional locally acquired human cases are subsequently identified, a more aggressive response should be planned in consultation with CDPH, in coordination with the local health department, and other appropriate agencies.

Response will further escalate in the event of widespread local transmission, and regional coordination may be necessary; if multiple jurisdictions are involved, CDPH may coordinate and lead the regional public health response including surveillance, investigation, and control. The local health department will follow up rapidly with all suspect, probable, and confirmed cases of dengue, chikungunya, and Zika infections, whether travel-associated or locally acquired, viremic or not, and share appropriate information with local vector control. Activities triggered by human infections should include enhanced mosquito surveillance and control in areas where potentially infected persons may have come into contact with invasive mosquitoes, collection and submission of female mosquito samples to DART to be tested for dengue, chikungunya, and

Zika, and consideration of more aggressive mosquito control including aerial spraying.

DISCUSSION OF RECOMMENDED ACTIONS FOR LOCAL HEALTH DEPARTMENTS

Human Disease Surveillance

To date, none of the exotic arboviruses carried and transmitted by *Ae. aegypti* and *Ae. albopictus* are known to be circulating among mosquitoes in California and the risk of the disease being introduced into the established *Aedes* mosquito populations from infected visitors and returning travelers is low; however, a single viremic person with dengue, chikungunya, or Zika who is subsequently bitten by a female *Ae. aegypti* or *Ae. albopictus* could start local disease transmission within a community. There are several conditions and a sequence of events that would need to be in place for local transmission of dengue, chikungunya, or Zika to occur.

These include:

1. An infected and viremic individual would need to return to a locality in California where there are *Ae. aegypti* and/or *Ae. albopictus* mosquitoes. The viremic period is typically 1-2 days before until 3-4 days after symptom onset for dengue, 4-6 days after symptom onset for chikungunya, and 3-5 days after symptom onset for Zika. Some people are asymptomatic. If the infected person returned more than a week after onset of illness, then transmission of virus from this person is less likely.
2. A female mosquito would need to bite the infected person while this person is viremic.
3. The mosquito would need to live approximately 10-11 days after taking a virus-infected blood meal to allow for the virus to multiply and migrate to the salivary glands (extrinsic incubation period); most mosquitoes live <14 days, but this is dependent on many environmental and ecological factors.
4. The infected mosquito would need to bite one or more susceptible persons who become infected and then viremic, but may or may not become symptomatic. Both *Ae. aegypti* and *Ae. albopictus* typically take multiple blood meals during each gonotrophic cycle (blood ingestion and egg development cycle; 2-7 day intervals) and therefore an infectious female may contact multiple people over a short period of time.
5. This cycle would need to be repeated for sustained transmission to occur.

Note that detection of locally acquired human infection with dengue, chikungunya, or Zika virus may occur prior to *Aedes* mosquito detection.

Pre-Detection of *Aedes aegypti/albopictus*

Detection and reporting of suspect, probable, or confirmed human infections with dengue, chikungunya, or Zika viruses is critical to monitor the possible points of introduction of these pathogens into California and the spread of disease in the event of an outbreak. All infections,

regardless of status (i.e., suspect, probable, or confirmed) should be reported using the real-time, secure web-based California Reportable Disease Information Exchange (CalREDIE) system maintained by CDPH. All non-participating jurisdictions should report all infections by submitting the appropriate paper case report form by secure email or fax immediately after the investigation is complete. Dengue, yellow fever, chikungunya, and Zika virus infection are all reportable in California. The surveillance case definitions and laboratory testing for dengue (i.e., dengue and severe dengue), chikungunya, and Zika are summarized in Appendices C, D, and E, respectively. Appendix F contains resources for more information on dengue, chikungunya, Zika, and *Aedes* mosquitoes.

Reports associated with human arboviral infections should include information regarding symptom onset date and travel history to elucidate if infections were acquired outside of California or locally. If the case-patient had no travel history to areas endemic for the disease within the incubation period and for Zika cases, no sexual contact with a returned traveler, CDPH and the local vector control agency should be contacted immediately. The local health department should ensure that patient confidentiality is maintained regarding sharing of personal identifiers (e.g., name, address, laboratory test results). The absence of travel suggests that the infection may have been acquired locally even if the person resides in an area not known to be infested with *Ae. aegypti* and *Ae. albopictus*. Invasive mosquitoes can be elusive in the environment and can be associated with relatively small habitats (e.g., residential backyards). The local vector control agency should conduct a follow-up investigation of the general area surrounding the case-patient's residence to determine if invasive mosquitoes are present, but previously undetected.

A public relations response plan should be prepared to include a media release to be implemented if invasive mosquitoes are detected within the jurisdiction of the local health department. A similar response plan should be prepared in the event that local transmission of dengue, chikungunya, or Zika virus is confirmed. Both plans should include: 1) a local health advisory to the medical community to increase awareness of exotic mosquito-borne viral infections in humans (the advisory should specify whether a locally acquired human case has been detected and recommendations should be tailored accordingly) and 2) a request for the public to report daytime-biting mosquitoes, minimize habitat suitable for invasive mosquitoes, protect themselves from mosquito bites, and recognize common symptoms of dengue, chikungunya, and Zika disease. Coordination with the local vector control agency, or CDPH where no local vector control agency exists, ensures that messages and materials distributed to the public and to the media remain consistent. Response plans can be administered independently or jointly with the local vector control agency.

Post-Detection of *Aedes aegypti/albopictus*

Once *Ae. aegypti* and *Ae. albopictus* mosquitoes are established in urban environments, visitors and returned travelers infected with dengue, chikungunya, or Zika virus may infect *Aedes*

mosquitoes if they are bitten while viremic. The previously established public relations response plan regarding the discovery of invasive mosquitoes should be initiated. Local health departments should ensure that the local medical community is educated about the exotic arboviral disease risks associated with invasive mosquitoes, signs and symptoms of these diseases in humans, human specimen collection for laboratory confirmation and clinical diagnosis, proper patient treatment, and disease reporting.

