ARIZONA ARBOVIRAL HANDBOOK FOR CHIKUNGUNYA, DENGUE, & ZIKA VIRUSES

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Arizona Department of Health Services

Arizona Arboviral Handbook for Chikungunya, Dengue, & Zika Viruses

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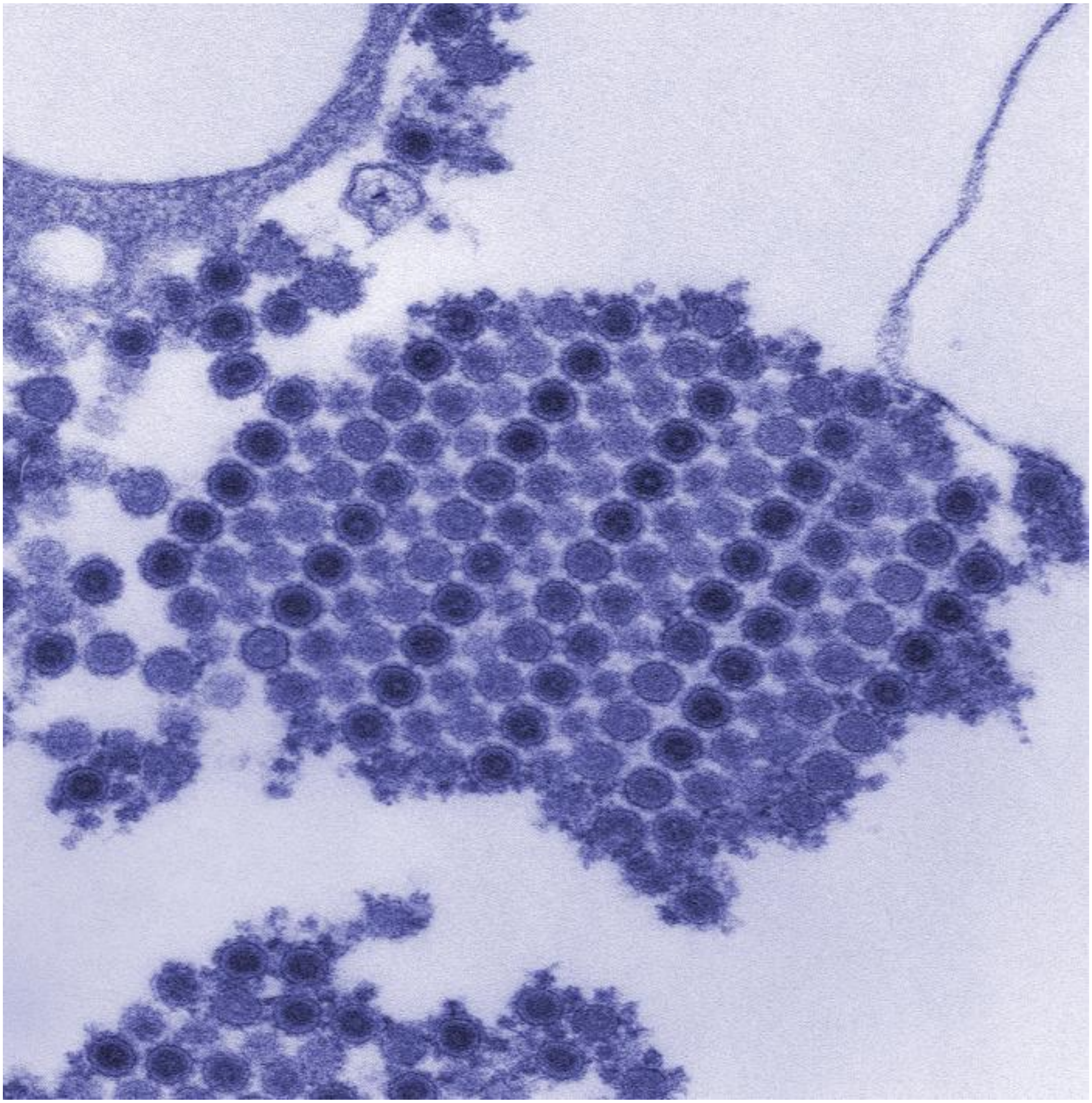
OBJECTIVES

The goal of this document is to outline a preparation and response plan for emerging arboviral threats in Arizona. With the expansion of chikungunya, dengue, and Zika viruses into the Caribbean and Latin America, there is an increasing risk for travelers to return to Arizona infected with one these viruses. All three of these diseases have potential for local transmission in Arizona, and this document was written in response to these encroaching threats.

This document includes detailed sections about chikungunya, dengue, and Zika background, clinical information, surveillance programs, and laboratory testing. The remainder of the handbook is applicable to prevention, investigation, and control of dengue, chikungunya, and Zika viruses. This includes suggested guidelines for public health officials, vector control agencies, and healthcare professionals. Points of contact and additional resources are also provided. This document was developed based on guidelines from the *PAHO/CDC Preparedness and Response for Chikungunya Virus Introduction in the Americas*, and the *WHO Dengue Guidelines for Diagnosis, Treatment, Prevention and Control*. Links to these documents are available in the appendix.

Thanks to all state and local partners who provided content or edits to this document.



Transmission electron micrograph of chikungunya virus particles, CDC

I: CHIKUNGUNYA

Chikungunya fever is a mosquito-borne disease caused by a virus in the Alphavirus genus, Togaviridae family. Chikungunya virus is primarily transmitted by *Aedes aegypti* and *Aedes albopictus* mosquitoes, which also transmit dengue, Zika, and yellow fever viruses. Beginning in 2004, chikungunya has caused large outbreaks in Africa, Asia, Indian Ocean islands, and in Italy. Attack rates in these outbreaks ranged from 38-63% and have reached over 500,000 cases in multiple outbreaks.

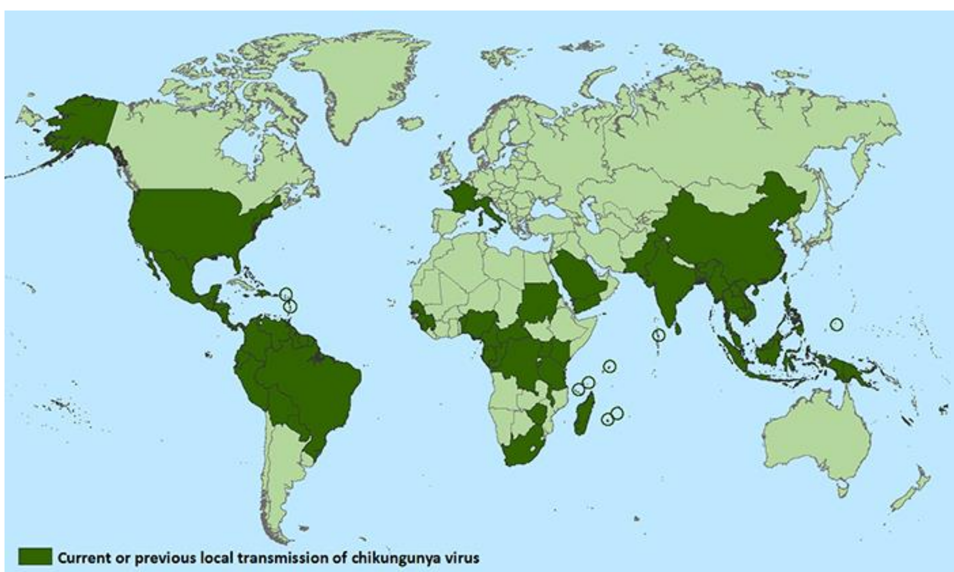
In late 2013, the first cases of locally acquired chikungunya in the western hemisphere were reported among residents of St. Martin in the Caribbean. The virus quickly began to spread across the Caribbean region, and locally acquired cases have been reported from North, Central, and South America. During 2014, 12 locally acquired chikungunya cases were identified in Florida.

Two distinct lineages of chikungunya have been identified — the Indian Ocean lineage and the Asian lineage. The Indian Ocean lineage is the strain currently circulating in the Americas, and has demonstrated less efficient transmission among *Aedes albopictus* mosquitoes than the Asian lineage. This difference might indicate lower risk for transmission in areas with only *Aedes albopictus* mosquitoes.

Chikungunya in Arizona

The introduction of chikungunya virus to the Americas increases the risk for disease importation to the United States. Arizona is at risk for local transmission of chikungunya virus because of the presence of *Ae. aegypti* mosquitoes. Local transmission could occur if a person was infected while traveling, and then bitten by local mosquitoes of the appropriate species after returning. This infected mosquito could then spread the virus to other people, who would be considered locally acquired cases. Infected mosquitoes could also potentially travel across state or national borders, although this would be unlikely due to the short flight range of *Aedes aegypti*.

A more detailed look at the *Aedes aegypti* vector in Arizona, and how to implement surveillance and control methods, are found in section VII of this document.



Countries and territories where chikungunya cases have been reported (as of October 20, 2015), CDC

Chikungunya Ecology & Transmission

Reservoirs

Humans serve as the primary reservoir for chikungunya, but several other vertebrate species have been implicated as potential reservoirs, including non-human primates, rodents, birds, and some small mammals. Animal reservoirs are not considered to play a significant role in transmission during outbreaks.

Incubation periods

- **Humans**: **3–7 days** (range: 1–12) between the bite of an infected mosquito and when symptoms begin (intrinsic incubation)
- **Mosquitoes**: **~10 days, on average,** between intake of an infected blood meal and when mosquitoes can transmit the virus to a naïve human host (extrinsic incubation)

Susceptibility

All persons not previously infected with chikungunya virus are at risk for infection and disease. This can occur anywhere where infected *Aedes* spp. mosquitoes are present. Due to the immunological naiveté of Arizona's population, all areas with known populations of *Aedes* vector mosquitoes are considered at risk for local transmission. It is believed that once exposed, individuals will develop long-lasting protective immunity.

Chikungunya Clinical Disease & Case Management

A person who is bitten by an infected mosquito usually develops signs and symptoms of disease 3–7 days after the bite (range 1–12 days). Most individuals (73–97%) develop symptomatic infection; however, some remain asymptomatic. Chikungunya can cause acute, subacute, and chronic disease.

Acute chikungunya fever usually lasts 3–10 days and is characterized by a sudden onset of high fever (usually >102°F) and severe joint pain. Fever can last from several days up to a week, and is sometimes intermittent. Joint pain is usually symmetric, and most commonly seen in the hands and feet, but can manifest in other joints as well. Other signs and symptoms can include headache, diffuse back pain, myalgia, nausea, vomiting, polyarthritis, tenosynovitis, rash, and conjunctivitis. About 50% of patients develop a rash 2–5 days after fever onset. The rash is typically maculopapular and involves the trunk and extremities, but can also occur on the hands and feet. Fatalities are extremely rare (<1% of cases), but when they do occur it is often among the elderly, newborn, or those with comorbidities. Morbidity due to joint pain and swelling can be severe and impact the person's ability to walk or return to work. These symptoms typically only last a few weeks, but in some cases have been shown to last for months or even years.

Abnormal laboratory findings can include thrombocytopenia, leukopenia, and elevated liver function tests.

Atypical manifestations of chikungunya can occur and include neurological, ocular, cardiovascular, dermatological, renal, or other complications.

Treatment

Treatment for acute chikungunya fever is supportive therapy; however, healthcare providers should first exclude more serious conditions such as malaria, dengue, yellow fever, and bacterial infections that would require more specific treatment. Nonsteroidal anti-inflammatories (NSAIDs) and acetylsalicylic acid (Aspirin) should be avoided until dengue has been ruled out as possible diagnosis due to the risk of hemorrhagic complications and Reyes Syndrome.

Chronic Chikungunya Infection

Patients with chikungunya often improve after the first 10 days of symptoms, but can experience symptom recurrence 2–3 months after initial infection. This usually presents as various rheumatic symptoms including distal polyarthritis, exacerbation of pain in previously injured joints and bones, and tenosynovitis in wrists and ankles. Vascular manifestations can occur, such as Raynaud's syndrome. Many patients also complain of general depression, fatigue, and weakness. Study results vary, but have suggested that after 3 months 80-93% of patients complain of chronic or recurrent symptoms. After 10 months, 49% of patients will complain of chronic symptoms. Between 18 months and 36 months, 12–18% of patients will complain of chronic symptoms. Chronic symptoms appear to be more common among persons 65 years of age or older, with preexisting joint conditions, and who experienced more severe acute stage disease.

Chikungunya Laboratory Testing

Laboratories

The Arizona State Public Health Laboratory (ASPHL) can perform PCR and IgM ELISA testing for chikungunya virus. Testing can also be performed at the CDC Arboviral Disease Branch laboratory in Fort Collins, CO. Several private commercial labs also offer chikungunya testing. Samples can be tested at commercial laboratories; if positive, the sample can be forwarded to ASPHL for confirmatory testing.

Samples

Chikungunya testing is most commonly performed on blood or serum samples; cerebrospinal fluid can be tested in patients with meningoencephalitic symptoms. Additional testing can be performed on other specimens in rare cases (i.e., autopsy material following a suspect chikungunya death), but there is little information on the detection of virus by isolation or RT-PCR from tissue or organs. Several methods are available for chikungunya virus diagnostic assays, and include the following:

- Viral culture
- Reverse transcriptase-polymerase chain reaction (RT-PCR)
- Enzyme-linked immunosorbent assay (ELISA) or immunofluorescence assay (IFA) for immunoglobulin (Ig) M or IgG antibodies
- Plaque reduction neutralization tests (PRNT)
    - Not routinely performed for initial diagnosis

    - Results are more specific than ELISA/IFA results and are generally required to confirm diagnosis
- Immunohistochemical staining (IHC)
    - Performed on tissues

For **routine** chikungunya virus diagnostic testing, serum specimens can be tested by RT-PCR and IgM antibody tests. To determine which test(s) are needed, identify the day after illness onset when the specimen is collected and use the following guidelines:

- **0–3 days: RT-PCR**
- **4–6 days: both RT-PCR and IgM**
- **≥7 days: IgM**

Specimen Collection, Storage and Transportation

- Collect 4–5 ml of blood aseptically in a tube or a vial. Any serum separator vial is appropriate, such as a red top, orange top, or tiger top.
- Allow blood to clot at room temperature
- Centrifuge blood at 2,000 rpm to separate serum, and then collect the serum in a clean dry vial.
- Samples should be frozen or refrigerated, depending on the testing laboratory's recommendations.

Chikungunya Case Definitions

Chikungunya falls under the arboviral disease case definition, as defined by the Council of State and Territorial Epidemiologists (CSTE). CSTE divides arboviral infection case classifications in two categories; neuroinvasive or non-neuroinvasive. Because chikungunya is a predominantly non-neuroinvasive disease, we have only included the non-neuroinvasive criteria in this handbook. If a neuroinvasive disease is suspected, please see the complete arboviral disease case definition in the Arizona Case Definitions for Public Health Surveillance.

