Response to Dengue Cases

in Non-Endemic Areas of the United States

Contents

Summary

This document was developed by the Centers for Disease Control and Prevention (CDC) to assist state, Tribal, local, and territorial (STLT) health departments in areas where dengue is not endemic to investigate and respond to importation and potential transmission of dengue virus (DENV). This includes algorithms to guide the investigation of suspected dengue cases (Algorithm A), DENV transmission risk levels and recommended actions for travel associated dengue cases (Algorithm B), and recommended actions for locally acquired dengue cases (Algorithm C). This document provides guidance on how to use the algorithms and additional considerations when implementing recommended actions. The CDC is available to support STLT partners and healthcare providers for any inquiries, consultations, or assistance with investigations. Please contact the Dengue Branch at dengue@cdc.gov.

1. Investigating Suspected Dengue Cases

STLT jurisdictions should investigate and report all dengue virus (DENV) infections. People with suspected dengue based on clinical criteria or exposures should be offered confirmatory testing whenever possible based on CDC guidance for dengue testing. STLT partners should use a standardized form to investigate all suspected cases, and report confirmed and probable cases to ArboNET. CDC has provided an example of a dengue case investigation form (Appendix A. Dengue Case Report Form) to assist STLT partners with case investigation and data collection. The goal of the investigation is to confirm that a case represents a recent DENV infection and to determine its origin (travel associated or locally acquired) to guide public health action (Algorithm A. Investigating Suspected Dengue Cases).

A suspected DENV infection is defined as a clinically compatible case of dengue, dengue-like illness, or severe dengue with one of the following:

▸ Travel to a dengue endemic country or location with an ongoing outbreak or known risk of dengue transmission in the two weeks before onset of an acute febrile illness (i.e., **travel associated).
Note:** Local transmission has been documented in parts of the continental United States; any returning traveler from a jurisdiction with ongoing local DENV transmission and compatible symptoms should be tested. If results are positive and travel was to a location in the United States, state health officials should notify the jurisdiction where infection was acquired. CDC can facilitate notifications to other jurisdictions if needed. Travel to an area with DENV transmission does not necessarily rule out the possibility of locally acquired DENV. Taking a good travel history, including determining the duration and location of travel, is crucial for correct classification of cases.

▸ Association in time and place (e.g., household member, family member, classmate, or neighbor) with a confirmed or probable dengue case (i.e., **locally acquired**).

All suspected DENV infections should undergo laboratory testing when possible. Suspected DENV infections can be further classified using the laboratory criteria:

Confirmed

▸ Positive nucleic acid amplification test (NAAT) (e.g., RT-PCR) or non-structural protein 1 (NS1) antigen test. NAAT testing is available at most public health labs and NS1 testing is available at some commercial laboratories.

▸ Change from negative to positive IgM or IgG antibody result (e.g., seroconversion) in paired acute and convalescent samples.

Probable

▸ Positive IgM antibodies in a single sample with unknown or negative NAAT or NS1 antigen test results

Suspect

▸ Absence of positive 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

▸ Do not report cases as suspect who have a clear alternative explanation for symptoms or whose test results are conclusive to rule out acute dengue infection

Health departments often become aware of cases through laboratory reports rather than clinical reports and work to determine if clinical compatible symptoms were present or if there was travel or an epidemiological link. When reviewing suspected cases with laboratory testing, please

ensure that the correct test was ordered and performed. If incorrect testing was ordered (i.e., IgG or IgM testing without NAAT or NS1 antigen on a sample collected 0–7 days from symptom onset), repeat testing of original specimens with NAAT. Negative RT-PCR (or NS1 antigen) and IgM results in a specimen collected within 7 days of symptom onset, and negative IgM results in specimens collected 7 days to 3 months after symptom onset provide strong evidence of lack of DENV infection. If further testing of acute specimens is not possible, consider classifying for local purposes as a suspect case or following up to request convalescent serum to identify IgM and/or IgG seroconversion if those tests were initially negative or equivocal.

CSTE dengue case definition

For a comprehensive list of laboratory criteria, clinical descriptions, case classifications, and epidemiological linkages, please refer to the 2015 CSTE dengue case definition. Of note, there are minor differences in the interpretation of IgM and plaque reduction neutralization test (PRNT) results in this document as compared to the 2015 CSTE dengue case definition for classifying confirmed and probable cases. In the 2015 case definition, positive IgM results were considered evidence of confirmed dengue if the person lived in or traveled to an 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). However, given the possibility of flavivirus cross-reactivity from Zika in many areas where dengue is endemic, as well as WNV in many parts of the United States, in this document single IgM positive results are considered probable. A revision of the CSTE dengue case definition is planned for 2025. Jurisdictions may choose to follow the 2015 case definition if preferred.

Confirmed and probable DENV cases

Once a DENV confirmed or probable case has been identified, investigators should inquire about other symptomatic persons in the same place of residence (i.e. household, shelter, etc.) as the DENV infected person and recommend DENV testing. During case investigations, persons with DENV infection and their household members should be provided directions to prevent the spread of dengue, identify and eliminate possible vector habitats around the household, and instructions on when to seek additional care or testing if symptomatic. Investigators should determine whether the case traveled to an area with active DENV transmission, including any U.S. states or territories with ongoing local transmission. For travel associated cases, STLT partners should follow **Algorithm B. DENV transmission risk levels and recommended actions for travel associated** dengue cases.

If a confirmed or probable case is thought to be locally acquired in a non-endemic area, the transmission route should be thoroughly investigated. Investigators should determine if mosquito vectors that transmit DENV (e.g., *Aedes aegypti* and *Aedes albopictus)* have been documented in the area and inquire about other less common modes of non-vector-borne transmission such as DENV infection related to transmission through recent receipt of blood, organ, or tissues or through occupational exposure (e.g., needlestick or mucosal exposure to DENV in a hospital or laboratory). Sexual transmission can also be considered but is extremely rare. Compared to *Aedes aegypti,* which is the most important vector of DENV, *Aedes albopictus* is a competent DENV vector but is less frequently associated with large outbreaks.

If a locally acquired case meets the *probable* case definition (i.e., positive IgM antibodies in a single sample), additional testing should be attempted. This may be done by conducting NAAT testing on any available acute specimens, repeating commercial laboratory tests at a public health laboratory to strengthen the overall interpretation, or by collecting additional

specimens to evaluate seroconversion or the presence of neutralizing antibodies by plaque reduction neutralization testing (PRNT).

If a *confirmed* locally acquired case is reported in a jurisdiction where local transmission of dengue has never been reported STLT partners may require assistance with testing of samples or results validation. For assistance with locally acquired suspect, *probable,* or *confirmed* cases, please consult with CDC Dengue Branch for additional support.

Once a locally acquired case is confirmed, follow recommendations for local DENV transmission shown in Algorithm C. Recommended Actions for Locally Acquired Dengue Cases. A jurisdiction may decide to implement the recommendations in Algorithm C when a probable case is identified and no further testing is possible, and the clinical presentation and available test results, other exposures, and local epidemiology indicate there is the possibility of local transmission.

Algorithm A. Investigating Suspected Dengue Cases

Accessible description of flow chart on [page 30](#).

Does the case meet laboratory criteria for recent DENV infection?

Yes

- Follow case report form for investigation.
- Identify other symptomatic or ill people in the household and recommend dengue testing.
- Tell everyone in the household how to prevent the spread of dengue.
- Advise patients to seek care in the presence of warning signs of severe dengue.

Has the person been to an area with active DENV transmission (including within the continental United States) in the 2 weeks before symptom onset?

Yes

Travel-associated dengue

Follow recommendations for travel-associated dengue cases (Algorithm B).

Yes

Follow recommendations for local dengue transmission (Algorithm C).

No

- If you suspect dengue based on clinical and exposure criteria, perform dengue testing.
- If testing has been performed and is negative, rule out as not a case.
- If no specimen is available for testing, classify as a suspect case.

No

Locally acquired dengue

If a locally acquired case is suspected in a non-endemic area, investigate all possible routes of infection, including:

- Known presence of and exposure to *Aedes* mosquitoes
- Receipt of blood, organs, or tissue products
- Possible laboratory or occupational exposure.

Does the case meet laboratory criteria for a confirmed case?

No

For probable (single IgM+) locally acquired cases in areas without documented DENV transmission, attempt confirmatory testing.

If further testing is possible:

- Retest original specimens by RT-PCR.
- Collect additional specimens to evaluate seroconversion or presence of neutralizing antibodies by PRNT.
- If results from further testing are confirmatory, follow recommendations in Algorithm C.

If no further testing is possible, or if confirmatory testing results are negative or inconclusive:

- A jurisdiction may decide to implement the recommendations in Algorithm C if the clinical presentation, available test results, and local epidemiology indicate there is the possibility of local transmission.
- Consider pursuing additional mosquito or human surveillance in the area.

Additional Considerations

For case confirmation in areas where local transmission of DENV has never been reported, including re-testing of specimens and result validation, contact the CDC Dengue Branch for assistance (dengue@cdc.gov).