The local vector control agency should be notified of any suspect, probable, or confirmed cases of dengue, chikungunya, or Zika identified from areas known to be infested with *Ae. aegypti* or *Ae. albopictus*, particularly if evidence suggests that the person may have been exposed to mosquitoes during the viremic period. Patient confidentiality should be maintained.

Detection of dengue, chikungunya, or Zika virus in Aedes mosquitoes before locally acquired infection documented

If *Ae. aegypti* or *Ae. albopictus* mosquitoes collected by a local vector control agency test positive for dengue, chikungunya, or Zika virus before any human case of locally acquired infection has been documented, this suggests that an infected individual returned from a region endemic for these diseases while still viremic and was bitten locally by *Aedes* mosquitoes. In addition, the presence of locally infected mosquitoes suggests that the virus may be circulating in the environment at a low level and increases the threat for locally acquired human infection.

The public and medical community should be notified via a press release, with careful wording to highlight the increased risk of exotic arboviral infection while acknowledging that no locally acquired infection has been confirmed. The public should be advised to use mosquito bite prevention measures, and the medical community encouraged to consider these conditions in patients with compatible illness or travel history and report promptly all suspect, probable, or confirmed cases of dengue, chikungunya, or Zika infection. The local health department should coordinate with the local vector control agency and CDPH on following up to human cases subsequently diagnosed in the vicinity of the positive mosquitoes to determine the extent of virus circulation in the environment.

Locally Acquired Human Infection(s) Identified

The discovery of one or more human infections of dengue, chikungunya, or Zika virus suspected to have been locally acquired should be addressed aggressively and immediately. To identify additional cases in an area where the locally acquired case may have been exposed to infected mosquitoes, an epidemiologic investigation and enhanced surveillance should be implemented to cover the areas where the case-patient has spent the most time within the 2 weeks leading to onset of illness, e.g., home, neighborhood, and work place. Local vector control agencies and CDPH should be notified to ensure that mosquito surveillance and control is enhanced around the residence and any areas the identified case-patient may have been exposed to biting mosquitoes during their viremic period. Patients should be advised to take all steps to prevent mosquito bites to reduce the risk of spread to local mosquito populations. Zika case-patients

should be advised to take measures to avoid sexual transmission to partners. The previously developed public relations response plan should be initiated. Additional response efforts could include: facilitated testing of suspect cases and enhanced case finding, additional coordination between local and state public health epidemiologists and public health laboratorians, enhanced coordination and communication with clinical diagnostic laboratories, outreach and education to healthcare providers on the diagnosis and clinical management of dengue, chikungunya, and Zika viruses, and an enhanced media campaign to the public. All activities should escalate in the event of widespread local transmission, and, if multiple jurisdictions are involved, CDPH may coordinate and lead the regional public health response including surveillance, investigation, and control. Neighboring jurisdictions, states, and the CDC should also be notified, depending on the extent of disease transmission.

The implications of local transmission of exotic mosquito-borne viruses are many and require the greatest level of response. Close and rapid interagency communication with CDPH and the local vector control agency is critical to ensure rapid suppression of *Aedes* mosquitoes to break the human-mosquito-human disease cycle and prevent outbreaks of dengue, chikungunya, or Zika.

APPENDIX A

Examples of Target-Specific Traps for Invasive Container-Breeding Mosquitoes such as *Aedes aegypti* and *Aedes albopictus*

Ovitrap (Advantages)	Ovitrap (Disadvantages)
<p>Advantages</p> <ul style="list-style-type: none">• Inexpensive• Easy to deploy, inspect, and refresh• Inspection intervals can be up to 7 days	<p>Disadvantages</p> <ul style="list-style-type: none">• Requires that eggs be reared in the laboratory or sent for testing* to confirm species identification• Ovitrap can support mosquito production if left in the environment for more than 7 days or if misplaced on properties• Success may be influenced by availability of competing container habitats• May be tipped over or flooded by weather or other environmental factors

The ovitrap is the most basic surveillance tool for *Ae. aegypti* and *Ae. albopictus* in the urban environment. In general, an ovitrap consists of a small dark-colored container (e.g., 24-32 oz black plastic cup) partially filled with water or mild attractant infusion and with an oviposition medium (e.g., wood tongue depressor, germination paper, construction paper). Female mosquitoes seeking an egg-laying site may choose to deposit some eggs on the oviposition medium provided in the cup. Almost any small container can be used as an ovitrap, but studies have found black-colored containers to have superior performance.

* [DART Protocol](http://gateway.calsurv.org/doc/Aedes_egg_protocol_DART.pdf) (http://gateway.calsurv.org/doc/Aedes_egg_protocol_DART.pdf)

Limitations

- Detection success may be directly dependent on the number of ovitraps deployed i.e., a city block with one ovitrap per property may increase the likelihood of detecting presence of *Ae. aegypti* and *Ae. albopictus* than the same city block with only one deployed ovitrap.
- Does not provide any information on the abundance of adults in the environment; only evidence of the presence of at least one adult female.

CDC-AGO (Autocidal Gravid Ovitrap) (Advantages)	CDC-AGO (Disadvantages)
<p>Advantages</p> <ul style="list-style-type: none"> • Inexpensive • Easy to deploy, inspect, and refresh • Inspection intervals can be lengthened; the trap will function for more than 8 weeks without need for maintenance • The design prevents access to standing water, thus will not support mosquito production if left unattended • Removes egg-laying females from the environment • Allows immediate identification of captured adults • Can provide some information on the relative abundance of adults in a given environment. 	<p>Disadvantages</p> <ul style="list-style-type: none"> • Larger, bulkier, and heavier than standard ovitraps • More visible in the environment • Adults trapped by the adhesive may be difficult to dislodge for identification and may not be suitable for testing for viruses or pesticide resistance • Glue paper maintenance frequency may vary depending on relative humidity of trap site

Several variants of “lethal ovitraps” similar in concept to the CDC-AGO have been developed. The concept behind these traps is to lure oviposition-site-seeking females to a container from which they cannot escape or where they come into contact with a lethal dose of insecticide. The AGO Trap is made from modified 1 gallon and 5 gallon black plastic utility buckets partially filled with a hay-based infusion. Female mosquitoes seeking an egg-laying site can enter part- way into the bucket through an opening but are blocked from accessing the water by a screen. An adhesive on the surface of the entrance captures mosquitoes on contact.