Clinical Criteria

A clinically compatible case of chikungunya is defined as follows:

- Fever (chills) as reported by the patient or a healthcare provider, AND
- Absence of more likely clinical explanation, AND
- Other clinically compatible symptoms including headache, myalgia, rash, arthralgia, vertigo, vomiting, paresis, and/or nuchal rigidity

Laboratory Criteria for Diagnosis

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, OR

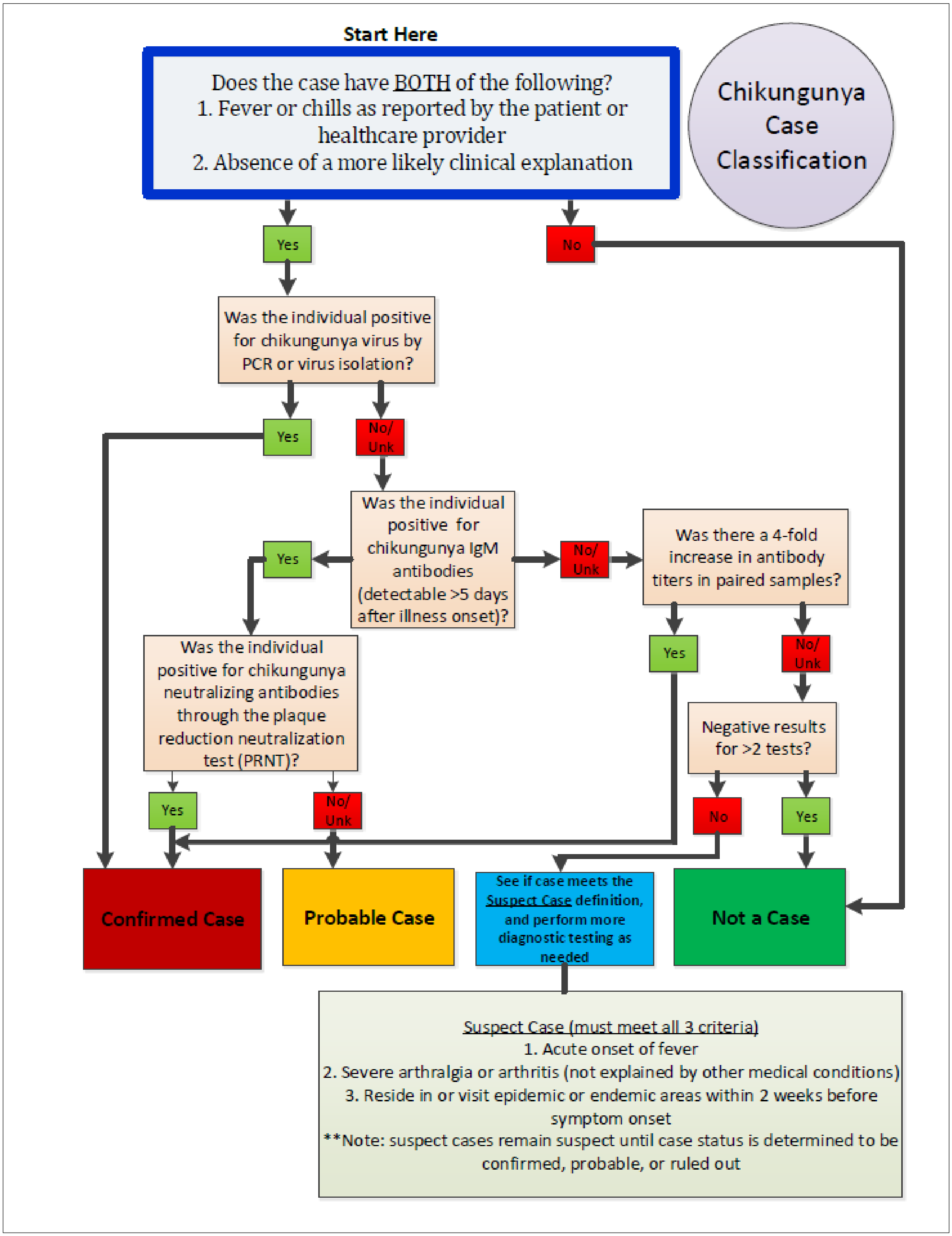
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, OR
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, OR
- Virus-specific IgM antibodies in CSF or serum.

A confirmed case meets the above clinical criteria and one or more of the following laboratory criteria:

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, OR
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, OR
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen.

A probable case meets the above clinical criteria and virus-specific IgM antibodies in serum but with no other testing.

Chikungunya Case Classification Algorithm



Female *Aedes aegypti* mosquito, CDC

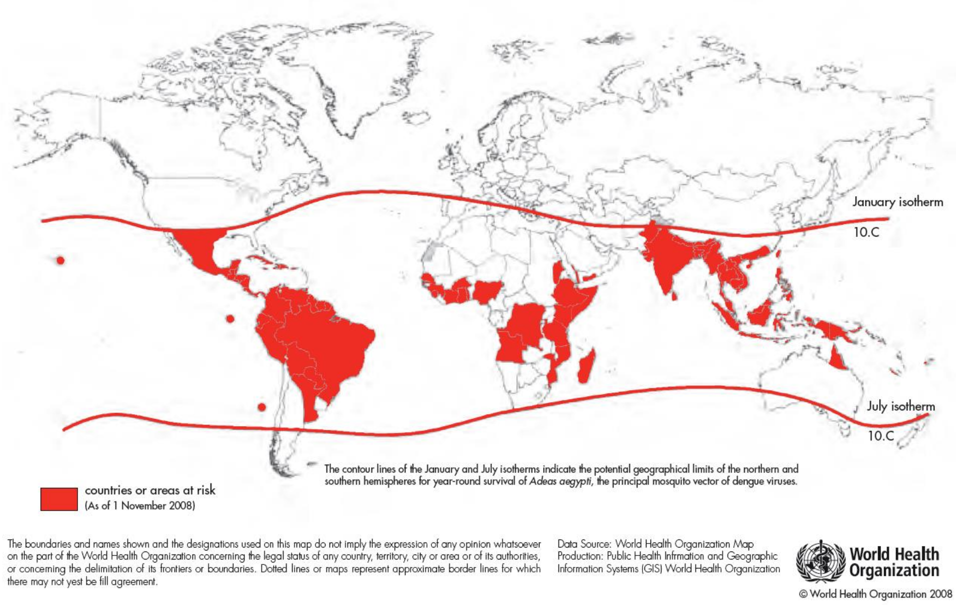
II: DENGUE

Dengue fever is a mosquito-borne disease in the flavivirus genus of the Flaviviridae family. It is primarily transmitted by *Aedes aegypti* and *Aedes albopictus* mosquitoes, which also transmit chikungunya and Zika viruses. These vectors are found throughout the world, and their abundance has aided in the geographic expansion of the virus. Dengue is expanding rapidly, and has had a 30-fold increase in incidence during 2000–2010. This includes increased disease incidence in endemic countries as well as encroachment into new countries and regions.

In many parts of the tropics and subtropics dengue is endemic. However, dengue also has significant epidemic potential. In order for dengue to become endemic three factors are required:

- A large population of *Aedes aegypti or Aedes albopictus* mosquitoes. Mosquito population growth can occur in response to increased rainfall or other environmental factors.
- A human population immunologically naïve to one or more of the dengue serotypes.
- Contact between the human population and the infected vector population, creating a cycle of human-mosquito-human transmission.

Figure 1.1 Countries/areas at risk of dengue transmission, 2008



Dengue in Arizona

The increasing incidence and geographic distribution of dengue increases the likelihood for travel-associated cases to occur in Arizona. Arizona is also at risk for local transmission of dengue virus because of the presence of *Ae. aegypti*. Local transmission could occur if a traveler was infected in a dengue-endemic area, and then bitten by an *Aedes* spp. mosquito after returning to Arizona. Dengue-infected mosquitoes could also potentially travel across state or national borders. In 2014, locally acquired dengue cases in Sonora, Mexico were identified near the Arizona border region, and Sonora reported >3600 dengue cases. Due to this outbreak, a large increase in travel-associated dengue cases occurred among Arizona residents, with over 90 cases reported.

Aedes aegypti mosquitoes are established in Arizona. A more detailed look at the vectors of concern in Arizona, and how to perform surveillance and vector control, are found in section VII of this document.

Dengue Ecology & Transmission

Reservoirs

Dengue does not have a non-human reservoir. It is host-specific to *Aedes spp.* mosquito vectors and humans.

Incubation period

- **Humans: 4–7 days** (range 3–14 days) between the bite of an infected mosquito and when symptoms begin (intrinsic incubation)
- **Mosquitoes: ~10 days** between intake of a dengue infected blood meal and when mosquitoes can transmit the virus to a naïve human host (extrinsic incubation)

Dengue Serotypes

Dengue fever is caused by any of the dengue serotypes I–IV. Following infection, patients are protected from illness with the same serologic strain. Unfortunately, upon a second infection with a *different* serotype, severe disease manifestations such as shock and hemorrhagic disease manifestations are more likely to occur. This is attributable to the overreaction of the immune response to the dengue antigens. The co-circulation of multiple virus serotypes in an area is termed **hyperendemicity**, and is associated with epidemic severe dengue in a geographical area.

Dengue Clinical Disease & Case Management

The clinical manifestations of dengue fever can be divided into three phases: febrile phase, critical phase, and recovery phase.

Febrile Phase

Only about 1 out of every 4 people bitten by an infected mosquito will develop symptoms, which usually begin 4–7 days after exposure. Common symptoms include sudden high fever accompanied by facial flushing, rash, body aches, myalgia, arthralgia and headache. Sore throat, anorexia, nausea and vomiting are also common. This phase usually last 2–7 days. Many symptoms during this period are non-specific, but a positive tourniquet test should increase suspicion for dengue infection. Patients should be monitored closely for warning signs of more severe disease. Mild hemorrhagic manifestations are not uncommon, and include petechial and mucosal membrane bleeding. Gastrointestinal bleeding or massive vaginal bleeding in women of childbearing age is also possible. The liver can be enlarged and tender during the febrile period.

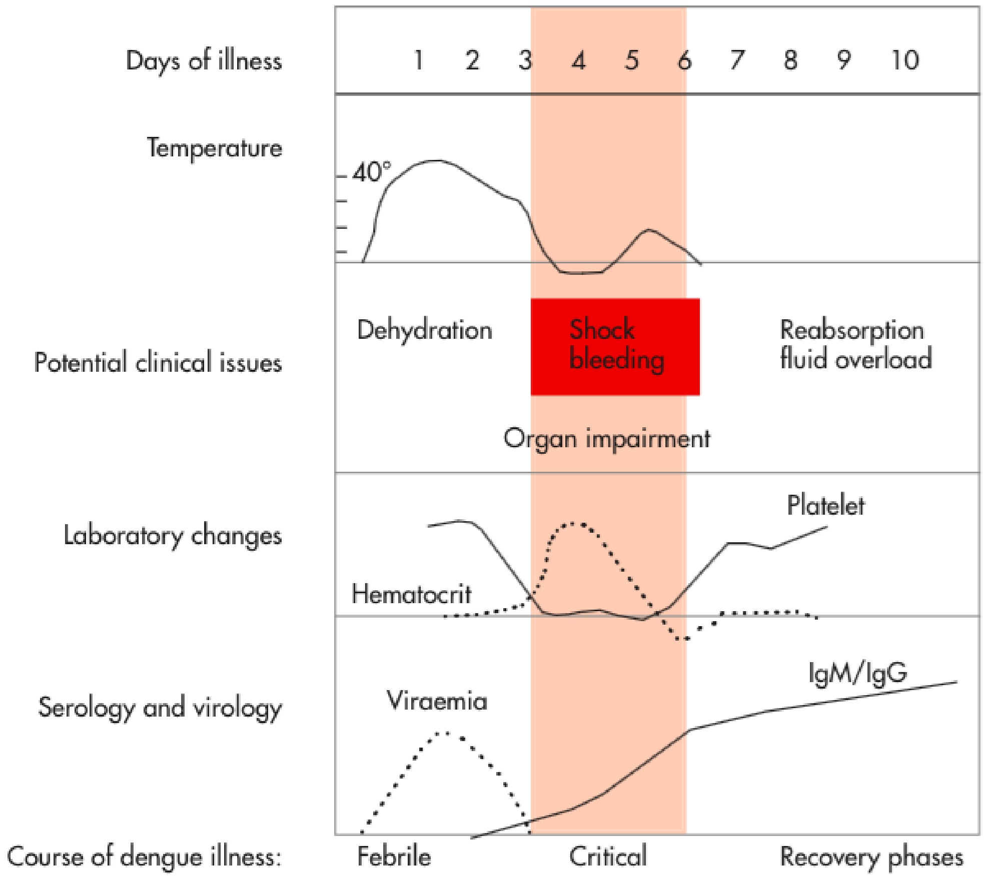
Critical Phase

During the critical phase of illness (days 3–7), the patient's fever often resolves concurrent with an increase in capillary permeability. This period of plasma leakage often lasts 24–48 hours. The level of capillary permeability determines disease progression and severity, and is highly variable. In more severe cases, this leads to pleural effusions and ascites. Shock occurs when a critical volume of plasma is lost through capillary leakage, and often coincides with a lowering of temperature, organ damage, metabolic acidosis, and disseminated intravascular coagulation or other coagulation abnormalities. The patient is considered in shock if their pulse pressure is ≤ 20 mm Hg. It is possible for patients to progress rapidly from the febrile phase to the critical phase without a drop in temperature, which is why patients should be monitored closely throughout the course of disease. A complete blood count can be used to determine the onset and severity of the critical phase and plasma leakage.

Recovery Phase

If the patient survives the critical phase, a 48–72 hour period of gradual reabsorption from the extravascular compartment fluid occurs. Patient wellbeing improves during this period. Bradycardia and electrocardiographic changes are common in this phase. It is important to avoid excessive fluid therapy, which is associated with pulmonary edema and congestive heart failure.

Figure 1: The course of dengue clinical illness (adapted from WHO guidelines for diagnosis, treatment, prevention, and control of dengue and yip et al.)



Phase	Duration	Clinical Concerns
Febrile	2–7 days	Dehydration and high fever; fever can lead to neurological disturbances or seizures in children
Critical	24–48 hours	Shock from plasma leakage, severe hemorrhage, organ impairment
Recovery	48–72 hours	Hypervolemia (following excessive fluid therapy)

Monitoring and Treatment

Clinical interventions should change based on disease manifestations. Vital signs, peripheral perfusion, urine output, hematocrit, blood glucose, and organ function should be monitored in the febrile stage for signs of clinical deterioration and warning signs of more severe disease. Patients with critical phase signs including abdominal pain or tenderness, 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 should be closely monitored until the risk period is over.

There is no specific treatment for dengue fever, but supportive therapy is essential. Excessive fluid therapy should be avoided. Additionally, non-steroidal anti-inflammatory agents (NSAIDs) and acetylsalicylic acid (ASA) should be avoided as these drugs can exacerbate gastritis and worsen hemorrhagic disease manifestations. For patients with signs of shock, hemorrhage, or organ impairment, hospitalization is required. Patients should receive fluid replacement for plasma loss to maintain circulation. Fluid input and output should be carefully monitored. Discharge criteria include no fever for 48 hours, clinical improvement (appetite and general wellbeing), increasing platelet counts, and stable hematocrit levels without intravenous fluids. For more specific information, please see the *WHO Dengue Guidelines for Diagnosis, Treatment, Prevention, and Control*.