Links

- [Laboratory criteria](#)
- [Case report form](#)
- [Prevent the spread of dengue](#)
- [Warning signs](#)
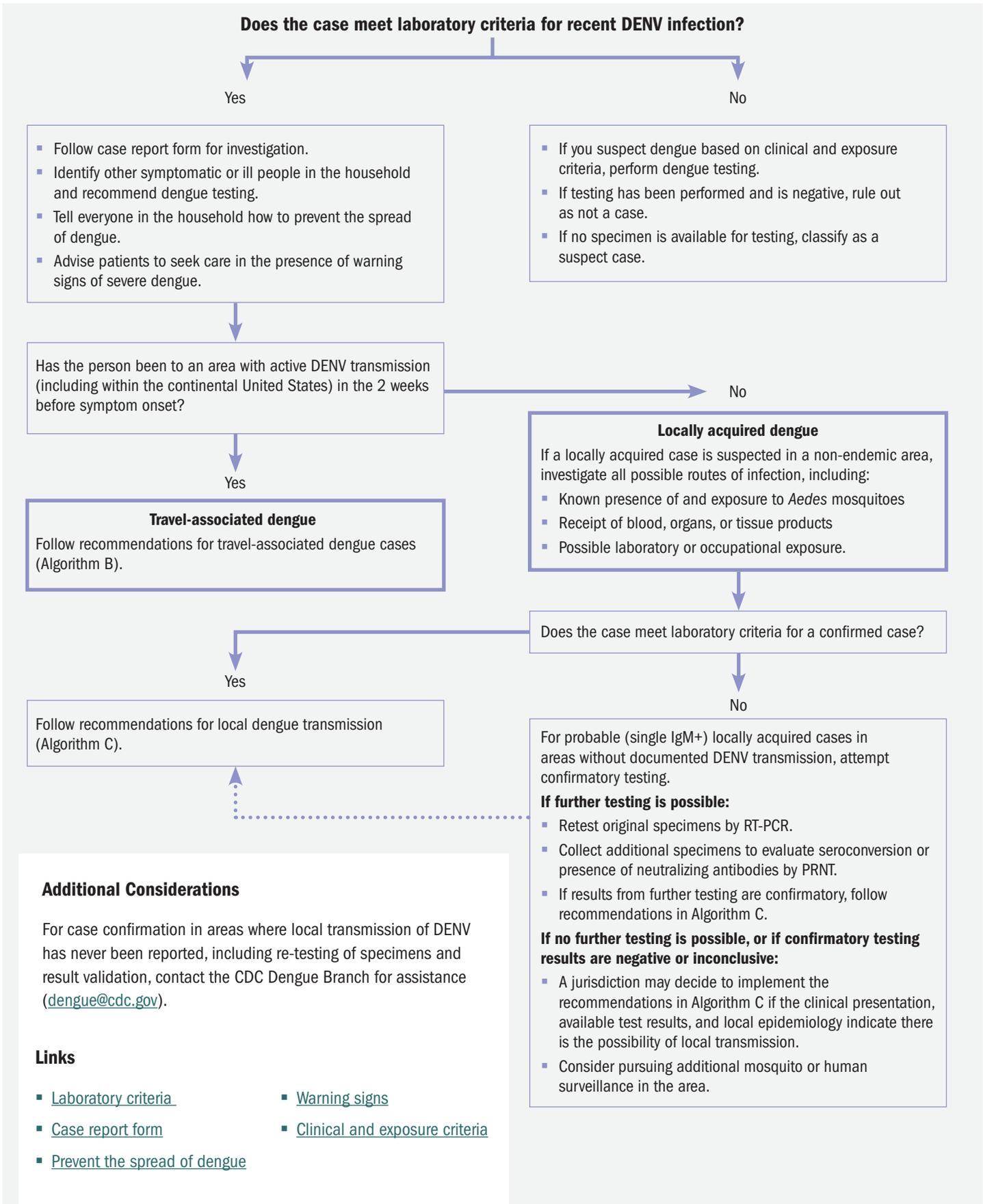- [Clinical and exposure criteria](#)

Table. DENV Risk Categories for Mosquito-borne DENV Transmission and Action Items

Risk Categories	Are *Ae, aegypti* or *Ae. albopictus* present?	Has local DENV transmission occurred in the past?	Summary of recommended actions
None	N/A	N/A	Recommendations for all areas: • Increase public awareness of protection against mosquito bites during travel to endemic areas. • Healthcare provider outreach to consider and test for DENV infection.
Low	No	No	Recommendations for all areas, plus: • Establish communication with vector control agencies. • Consider implementing vector control to reduce mosquito abundance.
Moderate	Yes	Yes	Recommendations for low probability areas, plus: • Source reduction, larvicide and insecticide spraying around reported cases. • Mosquito surveillance in areas with historically high numbers of travel-associated or locally acquired cases. • Active case finding around reported case(s). • Enhanced healthcare provider outreach to offer dengue testing to patients with signs and symptoms highly compatible with dengue.
Local DENV transmission identified	Yes	Yes	Recommendations for moderate transmission areas plus: • Coordination with other agencies. • Enhanced vector surveillance and control. • Monitor effectiveness of vector control efforts. • Enhanced human surveillance around cases and in the community. • Enhanced communication, emphasize the urgency of personal protection including the use of repellents.

2. DENV Transmission Risk Levels and Recommended Actions for Travel Associated Dengue Cases

Once a travel associated dengue case has been identified in your jurisdiction, Algorithm B. DENV transmission risk levels and recommended actions for travel associated dengue cases provides considerations around the risk of local vector-borne transmission, which depends on two principal factors:

▸ The presence of mosquito vectors that transmit DENV, *Aedes aegypti* and *Aedes albopictus.* Local vector control agency surveillance data can be used to confirm the presence and density of mosquito vectors. In the absence of local vector control data, jurisdictions can use CDC's estimated potential range of *Aedes aegypti* and *Aedes albopictus* in the United States to inform potential presence **(Figure 1. Estimated potential range of *Aedes aegypti* and *Aedes albopictus* in the United States, 2017*)**.

▸ Whether local DENV transmission has been documented before.

BOX 1. ADDITIONAL FACTORS THAT MAY INCREASE OR DECREASE THE PROBABILITY OF VECTOR-BORNE TRANSMISSION.

Increased probability of transmission:

▸ High number of travel associated cases (>10 cases per year)
  - If more travel associated cases are identified in a jurisdiction, there is a higher probability of spread of DENV infection if *Aedes* mosquito vectors are present.

▸ Presence of *Aedes aegypti*
  - Although *Ae. albopictus* has also proven to be a competent vector for dengue, *Ae. aegypti* is more frequently associated with large outbreaks in endemic areas.

▸ High human population density
  - Because the average flight range of *Aedes spp.* is approximately 100–200 meters (a few blocks), urban areas with high density are at higher risk of ongoing DENV transmission.

▸ Higher numbers of *Aedes* vector breeding sites (e.g., small backyard containers, yard drains, neglected swimming pools, discarded tires, drainage ditches with standing water)
  - *Aedes* mosquitoes only need a small amount of water to lay eggs. Bowls, cups, fountains, tires, barrels, vases, and any other container storing water make a great "nursery" for mosquitoes.

▸ High precipitation
  - Increased rainfall increases suitable breeding sites for *Aedes aegypti* and *albopictus,* increasing their populations in an area.

▸ Average daytime temperatures between 68–95°F
  - Higher risk of transmission in warmer months (spring and summer) than winter.
  - The highest levels of dengue transmission have been observed in these temperature ranges.

Decreased probability of transmission:

▸ Elevation ≥6,000 feet
  - Higher elevation climates are less suitable for proliferation of *Aedes aegypti* and *albopictus.*

Algorithm B. DENV transmission risk levels and recommended actions for travel associated dengue cases also provides considerations for public health action in each scenario. Risk categories include no probability of transmission, low probability of transmission, and moderate probability of transmission (none, low, moderate, or local DENV transmission identified). Additional factors that can be considered when informing risk levels are also provided (Box 1). Depending on the risk category for transmission of DENV, additional actions can be taken as described (Table).

2.1 DENV vector-borne transmission risk categories, definitions, and recommended actions

2.1.1 No probability of vector-borne transmission

Definition: areas where *Aedes aegypti* or *albopictus* mosquitoes are not known to be present.

▸ **Public health actions:**

- Follow recommendations for all areas (Box 2).

2.1.2 Low probability of vector-borne transmission

Definition: areas where *Aedes aegypti* or *albopictus* are present but where local transmission of DENV has not been documented.

▸ **Public health actions:**

- Follow recommendations for all areas (Box 2).

- Establish communication channels between public health and vector control agencies to coordinate surveillance and vector control efforts.

- Consider implementing source reduction, larviciding, and outdoor residual insecticide spraying targeting mosquito resting places and containers that cannot be eliminated guided by the presence of *Aedes spp.* mosquitoes and insecticide resistance patterns to reduce mosquito abundance.

- Implementation will depend on the availability of resources and expertise in implementing vector control.

- More detailed information on vector control methods and surveillance are available in Appendix B. Strategies to Control *Aedes aegypti* or *albopictus* Mosquitoes.

- Appendix C. Recommendations for Entomological Surveillance and at https://www.cdc.gov/mosquitoes/mosquito-control/index.html and Surveillance and Control of *Aedes aegypti* and *Aedes albopictus* in the United States (cdc.gov).
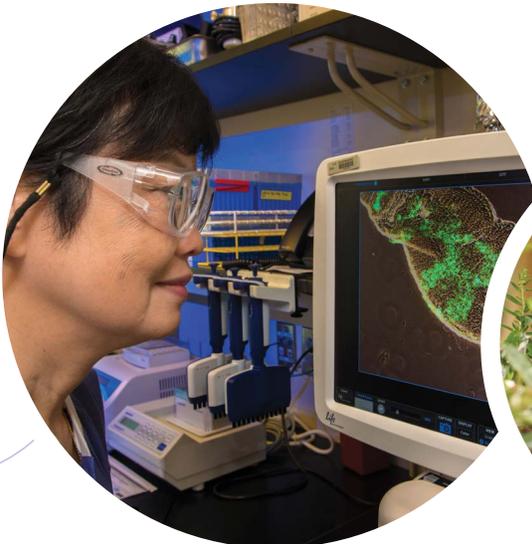
BOX 2. RECOMMENDATIONS FOR ALL AREAS REGARDLESS OF VECTOR-BORNE TRANSMISSION RISK.