Limitations

- Similar to standard ovitraps, detection success may be directly dependent on the number of AGO traps deployed in a given area.

Biogents (BG) Sentinel Adult Trap (Advantages)	BG Sentinel Adult Trap (Disadvantages)
<p>Advantages</p> <ul style="list-style-type: none"> • Target-specific trap developed for capture of adult <i>Ae. aegypti</i> and <i>Ae. albopictus</i>. Few non- target species are attracted to these traps unless other lures such as CO₂ are added to the system. • Does not require CO₂ to attract <i>Ae. aegypti</i> and <i>Ae. albopictus</i> • Can be plugged into available 110V outlets for continuous operation if desired to increase inspection intervals • Captures both males and females • Allows immediate identification of captured adults • Can provide some information on the relative abundance of adults in a given environment • Trapped live mosquitoes can be tested for arbovirus and submitted for microplate pesticide resistance assays if traps are serviced frequently (e.g., every 1-2 nights) 	<p>Disadvantages</p> <ul style="list-style-type: none"> • Expensive • Selection of suitable deployment areas safe from theft, vandalism, and weather/environmental damage can be time- consuming • Battery packs discharge rapidly, usually in less than 3 days • Trapped mosquitoes can escape from the net bag if the power supply is disconnected or discharged, or if the fan motor fails. Note* Newer models provide a trap-door to minimize escape in the event of a fan failure • Ants and other predators may damage or remove mosquitoes from trap

The “BG Trap” is an adult trap that preferentially attracts *Ae. aegypti* and *Ae. albopictus* and is currently considered the most effective commercially available adult trap for these two species. Both males and females may be attracted to the trap and are captured by a suction fan into a small net bag. The design is versatile in that commercially available lures can be incorporated into the body of the trap to improve attractiveness.

Limitations

- Similar to ovitraps, detection success may be directly dependent on the number of BG Traps deployed in a given area.

APPENDIX B

Media Release Templates

Example Vector Control Agency (VCA) / Local Health Department joint press release subsequent to first detection of an invasive *Aedes* mosquito

Aedes aegypti Mosquito Found in [City, County]

(Substitute *Aedes albopictus* for *Aedes aegypti* as appropriate.)

[City]. -The [VCA] has detected *Aedes aegypti* mosquitoes at/in [area]. The first detection was on [date]. [VCA] is working with the [City, County] Department of Health to evaluate the extent of the infestation and will aggressively target problem areas to prevent its spread.

Aedes aegypti is not native to California; however, it is a common mosquito in some urban areas of the southeastern United States and Arizona. Elsewhere in California, *Aedes aegypti* have been found in [list counties]. *Aedes aegypti* has the potential to transmit several viruses including dengue, chikungunya, Zika, and yellow fever. These viruses are not currently found in California. *Aedes aegypti* is a small (about ¼ inch) black and white mosquito that bites aggressively during the day.

"Our goal is to control and eliminate this mosquito population." said [VCA Manager]. "We are doing everything to help ensure this mosquito does not become established in our communities."

The [VCA] has expanded surveillance efforts for this type of mosquito. [Text example: The District has deployed a variety of traps for adult mosquitoes and mosquito eggs surrounding the location where *Aedes aegypti* was found. Additionally, District staff are conducting door to door inspections of properties for mosquito breeding and standing water at homes near *Aedes aegypti* detections].

[Insert if relevant - This mosquito was previously found in [area or county] in [year] near [place], but was successfully eradicated by the [VCA] and did not become established here].

The public can play a critical role in helping to control the spread of this mosquito population. *Aedes aegypti* lays its eggs just above the water line in small containers and vessels that hold water, such as dishes under potted plants, bird baths and feeders, ornamental fountains, tin cans, children's toys, or discarded tires. It's important for residents to look around their yard and outside their home and dump out even the smallest amount of standing water. Clean and scrub bird baths and pet watering dishes weekly and dump the water from overflow dishes under potted plants.

[County] Health Officer [Name] reminds people to do the following to reduce the chances of being bitten by mosquitoes:

- Apply repellents containing EPA registered ingredients such as DEET, picaridin, oil of lemon eucalyptus, or IR3535 to exposed skin and/or clothing (as directed on the product label).
- Wear long sleeve shirts, long pants, socks and shoes when mosquitoes are most active.
- Be sure window and door screens are in good repair to prevent mosquitoes from entering your home.

Residents experiencing mosquito bites during the day should report them immediately to [VCA contact info]

If you are sick with fever, headache, and joint or muscle pain after returning from an area where dengue, chikungunya, or Zika occurs, contact your doctor and stay indoors as much as possible to avoid mosquito bites and help prevent possible spread of the virus.

Additional information on *Aedes* [species] can be found at:

[Local health department website]

[VCA website]

[California Department of Public Health \(CDPH\) *Aedes aegypti* and *Aedes albopictus* Mosquitoes webpage](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-aegypti-and-Aedes-albopictus-mosquitoes.aspx)

(<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-aegypti-and-Aedes-albopictus-mosquitoes.aspx>)

Example Local Health Department [LHD] press release subsequent to first detection of a locally acquired human case of dengue. If this template is used for another locally acquired exotic mosquito-borne disease, such as chikungunya or Zika, please edit the paragraph describing symptoms.

--First Confirmed Locally Acquired Dengue Case in [County]

[City/County] Today, the [County] Health Department announced that the first locally acquired human dengue case has been confirmed in a [county] resident. [if applicable: To date, (number) locally acquired dengue cases have been previously detected in California].