Dengue Laboratory Testing

Laboratories

The Arizona State Public Health Laboratory (ASPHL) can perform PCR and IgM ELISA antibody testing for dengue virus. This testing does not determine the serotype. Several commercial laboratories also perform dengue diagnostic testing. Additional testing can be performed at the CDC Dengue Branch laboratory, located in San Juan, Puerto Rico. In general, samples should first be tested at a commercial lab, then forwarded to the Arizona State Public Health Laboratory (ASPHL) for confirmatory testing.

Samples

Dengue virus is most commonly detected in blood, serum, or plasma, but tissues from affected organs can also be tested in severe or postmortem cases. The following time periods after disease onset can be used to guide test selection.

- **0–3 days: RT-PCR**
- **4–6 days: both RT-PCR and IgM**
- **≥7 days: IgM**

For patients with negative acute IgM results, and no PCR testing performed, convalescent phase serum should be collected 10–14 days after the first sample to identify a four-fold change in antibody titer or to definitively rule out the diagnosis. Also, a single convalescent titer is sufficient for a probable case classification if no acute-phase specimen was collected. IgM antibodies can persist for months after illness. A table of additional diagnostic method options is found below.

Diagnostic Method	Specimen	Collection After Symptom Onset	Laboratory Classification
Viral isolation by cell culture	Whole blood, serum, plasma, CSF, tissues	1–5 days	Confirmed
Nucleic acid detection by RT-PCR or another molecular diagnostic test	Whole blood, plasma, serum, tissues, CSF	1–5 days	Confirmed
NS1 antigen detection by immunoassay	Serum or plasma	1–6 days	Confirmed
Antigen detection by immunofluoresence or immunohistochemistry	Tissue	Fatal cases only	Confirmed
IgM anti-DENV by validated immunoassay	Serum, plasma, whole blood, CSF	>3 days	Probable
IgG anti-DENV by validated immunoassay (paired sera)	Serum, plasma, whole blood	1–5 days & >15 days	Confirmed if >4-fold rise in titer

Specimen Collection, Storage and Transportation

1. Collect 4-5 ml of blood aseptically in a tube or a vial.
    a. Any serum vial is appropriate, including red top, orange top or tiger top tubes.
2. Allow blood to clot at room temperature
3. Centrifuge at 2,000 rpm to separate serum, and then collect the serum in a clean dry vial.
4. Transport samples at 2–8 °C (NOT frozen, as hemolysis can interfere with serological testing).
    a. If specimens are frozen, virus isolation and molecular diagnosis are still possible.
    b. If a delay of >24 hours is expected, the specimen should be separated and stored at a refrigerated temperature.

Additional Testing

Diagnostic testing for dengue is necessary because of the non-specific signs and symptoms, and range of disease manifestations. Antibody tests for dengue can cross-react with other flaviviruses, including West Nile virus, St. Louis encephalitis and Japanese encephalitis. If the case is suspected to be locally acquired, West Nile virus and St. Louis encephalitis virus should be ruled out through comparison of plaque reduction neutralization (PRNT) test results. RT-PCR can also be used for a confirmatory diagnosis if the specimen is collected early in the course of illness. If the case is travel-associated, other pathogens from the region where exposure occurred should be considered.

Dengue Case Definitions

The Council for State and Territorial Epidemiologists (CSTE) released new case definitions for dengue in early 2015. Based on the new case definitions, suspect dengue case should be assessed on two different criteria: clinical presentation and laboratory results/epidemiologic criteria. Clinical presentation is divided into dengue-like illness, dengue, or severe dengue. Case classifications as confirmed, probable, or suspect cases are based on the laboratory results and epidemiologic criteria. Dengue cases can be classified as one of nine classifications:

Dengue Clinical Presentation Criteria

Dengue-like Illness

Fever as reported by the patient or healthcare provider

Dengue

1. Fever
2. One or more of the following:
    - Nausea/vomiting
    - Rash
    - Aches and pains (headache, retro-orbital pain, joint pain, myalgia, arthralgia)
    - Tourniquet test positive
    - Leukopenia (total white blood cell count <5,000 mm3)
    - Any warning sign for severe dengue
        - Abdominal pain or tenderness
        - Persistent vomiting
        - Extravascular fluid accumulation (e.g., pleural or pericardial effusion, ascites)
        - Mucosal bleeding at any site
        - Liver enlargement >2 cm
        - Increasing hematocrit with rapid decrease in platelet count

Severe Dengue

Dengue with any one or more of the following scenarios:

- Severe plasma leakage evidenced by hypovolemic shock and/or extravascular fluid accumulation with respiratory distress
  ** High hematocrit value for patient age and sex offers further evidence of plasma leakage*
- Severe bleeding from the gastrointestinal tract or vagina 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: AST or ALT ≥1,000 U/L
    - Impaired level of consciousness and/or diagnosis of encephalitis, encephalopathy, or meningitis
    - Heart or other organ involvement including myocarditis, cholecystitis, and pancreatitis

Dengue Laboratory and Epidemiologic Criteria

A confirmed case is defined as having any one or more of the following:

- Detection of DENV nucleic acid in serum, plasma, blood, cerebrospinal fluid (CSF), other body fluid or tissue by validated reverse transcriptase-polymerase chain reaction (PCR)
- Detection of DENV antigens in tissue a fatal case by a validated immunofluorescence or immunohistochemistry assay
- Detection in serum or plasma of DENV NS1 antigen by a validated immunoassay
- Cell culture isolation of DENV from a serum, plasma, or CSF specimen
- Detection of IgM anti-DENV by validated immunoassay in a serum specimen or CSF in a person living in a dengue endemic or non-endemic area of the United States without evidence of other flavivirus transmission (e.g., WNV, SLEV, or recent vaccination against a flavivirus (e.g., YFV, JEV)
- Detection of IgM anti-DENV in a serum specimen or CSF by validated immunoassay in a traveler returning from a dengue endemic area without ongoing transmission of another flavivirus (e.g., WNV, JEV, YFV), clinical evidence of co-infection with one of these flaviviruses, or recent vaccination against a flavivirus (e.g., YFV, JEV)
- IgM anti-DENV seroconversion by validated immunoassay in acute (i.e., collected <5 days of illness onset) and convalescent (i.e., collected >5 days after illness onset) serum specimens
- IgG anti-DENV seroconversion or ≥4-fold rise in titer by a validated immunoassay in serum specimens 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

A probable case is defined as having any one or more of the following:

- Detection of IgM anti-DENV by validated immunoassay in a serum specimen or CSF in a person living in a dengue endemic or non-endemic area of the United States with evidence of other flavivirus transmission (e.g., WNV, SLEV), or recent vaccination against a flavivirus (e.g., YFV, JEV).
- Detection of IgM anti-DENV in a serum specimen or CSF by validated immunoassay in a traveler returning from a dengue endemic area with ongoing transmission of another flavivirus (e.g., WNV, JEV, YFV), clinical evidence of co-infection with one of these flaviviruses, or recent vaccination against a flavivirus (e.g., YFV, JEV).

A suspected case is defined as:

- 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*.

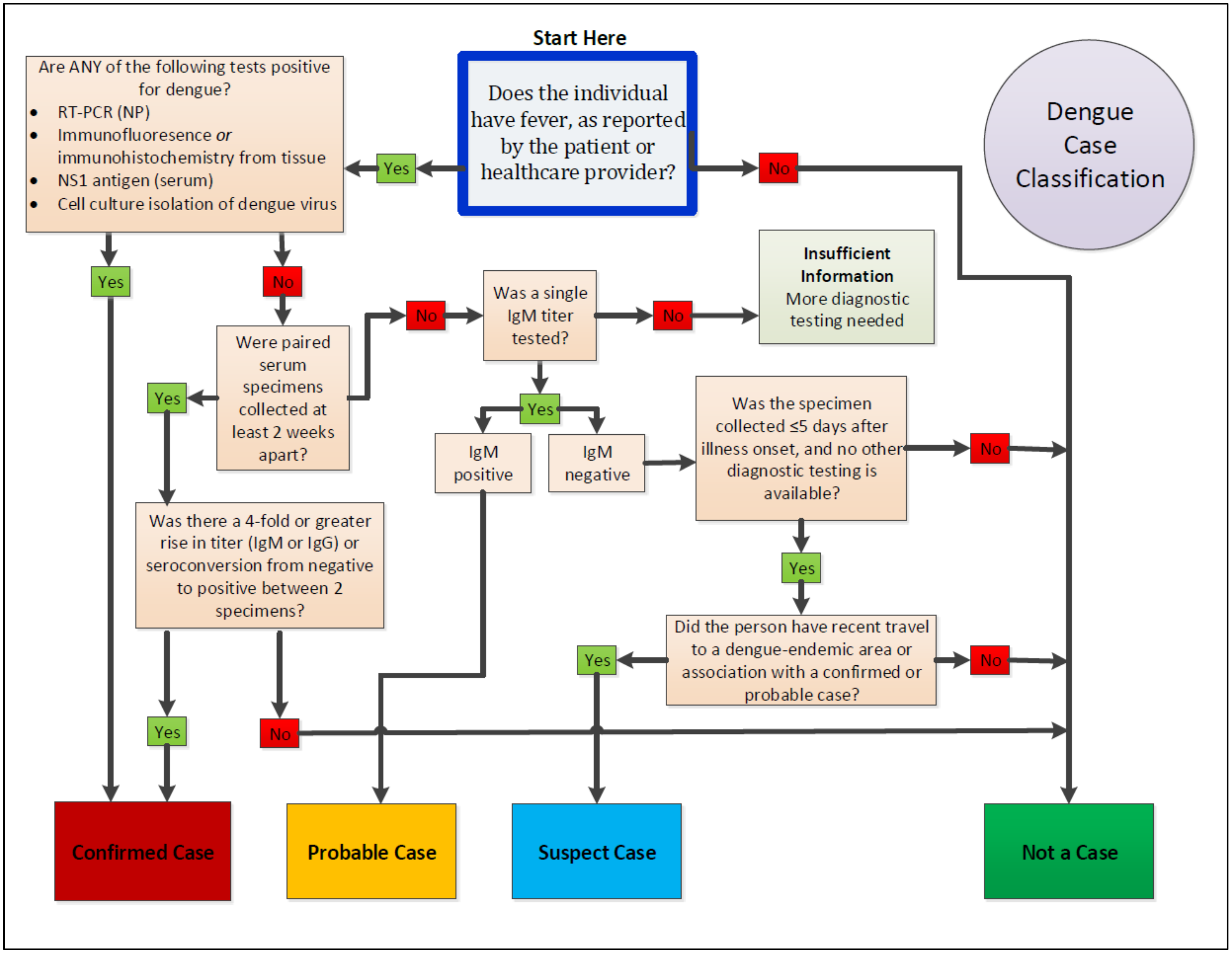
The person under investigation is **not a case** if there is no laboratory or epidemiological evidence* supporting the diagnosis.

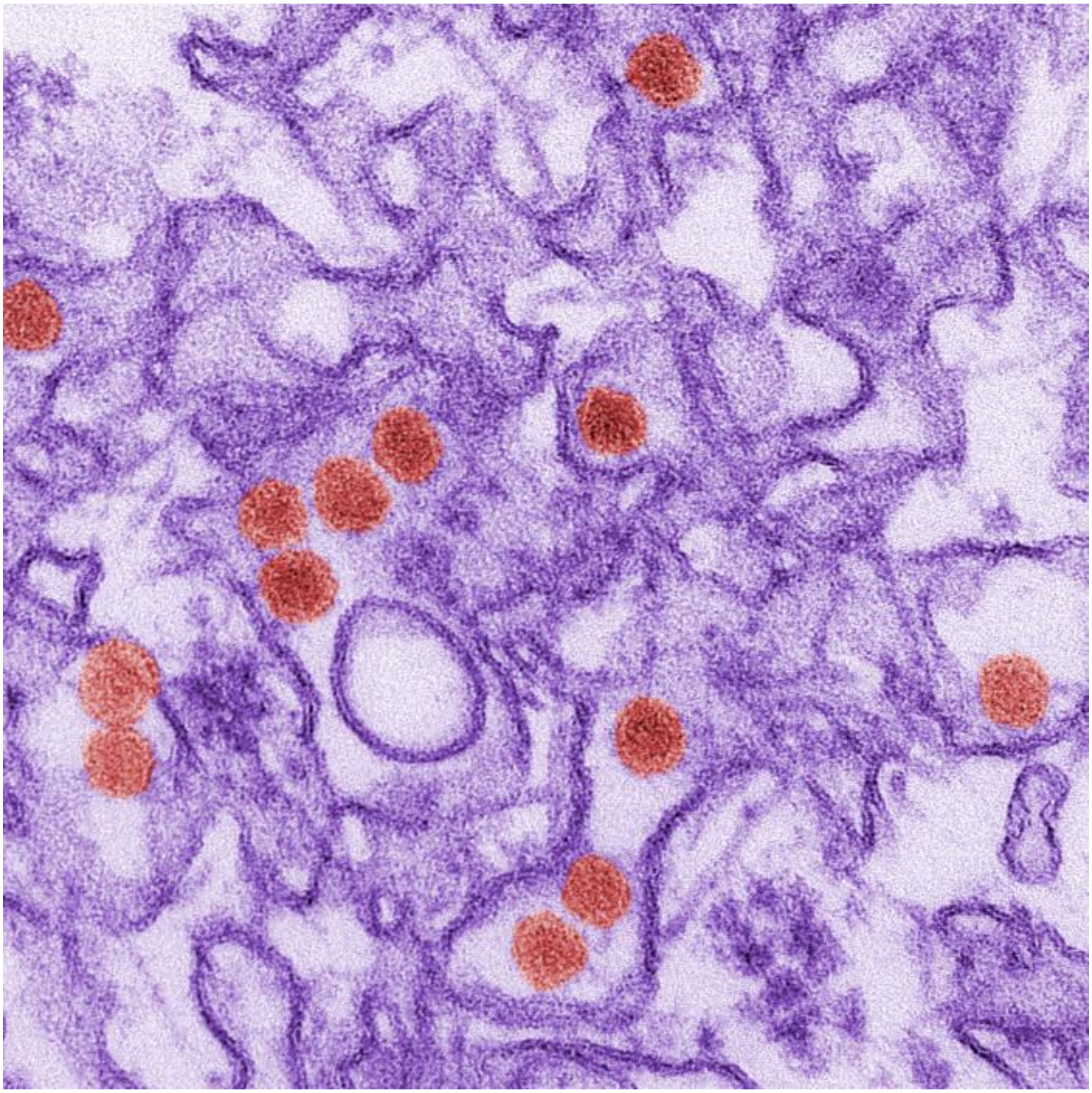
<u>*Criteria for epidemiologic linkage</u>

- Travel to a dengue endemic country or presence at location with ongoing outbreak within previous two weeks of onset of an acute febrile illness or dengue, or
- Association in time and place (e.g., household member, family member, classmate, or neighbor) with a confirmed or probable dengue case.