All jurisdictions should work to inform the public and healthcare providers on how to prevent, diagnose, manage, and report dengue cases. Specific recommendations include:

▸ **Public**

- Increase traveler awareness about how to protect themselves against mosquito bites during and after travel and to seek care if they develop symptoms.

- When *Aedes* mosquito vectors are present:

  ◆ Encourage the public to use screens in windows and doors, repair screens that have tears or holes in them, and keep doors to the outside closed to prevent mosquito bites.

  ◆ Promote the use of EPA-registered repellents and protective clothing while in areas where mosquito bites are possible.

▸ **Healthcare providers**

- Educate healthcare providers to consider and test for DENV infection in febrile travelers returning from areas with ongoing dengue transmission within the last 14 days.

- Familiarize healthcare providers with DENV testing, including the recommended test types and interpretation (ensuring the appropriate test is chosen according to time after symptoms onset).
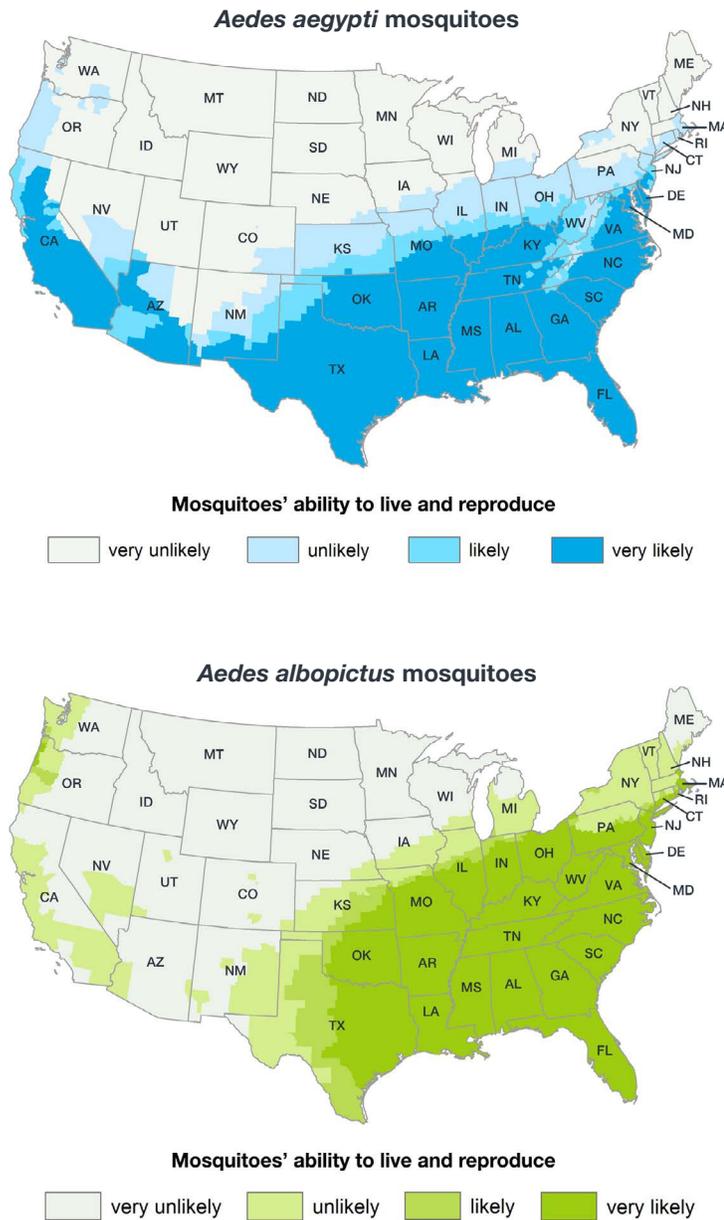
▸ **Suspected dengue cases**

- Advise patients to seek care in the presence of warning signs of severe dengue.

Figure 1. Estimated Potential Range of *Aedes aegypti* and *Aedes albopictus* in the United States, 2017*

Accessible description of maps on page 31.

Aedes aegypti mosquitoes

Mosquitoes' ability to live and reproduce

very unlikely · unlikely · likely · very likely

Aedes aegypti mosquitoes are more likely to spread Zika, dengue, chikungunya, and other viruses than other types of mosquitoes such as *Ae. albopictus* mosquitoes.

Aedes albopictus mosquitoes

Mosquitoes' ability to live and reproduce

very unlikely · unlikely · likely · very likely

These maps DO NOT show
· Exact locations or numbers of mosquitoes living in an area
· Risk or likelihood that these mosquitoes will spread viruses

These maps show
· CDC's best estimate of the potential range of *Ae. aegypti* and *Ae. albopictus* in the United States
· Areas where mosquitoes are or have been previously found

* CDC has updated the estimated range maps for *Ae. aegypti* and *Ae. albopictus* mosquitoes by using a model that predicts possible geographic ranges for these mosquitoes in the contiguous United States. The model used county-level records, historical records, and suitable climate variables to predict the likelihood (very low, low, moderate, or high) that these mosquitoes could survive and reproduce if introduced to an area during the months when mosquitoes are locally active. Maps are not meant to represent risk for spread of any specific disease. (See Johnson TL et al. Modeling the environmental suitability for *Aedes (Stegomyia) aegypti* and *Aedes (Stegomyia) albopictus* (Diptera: Culicidae) in the contiguous United States. *Jrl Med Entomol.* Sept. 2017;[ahead of print].)

2.1.3 Moderate probability of vector-borne transmission

Definition: areas where *Aedes aegypti* or *Ae. albopictus* are present and where local transmission of DENV has been confirmed. *Aedes albopictus* is a less efficient vector, but it has been associated with DENV outbreaks in some areas.

▶ **Public health actions**

- Follow recommendations for low probability areas.

- **Vector control**

  ◆ Implement vector control in a 100–200m radius of the reported case(s).

  ◆ Engage in community outreach and educational campaigns on effective mosquito control, the importance of clean-up campaigns to remove or reduce aquatic habitats and reporting possible mosquito sources to authorities.

  ◆ If resources are available, jurisdictions can consider conducting enhanced mosquito surveillance tasks in areas or communities with historically high numbers of travel associated cases, including immature (larvae/pupae) surveys to identify the most productive aquatic habitats of *Aedes aegypti* and *Ae. albopictus* and target control measures towards these habitats. Where feasible, annual insecticide resistance assays (CDC Bottle Bioassays) are useful to determine levels of resistance and which chemicals will be most effective in killing mosquitoes.

  ◆ More detailed information on vector control methods and surveillance are available in Appendix B. Strategies to Control *Aedes aegypti* or *albopictus* Mosquitoes.

- ◆ Appendix C. Recommendations for Entomological Surveillance and at https://www.cdc.gov/mosquitoes/mosquito-control/index.html and Surveillance and Control of *Aedes aegypti* and *Aedes albopictus* in the United States (cdc.gov).

- ◆ The intensity of vector control efforts should take into consideration the presence of risk factors that may increase the probability of transmission including the presence of *Aedes aegypti* that is a more efficient mosquito vector. For example, if multiple travel associated cases have been reported in New York City during the months of January–March, given average temperatures and precipitation transmission is unlikely. In contrast, the risk of transmission is higher if travel associated cases are reported in California during the months of June–October. The latter scenario may require more intensive vector control measures than the former.

- **Enhanced surveillance**

  ◆ Consider enhanced surveillance in areas with increased risk, such as higher-than-expected numbers of travel associated cases in a small geographic area. This can be done through:

    ▪ Active case finding in the household or place of residence of travel associated cases, including anyone with symptoms compatible with dengue.

- **Healthcare provider outreach**

  - Inform healthcare providers to consider testing for dengue in patients exhibiting signs and symptoms that are highly compatible with dengue (e.g., fever and at least one of the following: thrombocytopenia, leukopenia, body aches, joint pain, or rash), regardless of recent travel history, and in the absence of another diagnosis, and provide them with dengue clinical management resources (Appendix D. CDC Dengue Resources).

- Jurisdictions can provide guidance based on the local risk assessment and available resources. Determining which patients to test for dengue in the absence of a travel history to an area with known dengue transmission can be challenging due to the non-specific clinical presentation. Factors that would increase suspicion for dengue include signs or symptoms of fever and thrombocytopenia, leukopenia, body aches, joint pain, or rash, as well as reported travel among household members or patient residence in an area where travel associated dengue cases are frequently reported.

Algorithm B. DENV Transmission Risk Levels and Recommended Actions for Travel Associated Dengue Cases

Accessible description of flow chart on page 34.

Recommendations for all areas

- Increase traveler awareness about how to protect themselves against mosquito bites during and after travel and to seek care if they develop symptoms.
- Encourage people to use and repair screens in windows and doors to prevent mosquito bites.
- Promote the use of EPA-registered repellents and protective clothing while in areas where mosquito bites are possible.
- Educate healthcare providers to consider and test for dengue virus (DENV) infection in febrile returning travelers from an area with ongoing DENV transmission within the last 14 days.

- Familiarize healthcare providers with DENV testing, including the recommended test types and interpretation.
- Advise patients to seek care in the presence of warning signs of severe dengue.
- If travel was to a location in the United States, state health officials should notify the jurisdiction where infection was acquired.

Are *Aedes aegypti* or *Aedes albopictus* mosquitoes present? *†

Yes → / No →

No risk
Follow recommendations for all areas.

Has local dengue virus transmission occurred in the past?

Yes / No

Moderate risk

In addition to recommendations for all areas:
- Establish communication with vector control agencies to coordinate surveillance and vector control efforts.