Dengue (pronounced den' gee) is caused by a virus that is transmitted to humans by the bite of an infected *Aedes aegypti* or *Aedes albopictus* mosquito. *Aedes* mosquitoes have been found in [cities] in [county]. Dengue virus cannot be transmitted from person-to-person. Symptoms of dengue may include high fever, severe headache, pain behind the eyes, joint pain, and rash. Health care providers should contact the [County] Health Department if they suspect an individual may have dengue or another mosquito-borne illness.

The [Vector Control Agency - VCA] and the [LHD] are enhancing surveillance, prevention, and mosquito control efforts. Residents should take basic precautions to protect themselves from mosquitoes by following the Department of Health recommendations. [County] Health Officer [Name] reminds people to do the following to reduce their chances of being bitten by mosquitoes and to help prevent spread of the virus:

- Apply repellents containing EPA registered ingredients such as DEET, picaridin, oil of lemon eucalyptus, or IR3535 to exposed skin and/or clothing (as directed on the product label).
- Wear long sleeve shirts, long pants, socks and shoes when mosquitoes are most active.
- Be sure window and door screens are in good repair to prevent mosquitoes from entering your home. [and/ or use air conditioning keeping windows and doors closed.]
- Residents experiencing mosquito bites during the day should report them to [VCA contact info] and should contact their health care provider if they have dengue-like symptoms.

If you are sick with fever and joint pain contact your doctor and stay indoors as much as possible to avoid mosquito bites and help prevent possible spread of the virus.

Additional information on dengue and *Aedes [aegypti or albopictus]* can be found at:

[Local health department website]

[VCA website]

[CDPH *Aedes aegypti* and *Aedes albopictus* Mosquitoes webpage](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-aegypti-and-Aedes-albopictus-mosquitoes.aspx)

(<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-aegypti-and-Aedes-albopictus-mosquitoes.aspx>)

APPENDIX C

Dengue Surveillance Case Definition, Reporting, and Laboratory Testing

Clinical Description (Dengue, Severe Dengue)

Dengue: Dengue is most commonly an acute febrile illness defined by the presence of fever and one or more of the following, nausea/vomiting, rash, aches and pains (headache, retro-orbital or ocular pain, joint pain, muscle pain), leukopenia, positive tourniquet test, or any warning signs of severe dengue (persistent vomiting, extravascular fluid accumulation (e.g., pleural or pericardial effusion, ascites), mucosal bleeding at any site, liver enlargement >2 centimeters, or increasing hematocrit concurrent with rapid decrease in platelet count).

Severe Dengue is characterized by all of the following:

- Severe plasma leakage evidenced by hypovolemic shock and/or extravascular fluid accumulation (e.g., pleural or pericardial effusion, ascites) with respiratory distress. A high hematocrit value for patient age and sex offers further evidence of plasma leakage.
- Severe bleeding from the gastrointestinal tract (e.g., hematemesis, melena) or vagina (menorrhagia) as defined by requirement for medical intervention including intravenous fluid resuscitation or blood transfusion.
- Severe organ involvement, including any of the following: elevated liver transaminases (aspartate aminotransferase (AST) or alanine aminotransferase (ALT) $\geq 1,000$ per liter (U/L)), impaired level of consciousness and/or diagnosis of encephalitis, encephalopathy, or meningitis, or heart or other organ involvement including myocarditis, cholecystitis, and pancreatitis.

Laboratory Criteria for Classification

Confirmatory: Any one of the following:

- Isolation of dengue virus from or demonstration of specific arboviral antigen or genomic sequences in tissue, blood, cerebrospinal fluid (CSF), or other body fluid by reverse-transcriptase polymerase chain reaction (RT-PCR) test, immunofluorescence or immunohistochemistry.
- Detection in serum or plasma of DENV NS1 antigen by a validated immunoassay.
- Seroconversion from negative for dengue virus-specific serum immunoglobulin M (IgM) antibody in an acute phase (≤ 5 days after symptom onset) specimen to positive for dengue-specific serum IgM antibodies in a convalescent-phase specimen collected ≥ 5 days after symptom onset.
- Seroconversion or demonstration of a ≥ 4 -fold rise in reciprocal immunoglobulin G (IgG) antibody titer to dengue virus antigens serum samples collected >2 weeks apart, AND confirmed by a neutralization test (e.g., plaque reduction neutralization test) with a >4-fold higher end point titer as compared to other flaviviruses tested.

Presumptive/Probable:

- A positive dengue-specific IgM antibody test, on a single acute or convalescent phase serum specimen.

Suspect:

- The absence of IgM anti-DENV by validated immunoassay in a serum or CSF specimen collected <5 days after illness onset and in which molecular diagnostic testing was not performed in a patient with an epidemiologic linkage.

Exposure

- Travel to a dengue endemic country or presence at location with ongoing outbreak within previous two weeks of dengue-like illness, OR
- Association in time and place with a confirmed or probable dengue case.

Case Classification

Suspected: A clinically compatible case of dengue, or severe dengue with an epidemiologic linkage

Probable: A clinically compatible case of dengue, or severe dengue with laboratory results indicative of probable infection

Confirmed: A clinically compatible case of dengue, or severe dengue with confirmatory laboratory results

Dengue Reporting

All infections, regardless of status (i.e., suspect, probable, or confirmed) should be reported using the real-time, secure web-based California Reportable Disease Information Exchange (CalREDIE) system maintained by CDPH. Non-participating jurisdictions should report all dengue by submitting the paper dengue case report form by secure email or fax immediately after the investigation is complete. For cases in which no travel history is indicated or local transmission is suspected, CDPH should be notified immediately by telephone.

Dengue Laboratory Testing

Dengue viruses are members of the Flaviviridae and have sufficient antigenic similarity to Zika virus, yellow fever virus, Japanese encephalitis virus, and West Nile virus that previous infection or vaccination may raise cross-reactive serum antibodies. After a primary infection with a heterologous flavivirus, subsequent antibody testing by ELISA may produce false positive results for a different flavivirus. PRNT can often resolve cross-reactive serum antibodies in this situation

and identify the infecting virus; however, high-titered cross-reactive antibody levels produced from multiple previous flavivirus infections cannot be resolved by PRNT. This demonstrates the complexity inherent in serological diagnosis and differentiation in populations living in regions where more than one flavivirus co-circulates. However, only a small proportion of the US population has evidence of previous flavivirus infection (or vaccination) so that cross-reactive flavivirus antibodies should not be a significant limitation to dengue diagnosis among most US travelers. Among US residents, most testing for dengue is done through private clinical laboratories using IgM or IgG detection techniques.