A link to the full document Council of State and Territorial Epidemiologists (CSTE) *Revision of Case Definitions for National Notification of Dengue*
http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/2014PS/14_ID_10.pdf
To assist in classifying a potential dengue case, a case classification algorithm is found below.

Dengue Case Classification Algorithm



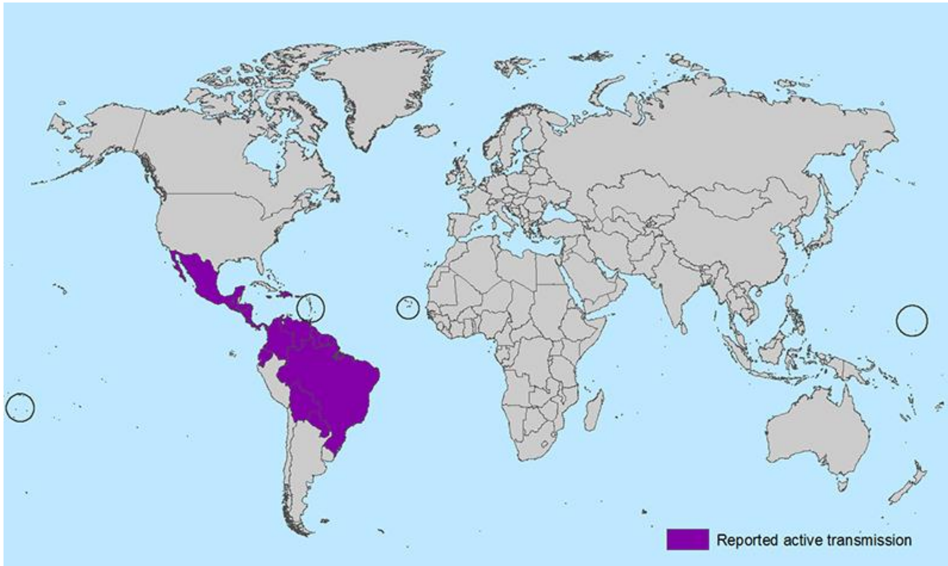


Digitally-colorized transmission electron micrograph of Zika virus. Viral particles are visible in red. (CDC)

III: ZIKA

Due to the nature of the rapidly evolving Zika outbreak in the Americas, information in this document is draft and subject to change. Please visit www.cdc.gov/zika or www.azhealth.gov/zika for updated guidance.

Zika virus is a single-stranded RNA virus of the *Flaviviridae* family that is primarily spread through the bite of an infected *Aedes* species mosquito. The virus was first identified in 1947 from a Rhesus monkey in Uganda; however, the first outbreak in the Americas occurred in early 2015, when the virus was found in northeastern Brazil. In less than a year, Zika spread to over 30 countries or territories in Central America, South America, the Caribbean, and Mexico. For more information about areas with Zika transmission, please see CDC's webpage or the PAHO/WHO Zika webpage.



Countries and territories where local transmission of Zika virus has been identified (as of March 2, 2016), CDC

Zika in Arizona

The presence of Zika virus in the Americas greatly increases the likelihood for imported cases of Zika virus in Arizona. Local transmission of Zika virus from mosquitoes is possible due to abundant populations of *Ae. aegypti* in many parts of the state. However, imported cases of chikungunya and dengue virus in recent years have not led to local transmission of disease, and the probability of widespread locally acquired mosquito-borne disease is likely low. Travelers and residents are reminded to avoid mosquitoes both when traveling and in Arizona to reduce the risk of travel-associated disease from chikungunya, dengue, or Zika, as well mosquito-borne diseases in the state such as West Nile virus and St. Louis encephalitis virus.

Unlike chikungunya and dengue viruses, Zika transmission through sexual contact or congenital or perinatal infection is also a concern. Limited transmission in Arizona through these mechanisms is possible; to decrease this risk, pregnant women should consider avoiding travel to Zika-affected areas during pregnancy. In addition, pregnant women and men with pregnant partners are recommended to abstain from sexual activity or correctly use condoms during sex with their pregnant partner for the duration of the pregnancy. More information about Zika and pregnancy is available here.

Zika Ecology & Transmission

Reservoirs

Zika virus has been shown to infect and cause disease in humans and non-human primates. No other animals have been found to develop disease, although serologic evidence of infection was identified in a few animals from one study in Indonesia, including horses, cows, water buffalos, goats, ducks, and bats. However, these animals are not believed to play a role in Zika virus transmission to humans.

Incubation period

- **Humans: a few days to a week** between the bite of an infected mosquito and when symptoms begin (intrinsic incubation)
- **Mosquitoes: ~10 days** between intake of a Zika- infected blood meal and when mosquitoes can transmit the virus to a naïve human host (extrinsic incubation)

Zika Virus Strains

Two major lineages of Zika virus have been identified — the Asian strain and the African strain. The 2015-2016 Zika virus outbreak in the Americas was identified as the Asian strain.

Zika Clinical Disease & Case Management

The most common symptoms of Zika infection include acute onset of fever, maculopapular rash, arthralgia, and nonpurulent conjunctivitis, as well as myalgia and headache; however, nearly 80% of infected patients are asymptomatic. If symptoms occur, they are thought to occur 2-12 days after the bite of an infected mosquito and can last up to a week. Hospitalization is rarely required, and death from Zika complications is a rare occurrence. Guillain-Barre syndrome has also been reported in patients following suspected Zika virus infection.

Testing for Zika virus should be considered among patients who traveled to affected areas and have signs and symptoms of disease, or had sexual contact with someone suspected to have Zika virus infection. Testing for asymptomatic pregnant women is also available on a case by case basis. Currently, commercial testing is not available; healthcare providers should contact the local health department to report suspect cases and coordinate testing at a public health laboratory. More information about specimen collection, handling, and shipping for Zika virus is available here.

Many other diseases can have a similar clinical presentation as Zika virus. Dengue, chikungunya, leptospirosis, malaria, rickettsia, group A streptococcus, rubella, measles, parvovirus, enterovirus, adenovirus, and other pathogens should be considered in persons suspected of Zika infection.

Currently, there is no vaccine or specific treatment for Zika virus infection. Patients can be treated with supportive care; aspirin and non-steroidal anti-inflammatory drugs should be avoided until dengue is ruled out. Persons suspected of Zika infection should be advised to prevent mosquito bites to stop disease transmission.

Microcephaly

In 2015, a temporal and geographic association with a large Zika virus outbreak in Brazil and an increase in microcephaly cases in infants was identified. Health authorities in Brazil, the Pan American Health Organization, CDC, and other agencies have been investigating the association between Zika virus infection and microcephaly, as well as other abnormalities of the developing brain and eye. Zika virus has been isolated from fetal brain tissue and amniotic fluid in mothers infected with Zika. Additional studies are needed. Association has been established, but causation has not. There is currently no evidence to suggest that a Zika infection in a non-pregnant woman can affect future pregnancies.

Zika Laboratory Testing

***Note: Testing algorithms are available online at: http://www.azdhs.gov/preparedness/epidemiology-disease-control/mosquito-borne/index.php#zika-info-for-providers.**

Laboratories

All Zika virus testing is currently performed at public health laboratories. The Arizona State Public Health Laboratory (ASPHL) can perform RT-PCR testing for Zika virus in serum, urine, CSF, and amniotic fluid; IgM serologic testing is also available in serum or CSF. Plaque reduction neutralization testing (PRNT) is performed at CDC Arboviral Diseases Branch laboratory. For more information about Zika specimen handling and shipment, please the ADHS Zika laboratory webpage.

Samples

Serum is the preferred specimen for Zika virus testing. In the first week of illness, both RT-PCR and serologic testing is recommended; after the first week, only serology should be utilized. Urine can also be tested in the first two weeks after illness onset by RT-PCR. Additional specimens can be tested in consultation with the local health department and

Arizona Department of Health Services, including cerebrospinal fluid and placental and umbilical cord tissues.

Additional Testing

When testing symptomatic patients for Zika virus, testing for dengue and chikungunya viruses should also be considered. All three infections have similar clinical manifestations, and testing can help identify the causative agent.

If Zika testing is being performed as part of a workup for an infant with microcephaly, diagnostic testing for other causes of microcephaly should also be performed.

Zika Case Definitions

The Council for State and Territorial Epidemiologists (CSTE) released draft case definitions for Zika virus in early 2016. These case definitions are subject to change, but have been included here as interim guidelines.

Clinical Criteria for Zika Virus (ZIKV) Disease

Mosquito-borne or sexually transmitted case — a person with one or more of the following:

- acute onset of fever (measured or reported)
- maculopapular rash
- arthralgia
- conjunctivitis
- complication of pregnancy
    - fetal loss in a mother with compatible illness and/or epidemiologic risk factors; or
    - in utero findings of microcephaly and/or intracranial calcifications with maternal risk factors
- Guillain-Barré syndrome not known to be associated with another diagnosed etiology.

Congenital case — live birth with microcephaly or intracranial calcifications or central nervous system abnormalities.

Case Classification for Zika Virus Disease

A confirmed case meets clinical criteria, AND:

- Has laboratory evidence of recent ZIKV infection by:

- 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
- ZIKV IgM antibodies in serum or CSF with ZIKV neutralizing antibody titers 4-fold or greater than neutralizing antibody titers against dengue or other flaviviruses endemic to the region where exposure occurred.

<u>A probable case</u> meets clinical criteria AND

- resides in or has recently traveled to an area with ongoing ZIKV transmission, OR
- has direct epidemiologic linkage* to a person with laboratory evidence of recent ZIKV infection (e.g. sexual contact, in utero or perinatal transmission, blood transfusion, organ transplantation), OR
- association in time and place with a confirmed or probable case

AND meets the following laboratory criteria:

- positive ZIKV-specific IgM antibodies in serum or CSF; and
- negative dengue virus-specific IgM antibodies; AND
    - No neutralizing antibody testing performed; or
    - Less than four-fold difference in neutralizing antibody titers between ZIKV and dengue or other flaviviruses endemic to the region where exposure occurred.

<u>*Criteria for epidemiologic linkage</u>

- Travel to a country or region with known ZIKV transmission, OR
- Sexual contact with a laboratory confirmed case of ZIKV infection, OR
- Receipt of blood or blood products within 30 days of symptom onset; OR
- Organ transplant recipient within 30 days of symptom onset; OR
- Association in time and place with a confirmed or probable case.
- For congenital syndrome, a pregnancy with maternal epidemiologic linkage.

Case Classification for Zika Virus Congenital Infection

<u>A confirmed case</u> meets clinical criteria, AND ONE OF THE FOLLOWING laboratory criteria:

- ZIKV detection by culture, antigen test, or polymerase chain reaction (PCR) in serum, CSF, amniotic fluid, urine, placenta, umbilical cord, or fetal tissue; OR
- ZIKV IgM antibodies present in serum or CSF with ZIKV neutralizing antibody titers 4-fold or greater than neutralizing antibodies against dengue or other flaviviruses endemic to the region where exposure occurred.

<u>A probable case</u> meets clinical criteria, AND:

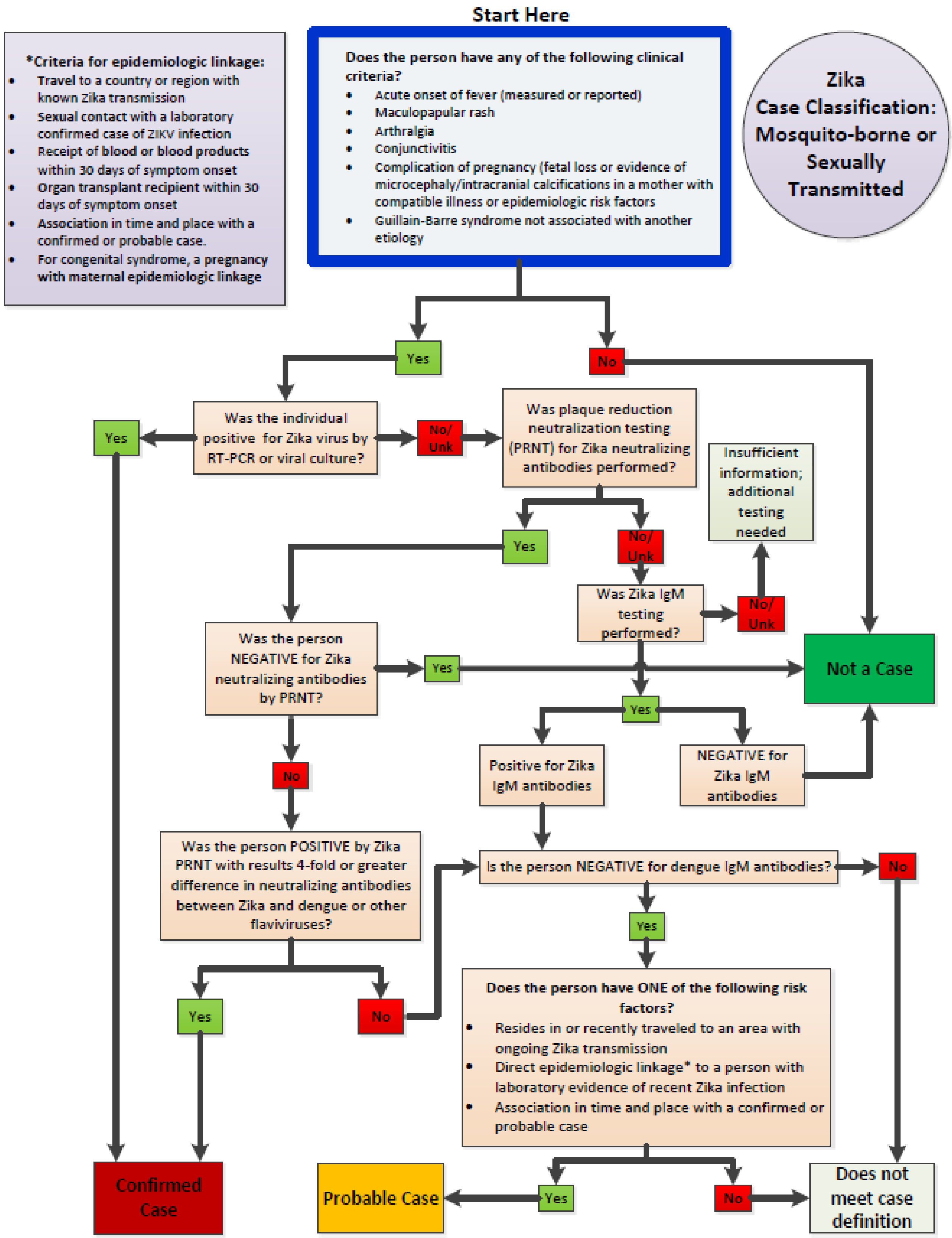
- Mother lived in or traveled to a country or area with ongoing ZIKV transmission during the pregnancy; OR

- Mother has laboratory evidence of ZIKV or unspecified flavivirus infection during pregnancy