Vector control
- Implement source reduction, larvicide treatment, and spray mosquito resting places and containers that cannot be eliminated around the home with residual insecticide.
- These steps should extend to a 100–200-meter radius‡ of the reported case(s).
- Engage in community outreach and educational campaigns on effective mosquito control, clean-up campaigns to remove or reduce aquatic habitats, and reporting possible mosquito sources.

Enhanced surveillance
- Consider enhanced surveillance in areas with increased risk, such as higher-than-expected numbers of travel-associated cases in a small geographic area or historical locally acquired cases. Use larvae/pupae surveys to identify and target the most productive aquatic habitats.
- Active case finding around travel-associated cases, including anyone symptomatic or with recent travel to an area with dengue transmission.
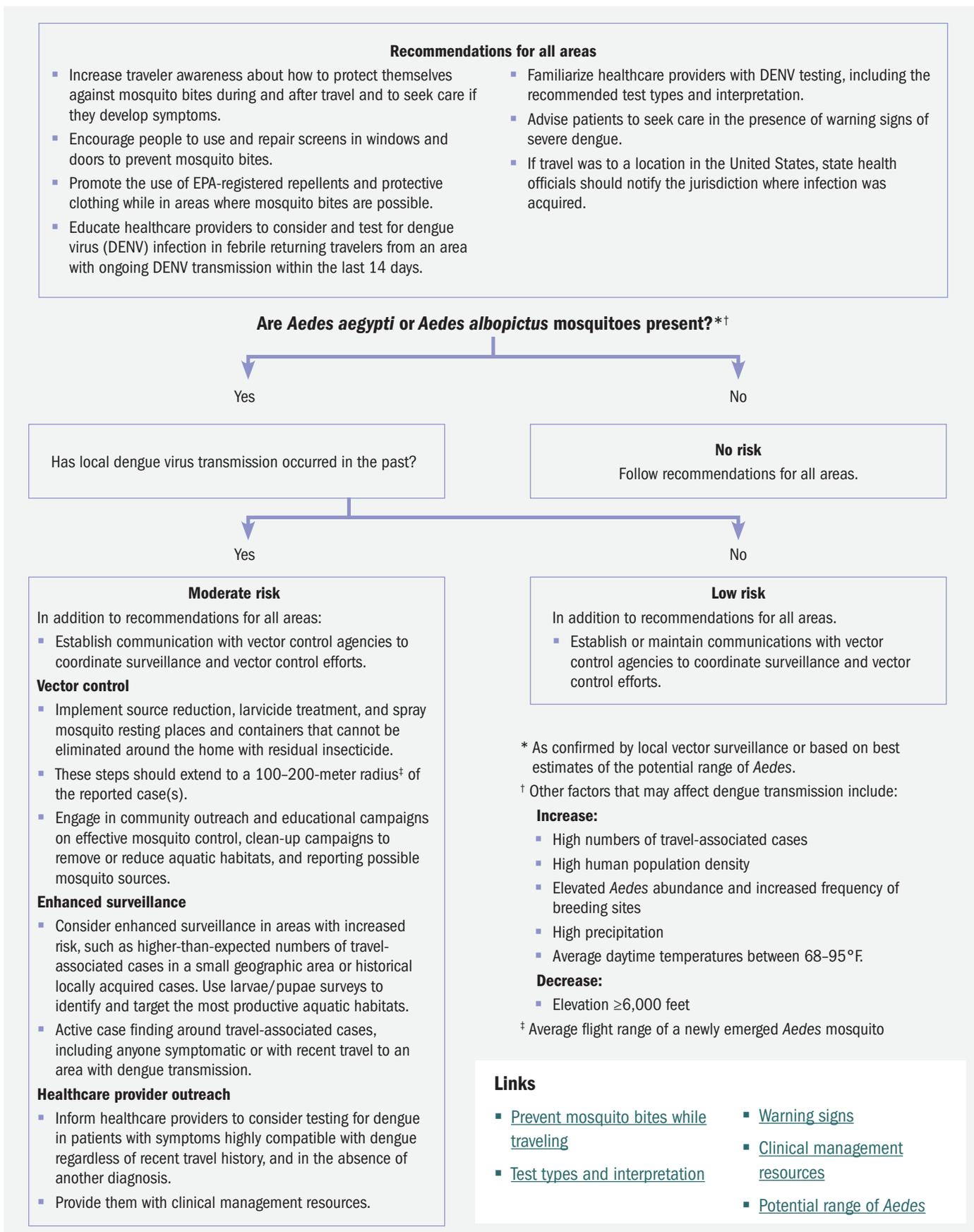
Healthcare provider outreach
- Inform healthcare providers to consider testing for dengue in patients with symptoms highly compatible with dengue regardless of recent travel history, and in the absence of another diagnosis.
- Provide them with clinical management resources.

Low risk

In addition to recommendations for all areas.
- Establish or maintain communications with vector control agencies to coordinate surveillance and vector control efforts.

* As confirmed by local vector surveillance or based on best estimates of the potential range of *Aedes*.

† Other factors that may affect dengue transmission include:

Increase:
- High numbers of travel-associated cases
- High human population density
- Elevated *Aedes* abundance and increased frequency of breeding sites
- High precipitation
- Average daytime temperatures between 68–95°F.

Decrease:
- Elevation ≥6,000 feet

‡ Average flight range of a newly emerged *Aedes* mosquito

Links

- Prevent mosquito bites while traveling
- Test types and interpretation

- Warning signs
- Clinical management resources
- Potential range of *Aedes*

3. Recommended Actions for Ongoing Local Transmission

When evaluating the extent of local transmission, a focus should be placed on the epidemiological links between cases and the geographic areas where local transmission is suspected. In general, local transmission risk is highest within the household of a travel associated case. However, DENV infections in patients with no history of travel in the last two weeks and no clear epidemiological link with a confirmed or probable case indicate that local transmission may be occurring more broadly.

When ongoing local transmission is suspected, the intensity of public health action will depend on whether locally acquired DENV infections are reported in multiple geographic areas. Locally acquired cases are in distinct geographic areas if case residences (or other suspected location of acquisition) are >500 meters from each other. A summary of actions in response to a confirmed case of locally acquired DENV infection is provided in Algorithm C. Recommended Actions for Locally Acquired Dengue Cases.

3.1 In the setting of locally acquired cases in one geographic area, the following actions are recommended:

Coordination

▸ Coordinate with CDC, other agencies, and authorities regarding the local DENV transmission event and response.

▸ Develop or strengthen communication channels between epidemiology and vector control officials to coordinate surveillance and vector control efforts.

Vector control

▸ Perform vector surveillance and control activities around the home and within a 100–200-meter radius of reported cases, including the neighborhood where the dengue case resides, and extend further to neighboring areas in case the virus is detected in the vector or cases are identified outside of the immediate neighborhood.

▸ Intensify source reduction efforts and potentially larvicide and adulticide treatments (as outlined in the vector control actions in areas with moderate probability of dengue transmission).

▸ Monitor the effectiveness of vector control efforts. More detailed information on vector control methods and surveillance are available in Appendix B. Strategies to Control *Aedes aegypti* or *albopictus* mosquitoes.

▸ Appendix C. Recommendations for Entomological Surveillance and Surveillance and Control of *Aedes aegypti* and *Aedes albopictus* in the United States (cdc.gov).

Enhanced surveillance

▸ Offer DENV testing for other household members and ascertain information on any recent febrile illness episodes.

▸ Strongly consider enhanced surveillance around the household, particularly if the source of DENV introduction is unknown, including:

  • Conducting door-to-door active case finding in homes 100–200 meters of the confirmed local dengue case to identify and offer testing to people with elevated epidemiologic dengue risk based on proximity to a confirmed case and symptoms. Ask about travel history.

  • Serosurveys among households within 100–200 meters of dengue case households can help identify more widespread dengue transmission and guide the geographic extent of vector control activities.

▸ Virological surveillance of *Aedes aegypti* or *Aedes albopictus* mosquitoes within 100–200-meter radius of the home or locations where the individual is likely to have been infected based on feedback

from epidemiologists. Testing mosquitoes for arboviruses can help confirm local transmission. However, negative results are not conclusive, as virologic surveillance in mosquitoes has imperfect sensitivity and local transmission can occur in the absence of positive mosquito pools. See Appendix C. Recommendations for Entomological Surveillance for recommendations on the implementation of virological surveillance.

- Virologic vector surveillance may be most useful in focal areas where DENV transmission is suspected but unprecedented (i.e., first evidence of mosquito-borne local DENV transmission in a non-endemic area). In Puerto Rico, evaluations of virologic surveillance in mosquitoes in areas with active DENV transmission have found ~7 DENV positive mosquitoes among every 10,000 mosquitoes captured. These findings indicate that it may be difficult to detect DENV in mosquitoes even in areas where transmission is occurring, and that negative results in mosquitoes should not be used to rule out local transmission. However, positive findings in mosquitoes, when available, can be very valuable in confirming local DENV transmission in an area and identifying the circulating DENV serotype. Sensitivity for DENV detection in mosquitoes can be increased by using higher numbers of traps (more mosquitoes captured) and maintaining surveillance for multiple weeks.

Healthcare provider outreach

▶ Intensify clinician outreach activities to enhance dengue detection, diagnosis, and management.

▶ Inform healthcare providers to consider testing for dengue in patients exhibiting signs and symptoms that are highly compatible with dengue (e.g., fever and at least one of the following: thrombocytopenia, leukopenia, body aches, joint pain, or rash), regardless of recent travel history, and in the absence of another diagnosis, and provide them with dengue clinical management resources (See Appendix D. CDC Dengue Resources).