Serologic testing (IgG and IgM) for exposure to dengue virus is available through commercial laboratories (e.g., Focus/Quest and ARUP), as well as from the California Department of Public Health, Viral and Rickettsial Disease Laboratory (VRDL). The VRDL has serologic and molecular assays for dengue. Testing may include:

- EIA or IFA for IgM and IgG antibodies. Serologic assays do not distinguish among dengue serotypes and may be cross-reactive with other flaviviruses. When a positive detection is made for dengue, VRDL can perform a plaque reduction neutralization assay (PRNT) to distinguish between dengue and other endemic flaviviruses (i.e., West Nile virus, St. Louis encephalitis virus).
- Real-time RT-PCR for acute serum specimens. This test will discriminate among the four dengue serotypes. Blood for PCR should be collected within 8 days of symptom onset.

Acute samples that test positive at commercial laboratories should prompt ordering of a convalescent testing. Both acute and convalescent samples should be forwarded to VRDL for confirmatory testing.

Samples may be submitted to VRDL using the “General Purpose Specimen Submittal Form” available on the [VRDL specimen guidelines webpage](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VRDL_Specimen_Submittal_Forms.aspx#) (https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VRDL_Specimen_Submittal_Forms.aspx#).

Detailed instructions on sample submission can be found in the VRDL “Guidelines for Laboratory Services” on the [VRDL webpage](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/vrdl.aspx#) (<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/vrdl.aspx#>).

VRDL Contact information

Main Telephone: (510) 307-8585

Fax: (510) 307-8599

Mailing Address(for US Postal Service):

California Department of Public Health
Viral and Rickettsial Disease Laboratory
850 Marina Bay Parkway
Richmond, CA 94804

Shipping Address (for hand delivery or private carriers):

Viral and Rickettsial Disease Laboratory

Attn: Specimen Receiving

850 Marina Bay Parkway

Richmond, CA 94804

Reference testing is available from CDC's Dengue Branch, Division of Vector-Borne Infectious Diseases, National Center for Infectious Diseases,
1324 Calle Cañada, San Juan, PR 00920-3860, telephone 787-706-2399, fax 787-706-2496.

APPENDIX D

Chikungunya Surveillance Case Definition, Reporting, and Laboratory Testing

Clinical Description (Chikungunya Fever)

Chikungunya Fever: Chikungunya fever is characterized by ALL of the following:

- Fever or chills as reported by the patient or a health-care provider.
- Arthralgia or arthritis involving two or more joints.
- Absence of a more likely clinical explanation.

Chikungunya is most often characterized by acute onset of fever (typically $>39^{\circ}\text{C}$ [102°F]) and polyarthralgia. Joint symptoms are usually bilateral and symmetric, and can be severe and debilitating. Other symptoms may include headache, myalgia, arthritis, conjunctivitis, nausea/vomiting, or maculopapular rash. Clinical laboratory findings can include lymphopenia, thrombocytopenia, elevated creatinine, and elevated hepatic transaminases.

Acute symptoms typically resolve within 7–10 days. Rare complications include uveitis, retinitis, myocarditis, hepatitis, nephritis, bullous skin lesions, hemorrhage, meningoencephalitis, myelitis, Guillain-Barré syndrome, and cranial nerve palsies. Persons at risk for severe disease include neonates exposed intrapartum, older adults (e.g., > 65 years), and persons with underlying medical conditions (e.g., hypertension, diabetes, or cardiovascular disease). Some patients might have relapse of rheumatologic symptoms (e.g., polyarthralgia, polyarthritis, tenosynovitis) in the months following acute illness. Studies report variable proportions of patients with persistent joint pains for months to years. Mortality is rare and occurs mostly in older adults. The majority of people infected with chikungunya virus become symptomatic. The incubation period is typically 3–7 days (range, 1–12 days).

Laboratory Criteria for Classification

Confirmatory: A clinically compatible case as reported by the patient or healthcare provider, absence of a more likely explanation and one or more of the following laboratory criteria:

- Isolation of chikungunya virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, or other body fluid, by polymerase chain reaction (PCR) test (≤ 5 days after illness onset), immunofluorescence or immunohistochemistry OR
- Demonstration of a ≥ 4 -fold rise in reciprocal immunoglobulin G (IgG) antibody titer or hemagglutination inhibition titer to chikungunya virus antigens in paired acute and convalescent serum samples, OR
- Demonstration of a > 4 -fold rise in PRNT (plaque reduction neutralization test) end point titer (as expressed by the reciprocal of the last serum dilution showing a 90% reduction in plaque counts compared to the virus infected control) between chikungunya virus and other arboviruses tested in a convalescent serum sample.

Probable:

- A clinically compatible case as reported by the patient or healthcare provider, absence of a more likely explanation, and virus-specific IgM antibodies in serum but with no other testing.

Suspected:

- A clinically compatible case with acute onset of fever and severe arthralgia or arthritis not explained by other medical conditions, and who resides or has visited epidemic or endemic areas within 2 weeks before the onset of symptoms.

Not a Case:

- A suspected case with negative virus-specific IgM or neutralizing antibodies in serum collected ≥ 8 days after illness onset or evidence of a more likely explanation for their illness.

Chikungunya Reporting

All infections, regardless of status (i.e., suspect, probable, or confirmed) should be reported using the real-time, secure web-based California Reportable Disease Information Exchange (CalREDIE) system maintained by CDPH. Non-participating jurisdictions should report chikungunya infections by submitting the paper chikungunya case report form by secure email or fax immediately after the investigation is complete. For cases in which no travel history is indicated or local transmission is suspected, CDPH should be notified immediately by telephone.