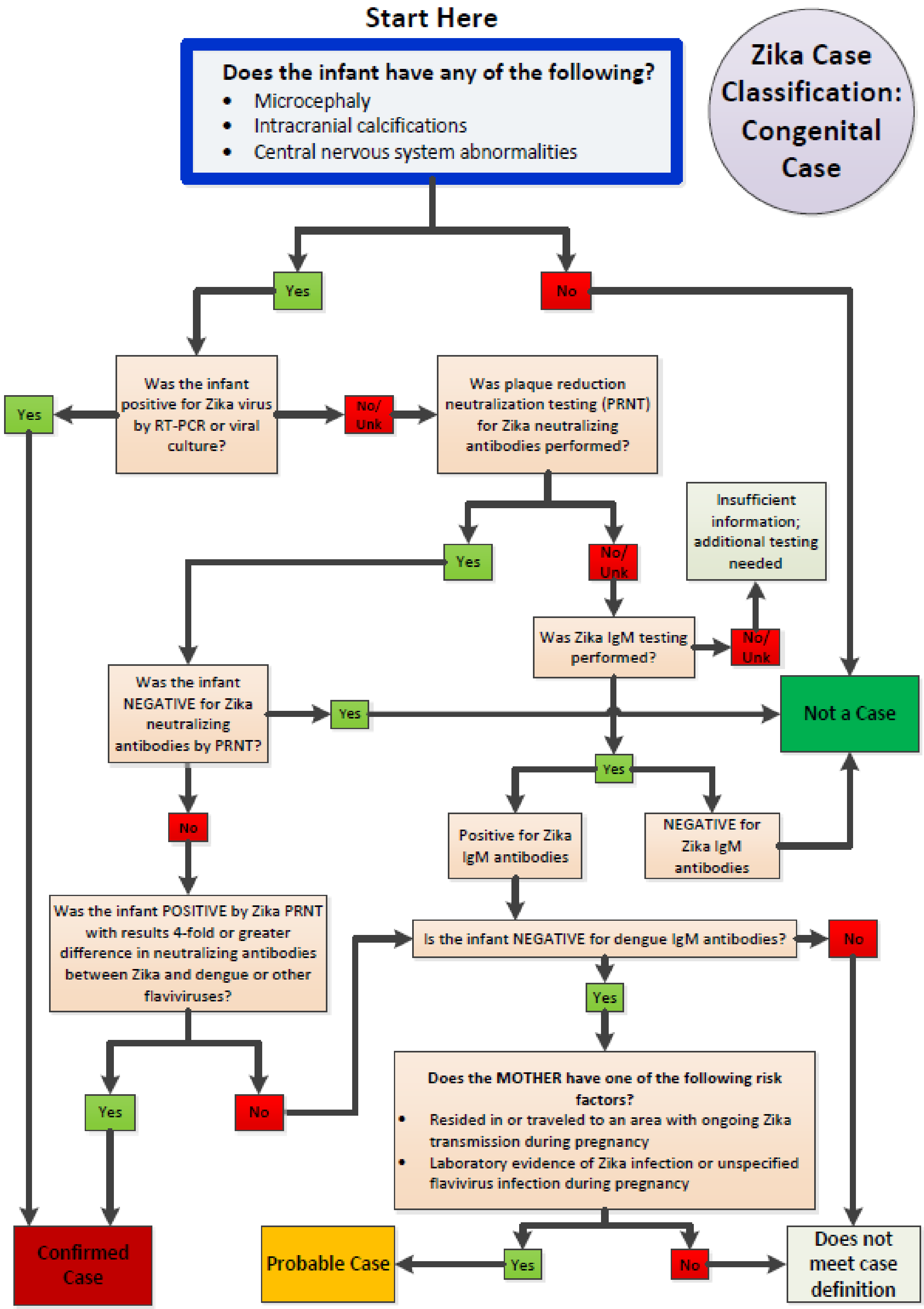
AND the infant meets the following laboratory criteria:

- ZIKV IgM antibodies detected in serum or CSF; and
- Tests negative for dengue or other endemic flavivirus-specific IgM antibodies; AND
    - No neutralizing antibody testing performed; OR
    - Less than four-fold difference in neutralizing antibody titers between ZIKV and dengue or other flaviviruses endemic to the region where exposure occurred.

Zika Virus Disease Case Classification Algorithm



Zika Virus Congenital Infection Case Classification Algorithm



IV. CHIKUNGUNYA, DENGUE, & ZIKA COMPARISON

Dengue, chikungunya, or Zika virus infection can lead to acute febrile illness, and determining the causative virus can be challenging to differentiate clinically. The information in this section is intended to assist in differential diagnosis of these diseases.

Comparison of the clinical and laboratory features of chikungunya, dengue, and Zika virus infections[1,2]

Clinical and laboratory features	Chikungunya virus infection	Dengue virus infection	Zika virus infection
Fever (>102F or 39C)	+++	+++	++
Myalgias	+	++	+
Arthralgias	+++	+	++
Headache	++	++	+
Rash	++	+	+++
Conjunctivitis	-	-	++
Hemorrhage	-	++	-
Shock	-	+	-
Leukopenia	++	+++	not available
Neutropenia	+	+++	not available
Lymphopenia	+++	++	not available
Elevated hematocrit	-	++	not available
Thrombocytopenia	+	+++	not available

Key points:

- **Chikungunya** cases are more likely to have **high fever, arthralgia, and lymphopenia**
- **Dengue** cases are more likely to have **leukopenia, neutropenia**, and **thrombocytopenia**
- **Zika** cases are more likely to have a **rash and conjunctivitis**

Differential diagnoses for dengue, chikungunya, and Zika include the following agents or diseases:

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1 Table modified from Staples et al.

2 Mean frequency of symptoms from studies where the two diseases were directly compared among patient seeking care; +++ = 70-100% of patients; ++ = 40-69%; + = 10-39%; +/- = <10%; - = 0%

- Malaria
- Rocky Mountain spotted fever
- Leptospirosis
- Other alphaviral infections (Mayaro, Ross River, Barmah Forest, O'nyong nyong, and Sindbis viruses)
- Post-infectious arthritis (including rheumatic fever)
- Juvenile rheumatoid arthritis
- Unknown hemorrhagic fever

Epidemiology	Chikungunya virus infection	Dengue virus infection	Zika virus infection
Incubation period in humans	3–7 (range 1–12) days	4–7 (range 3–14) days	Likely a few days to a week
Extrinsic incubation period in mosquitoes	~10 days	8–12 days	~10 days
Duration of acute disease	7–10 days	7–10 days	~1 week

Recommendations for Healthcare Providers

1) **Consider chikungunya, dengue, & Zika viruses in patients with acute febrile illness, particularly if travel out of the country to areas with high mosquito activity is reported. Compatible symptoms include:**
    a. Fever
    b. Myalgia
    c. Arthralgia
    d. Maculopapular rash
    e. Conjunctivitis
    f. Retro-orbital pain
    g. Headache

Other differentials can include malaria, leptospirosis, influenza, Rocky Mountain spotted fever, and other diseases.

2) If chikungunya, dengue or Zika is suspected, order tests for ALL THREE diseases. Count the number of days after symptom onset to determine which test types are indicated:

a. Test intervals:
   i. 0–3 days: PCR only
   ii. 4–6 days: PCR & IgM
   iii. ≥7 days: IgM only
b. Specimen type (note: please check with receiving laboratory to confirm shipping instructions)
   i. Blood should be collected in serum separator tubes.
   ii. Serum for IgM/IgG tests should be shipped REFRIGERATED
   iii. Serum for PCR tests should be shipped FROZEN

3) Notify public health IMMEDIATELY about suspect cases

a. Cases should be reported to the local health department (preferred) or the Arizona Department of Health Services at 602-364-3676 or vbzd@azdhs.gov
b. Local health departments should coordinate with ADHS to alert the laboratory of incoming specimens.
c. Advise suspect cases to avoid mosquitoes during the first week of illness
   i. Explanation: viremic patients are at risk for virus transmission to mosquitoes during the first week of illness. This can lead to locally-acquired disease and community outbreaks. Patients should also contact public health if other household members develop compatible symptoms.

4) Manage cases as dengue until proven otherwise

a. Do not prescribe aspirin, non-steroidal anti-inflammatory drugs (NSAIDS), or corticosteroids
b. Do not overload fluids

V: PLANNING & RESPONSE SCENARIOS

Different actions by public health, healthcare providers, and vector control staff are warranted depending on the epidemiologic scenario. This section describes a brief overview of different response scenarios and which actions should be considered. More detailed recommendations by agency are found in the public health, vector control, and messaging sections.

Scenario 1: Risk for imported cases

This is the baseline status for areas with no chikungunya, dengue, or Zika virus transmission. No locally acquired disease cases have been reported. This could be further characterized into 2 categories: low risk and elevated risk.

- Low Risk:
  - *Aedes aegypti* or *Aedes albopictus* mosquitoes not present in the area
  - Few imported cases of chikungunya, dengue or Zika virus infection
- Elevated Risk:
  - *Aedes aegypti* or *Aedes albopictus* present in area
  - Immunologically naïve population
  - High numbers of imported cases of chikungunya, dengue, or Zika virus infection

Scenario 2: Response to locally acquired cases

This scenario occurs if locally acquired cases of dengue, chikungunya, or Zika are identified. This would most likely begin with focal transmission in households, neighborhoods, or communities, but could spread over broader areas.

- Focal transmission
  - Discrete areas (such as neighborhood) affected
  - Small number of locally acquired cases
- Widespread transmission
  - Multiple areas of communities affected
  - High case numbers reported, with exposure locations unknown

Scenario 3: Recovery

The recovery phase is a time to implement sustainable public health measures and to inform the public about the decreased disease incidence and risk. This phase is initiated following a demonstrated decrease in surveillance results (as determined by vector control data) or human disease cases (as determined by epidemiological data).

Collaboration Between Agencies

Control of vectorborne diseases requires cooperation between many different agencies, including public health, environmental health, and vector control partners. Chikungunya, dengue, and Zika are unique arboviruses for Arizona in that they spread only between humans and mosquitoes. Because of this anthropocentric-cycle, surveillance for human disease cases is an effective method to approximate where the virus is found in the environment. The areas with cases should be considered priorities for enhanced surveillance and potentially for vector control interventions.

Public health, vector control, and health educators should collaborate in development and dissemination of educational materials and outreach to the public. As previously noted, major control factors for *Aedes aegypti* or *Aedes albopictus* mosquitoes are personal protection and elimination of mosquito breeding sites near and around the home, and community education and action is necessary to prevent disease transmission.

<u>Partners to Consider for Chikungunya, Dengue, & Zika Response</u>

- Local health departments
- Local vector control agencies
- Pest abatement districts
- State health department
- Centers for Disease Control and Prevention
    - Dengue Branch
    - Arboviral Diseases Branch
    - Division of Global Migration & Quarantine
- Healthcare providers
- Blood donation centers
- Community leaders
- Media partners
- Customs and Border Protection
- Binational partners in Mexico

Recommended Response Activities by Epidemiologic Scenario

The table below indicates key preparedness and response activities to consider for chikungunya, dengue, or Zika virus introduction. Earlier actions should be continued into later stages, but are only listed once for simplicity. **More details about recommended actions are found in the public health, vector control, and messaging sections.**

Response scenario	Other considerations	Actions
Risk for imported cases	**Low Risk**	❖ Prepare messaging for public outreach ❖ Strengthen working relationships between public health and vector control agencies
	Elevated Risk	❖ Provide education and outreach to healthcare providers ❖ Ensure rapid laboratory testing available for suspect human cases of chikungunya, dengue, or Zika testing ❖ Raise public awareness about *Aedes aegypti* mosquitoes
	Case Investigation and Response	❖ Investigate cases to determine travel history and where acquisition occurred ❖ Advise ill persons to prevent mosquito bites during viremic period (~1 week after illness onset) ❖ Perform *Aedes aegypti* trapping around the surrounding neighborhoods of cases ❖ Consider laboratory testing for chikungunya, dengue, or Zika among *Aedes aegypti* mosquitoes ❖ Inquire about illnesses among other household members (active case finding for locally-acquired cases) ❖ Visit surrounding neighborhoods of cases to look for potential *Aedes aegypti* breeding locations (i.e. water-holding containers) and perform source reduction ❖ Eliminate breeding sites, use larvicide insecticides, and then consider adulticide treatment around case neighborhoods

Response scenario	Other considerations	Actions
Response to locally-acquired cases	**Focal transmission**	❖ Inform public about risk of locally-acquired cases through press releases and social media ❖ Consider door-to-door campaign in affected neighborhood(s) for source reduction and to encourage mosquito avoidance ❖ Increase *Ae. aegypti* trapping and surveillance in affected areas by using oviposition traps or adult traps ❖ Consider laboratory testing for chikungunya, dengue, or Zika among *Aedes aegypti* mosquitoes in the area, if not already implemented ❖ Perform active case finding in affected communities, or within 150m of case residences ❖ Perform larvicide and/or adulticide spraying of affected neighborhoods ❖ Consider need for screening or deferring blood donations from affected areas ❖ Analyze human and mosquito surveillance data through mapping ❖ Describe epidemiology of persons affected and possible risk factors ❖ Ensure data is shared with public health, vector control, and healthcare partners
	Widespread transmission	❖ Launch widespread media campaign o Raise awareness about risk from disease from mosquito bites o Emphasize importance of source reduction o Encourage ill persons to seek care ❖ Consider extensive larvicide applications and ultra-low volume spraying in highly-affected neighborhoods to lower mosquito numbers ❖ Activate medical surge capacity plans for healthcare facilities and laboratories as needed ❖ Ensure blood donations from affected areas are tested or deferred to prevent

Response scenario	Other considerations	Actions
		transfusion-associated disease cases ❖ Prioritize laboratory testing for suspect cases in new areas, or with atypical disease presentations ❖ Consider utilization of mosquito testing for viruses to determine risk levels and viral presence ❖ Continue mapping of human and mosquito data; focus response resources on most affected areas. ❖ Consider screening in blood banks or among blood donors to avoid disease transmission through blood transfusion.
Recovery		❖ Consider enhanced surveillance for human cases in high-risk areas ❖ Decrease *Aedes aegypti* surveillance to baseline levels

Laboratory Surveillance Guidelines: Response Scenarios[3]

Epidemiologic scenario	Samples to test
Risk for imported cases	❖ All samples from patients exhibiting clinically compatible illness ❖ With new introduction of a virus, extra testing should be done to verify viral presence
Response to locally acquired cases	❖ Consider testing mosquitoes near the home of locally acquired cases ❖ If widespread transmission, subset samples from human cases with compatible symptoms, as determined by lab constraints and epidemiological status ❖ Samples from all atypical or severe cases should be tested ❖ Once viral presence has been verified, limited testing can be considered.

[3] Modified from CDC/PAHO guidelines

VI: PUBLIC HEALTH SURVEILLANCE AND RESPONSE

Section Overview

- Reporting & Agency Roles
- Surveillance and Investigation Guidelines
    - Goals
    - Surveillance Strategies
    - Case Investigation
    - Outbreak Investigation
    - Preventing Transmission
    - Geographic Information Systems
- Other Planning Considerations
    - Bloodborne Transmission
    - Medical Surge
- Incident Command System
- Response Scenarios

Reporting & Agency Roles

Reporting

Chikungunya and dengue are both nationally reportable diseases through the National Notifiable Disease Surveillance System (NNDSS); Zika virus reporting has also been requested. All three diseases are unique morbidities in MEDSIS for electronic surveillance within Arizona. In an area with no previous locally acquired cases, even a single locally acquired case is considered an outbreak.