Communication

▶ Provide updated epidemiologic reports to key stakeholders on the status of local transmission on a weekly basis.

▶ Continue mosquito control educational campaigns and tailor messaging to communities vulnerable to increased transmission.

▶ Conduct appropriate risk communication, following established principles (e.g., be first, be right, be credible).

- Inform the public about what is known and what is not known.

- Provide actions people can take to protect themselves and their families to reduce the risk of infection through mosquito bites including use of repellents.

- Use available communication channels appropriate for the local community.

3.2 If multiple geographic areas are affected (>500 meters apart) or locally acquired cases are higher than expected compared to the median for previous years, the following actions can be pursued.

Vector control

▸ Implement area-wide larvicide and adulticide treatments by prioritizing areas based on the number of cases reported and vector surveillance results as outlined in vector control recommendations in section 3.1.

▸ Intensify community outreach and educational campaigns on effective mosquito control, the importance of clean-up campaigns to remove or reduce aquatic habitats and reporting possible mosquito sources to authorities, and personal protective measures.
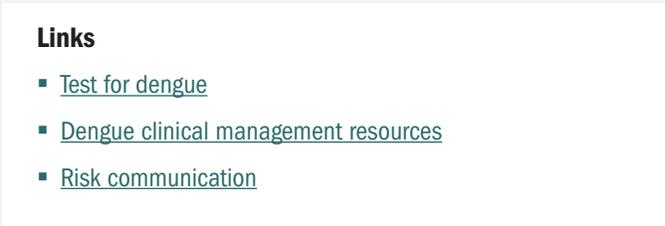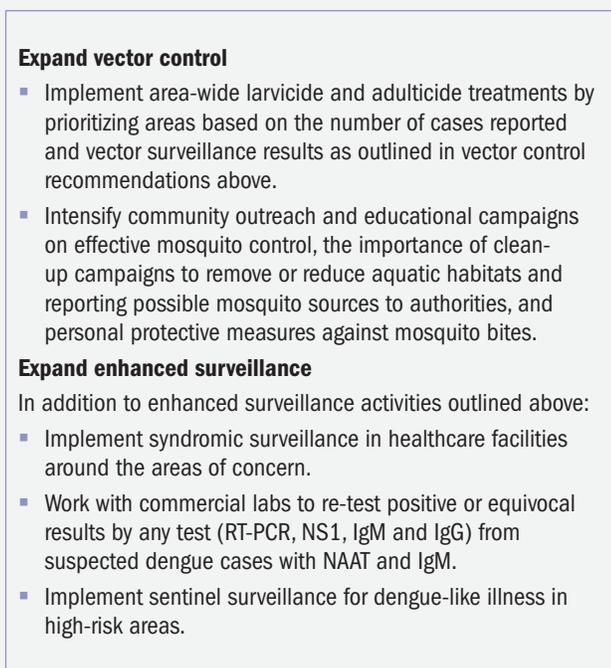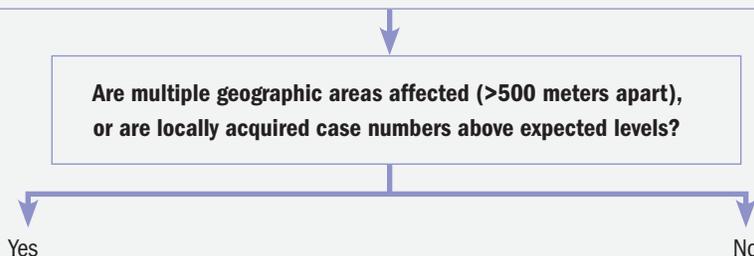
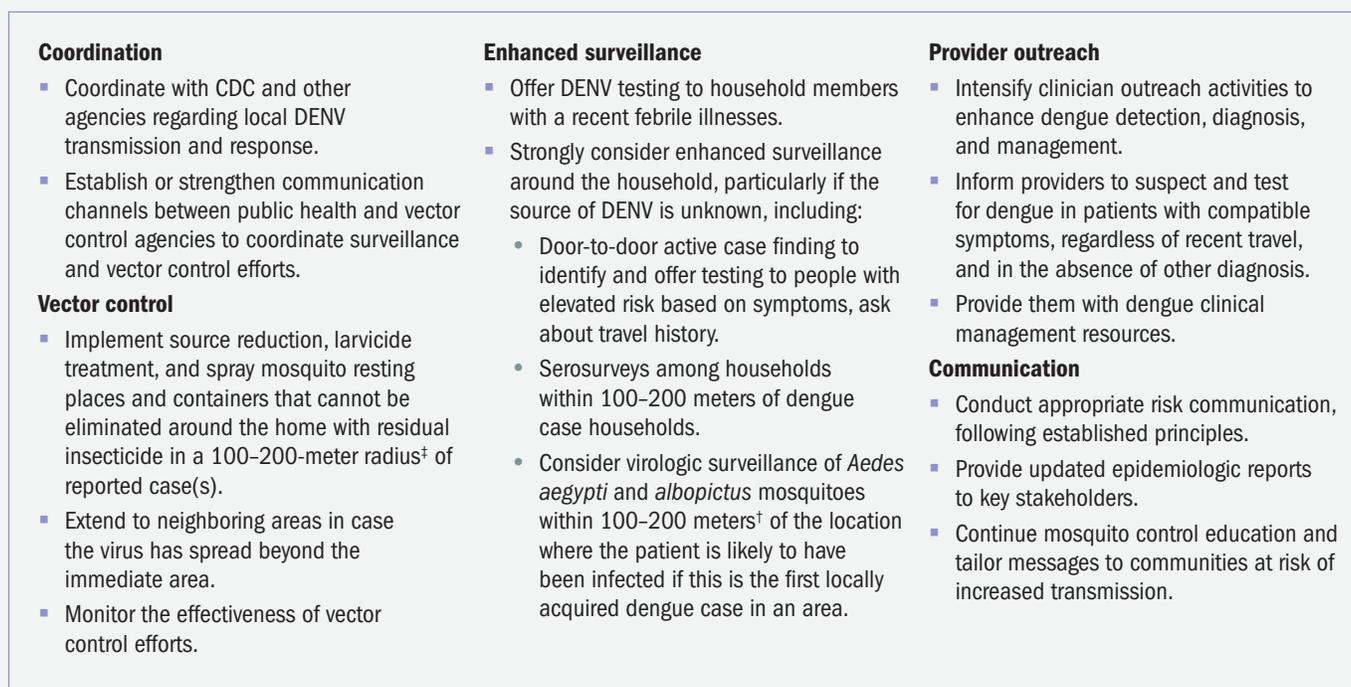▸ Monitor the effectiveness of vector control efforts.

Enhanced surveillance

▸ In addition to enhanced surveillance activities outlined in section 3.1, STLT can consider:

• Implementing syndromic surveillance in healthcare facilities around the areas of concern to enhance case finding, guide response decisions, and potentially develop a lower threshold for dengue testing among people with febrile illnesses (Appendix E. Enhanced Dengue Surveillance for Ongoing Local Transmission).

• Working with commercial labs to re-test specimens with positive or equivocal results for any of the assays (RT-PCR, NS1, IgM and IgG) from suspected dengue cases with NAAT and IgM to increase case capture and determine circulating serotype.

• Implementing sentinel surveillance for dengue-like illness in high-risk areas and considering wastewater surveillance if resources are available in consultation with the CDC.

Algorithm C. Recommended Actions for Locally Acquired Dengue Cases

Accessible description of flow chart on [page 36](#).

Coordination

- Coordinate with CDC and other agencies regarding local DENV transmission and response.
- Establish or strengthen communication channels between public health and vector control agencies to coordinate surveillance and vector control efforts.

Vector control

- Implement source reduction, larvicide treatment, and spray mosquito resting places and containers that cannot be eliminated around the home with residual insecticide in a 100–200-meter radius[†] of reported case(s).
- Extend to neighboring areas in case the virus has spread beyond the immediate area.
- Monitor the effectiveness of vector control efforts.

Enhanced surveillance

- Offer DENV testing to household members with a recent febrile illnesses.
- Strongly consider enhanced surveillance around the household, particularly if the source of DENV is unknown, including:
  - Door-to-door active case finding to identify and offer testing to people with elevated risk based on symptoms, ask about travel history.
  - Serosurveys among households within 100–200 meters of dengue case households.
  - Consider virologic surveillance of *Aedes aegypti* and *albopictus* mosquitoes within 100–200 meters[†] of the location where the patient is likely to have been infected if this is the first locally acquired dengue case in an area.

Provider outreach

- Intensify clinician outreach activities to enhance dengue detection, diagnosis, and management.
- Inform providers to suspect and test for dengue in patients with compatible symptoms, regardless of recent travel, and in the absence of other diagnosis.
- Provide them with dengue clinical management resources.

Communication

- Conduct appropriate risk communication, following established principles.
- Provide updated epidemiologic reports to key stakeholders.
- Continue mosquito control education and tailor messages to communities at risk of increased transmission.

Are multiple geographic areas affected (>500 meters apart), or are locally acquired case numbers above expected levels?

Yes

No

Continue steps above

Expand vector control

- Implement area-wide larvicide and adulticide treatments by prioritizing areas based on the number of cases reported and vector surveillance results as outlined in vector control recommendations above.
- Intensify community outreach and educational campaigns on effective mosquito control, the importance of clean-up campaigns to remove or reduce aquatic habitats and reporting possible mosquito sources to authorities, and personal protective measures against mosquito bites.

Expand enhanced surveillance

In addition to enhanced surveillance activities outlined above:

- Implement syndromic surveillance in healthcare facilities around the areas of concern.
- Work with commercial labs to re-test positive or equivocal results by any test (RT-PCR, NS1, IgM and IgG) from suspected dengue cases with NAAT and IgM.
- Implement sentinel surveillance for dengue-like illness in high-risk areas.