Chikungunya Laboratory Testing

Serologic testing (IgG and IgM) for exposure to chikungunya virus is available through commercial laboratories (e.g., Focus/Quest), as well as from the California Department of Public Health, Viral and Rickettsial Disease Laboratory (VRDL). The VRDL has serologic and molecular assays for chikungunya. Testing may include:

- EIA or IFA for IgM and IgG antibodies. This test is available as a validated clinical diagnostic test. Serologic assays may be cross-reactive with other alphaviruses. When a positive detection is made for chikungunya, VRDL can perform a plaque reduction neutralization assay (PRNT) to distinguish between chikungunya and other endemic alphaviruses (i.e., western equine encephalitis virus).
- Real-time RT-PCR for acute serum specimens. This test is validated for clinical diagnostic use. Blood for PCR should be collected within 8 days of symptom onset.

Acute samples that test positive at commercial laboratories should prompt ordering of a convalescent testing. Both acute and convalescent samples should be forwarded to VRDL for confirmatory testing.

Samples may be submitted to VRDL using the “General Purpose Specimen Submittal Form” available on the [VRDL specimen guidelines webpage](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VRDL_Specimen_Submittal_Forms.aspx#) (https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VRDL_Specimen_Submittal_Forms.aspx#).

Detailed instructions on sample submission can be found in the VRDL “Guidelines for Laboratory Services” on the [VRDL webpage](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/vrdl.aspx#) (https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/vrdl.aspx#).

VRDL Contact information

Main Telephone: (510) 307-8585

Fax: (510) 307-8599

Mailing Address (for US Postal Service):

California Department of Public Health
Viral and Rickettsial Disease Laboratory
850 Marina Bay Parkway
Richmond, CA 94804

Shipping Address (for hand delivery or private carriers):

Viral and Rickettsial Disease Laboratory
Attn: Specimen Receiving
850 Marina Bay Parkway
Richmond, CA 94804

APPENDIX E

Zika Surveillance Case Definition, Reporting, and Laboratory Testing

Clinical Description (Zika virus disease)

Zika is most often characterized by acute onset of fever with maculopapular rash, arthralgia, or conjunctivitis. Other commonly reported symptoms include myalgia and headache. Clinical illness is usually mild with symptoms lasting for several days to a week. Severe disease requiring hospitalization is uncommon and case fatality is low. However, there have been cases of Guillain-Barré syndrome reported in patients following suspected Zika virus infection and increased cases of microcephaly among newborns in areas with ongoing Zika outbreaks. Due to concerns of microcephaly associated with maternal Zika virus infection, fetuses and infants of women infected with Zika virus during pregnancy should be evaluated for possible congenital infection and neurologic abnormalities in the months following diagnosis. The majority of people infected with Zika virus are asymptomatic. The incubation period is typically 3–7 days.

Laboratory Criteria for Classification

Confirmatory: A clinically compatible case, or a person who does not meet clinical criteria but has an epidemiologic linkage, AND one or more of the following laboratory criteria:

- Detection of ZIKV by culture, viral antigen or viral RNA in serum, CSF, tissue, or other specimen (e.g. amniotic fluid, urine, semen, saliva); OR
- Positive ZIKV IgM antibody test of serum or CSF with positive ZIKV neutralizing antibody titers and negative neutralizing antibody titers against dengue or other flaviviruses endemic to the region where exposure occurred.

Probable: A clinically compatible case, or a person who does not meet clinical criteria but has an epidemiologic linkage, AND

- Positive ZIKV IgM antibody test of serum or CSF with:
 - Positive neutralizing antibody titers against ZIKV and dengue or other flaviviruses endemic to the region where exposure occurred; OR
 - Negative dengue virus IgM antibody test and no neutralizing antibody testing performed.

Flavivirus of undetermined species:

- Evidence of recent infection with a flavivirus where the ZIKV IgM is negative and the neutralizing antibody test results on a single specimen are insufficient to determine the identity of the infecting virus.

Zika Reporting

All infections, regardless of status (i.e., flavivirus of undetermined species, suspect, probable, or

confirmed) should be reported using the real-time, secure web-based California Reportable Disease Information Exchange (CalREDIE) system maintained by CDPH on a daily basis. All non-participating jurisdictions should report all flavivirus of undetermined species, suspect, probable, or confirmed Zika infections as a line list weekly to CDPH, followed by submitting the paper Zika case report form by secure email or fax immediately after the investigation is complete. For cases in which no travel history is indicated or local transmission is suspected, CDPH should be notified immediately by telephone.

Zika Laboratory Testing

The California Department of Public Health (CDPH) has been actively working on laboratory testing for Zika and other exotic mosquito-borne diseases such as dengue and chikungunya over the last two years building upon experience with West Nile virus. Due to the ongoing Zika outbreak in the Americas, CDPH accelerated the pace of diagnostic test development and validation for this disease.

CDPH is currently using the U.S. Centers for Disease Control and Prevention (CDC) Trioplex Real-time RT-PCR Assay, the real-time reverse transcription polymerase chain reaction (rRT-PCR) test authorized by FDA under Emergency Use Authorization (EUA) for clinical diagnostic use. This test detects viral genetic material (i.e., RNA) from Zika virus, dengue virus, and chikungunya virus in human sera or cerebrospinal fluid as well as Zika RNA virus in urine and amniotic fluid and is used to diagnose acute Zika virus disease in persons who meet CDC Zika virus clinical criteria and/or epidemiological criteria for testing. This RT-PCR assay is performed on individuals who had symptom onset within the fourteen days prior to specimen collection or in pregnant women who either had possible exposure to Zika virus within the previous fourteen days or test positive or equivocal for Zika virus-specific IgM.