If an outbreak is identified, the cases should be entered in Outbreak Module in MEDSIS. This system facilitates outbreak management and tracking. After completion of the investigation, the outbreak should be closed within 30 days.

Local, State, & Federal Roles

As with other infectious disease investigations, local health departments are the lead agency for responding to disease threats within their jurisdictions. Arizona Department of Health Services (ADHS) can assist counties as needed in case investigation and response, and also plays the lead in coordinating outbreak responses across multiple counties or jurisdictions. CDC Dengue Branch (Puerto Rico) and CDC Arboviral Diseases Branch (Fort Collins, CO) can offer subject matter expertise and additional support.

Surveillance & Investigation Guidelines

Human case surveillance for chikungunya, dengue, or Zika should include the following goals.

- Track the number and distribution of disease cases
- Identify circulating virus types
- Identify risk factors for infection
- Monitor case distribution for disease introduction into surrounding areas
- Develop disease prevention strategies
- Assess clinical severity and impact on society
- Feedback of findings to collaborative agencies

Surveillance Strategies

In Arizona, passive case-based surveillance is routine. This system relies on case reporting from clinicians and laboratories to public health.

In the event of a locally acquired case or increased risk for cases, public health officials should consider utilizing enhanced surveillance. This includes **active surveillance**, in which public health officials actively collect disease data from suspect cases, clinicians, or laboratories. For more information about active surveillance at the community level, please see "Household-based Cluster Investigations" section below. **Syndromic surveillance**, which detects syndromes rather than disease etiologies, may be useful for detecting underreported cases and disease trends in a timely manner. Syndromic surveillance for arboviral diseases (dengue, chikungunya, West Nile, and St. Louis encephalitis viruses) was implemented in Arizona in 2015 using the Biosense system; Zika was added in early 2016.

Laboratory sentinel surveillance is another form of enhanced surveillance that can be used to gather high-quality, detailed data not captured through passive surveillance. This entails using selected reporting facilities to collect detailed information about cases and disease trends, or perform more specific testing for disease syndromes that could be caused by multiple etiologies (e.g., febrile illnesses). The state can assist local public health authorities in initiating enhanced surveillance if requested.

In 2015, ADHS implemented an enhanced **laboratory surveillance system through laboratory orders** for dengue and chikungunya viruses. Because notification of positive laboratory test results can occur days to weeks after illness onset, and because public health intervention is most valuable in the first few days of illness (the viremic period), this system involves notification of laboratory orders to public health before final test results are available. Currently, it is in place with several commercial laboratories and healthcare facilities in Arizona. Zika virus is not currently in this system because all test requests go through public health agencies.

Case Investigation

Investigation of suspected cases is an important part of public health activities for chikungunya, dengue, or Zika viruses. A short checklist of overview case investigation goals is listed below.

Checklist for Case Investigation

- Ensure case is entered in MEDSIS
    - Ensure that all of the disease specific observations (DSO) are filled out in MEDSIS
- Interview case to determine where exposure most likely occurred (country and region, if possible) and clinical course
- Attach laboratory results if available
- Attach medical records if available

Outbreak Investigation

To understand outbreak development and trends, case information should be assessed in aggregate. A line list of suspect and confirmed cases is useful for data analysis. MEDSIS extracts can be used to pull up-to-date data on a regular basis; Excel worksheets and other databases (Epi Info or Access) are alternatives, but can prove more challenging for data sharing and updating case information. Case investigation forms are available for chikungunya, dengue, and Zika.

Household-based Cluster Investigations

In the event of local disease transmission or increased numbers of travel-associated cases in a focal area, enhanced surveillance for asymptomatic cases or persons who did not seek healthcare can be valuable in identifying the extent of disease spread and directing vector control actions. The cluster investigations are usually focused around confirmed case residences (150m radius) or neighborhoods, and involve interviews, education, and testing of other persons at risk for disease in the area. These also provide an opportunity to identify mosquito breeding sites and take vector control actions (larvicide or adulticide) in high risk zones. Team members needed include interviewers, phlebotomists, and vector control specialists. Additional details, form templates, and supply information for cluster investigations are available by request from ADHS.

Preventing Transmission

Stopping the spread of chikungunya, dengue, or Zika is challenging because there are currently no approved vaccines available to prevent disease. There are, however, several opportunities for how transmission chain can be stopped. These opportunities and associated prevention actions listed in the following table.

Opportunities	Potential actions
Prevent introduction of human illness	❖ Provide information to travelers about disease risk and prevention while traveling ❖ Ensure viremic persons are not bitten by mosquitoes ❖ Educate travelers about the risk for sexual transmission
Reduce or eliminate the competent vector population	❖ Eliminate containers used for breeding (source reduction) ❖ Use larvicide on immature mosquitoes ❖ Use adulticide for adult mosquitoes
Limit contact between humans and mosquitoes	❖ Prevent mosquito entry into households (screens in windows or air conditioning) ❖ Prevent mosquito bites by using insect repellant and wearing loose-fitting, long-sleeved shirts and pants

Geographic Information Systems

Geographic Information Systems (GIS) are an extremely useful tool for providing operational direction and analysis during an outbreak. Several programs are available for mapping, and include ESRI Arc GIS, QGIS, and others. Maps can be created to indicate disease incidence, spatially monitor the outbreak, and track changes in human disease and vector surveillance data as a response to vector control efforts.

Ideally, the baseline vector data as well as the human case data from imported cases will have been mapped prior to the start of the outbreak. This allows for a more accurate comparison of disease incidence across time and space.

Other Planning Considerations

Bloodborne Transmission

Bloodborne disease transmission of chikungunya, dengue, and Zika is possible; this should be considered both at the hospital level for potential needle-sticks, as well as for screening of blood donors if local transmission occurs. Currently, blood donors are not screened for chikungunya, dengue, or Zika. If local disease transmission is identified, blood donation centers should be contacted immediately to discuss the need for deferral of blood donors from affected areas.

Medical Surge

In the event of a large number of human cases, plans for influenza surge capacity could be activated to accommodate healthcare facility needs. These plans include diverting ill persons to other facilities, implementing triage protocols in urgent care settings, and encouraging persons with mild or no illness ('worried well') to remain at home. Mosquito control on-site should be considered at healthcare facilities with large numbers of cases. Local vector control agencies should collaborate with local public health to determine the need for vector control management around healthcare facilities.

Guidelines for which individuals should seek medical care in the event of an outbreak, as well as suggested triage protocols for healthcare facilities, can be found in the PAHO/CDC and WHO guidelines found in the appendix of this document.

Outreach to Pregnant Women

In the event of Zika virus transmission, additional outreach and prevention actions for pregnant women should be considered because of the risk for congenital or perinatal Zika virus transmission. Potential activities include messaging about disease transmission through mosquitoes and sexual contact, enhanced prevention through mosquito control or dissemination of Zika prevention kits, Zika testing and counseling during pregnancy, and long-term follow-up of women and infants with Zika virus infection.

Incident Command System

If an outbreak occurs, public health agencies are encouraged to utilize the incident command system called the Public Health Incident Command System (PHIMS) to manage the incident. The ADHS Health Emergency Operations Center (HEOC) can be activated to respond. The PHIMS system is compliant with the National Incident Management System (NIMS) and is divided into four functional areas: Operations, Planning, Logistics, and Finance. For more specific information about PHIMS operation, please see the ADHS HEOC Standard Operating Procedures. The major operational components of the emergency operations structure include epidemiology, vector control and communications. Epidemiology and disease control staff should work closely with all operational components. Each group should provide reports to assess progress and track updates. All groups should meet regularly to ensure consistency of information and response plans, including but not limited to, data points (such as incidence rate, geographic factors, etc.), activities, and messaging to stakeholders. Coordination is paramount to avoid confusion during the outbreak response

Public Health Response Scenarios

Scenario 1: Risk for imported cases

Messaging

- Develop educational materials, such as fact sheets and frequently asked questions
- Inform key stakeholders (healthcare partners, vector control officials, and the public) about available resources and guidelines
- Provide information to the public about prevention and risk reduction while traveling
- Disseminate prevention-based educational material, such as instructing the public about how to protect themselves and their homes from mosquitoes
- Provide education and messaging to healthcare partners

Case Investigation and Surveillance

- Closely investigate cases with travel history to areas where chikungunya, dengue, or Zika were reported
- Educate suspect cases about the need to avoid mosquito contact to prevent disease transmission
    - Consider active case finding among household members
- Facilitate confirmatory laboratory testing for suspect and probable cases
- Track the number and distribution of travel-associated cases
    - Identify risk factors and perform descriptive analysis of cases
- Ensure vector control is notified of areas where cases reside
- Collaborate with vector control counterparts to compare imported human disease cases and mosquito surveillance results

Other Activities

- Consider outreach to partners to develop collaborative response activities
- Develop plans for medical surge capacity at healthcare facilities or laboratories
- Anticipate sensitive issues, including:
    - Safety of increased pesticide application near homes
    - Cost of control measures
    - Potential for bloodborne transmission through transfusions

Scenario 2: Response to locally-acquired cases

Messaging

- Notify media and raise public awareness through press releases about locally acquired cases
- Increase public messaging about key topics:
    - Source reduction and mosquito avoidance
    - Disease symptoms and healthcare seeking recommendations
    - Local public health contacts
- Consider enhanced outreach and education in areas with known human cases
- Provide additional outreach to healthcare providers about diagnostic testing and treatment recommendations

Case Investigation and Surveillance

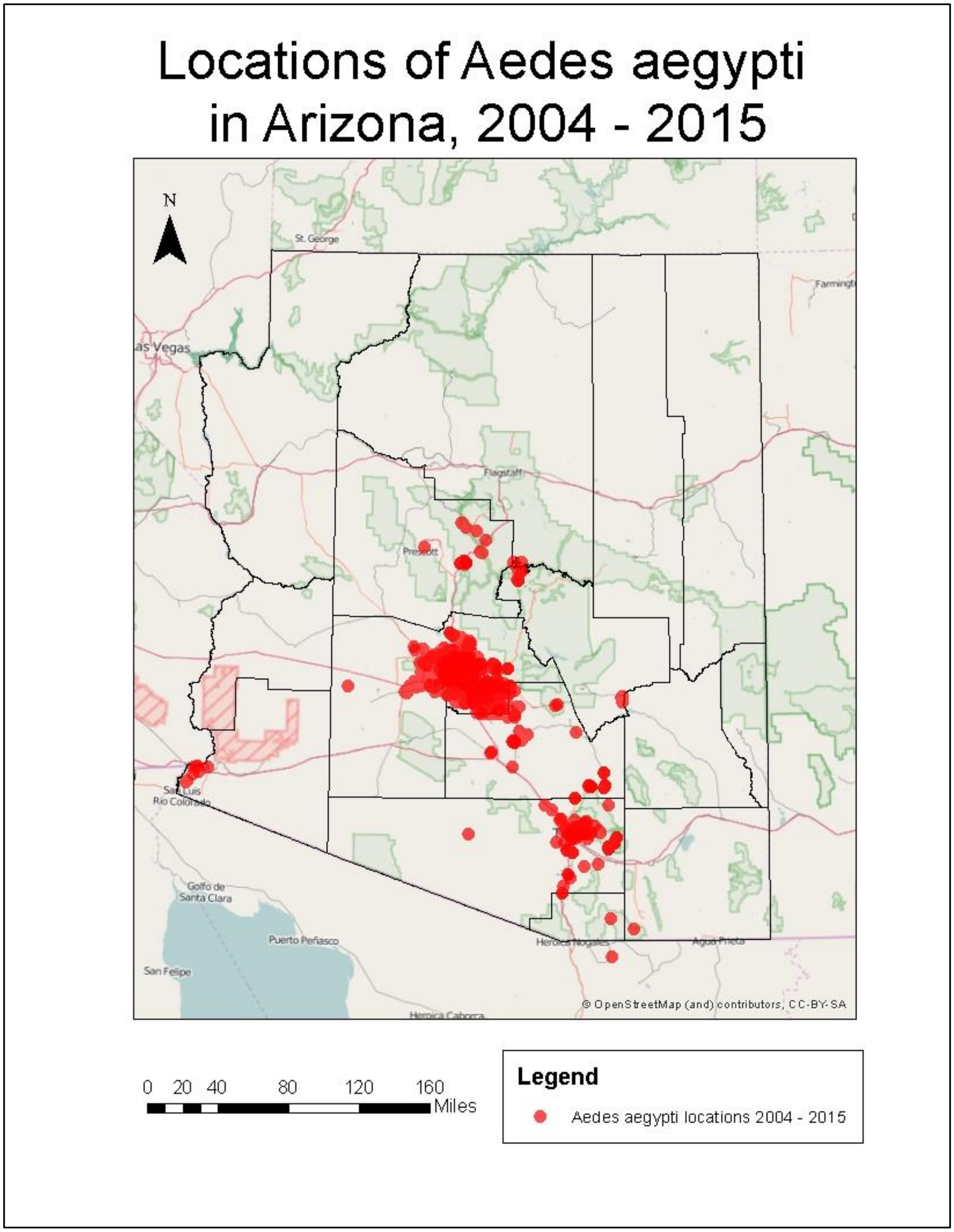
- Consider methods for enhanced disease surveillance
    - Active case finding or household-based cluster investigations in communities where cases are identified
    - Enhanced laboratory surveillance
    - Enhanced screening for febrile illnesses in healthcare settings
- Maintain up-to-date line list(s) of imported and locally-acquired cases
    - Consider use of Outbreak Module in MEDSIS
- Continue to track the number and spatial distribution of cases
- Describe key epidemiological and clinical features of cases
    - Assess clinical severity and impact on society
- Identify circulating virus types
- Continue collaboration with vector control
    - Collaborative outreach and education about source reduction
    - Map human cases and *Aedes aegypti* mosquito surveillance data to identify high-risk areas
    - Target high-risk areas for vector control operations

Other Activities

- Consider ICS activation to organize public health response
- Communicate with blood banks about risk of disease transmission through transfusion; consider screening donors for disease

Scenario 3: Recovery

- Finalize line-lists of imported and locally acquired cases
    - Close outbreaks within 30 days of completion
- Describe key epidemiologic and clinical features discovered during the outbreak
- Scale down interventions to a sustainable level for education dissemination, vector control, etc.
    - Continue collaboration with vector control and the communications branch
- Evaluate and assess the effectiveness of disease surveillance and control efforts