Links

- [Test for dengue](#)
- [Dengue clinical management resources](#)
- [Risk communication](#)

[†] Average flight range of a newly emerged *Aedes* mosquito.

APPENDICES

Appendix A. Dengue Case Report Form

This form is intended as an example. Dengue cases should be reported into ArboNET using existing reporting mechanisms. For additional information, please contact dengue@cdc.gov. Access the full case report form at https://www.cdc.gov/dengue/php/resources/case-investigation.html

---

CDC

CASE ID: _____   Reporting Jurisdiction: _____
(Please enter the case ID as assigned by your jurisdiction)

Dengue Case Investigation Form

NOTES: Enter dates as MM/DD/YYYY unless otherwise specified, Guidance, see page 6
This form includes a combination of variables that are reported to ArboNET (the national arbovirus surveillance system) and optional variables that may be helpful for case investigations but are not reportable to CDC. The optional variables are clearly indicated in marked sections.

PATIENT INFORMATION

Date of birth *(YYYY/MM/DD)*: _____   Age: _____ ○ years ○ months   Sex: ○ Male ○ Female ○ Unknown

Country of birth: _____   Country of usual residence: _____

State of residence: _____   County of residence: _____

Zip Code of residence: _____

Race *(check all that apply)*:
☐ American Indian/Alaska Native   ☐ Black/African American   ☐ White   ☐ Other, specify:
☐ Asian   ☐ Native Hawaiian/Pacific Islander   ☐ Unknown

Ethnicity: ○ Hispanic or Latino ○ Not Hispanic or Latino ○ Unknown ○ Other, specify: _____

OPTIONAL VARIABLES FOR JURISDICTION USE

Last name: _____   First name: _____

Patient email: _____   Patient phone: _____

CLINICAL INFORMATION

Date of illness onset: _____   Was the patient hospitalized? ○ Yes ○ No ○ Unknown

Did the patient die from this illness? ○ Yes ○ No ○ Unknown   Date of death: _____

OPTIONAL VARIABLES FOR JURISDICTION USE

Physician name: _____   Physician phone: _____

Hospital or clinic name: _____

Date of first evaluation by healthcare provider: _____   *If hospitalized*, admission date: _____   Discharge date: _____

EPIDEMIOLOGICAL INFORMATION

Where was this illness acquired? Please indicate if this was an imported case *(i.e., travel outside of the jurisdiction in the past 14 days prior to illness onset?)*
○ International   ○ Imported, but not able to determine source state and/or country   ○ Indigenous, within jurisdiction (locally acquired)
○ Out of state   ○ In state, out of jurisdiction   ○ Unknown

Imported Cases

If this case was imported (Acquired out of country or state), please list all countries or states visited during the 14 days before symptom onset.

What was the country of origin of the infection? _____

Other country 1: _____   Other country 2: _____

Other country 3: _____

Other country, specify: _____

OR, What was the U.S. state/territory of origin of the infection? _____

Other state/territory 1: _____   Other state/territory 2: _____

Other state/territory 3: _____   Other state/territory, specify: _____

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Appendix B. Strategies to Control *Aedes aegypti* or *albopictus* Mosquitoes

Effective control of the mosquito vectors *Ae. aegypti* and *albopictus* can help reduce the likelihood of DENV transmission after importation of a travel associated case in areas with moderate probability of transmission or responding to locally acquired dengue cases. Effective mosquito control relies on an integrated vector management approach using multiple interventions coordinated broadly across different sectors.

When travel associated cases are reported in an area with moderate transmission risk, vector control efforts should be focused around the residence of cases. Priority should be given to performing *Aedes* larval source reduction around the home and within a 100–200-meter radius (the average flight range of a newly emerged *Aedes* mosquito) of reported cases.

If locally acquired cases have been reported, vector control activities need to include the neighborhood where the dengue case resides and extend further to neighboring areas in case the virus has moved outside of the immediate neighborhood.

1. **Education and community engagement**

   - **Educational campaign.** Public messaging (newspapers, radio, TV, social media) informing people about measures that the population can take to prevent mosquito bites and mosquito breeding sites and to seek medical attention if dengue symptoms appear. Emphasis should be placed on a simple, easy to understand messages. Banners placed at community access points could be used to inform residents about the risk of dengue infections and disease, and to encourage them to participate in reducing mosquito habitats on their properties. The messages should specify what containers need to be removed or treated, with pictures and instructions.

   - **Clean-up campaigns.** Local officials should conduct clean-up activities asking residents to clean their yards or patios and to offer help moving away heavy trash/junk objects (this should be conducted approximately every three months for prevention of new larval habitats). Some residents may need assistance to clear their yards (e.g., elderly, persons with disabilities, etc.).

   - **Community engagement.** Residents should be asked for permission to inspect the property to eliminate or treat containers with larvicides that are not used for pet or human consumption. Residents should be encouraged to discard containers (provide a list/graphics of containers that produce *Aedes* mosquitoes) that accumulate water and other actions that would prevent producing mosquitoes on their properties.

   - **Training** of public health professionals, emergency response personnel, and volunteers should be conducted in areas with local DENV transmission.

2. **Traditional vector control**

   - **Consider focal or area-wide treatments with larvicides and adulticides using application methods appropriate for the treatment area.**

   - **Adulticides.** Outdoor insecticide residual spraying using an appropriate insecticide for containers (not for pet or human consumption) and adjacent surfaces where mosquitoes land is highly recommended to disrupt transmission of DENV. Outdoor spaces include garages and other dark or protected areas where mosquitoes rest or land. It is not necessary to spray the entire outdoor walls, just below 1.5 meters from the ground, avoiding exposed surfaces to rain and sun. Integrated vector management programs should include an insecticide resistance management component.

- **Larvicides.** Wide area larvicide spraying (WALS) can be useful to treat abandoned lots, cemeteries, illegal dump sites, and houses whose residents refuse inspections or that are closed or abandoned. WALS alone, like other control agents/delivery systems, will not achieve sufficient control of *Ae. aegypti* and *albopictus* unless it is used as part of an integrated mosquito management approach. WALS alone will not interrupt active DENV transmission.

- **Environmental control.** Local officials should inspect and have septic tanks repaired, if applicable. Tire shops with outdoor stockpiles should be treated with larvicides/adulticides once a month and ensure that excess discarded tires are picked up and taken to recycling facilities as frequently as possible.

- **Monitor the effectiveness of mosquito control.** The effectiveness of pre-adult mosquito control is usually assessed by comparing the presence/absence or abundance of immature mosquitoes in treated containers before and after treatment or by comparing with untreated areas. Adult mosquito surveillance can be used to monitor the effectiveness of mosquito control.

3. **Protection against mosquito bites**

- **Installation or repair of screens** as window and door screens have been shown to reduce the risk of dengue.

- **Use of commercially available spatial repellents** for houses without screens (available in hardware stores, pharmacies, etc.),

- **Topical repellents** (as recommended by EPA).

Appendix C. Recommendations for Entomological Surveillance

To better understand the risk of DENV transmission, health departments and vector control agencies can prepare by:

▸ Determining the abundance and seasonality of *Aedes aegypti* and *albopictus* vectors in their jurisdictions.

▸ Identifying main containers producing *Aedes aegypti* and *albopictus* to target clean-up campaigns and vector control measures.

▸ Conducting annual insecticide resistance assays (CDC Bottle Bioassays) to determine effective mosquito control strategies.

▸ Conducting educational campaigns on effective mosquito control, the importance of clean-up campaigns to remove or reduce aquatic habitats and reporting possible mosquito sources to authorities, and the use of personal protective measures against mosquito bites.

In addition, some health departments with previously reported locally acquired dengue cases may coordinate with vector control agencies to conduct mosquito surveillance and control to identify areas at risk for transmission by:

▸ Identifying cumulative and interannual patterns of historical travel associated cases to determine if clusters of cases could be prioritized and targeted for *Aedes aegypti* and *albopictus* surveillance and control.

▸ Conducting enhanced mosquito surveillance in areas with historically high numbers of travel associated cases, including immature (larvae/pupae) surveys to identify the most productive aquatic habitats of *Aedes aegypti* and *albopictus* and target control measures towards these habitats.

Entomological surveillance for confirmed DENV infections

▸ **For travel associated cases** in areas with moderate probability of transmission, vector control programs may conduct surveillance of *Aedes aegypti* and *albopictus* mosquitoes within 100–200 meters of the home(s) of travel associated case(s).

▸ **For locally acquired cases** vector control programs should conduct surveillance of *Aedes aegypti* and *albopictus* mosquitoes within 100–200 meters of the home or locations where the individual is likely to have been infected based on feedback from epidemiologists. Vector surveillance may include the neighborhood where the locally acquired dengue case resides, and extend further to neighboring areas in case additional locally acquired cases are reported outside the immediate neighborhood. Mosquito surveillance will assist in evaluating the impact of vector control efforts.

▸ **Mosquito virologic surveillance** may be most useful in focal areas where DENV transmission is suspected but unprecedented (i.e., first evidence of mosquito-borne local DENV transmission in a non-endemic area). Testing mosquitoes for arboviruses can help confirm local transmission. However, negative results are not conclusive, as virologic surveillance in mosquitoes has imperfect sensitivity and local transmission can occur in the absence of positive mosquito pools.

• **Implementing mosquito population and virologic surveillance**

  ◆ There is currently no 'best practice' guidance on the type or number of traps to use. However, in previous dengue investigations, CDC scientists have placed 20–30 traps within 100–200 meters of the

suspected site of infection. BG-Sentinel or Autocidal Gravid Ovitraps (AGO) have been shown useful in detecting infected container *Aedes* mosquitoes.