CDPH also performs serological testing using the FDA-emergency use authorized ZIKV Detect™ IgM Capture ELISA (Inbios International Inc.) to detect Zika virus-specific IgM antibodies in patient blood that is indicative of a recent infection. For symptomatic individuals with indicated travel history, serum samples should be collected three or more days after illness onset for serological testing. For asymptomatic pregnant women who travel to or reside in an area of Zika virus transmission or have had unprotected sex with a partner who traveled to or resided in such an area, the blood sample should be collected between 2 and 12 weeks after last known potential exposure for IgM testing. The test is an initial screening assay to detect evidence of a recent Zika virus infection. For specimens that are reactive (i.e., Zika virus IgM detected or equivocal) using this test, CDPH conducts a confirmatory test to detect for neutralizing antibodies that may distinguish Zika virus from other viruses.

To submit samples to VRDL for Zika testing, you must complete the VRDL “General Purpose Specimen Submittal Form” available on the [VRDL specimen guidelines page](https://www.cdph.ca.gov/Program/CID/DCDC/Pages/VRDL_Specimen_Submittal_Forms.aspx) (https://www.cdph.ca.gov/Program/CID/DCDC/Pages/VRDL_Specimen_Submittal_Forms.aspx).

Detailed instructions on sample submission and the VRDL “Zika Laboratory Testing Guidance” document are available on the [VRDL Zika website](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Zika_VRDL.aspx), (https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Zika_VRDL.aspx).

When completing this form, the following information is required for testing to be performed:

- Your local public health department contact information
- Date of symptom onset and sample collection date
- Travel history – list countries visited and date of departure from risk area
- List of clinical symptoms
- Pregnancy status and estimated due date, as applicable (testing will be expedited for all pregnant women)

For asymptomatic pregnant women:

- For Disease Onset date, enter “N/A”
- Under Other clinical findings, state “Asymptomatic”
- Pregnancy status and estimated due date, as applicable (testing will be expedited for all pregnant women)

Please email electronic copies of all forms to VRDL.submittal@cdph.ca.gov.

VRDL Contact information

Main Telephone: (510) 307-8585

Fax: (510) 307-8599

Mailing Address (for US Postal Service):

California Department of Public Health
Viral and Rickettsial Disease Laboratory
850 Marina Bay Parkway
Richmond, CA 94804

Shipping Address (for hand delivery or private carriers):

Viral and Rickettsial Disease Laboratory
Attn: Specimen Receiving
850 Marina Bay Parkway
Richmond, CA 94804

APPENDIX F

Procedures for Processing Mosquitoes for Arbovirus Detection

1. Collect mosquitoes alive and return them immediately to the laboratory. Collections should be kept humid during transport with moist toweling to prevent desiccation. Females held overnight or longer before processing should be offered 5-10 percent sucrose.
2. Anesthetize mosquitoes by cold, carbon dioxide, or triethylamine (TEA). TEA is recommended because specimens are permanently immobilized with minimal mortality and with no loss of virus titer (Kramer et al. 1990). TEA should be used either outdoors or under a chemical hood. Collections can be anesthetized outdoors using a few drops of TEA, the specimens transferred to Petri dishes, and then taken into the laboratory for processing. If refrigerated and kept humid, mosquitoes will remain alive in covered Petri dishes for one or two days without additional anesthesia. If mosquitoes are frozen before processing, counting and sorting to species must be done on a chill table to prevent virus loss.
3. Sort mosquito collections to species under a dissecting microscope at 10X to ensure correct identification and to make sure that extraneous mosquito parts (i.e., legs, wings) or other small insects such as chironomids or *Culicoides* are not inadvertently included in the pools. This is extremely important because diagnostics have transitioned from virus isolation to sensitive RT-PCR methods of viral detection. Count and discard dead and dried mosquitoes. Pools are comprised of 1 to 50 females of each mosquito species from each collection site counted into individual polystyrene vials with snap caps (SPEX Sample Prep #3116) containing two 5mm glass beads. Vials with pools should be labeled sequentially starting with #1 each year after the site code; e.g., KERN-1-15; where 16 refers to year 2016. The same number series should be maintained for all pools, including both *Aedes* and *Culex* species. Data on each pool should be entered online in electronic format through the [California Vector-Borne Disease Surveillance Gateway](http://gateway.calsurv.org) (<http://gateway.calsurv.org>). Pools to be tested for chikungunya, dengue, and Zika. POOLS MUST BE ACCOMPANIED BY "MOSQUITO POOLS SUBMITTED FORM MBVS-3" AND CAN ONLY BE TESTED FROM SITES WITH DOCUMENTED LOCATIONS. Surveillance sites should be registered online through the [CalSurv Gateway Database](http://gateway.calsurv.org) (<http://gateway.calsurv.org>). Pools from unregistered sites (e.g., from door-to-door collections or single-use trap locations) should be assigned the site code "000000" and the exact location should be recorded for each pool using the Gateway's online map.
4. Freeze pools immediately at -80C either on dry ice in an insulated container or in an ultra- low temperature freezer. Pools should be shipped frozen on dry ice to CVEC for testing by real-time multiplex RT-qPCR. Agencies will receive an automated email notification that results have been entered into the CalSurv Gateway; additionally, positive pools will be reported weekly in the California Arbovirus Surveillance Bulletin. Each pool is screened for WNV, SLEV, and WEEV, and if testing for chikungunya, dengue, and Zika viruses is also desired, this

should be indicated by checking the box for “CDZ Testing” when preparing the online pool submission form in the CalSurv Gateway. Pools can be tested for other *Aedes*-borne viruses such as yellow fever on request. Care must be taken not to allow pools to defrost during storage or shipment, because each freeze-thaw cycle may result in a decrease in viral titer; all virus will be lost if the specimens sit at room temperature for extended periods. Address shipments to: Ying Fang, University of California, One Shields Ave, Vet Med:PMI (Room 3336 Vet Med 3A), Davis CA 95616.

APPENDIX G

Additional Resources

Peer-Reviewed Documents for Vector Control

Bonizzoni, M., G. Gasperi, X. Chen, and A.A. James. 2013. The invasive mosquito species *Aedes albopictus*: current knowledge and future perspectives. *Trends Parasitol.* 29(9): 460-468.