VII: VECTOR SURVEILLANCE AND RESPONSE

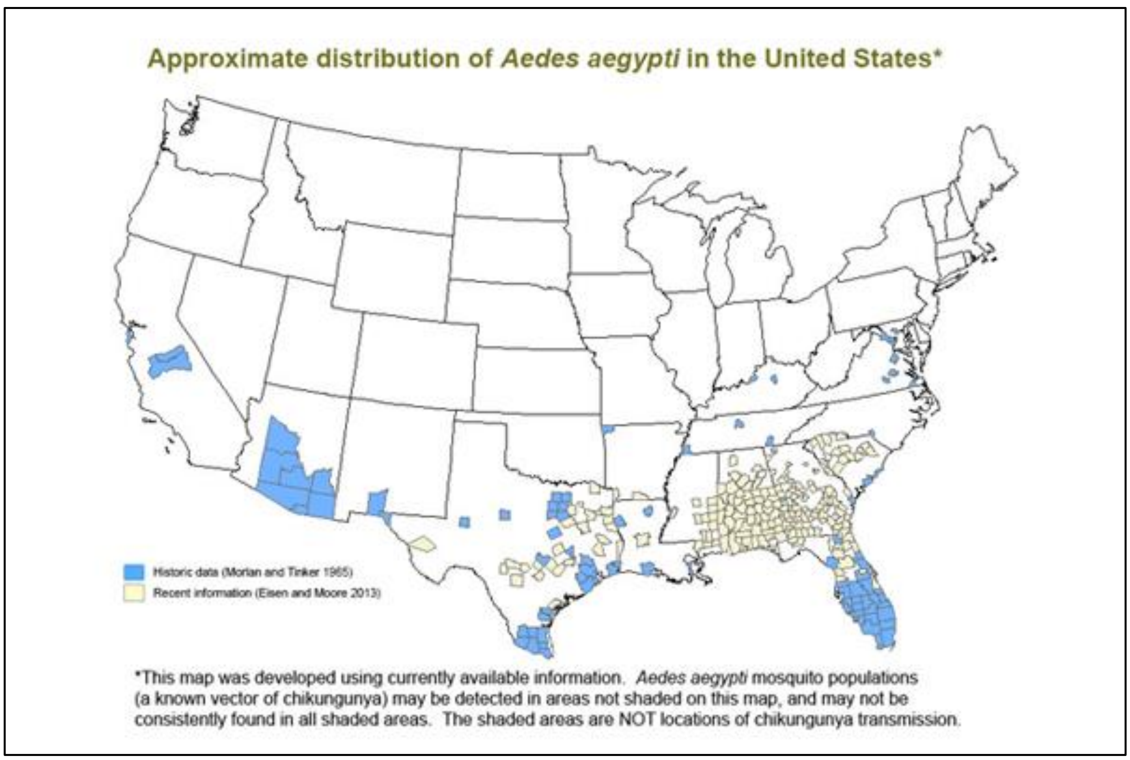
Aedes aegypti Epidemiology

Aedes species mosquitoes are widespread worldwide, from tropical to arctic regions. Of the potential *Aedes spp.* mosquito vectors, only two are known to be established in the

United States: *Aedes aegypti* and *Aedes albopictus.* In Arizona, *Ae. aegypti* mosquitoes have been identified in multiple areas, including Maricopa, Pinal, Pima, Gila, Graham, Cochise, Santa Cruz, Yavapai, and Yuma counties. Current data suggest the *Aedes albopictus* is not found anywhere in Arizona. Arizona is home to other *Aedes* species, such as *Aedes vexans*, but these species have never been implicated as chikungunya, dengue, or Zika vectors and will not be discussed in this document.

Ae. aegypti mosquitoes are a peridomestic species and have adapted to live around humans and their homes. They exhibit different behaviors than the mosquito species that transmit West Nile virus. These differences will be discussed further throughout this section and become important in the context of current capacities of local vector control agencies.

The map on the previous page includes the available data for *Aedes aegypti* presence in Arizona between 2004 and 2015. The data was gathered during the process of West Nile virus surveillance using non-optimal traps for *Aedes aegypti*. This map might not be indicative of all *Ae aegypti* locations throughout the state, particularly in the southern border region.



Vector Surveillance Background

Vector surveillance is used for both technical and research purposes and provides information on potential viral distribution in the environment, as well as distribution changes in time and space. The primary objectives of vector surveillance include the following:

- Determine the baseline population of the relevant vector species in time and space
- Track spatial and temporal changes in the vector's population
- Monitor the effectiveness of control interventions
- Determine which areas are at greatest risk for human disease introduction and transmission

Mosquito surveillance can be divided into two categories: larval and pupal surveillance, and adult surveillance.

***Aedes aegypti* eggs, CDC**

Larval & Pupal Surveillance

During larval or pupal, surveillance all water-holding containers and locations on a household or property are searched for *Aedes aegypti* immatures. Larval or pupal presence is determined, and species identification is confirmed. There are three indices currently used by the World Health Organization (WHO) to quantify findings of these surveys: house index, container index, and Breteau index. The following table describes these indices.

It should be noted that a systematic review[4] of vector indices and dengue transmission found that single BI or HI indices were unreliable predictors for dengue transmission risk, as transmission occurred in areas below the recognized thresholds as well.

Larval surveillance is labor-intensive and is not an optimal form of standard or large-scale surveillance. It also requires cooperation with property owners, as *Aedes aegypti* are most often found in and around homes. This type of surveillance can be useful when investigating mosquito exposure of individual cases or clusters.

[4] Bowman, Leigh R., Silvia Runge-Ranzinger, and P. J. McCall. "Assessing the relationship between vector indices and dengue transmission: a systematic review of the evidence." (2014): e2848.

Larval & Pupal Surveillance Indices	Definition	Formula	Notes
House index (HI)	Percentage of houses infested with larvae and/or pupae	HI = (Number of Infested houses X 100) /houses inspected	Percentage of houses infested with larvae and/or pupae. Best for population level data HI <1% may indicate low risk
Container index (CI)	Percentage of water-holding containers infested with larvae and/or pupae	CI = (Number of infested containers X 100) /containers inspected	Indicates percent of infested containers
Breteau index (BI)	Number of larvae/pupae infested containers per 100 houses inspected	BI = (Number of infested containers X 100 /houses inspected	Indicates number of infected containers per 100 homes

Adult Surveillance

Adult *Aedes aegypti* surveillance can be valuable in determining the effectiveness of adulticide control measures and seasonal trends. There are three primary methods of collection, which include landing counts, resting collections, and trappings. For **landing counts**, a human subject is used as bait and the numbers of feeding mosquitoes that land on the person are counted. The result should be expressed as landing rate per hour. This method is generally not employed for safety reasons. **Resting collections** are a safer option, in which a mouth or a battery-powered aspirator is used to capture adult mosquitoes at rest. The result is expressed as the number of adult mosquitoes per house. Much like larval and pupal sampling, these methods are both labor and time-intensive and should only be considered under certain circumstances, such as for risk assessments of individual cases or clusters. Adult mosquito **traps** are the least labor and time-intensive, and provide the most data.

To focus *Aedes aegypti* surveillance efforts, different statistical sampling methods can be used to develop estimates of community levels. Options to consider include the following:

- Simple random sampling
- Systematic sampling (selecting every "nth" house),
- Stratified random sampling (stratifying by populations and selecting randomly within strata).
    - For example, stratifying populations by neighborhood, and randomly selecting "x" number of homes in each neighborhood based on population estimates. This can help ensure areas are equally represented. If arboviral disease cases are clustered in certain areas, additional *Aedes aegypti* surveillance efforts could be focused there.

A variety of traps can be used for *Aedes aegypti* surveillance; brief descriptions of several common types are included in the table below.

Trap Type	Description
Sticky Traps	Visual or odor-baited traps that attract and trap adult mosquitoes to sticky surfaces
Oviposition Traps	Traps are visually pleasing and odor-baited for mosquitoes. They often contain germination paper or another substrate on which ovipositing female mosquitoes can deposit eggs. The traps are checked weekly and the eggs are identified and counted. SpringStar Trap-N-Kill is an example of a **lethal ovitrap**, in which the egg laying female cannot escape and is trapped inside and killed.
BG Sentinel Traps	Adult mosquitoes are attracted to the odor-baited traps and are sucked into a black catch bag with a suction fan. Air exits with ascending currents through the white mesh.
CO2 Traps	Mosquitoes are attracted to the carbon dioxide and light used in the traps. These traps were designed for *Culex* species mosquitoes, and are not optimal for *Aedes aegypti*.

The table below lists *Aedes aegypti* surveillance options, and pros and cons of each method.

Surveillance Type	Life Stage	Pros	Cons
Larval/pupal sampling	Larval and pupal	❖ Not resource intensive	❖ Time intensive ❖ No information on adult populations ❖ No viral testing possible
Oviposition Traps	Egg	❖ Not resource intensive ❖ Inexpensive ❖ Effectively provides presence and absence data	❖ Time intensive ❖ Can only provide presence and absence data (not population density data) ❖ Species must be identified at egg stage, or reared to adulthood ❖ No viral testing possible
BG Sentinel Traps	Adult	❖ Most effective trap for capturing Aedes aegypti mosquitoes ❖ Provides population density data ❖ Adult mosquitoes can be tested for virus	❖ Very high initial cost ❖ Time intensive
CO2 Traps	Adult	❖ Already frequently used in AZ ❖ Adults mosquitoes can be tested for virus	❖ Inefficient at capturing Aedes spp. mosquitoes ❖ Not ideal for population density estimates

Vector Surveillance Guidelines

Because *Aedes aegypti* mosquitoes have short flight distances, residences of persons with chikungunya, dengue, or Zika virus infections are often used as an approximation of exposure locations. The caveat to this approach is that it requires vector control and public health agencies to wait for an increase in disease incidence before geographically targeted interventions can be implemented.

Viral testing of mosquitoes by RT-PCR for chikungunya, dengue, and Zika virus is available at the Arizona State Public Health Laboratory; however, the value of *Ae. aegypti* mosquito testing for surveillance is not well defined. This is one of the major differences between West Nile virus surveillance and chikungunya, dengue, or Zika surveillance. Chikungunya, dengue, and Zika only amplify in humans and not birds, so human cases are believed to be the best indicators of circulating virus. However, viral testing of mosquitoes may be helpful under certain circumstances. This should be considered, for example, around the homes of identified locally acquired cases or clusters of travel-associated cases. It's also possible that effective viral testing of mosquitoes could be valuable within the context of a large and well-established vector surveillance program.

Enhanced vector surveillance should be considered in response to any increased risk factor, such as the first locally acquired case or a sharp increase in travel-associated cases. Enhanced surveillance is defined as any surveillance activities above what is routine; this will entail different actions for different communities. The following tables can be used as a statewide guideline for minimum expectations. The Vectorborne and Zoonotic Disease Program within the Arizona Department of Health Services can assist with these activities.

Scenario 1: Risk for Imported Cases

☐ **Determine presence or absence of *Aedes aegypti* mosquitoes in community or region**
    o **Consider use of ovitraps and *Ae. aegypti*-specific adult traps (e.g., BG Sentinel traps)**
☐ **Map mosquito surveillance results with GIS technology to better understand baseline levels and distribution**
    o **Areas with high *Aedes aegypti* populations should be targeted for education on source reduction and control measures, particularly during warm, wet seasons**
☐ **Communicate with public health partners to learn where new or suspected human cases are located. Surveillance and control activities should be focused in these areas in addition to routine surveillance and control, and include:**
    o **Environmental investigation and source reduction education at case households**
    o ***Aedes aegypti* trapping in and around case households**
    o **Adulticide spraying (handheld sprayer) in 150m radius around case**

households

- **Collaborate with public health partners to compare maps of known *Ae. aegypti* distribution and imported human disease cases.**
- **Continue routine surveillance in other areas**
- **Provide public education about *Aedes aegypti* mosquitoes and source reduction; consider community-wide cleanup campaigns to reduce or eliminate sources of standing water**

Scenario 2: Response to locally-acquired cases

- **Immediately implement enhanced vector surveillance and control in areas with known human cases**
    - **Perform *Aedes aegypti* trapping (ovitraps and adult traps) around case households and at other homes in neighborhood (at least 150m radius)**
    - **Perform environmental investigations in affected neighborhoods to educate homeowners about source reduction**
    - **Use adulticide sprays (handheld) in and around case households**
    - **Consider ultra-low volume spraying in areas with large *Aedes aegypti* populations and locally-acquired cases**
- **Continue close communication and collaboration with public health officials to identify affected areas and focus response efforts**
    - **The localized enhanced surveillance and control measures should be continued for two incubation cycles (i.e. 4 weeks) following the last identified case**
    - **Compare maps of known *Ae. aegypti* distribution and known human cases.**
- **Continue routine surveillance, education, and source reduction efforts in other areas**

Scenario 3: Recovery

- **Scale down response phase activities**
    - **Initiate only after a demonstrated decrease in positive surveillance results (as determined by vector control data) and human disease cases (as determined by epidemiologic data)**
- **Evaluate the effectiveness of vector control efforts with monitoring and evaluation procedures**
- **Continue routine surveillance procedures**
- **Continue collaboration with epidemiology and communications branches**

All surveillance data should be entered into a standardized spreadsheet used for mosquito surveillance results reporting. The official spreadsheet and data dictionary is found in the appendix of this document. These results should be e-mailed to the Arizona Department of Health Services as an Excel file. The results from individual jurisdictions can then be integrated into a statewide mosquito surveillance report to be issued by ADHS on a consistent basis. This report will help local partners keep abreast of mosquito activity throughout the state.

Vector Control Guidelines

Vector control is the single most important intervention during an outbreak. *Ae. aegypti* mosquitoes have unique behavioral characteristics and ecological preferences that can help target interventions.

Control for *Ae. aegypti* mosquitoes is challenging because they are primarily outdoor daytime biters that live near human habitats. Removing larval habitats is considered the most effective way to reduce *Ae. aegypti* populations. This is termed **source reduction**. *Ae. aegypti* oviposit (lay eggs) primarily in man-made containers filled with water, although suitable natural containers can also serve as mosquito breeding areas. One of the best methods for source reduction is for residents to ensure there are no containers near the home that are uncovered and filled with water, or have the potential to hold water. For source reduction, education is the best intervention. Educating people on how and why to protect themselves from mosquitoes will foster a greater sense of self-reliance and accountability among the public.

Ae. aegypti mosquitoes have relatively short flight distances from their birthplaces. This enhances the value of source reduction, as they will not fly great distances to reestablish elsewhere. However, it should be noted that human transportation activity assists in mosquito transport through contaminated containers, with tires as a key example.

Although source reduction is a necessary first line of defense, **during an outbreak** additional actions may be needed. Insecticides are also available, and include the following:

- Organophosphates (fenthion, temephos, and pirimphos-methyl)
- Spinosin based products
- Insect growth regulators (methoprene, pyriproxyfen and diflubenzuron)
- Biological control (*Bacillus thuringiensis* isralensis, *Bacillus sphaericus* and compounds derived from *Saccharopolyspora spinosa*)
- Insecticidal oils

Granular applications affect young larvae as they emerge from their egg state because of the longer chemical release period. These treatments can be done pre- or post-flooding. When applied before flooding, organophosphates will land on the dry ground, and only later become activated when the area becomes flooded with water. An exception is temephos, which is labeled to be applied directly to water. This happens concurrently with the reactivation of *Ae. aegypti* eggs that had previously been inactive on dry ground. *Ae. aegypti* eggs are typically laid just above the water line on damp substrates. The eggs are extremely hardy and can withstand desiccation for anywhere from months to over a year, and will reactivate upon contact with water.