◆ Traps should be serviced every day if using BG traps or twice a week for AGO traps to collect pools of *Aedes aegypti* and *albopictus* females for DENV testing and maximize chances of detecting the virus in mosquitoes. If the number of mosquito pools is high and straining resources of vector control programs, a super pool approach can reduce the number of RT-PCR tests required to detect dengue viral RNA in female *Aedes aegypti* and *albopictus* mosquitoes. A super pool consists of testing a pooled sample of aliquots taken from several individual mosquito pools (e.g., 10 individual pools; 1–20 individuals/pool). If a super pool is positive, then each individual pool needs to be tested, but if the super pool is negative there is no further testing.

◆ Sensitivity for DENV detection in mosquitoes can be increased by using higher numbers of traps (more mosquitoes captured) and maintaining surveillance for multiple weeks.

Appendix D. CDC Dengue Resources

Healthcare providers

▸ A Dengue Health Advisory was issued by CDC through the Health Alert Network, recommending having a high suspicion for dengue among people with fever and recent travel to dengue-endemic areas, and considering dengue among people without a history of travel who have signs and symptoms highly compatible with dengue (e.g., fever, rash, leukopenia, and thrombocytopenia): https://emergency.cdc.gov/han/2024/han00511.asp

▸ CDC Yellow Book, Dengue Chapter: Dengue | CDC Yellow Book 2024

▸ Dengue clinical courses, which are available from the CDC (Dengue Clinical Case Management course (DCCM) | Dengue | CDC) and the Pan American Health Organization (Self-learning course: Clinical Diagnosis and Management of Dengue | Virtual Campus for Public Health (VCPH/PAHO))

▸ A Clinician Outreach and Communication Activity Call developed by the CDC (Webinar Thursday, September 29, 2022 - What Clinicians Need to Know about Dengue in the United States (cdc.gov))

▸ A dengue pocket guide to assist clinicians with clinical management of dengue

▸ A podcast from Emory University's Serious Communicable Disease Program and Project ECHO discusses a case of dengue fever tailored to clinicians (A Case of Dengue Fever | SCDP ECHO Podcast (simplecast.com))

▸ Travel Health Notices | Travelers' Health | CDC

▸ Additional resources can be found here: Dengue for Health Care Providers | Dengue | CDC.

In addition, health departments should coordinate with public health laboratories and healthcare providers to provide them with updated information on dengue testing practices, testing recommendations, available resources, and diagnostic kits (Clinical Testing Guidance for Dengue)

Public

▸ **Web site**

- Dengue | Dengue | CDC

▸ **Fact sheets**

- About Dengue | Virus del dengue

- Protect Yourself from Bites | Cómo protegerse de las picaduras de mosquito

- Information for Dengue Patients | Información para personas con dengue

- Prevent Dengue During Pregnancy | El dengue durante el embarazo

- Protect your Baby | Su bebé tiene dengue

- Mosquito Life Cycle | Ciclo de vida del mosquito

- Get Rid of Mosquitoes at Home | Elimine los mosquitoes en la casa

- Septic Tank | Tanque séptico
- Mosquito Control During an Outbreak | Control de mosquitos durante un brote

▸ **Other materials**

- Mosquito Bites Are Bad! (activity book) | Las picaduras de mosquitos son malas (libro de actividades)
- Door Hangers | Colgadores de puerta
- Recursos—Unidad Control de Vectores de Puerto Rico (prvectorcontrol.org)

▸ **Social Media Posts**

- https://www.facebook.com/cdc/videos/1489280128601050
- https://www.facebook.com/share/p/7EuR7HV3yVRXAGgM/?mibextid=WC7FNe
- https://www.facebook.com/share/p/iGHNGLompJjuskC6/?mibextid=WC7FNe
- https://www.facebook.com/story.php?story_fbid=862128545951156&id=100064620552388&rdid=6fS1VqD44w8oSfsW
- https://x.com/cdcgov/status/1778840531428167770?s=46&t=bR4uog4tb5sAuGvW34qPwQ
- https://x.com/cdcespanol/status/1777384937974374683?s=46&t=bR4uog4tb5sAuGvW34qPwQ
- https://www.instagram.com/p/C-di7ACurXr/
- https://www.instagram.com/p/C95DbFjtLem/?img_index=1
- https://www.instagram.com/p/C74haxNMckO/?img_index=1

Media

▸ Press Kit: Mosquitoes | Mosquitoes | CDC

Appendix E. Enhanced Dengue Surveillance for Ongoing Local Transmission

Some health departments may choose to conduct enhanced surveillance when locally acquired cases are detected. Approaches to consider are discussed below.

Active case finding around travel associated dengue cases

Active case finding can be implemented around travel associated or locally acquired dengue cases. Household members and persons with similar exposures (e.g., neighbors, work colleagues, schoolmates) of travel associated and locally acquired case patients can be interviewed about symptoms of DENV infection and urged to contact the local health department if symptoms develop. While household contacts of a dengue case may be most at risk, other settings in which persons with DENV infection may spend a large amount of time (e.g., workplace or school) may play a role in amplifying transmission. Special attention should be placed to settings in which transmission can amplify rapidly, such as densely populated encampments in urban areas where air-conditioning and mosquito screens are uncommon. Any persons with symptoms consistent with DENV infection who live near or in close proximity to a suspected human DENV infection case or reside within a 100–200-meter radius of a mosquito pool where DENV has been detected should be tested.

Implementation of syndromic surveillance for dengue

Emergency department electronic health records and other local sources of syndromic data could be evaluated prospectively and retrospectively to identify missed dengue cases. STLT Health Officers should work with facilities to sequester all blood specimens available from persons meeting dengue syndromic definitions for additional testing. The Florida Department of Health has developed syndromic definitions for dengue (available upon request). Using medical records of confirmed dengue cases could be useful to detect patterns to be used for case identification (e.g., fever plus leukopenia and thrombocytopenia). In addition, ICD-10 codes compatible with DENV infection can be queried to evaluate the potential for missed cases (available upon request).

Expanded diagnostic testing for DENV in areas with locally acquired dengue cases

State health departments in areas at higher risk for local DENV transmission can consider working with commercial laboratories to perform additional DENV testing by RT-PCR and IgM on the following:

▸ Specimens tested for dengue RT-PCR, NS1, IgM or IgG with positive or equivocal results

▸ Specimens tested for Zika or chikungunya with negative results that were not already tested for dengue

The CDC can coordinate with state health departments and public health labs to perform confirmatory DENV RT-PCR testing with serotyping and consider additional testing such as Plaque Reduction Neutralization Test (PRNT) if appropriate.

Sentinel site surveillance

State health departments can consider leveraging existing collaborations with hospitals or academic centers to test subsets of patients presenting with a dengue-compatible syndrome for DENV infection.

Wastewater surveillance

Recent findings from a feasibility study in Florida indicate that wastewater surveillance of DENV is possible (https://pubs.acs.org/doi/10.1021/acs.estlett.3c00769). However, limited data exist regarding the sensitivity of this method. Jurisdictions at increased risk of DENV transmission and with active wastewater surveillance activities could consider the implementation of protocols to better evaluate its utility in monitoring dengue transmission trends and detecting silent transmission in areas without reported human cases.

Appendix F. Accessible Decription for Figures

Algorithm A. Investigating Suspected Dengue Cases

A flowchart describing how to investigate suspected dengue cases. The first step in the flowchart is to determine if the case meets the laboratory criteria for recent DENV infection. If "no—the case does not meet laboratory criteria for recent DENV infection," and you suspect dengue based on clinical and exposure criteria, perform dengue testing. If "no," and testing has been performed and is negative, rule out as not a case. If "no" and no specimen is available for testing, classify as a suspect case. Alternatively, if "yes—the case does meet laboratory criteria for recent DENV infection," follow the case report form for investigation, identify other symptomatic or ill people in the household and recommend dengue testing, tell everyone in the household how to prevent the spread of dengue, and advise patients to seek care in the presence of warning signs of severe dengue.

For cases who meet the laboratory criteria for recent DENV infection, also determine if the person has been to an area with active DENV transmission (including within the continental United States) in the 2 weeks before symptom onset. If yes, this is travel-associated dengue. Follow recommendations for travel-associated dengue cases (Algorithm B). If no, this is suspected locally acquired dengue. If a locally acquired case is suspected in a non-endemic area, investigate all possible routes of infection, including known presence of and exposure to *Aedes* mosquitoes, receipt of blood, organs, or tissue products, and possible laboratory or occupational exposure.

If the locally acquired case meets laboratory criteria for a confirmed case, follow recommendations for local dengue transmission (Algorithm C). If the locally acquired case has a single IgM+, and does not meet laboratory criteria for a confirmed case, it is considered probable. For probable (single IgM+) locally acquired cases in areas without documented DENV transmission, attempt further confirmatory testing. If further testing is possible, retest the original specimens by RT-PCR and collect additional specimens to evaluate seroconversion or presence of neutralizing antibodies by PRNT. If results from further testing are confirmatory, follow recommendations in Algorithm C. If a probable case is identified and no further testing is possible, or if confirmatory test results are negative or inconclusive, a jurisdiction may decide to implement the recommendations in Algorithm C if the clinical presentation, available test results, and local epidemiology indicate there is the possibility of local transmission. Additionally, consider pursuing additional mosquito or human surveillance in the area.

Additional Considerations

For case confirmation in areas where local transmission of DENV has never been reported, including re-testing of specimens and result validation, contact the CDC Dengue Branch for assistance (dengue@cdc.gov).