Crepeau, T.N, S.P Healy, K. Bartlett-Healy, I. Unlu, A. Farajollahi, and D.M Fonseca. 2013. Effects of Biogents Sentinel trap field placement on capture rates of adult Asian tiger mosquitoes, *Aedes albopictus*. *PLoS ONE* 8(3): e60524. doi:10.1371/journal.pone.0060524
<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0060524>

Eisen, L., and C. G. Moore. 2013. *Aedes (Stegomyia) aegypti* in the continental United States: a vector at the cool margin of its geographic range. *J. Med. Entomol.* 50(3): 467-478.
<http://docserver.ingentaconnect.com/deliver/connect/esa/00222585/v50n3/s1.pdf?expires=1391713101&id=0000&titleid=10266&checksum=959A687384154C796A1DA096E9419C61>

Farajollahi, A., and D. C. Price. 2013. A rapid identification guide for larvae of the most common North American container-inhabiting *Aedes* species of medical importance. *J. Am. Mosq. Control Assoc.* 29(3): 203-221.

Farajollahi, A, S.P. Healy, I. Unlu, R. Gaugler, and D.M. Fonseca. 2012. Effectiveness of ultra-low volume nighttime applications of an adulticide against diurnal *Aedes albopictus*, a critical vector of dengue and chikungunya viruses. *PLoS ONE* 7(11): e49181. doi:10.1371/journal.pone.0049181
<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0049181>

Fonseca, D.M., I. Unlu, T. Crepeau, A. Farajollahi, S.P. Healy, K. Bartlett-Healy, D. Strickman, R. Gaugler, G. Hamilton, D. Kline, and G.G. Clark. 2012. Area-wide management of *Aedes albopictus*. Part 2: Gauging the efficacy of traditional integrated pest control measures against urban container mosquitoes. *Pest Management Science.* 69(12): 1351-1361. Doi 10.1002/ps.3511
<http://onlinelibrary.wiley.com/doi/10.1002/ps.3511/pdf>

Hawley, W.A. 1988. The biology of *Aedes albopictus*. *J. Am. Mosq. Control Assoc.* 4: 1-39.
Mackay, A. J., M. Amador, and R. Barrera. 2013. An improved autocidal gravid ovitrap for the control and surveillance of *Aedes aegypti*. *Parasites & Vectors* 6: 225.
<http://www.parasitesandvectors.com/content/pdf/1756-3305-6-225.pdf>

Unlu, I., A. Farajollahi, D. Strickman, D.M. Fonseca. 2013. Crouching tiger, hidden trouble: urban sources of *Aedes albopictus* (Diptera: Culicidae) refractory to source-reduction. *PLoS ONE* 8(10):

e77999. Doi:10.1371/journal.pone.0077999

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0077999>

Peer-Reviewed Documents for Public Health Lessons

Locally acquired Dengue--Key West, Florida, 2009-2010. Centers for Disease Control and Prevention (CDC).MMWR Morb Mortal Wkly Rep. 2010 May 21;59(19):577-81.

<http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5919a1.htm>

Effler P et al. Dengue fever, Hawaii, 2001-2002. Emerg Infect Dis. 2005 May;11(5):742-9.

<http://wwwnc.cdc.gov/eid/article/11/5/pdfs/04-1063.pdf>

Adalja AA, et al Lessons learned during dengue outbreaks in the United States, 2001-2011.

Emerg Infect Dis. 2012 Apr;18(4):608-14. <http://wwwnc.cdc.gov/eid/>

[article/18/4/11-0968_article.htm](http://wwwnc.cdc.gov/eid/article/18/4/11-0968_article.htm)

Surveillance and Control Manuals

World Health Organization: Dengue Guidelines for Diagnosis, Treatment, Prevention, and Control, 2009. <http://www.who.int/rpc/guidelines/9789241547871/en/>

European Centre for Disease Prevention and Control. Guidelines for the surveillance of invasive mosquitoes in Europe. Stockholm: ECDC; 2012.

<http://www.ecdc.europa.eu/en/publications/publications/ter-mosquito-surveillance-guidelines.pdf>

Florida Department of Health. Surveillance and Control of selected Mosquito-Borne Disease in Florida: 2013 Guidebook

http://www.floridahealth.gov/diseases-and-conditions/disease-reporting-and-management/disease-reporting-and-surveillance/_documents/mosquito-guide-2013.pdf

General Resources

[CDPH Vector-Borne Disease Section](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VBDS.aspx). Includes links to dengue, chikungunya, and Zika webpages. <https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VBDS.aspx>

[CDPH *Aedes aegypti* and *Aedes albopictus* mosquitoes](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-aegypti-and-Aedes-albopictus-mosquitoes.aspx)

<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-aegypti-and-Aedes-albopictus-mosquitoes.aspx>

[CDPH "Information for Clinicians: *Aedes aegypti* and *Aedes albopictus* Mosquitoes in California and Reporting Patients with Suspected Dengue or Chikungunya to Public Health"](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-aegypti-and-Aedes-albopictus-mosquitoes.aspx)

<https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/DengueorChikInformationForCliniciansinCA.pdf>

[CDC Chikungunya Information](http://www.cdc.gov/chikungunya/): <http://www.cdc.gov/chikungunya/>

[CDC Dengue Information](http://www.cdc.gov/dengue/): <http://www.cdc.gov/dengue/>

[CDC Zika Information](http://www.cdc.gov/zika/): <http://www.cdc.gov/zika/>

Mosquito Submittal and Testing

Pools of captured female *Aedes* mosquitoes (1 – 50 mosquitoes per pool; separated by species) should be shipped on dry ice to the following address:

Davis Arbovirus Research and Training (DART) Laboratory
ATTN: Ying Fang
University of California One
Shields Avenue
Vet Med: Pathology, Microbiology, & Immunology Building:
Vet Med 3A, Room: 3336
Davis, CA 95616

Unless specified, each pool will be tested for dengue (all serotypes), chikungunya, Zika, and West Nile viruses by qRT-PCR. Pools can be tested for other *Aedes*-borne viruses such as yellow fever on request.