Ultra-low volume (ULV) aerial or ground-based spraying of organophosphates (malathion, fenitrothion, pirimiphos-mehtyl or pyrethroids) is generally not recommended for *Ae. aegypti* control because ULV night spraying is inefficient at reaching *Ae. aegypti* mosquitoes that are active during the day, and which are most commonly found in and around homes. However, new studies have demonstrated that spraying in the early mornings may prove effective against Aedes mosquitoes. This method should be considered if there is a large *Ae. aegypti*-borne disease outbreak, or if *Ae. aegypti* population numbers are exceptionally high.

Another option for adult *Ae. aegypti* control includes use of a handheld sprayer to apply insecticide around the homes and yards of human cases and their neighbors. However, if locally acquired cases are identified, this method should be strongly considered to prevent further disease spread.

Barrier pesticide treatments provided by commercial pest control organizations can also be considered. These aim to control roosting mosquitoes, and could be incorporated into routine door/yard pest maintenance packages sold by private parties.

The following table looks at the different *Ae. aegypti* control options, and when to implement each.

Control Type	When and Where to Implement
Source reduction	❖ Year round ❖ Relies on public education and personal responsibility ❖ Target education to known cases and case neighborhoods
Larvicide	❖ Should be used in response to vector surveillance data ❖ Can be used to treat standing water that is not removable ❖ Target towards known cases and case neighborhoods
Adulticide[5]	❖ Not typically useful for *Ae. aegypti* mosquitoes unless done on individual properties, due to their proximity to homes ❖ Most useful when cases or mosquitoes are highly clustered ❖ Should only be used in response to vector surveillance data ❖ When used, target to known cases and case neighborhoods

[5] Some products containing prallethrin claim to stir up mosquitoes that are roosting, and expose them to the toxic component of the ULV spray (Duet). This product MAY be useful when sprayed after dark to control roosting Ae. aegypti. This should be evaluated as a priority because it is the only area-wide ULV method with any real promise for *Ae. aegypti* control.

Recommendations for Local Vector Control Staff

The recommended standards for *Ae. aegypti* surveillance and control are highly dependent upon the resources of each community; however, general suggestions are outlined below. Routine mosquito surveillance control should be conducted consistently and throughout the year. Control actions can be escalated as needed based on surveillance data. The level of baseline surveillance will depend upon available resources.

Regardless of the scope of activities, a few key principles should always be considered. For routine surveillance, it is important that activities are done at **consistent locations** to enable comparisons across both space and time. *Ae. aegypti* surveillance is best conducted near human homes, and particularly near known disease cases. If resources allow, surveillance should be conducted yearlong in densely populated areas, with increased vigilance during warm rainy seasons. It is important to document the number of mosquitoes collected, trap type, species identification of all specimens, and any testing performed.

The number and distribution of traps used should be decided based on results of past surveillance, incidence of human cases in the area, and resource availability. Although BG Sentinel traps are best for capturing *Ae. aegypti* adults, they are also expensive and resource-intensive. They are also prone to theft and vandalism. Oviposition traps are a good alternative and can provide adequate presence and absence data. At a minimum, already available non-optimal traps, such as CO2 traps used for *Culex spp*. surveillance can be utilized. Although results cannot definitely determine the presence of *Ae. aegypti*, CO2 trap results can be valuable when other options are not available. By hanging the trap lower to ground, during the daytime, and near homes the likelihood to catching *Ae. aegypti* is increased.

Legal Authority for Vector Control Response

ARS 36-601 is the nuisance statute. This is under state authority, but is delegated to the county health departments. Locals also have some additional authority under 36-602.

Communicable disease rules, which specify reporting requirements and control measures, are AAC R9-6-202, 203, 204, 205 and AAC R9-6-323 (dengue) and AAC R9-6-391 (WNV). The control measures are only related to epi investigation; mosquito control is not included at this time.

The Role of Public Education

Aedes aegypti control is highly dependent on the actions of community members to eliminate sources of standing water where eggs and larvae can develop. Many breeding sites are found in homes and backyards, and prevention and control efforts should emphasize reduction of water-holding containers. In addition, personal protection from mosquitoes is critical in preventing bites.

Public education and community engagement is a necessary part of *Aedes aegypti* control, and prevention of mosquito bites. Messaging will be discussed further in the following section, but key messages should address the following topics.

- Source reduction: learning where mosquitoes oviposit and how to eliminate potential oviposition sites from in and outside the home
- Correct use of insect repellant or long-sleeved shirts and pants when outdoors
- Use of intact screens in windows and doors

VIII: OUTBREAK COMMUNICATIONS

Public Information During a Potential or Ongoing Outbreak:

A necessary component of successfully managing a disease outbreak or potential outbreak is communication with stakeholders. For a chikungunya, dengue, or Zika outbreak, all community members in and around the affected area are considered stakeholders. It is necessary to inform them about concerns over a potential or ongoing outbreak because the public must participate in vector control. Because *Aedes aegypti* reside in and around homes this is a pivotal step in disease prevention. The public should be kept informed in a timely manner, but steps must also be taken to avoid public panic and spread of misinformation. There should be a close partnership between media, public health, and vector control. In addition to a close partnership with media outlets, public health should also launch public education campaigns and have a strong social media presence. This should be initiated when cases identified in the county, even if they are travel-associated. Outreach and education should be scaled up if a locally acquired case is identified, and scaled down following two incubation periods (i.e. 14 days) with no newly reported cases.

Public Education

Public education should focus on three pivotal areas:

- **Disease information**
    - *Who is at risk?* Anyone with exposure to mosquitoes.
        i. Emphasize the true risk of disease, as well as the appropriate statistics
    - *How is it transmitted?* Via a mosquito vector that bites during the day and lives around houses.
    - *What are the symptoms?* Most commonly, fever, rash, severe joint pain, headache, body aches, etc.
    - *What is the treatment?* No specific treatment, disease usually resolves on its own. Dengue fever may require supportive therapy in a hospital setting.
    - *How dangerous is it?* Symptoms can be severe and very unpleasant. Dengue may be fatal. Sometimes symptoms of chikungunya can linger after the disease resolves, such as arthritis lasting for months following illness. Adults over 65 years of age, those with health conditions, and newborns, are at risk for more severe disease manifestations.
- **Personal protection against mosquito vectors**
    - *How do I protect myself?* Always wear an insect repellant while outside.
        i. Also wear long sleeves and long pants when outdoors.
- **Property and home protection against mosquito vectors**

- *How do I protect my home and family?* Always use air conditioning instead of leaving doors or windows open, or make sure all doors and windows have *intact* screens.
    i. Dump any standing water in or around your home. Mosquitoes can lay eggs in there! If you cannot dump it (i.e. a pool, pond, etc.) treat it with the appropriate pesticides.

Educational materials can be found through the Centers for Disease Control and Prevention, Arizona Department of Health Services, and local health department websites. The goal of public messaging is to help the public make informed decisions, encourage positive behavior change, and maintain a dialog and culture of trust between stakeholders (i.e. the public) and authorities. As chikungunya and Zika viruses are new to the Americas, and dengue to Arizona, public knowledge is likely low. A focused educational campaign is essential.

Social Media Messaging

Social media messaging is defined as any messaging shared on a social media platform. It allows for information to be dispersed to a wider audience and then shared further by interested parties. Infographics and other educational materials can be shared on Facebook, Twitter and LinkedIn pages. The more this information is shared, the wider the audience will be.

During an increase in disease cases or vector populations, relevant materials should be shared more frequently so stakeholders have timely access to relevant and factual information. By sharing up-to-date incidence information and prevention messages, social media messaging can also be used to allay fears about the emerging disease.

Messaging for Healthcare Providers

Communication with healthcare providers is critical in all phases of preparedness and response for mosquito-borne disease threats. These messages should include the signs and symptoms of chikungunya, dengue, or Zika fever, diagnostic testing, reporting, and treatment recommendations.

Messaging for Vector Control

Communication with vector control agencies in all stages of the response is necessary to share information about vector presence, epidemiologic updates, and mosquito surveillance and control guidelines. Vector control agencies should be encouraged to conduct surveillance for *Aedes aegypti*, and develop plans for local response. Surveillance findings can be shared at the state level through the Arbonet database.

Messaging for At-Risk Populations

Certain populations, including newborns, adults over 65 years of age, and persons with underlying medical conditions (high blood pressure, diabetes, and heart disease), are at higher risk for severe disease and death from arboviral disease. Special outreach and messaging should be considered for these groups. This could include outreach through healthcare facilities to at-risk populations, as well as targeted messaging through social media.

Communication Response Scenarios

Scenario 1: Risk for imported cases

- Develop educational materials including fact sheets, frequently asked questions, press releases, and talking points for chikungunya, dengue, and Zika, as well as *Aedes aegypti* mosquitoes
- Inform key stakeholders about preparedness materials and guidelines
    - Healthcare facilities
    - Local public health partners
    - State health agencies and partners
- Begin dissemination of prevention-oriented educational materials through various formats
    - Printed materials
    - Websites
    - Social media messaging
    - Text messaging
- Develop a strong relationship with journalists and media partners. Media opportunities can be used to educate the public and avoid spread of misinformation
- Anticipate sensitive issues involved in the response and address them proactively. Some potential issues include:
    - Safety and risks associated with the increased pesticide application near homes
    - Large numbers of at-risk people inundating healthcare settings
    - Cost of control measures
    - Stigma issues associated with binational transmission

Scenario 2: Response to locally-acquired cases

- Issue local and statewide press releases to raise community awareness
  - Use a consistent spokesperson (preferably a local representative) as much as possible
  - Ensure information is released promptly
  - Use opportunity to promote source reduction and mosquito avoidance
- Increase efforts to disseminate educational materials to the public about mosquito control and disease symptoms
- Initiate consistent and frequent messaging via websites and social media platforms.
  - Ensure messaging is consistent from different partners (state and local levels)
- Intensify communications with healthcare providers. Messaging should include disease information, differential diagnoses, and reporting requirements. Provide up to date incidence rates. This may be done via hospital associations, professional groups, or network notices determined during the preparedness phase
  - Instruct healthcare providers to tell patients to AVOID mosquito contact while ill to assist in disrupting the furthering of disease transmission

Scenario 3: Recovery

- Scale down interventions to a sustainable level for disease surveillance, education dissemination, vector control, etc.
- Communicate the decreasing threat of disease transmission to the public
- Evaluate and assess the effectiveness of risk communications and communications between agencies during the response phase

IX: APPENDIX

Investigation Forms

- Arizona State Public Health Laboratory (ASPHL) Submission Form: http://www.azdhs.gov/lab/documents/microbiology/clinical-microbiology-submission-form.pdf

  Note: the above form must be included with any specimen submission to ASPHL. If there is not a specific box for chikungunya, dengue, or Zika, please write in the testing request under "other."

Please see the following links for chikungunya, dengue, and Zika investigation forms. All case investigation forms are available on the ADHS Disease Investigation Resources webpage.

- Chikungunya case investigation form
- Dengue case investigation form
- Zika case investigation form

Chikungunya, dengue, and Zika morbidities are also available in MEDSIS for case investigators.

ADHS Educational Materials and Resources

- Mosquito Breeding Sites poster
- Preventing Dengue poster
- Dengue Infographic Fact Sheet (English & Spanish)
  - Available by request
- Modifiable versions of the following documents are also available by request:
  - Locally acquired case press release
  - Locally acquired case Health Alert Network notification
  - Talking points
  - Household investigation forms
  - Individual questionnaire forms
  - Adult and child consent forms for community investigations
  - Adult and immature mosquito assessment forms

ADHS & County Health Department Contacts

Arizona Department of Health Services
Office of Infectious Disease Services
Regular hours: 602-364-3676
After hours: 480-303-1919

County Public Health Communicable Disease Contact List:

County	Regular Number	After Hours Number
Apache County	(928) 333-2415	(928) 337-4321
Cochise County	(520) 432-9400	(800)-423-7271
Coconino County	(928) 679-7222	(928) 255-8715
Gila County	(928) 402-8811	(928) 701-1610
Graham County	(928) 428-1962	(928) 965-8921 (928) 428-0808
Greenlee County	(928) 865-2601	(928) 865-4149
La Paz County	(928) 669-6155	(928) 669-2281 (sheriff dispatch)
Maricopa County	(602) 506-6767	(602) 747-7111 (Banner poison control hotline)
Mohave County	(928) 753-0743	(928) 718-4927
Navajo County	(928) 524-4750	(928) 241-0960
Pima County	(520) 724-7797	(520) 743-7987
Pinal County	(520) 866-7325	(520) 866-6239
Santa Cruz County	(520) 375-7900	(877) 202-0586
Yavapai County	(928) 771-3134	(928) 442-5262
Yuma County	(928) 317-4550	(928) 317-4624
Gila River Indian Community	N/A	(520) 610-6435

Recommended Resources

- CDC/PAHO Preparedness and Response for Chikungunya Virus Introduction in the Americas: http://www.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=16984&Itemid

- CDC Guidelines for Surveillance and Control of *Aedes aegypti* and *Aedes albopictus* in the United States: http://www.cdc.gov/chikungunya/resources/vector-control.html

- WHO Dengue Guidelines for Diagnosis, Treatment, Prevention and Control: http://whqlibdoc.who.int/publications/2009/9789241547871_eng.pdf

- Council of State and Territorial Epidemiologists (CSTE) Revision of Case Definitions for National Notification of Dengue: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/2014PS/14_ID_10.pdf

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- Yip WCL. Dengue haemorrhagic fever: current approaches to management. *Medical Progress*, October 1980.

Mosquito Surveillance Data Submission Form Example

Note: several of the column are drop down menus. For example, column F includes WNV, DEN, CHIK, etc. Please ask ADHS Vectorborne and Zoonotic Disease Program staff for an Excel version of document, the accompanying data dictionary, or for any questions about fields.

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	S
1	County (FIPS Code)	Date Collected	Species	Arbovirus	Case Status	Trap Location (valid address or closest cross street)	Submitting Agency	Submitting agency ID	GPSLat *(example: 31.0000000)*	GPSLong *(example: -111.0000000)*	City	Zipcode	Trap Type	# Mosquitoes collected	# Mosquitoes Tested	RAMPValue
2				WNV									CO2			
3	0			WNV			0						CO2			
4	0			WNV			0						CO2			
5	0			WNV			0						CO2			
6	0			WNV			0						CO2			
7	0			WNV			0						CO2			
8	0			WNV			0						CO2			
9	0			WNV			0						CO2			
10	0			WNV			0						CO2			
11	0			WNV			0						CO2			
12	0			WNV			0						CO2			
13	0			WNV			0						CO2			
14	0			WNV			0						CO2			
15	0			WNV			0						CO2			
16	0			WNV			0						CO2			
17	0			WNV			0						CO2			
18	0			WNV			0						CO2			
19	0			WNV			0						CO2			
20	0			WNV			0						CO2			
21	0			WNV			0						CO2			
22	0			WNV			0						CO2			
23	0			WNV			0						CO2			
24	0			WNV			0						CO2			