Links

- Laboratory criteria
- Case report form
- Prevent the spread of dengue
- Warning signs
- Clinical and exposure criteria

Figure 1. Estimated Potential Range of *Aedes aegypti* and *Aedes albopictus* in the United States, 2017

The figure contains two maps. The map at the top of the page shows the potential range of *Aedes aegypti* mosquitoes in the contiguous United States by using various shades of blue. Dark blue means that *Aedes aegypti* are very likely to be able to live and reproduce. The medium blue shade means that *Aedes aegypti* are likely able to live and reproduce. Light blue means that *Aedes aegypti* are unlikely to be able to live and reproduce. Gray means *Aedes aegypti* are very unlikely to be able to live and reproduce. Text to the right of this map reads, *"Aedes aegypti* mosquitoes are more likely to spread Zika, dengue, chikungunya, and other viruses than other types of mosquitoes such as *Ae. albopictus* mosquitoes."* The following is the list of the 48 states in the contiguous United States and the likelihood of *Aedes aegypti* to be able to live and reproduce in that state.

- Alabama—very likely
- Arizona—mixture of very likely (southeast, central, and northwest), likely (southwest and small part of southeast), unlikely (central north), and very unlikely (east central & north)
- Arkansas—very likely
- California—mixture of very likely (most of the state including the southern half and parts of the central north), likely (small strip on the northern west coast and patches to the central east), unlikely (northwest corner), and very unlikely (northeast and small part of east central)
- Colorado—mixture of unlikely (southeast corner and small patch in the center of the state) and very unlikely (rest of state)
- Connecticut—mixture of unlikely (entire state excluding parts that are very unlikely) and very unlikely (northwest corner)
- Delaware—very likely
- Florida—very likely
- Georgia—most of the state is very likely except for a small match in the northeast corner which is likely
- Idaho—very unlikely
- Illinois—mixture of very likely (south), likely (southern central), unlikely (majority of the central and northern parts of the state), and very unlikely (northernmost part of the state)
- Indiana—mixture of very likely (south), likely (southern central), unlikely (central and north)

- Iowa—mixture of unlikely (southeast corner and small patch in the southwest of the state) and very unlikely (rest of state)
- Kansas—mixture of very likely (small patches in south central and southeast), likely (south and central parts of the state that are not very likely), and unlikely (the remaining northern and central parts of the state)
- Kentucky—most of the state is very likely except for the southeast corner and a small patch in the northeast which are likely
- Louisiana—very likely
- Maine—very unlikely
- Maryland—most of the state is very likely excluding small patches across the north which are likely
- Massachusetts—mixture of unlikely (eastern third of the state) and very unlikely (rest of state)
- Michigan—mixture of unlikely (southern third of the state) and very unlikely (rest of state)
- Minnesota—very unlikely
- Mississippi—very likely
- Missouri—mixture of very likely (southern half of state), likely (central strip) and unlikely (northern third of state)
- Montana—very unlikely
- Nebraska—mixture of unlikely (southeast corner) and very unlikely (rest of state)

- Nevada—mixture of likely (southeast corner), unlikely (southeast quarter of state excluding part that is likely), and very unlikely (rest of state)
- New Hampshire—very unlikely
- New Jersey—mixture of very likely (southern), likely (southeast corner and central), and unlikely (northern third of state)
- New Mexico—mixture of very likely (southernmost part of state), likely (east and some parts of south), unlikely (central and northeast), very unlikely (northwest half of state)
- New York—mixture of unlikely (some areas in the southeast and southwest of state) and very unlikely (rest of state)
- North Carolina—most of the state is very likely except for some areas in the southwest which are likely and small patches in the western part of the state that are unlikely
- North Dakota—very unlikely
- Ohio—mixture of very likely (small patches in the south), likely (southern half of state excluding parts that are very likely), and unlikely (northern half of state)
- Oklahoma—mixture of very likely (entire state excluding the panhandle), likely (most of the panhandle), and unlikely (the westernmost tip of the panhandle)
- Oregon—mixture of unlikely (western third of the state and some patches in the north) and very unlikely (rest of the state)

- Pennsylvania—mixture of likely (small patches in the southernmost part of the state), unlikely (majority of the rest of the state excluding parts that are very unlikely), and very unlikely (northern third of the state)
- Rhode Island - unlikely
- South Carolina—very likely
- South Dakota—very unlikely
- Tennessee—most of the state is very likely except for patches in the east that are likely and the northeast corner which is unlikely
- Texas—mixture of very likely (majority of state), likely (most of the panhandle), and unlikely (northwest corner of panhandle)
- Utah—mixture of likely (southwest corner) and very unlikely (rest of the state)
- Vermont—very unlikely
- Virginia—mixture of very likely (majority of the state), likely (majority of the western third of the state), and unlikely (small patches in the west)
- Washington—mixture of unlikely (small patches in the south and central parts of state) and very unlikely (rest of the state)
- West Virginia—mixture of very likely (westernmost part of state), likely (central), and unlikely (eastern third of state and small area in north)
- Wisconsin—very unlikely
- Wyoming—very unlikely

The map at the bottom of the page shows the potential range of *Aedes albopictus* mosquitoes in the contiguous United States by using various shades of green. Dark green means that *Aedes albopictus* are very likely to be able to live and reproduce. The medium green shade means that *Aedes albopictus* are likely able to live and reproduce. Light green means that *Aedes albopictus* are unlikely to be able to live and reproduce. Gray means *Aedes albopictus* are very unlikely to be able to live and reproduce. The following is the list of the 48 states in the contiguous United States and the likelihood of *Aedes albopictus* to be able to live and reproduce in that state.

- Alabama—very likely
- Arizona—mixture of unlikely (southwest corner) and very unlikely (rest of state)
- Arkansas—very likely
- California—mixture of unlikely (patches throughout the south and along most of the coast) and very unlikely (rest of state)
- Colorado—mixture of unlikely (small patches in the southeast, south central, and north central) and very unlikely (rest of state)
- Connecticut—mixture of very likely (southern half of state), likely (patch in north central), and unlikely (northern half of state excluding part that is likely)
- Delaware—very likely
- Florida—very likely
- Georgia—very likely
- Idaho—very unlikely
- Illinois—mixture of very likely (southern half of state), likely (strip across northern central part of state), and unlikely (northern third of state)
- Indiana—mixture of very likely (entire state excluding parts that are likely and unlikely), likely (northern quarter of state excluding area that is unlikely), and unlikely (northeast corner)
- Iowa—mixture of unlikely (southeastern half of state) and very unlikely (rest of state)
- Kansas—mixture of very likely (southeast corner), likely (strip spanning from the south central to the northeast), unlikely (majority of state from southwest to northeast), and very unlikely (northwest corner)
- Kentucky—very likely
- Louisiana—very likely
- Maine—mixture of unlikely (small patches in the south) and very unlikely (rest of state)
- Maryland—very likely
- Massachusetts—mixture of very likely (eastern quarter of state) and likely (rest of state)
- Michigan—mixture of likely (tiny patch in southwest corner), unlikely (majority of state excluding likely and very unlikely areas), and very unlikely (northern third of state)
- Minnesota—very unlikely
- Mississippi—very likely
- Missouri—mixture of very likely (bottom three quarters of state), likely (small patches in the north), and unlikely (northern quarter of the state excluding likely patches)
- Montana—very unlikely
- Nebraska—mixture of unlikely (southeast corner) and very unlikely (rest of state)
- Nevada—mixture of unlikely (large chunk in the southeast of the state) and very unlikely (rest of state)
- New Hampshire - unlikely
- New Jersey—most of the state is very likely except a small patch in the northwest which is likely
- New Mexico—mixture of unlikely (majority of the southern and eastern parts of the state with some patches throughout) and very unlikely (rest of state)
- New York—mixture of very likely (tiny corner in southeast), likely (small patches in the southeast and west), and unlikely (rest of state)
- North Carolina—very likely
- North Dakota—very unlikely
- Ohio—most of the state is very likely except the northwest corner which is likely
- Oklahoma—mixture of very likely (majority of the state from east to central), likely (western part of state excluding panhandle), and unlikely (entire panhandle)

- Oregon—mixture of very likely (small patches on coast), likely (patches along coast and central east), unlikely (western third of state excluding areas that are likely and very likely), and very unlikely (rest of state)
- Pennsylvania—mixture of very likely (southern half of state and patch in northwest corner), likely (small patches in northwest and central east), and unlikely (rest of state)
- Rhode Island- mixture of very likely (southern half of state) and likely (northern half of state)

- South Carolina—very likely
- South Dakota—very unlikely
- Tennessee—very likely
- Texas—mixture of very likely (eastern half of state), likely (large strip from north to south in the center of the state), unlikely (western part of state including very unlikely area), and very unlikely (westernmost corner)
- Utah—mixture of unlikely (small patches in the north central and southwest areas) and very unlikely (rest of state)
- Vermont—unlikely

- Virginia—very likely
- Washington—mixture of likely (small patch on southern coast), unlikely (western third of state excluding very likely part), and very unlikely (rest of state)
- West Virginia—very likely
- Wisconsin—mixture of unlikely (southern border area) and very unlikely (rest of state)
- Wyoming—very unlikely

Text to the right of both maps explains that these maps DO NOT show exact locations or numbers of mosquitoes living in an area or the risk or likelihood that these mosquitoes will spread viruses. These maps show CDC's best estimate of the potential range of *Ae. Aegypti* and *Ae. Albopictus* in the United States and areas where mosquitoes are or have been previously found.

*CDC has updated the estimated range maps for *Ae. aegypti* and *Ae. albopictus* mosquitoes by using a model that predicts possible geographic ranges for these mosquitoes in the contiguous United States. The model used county-level records, historical records, and suitable climate variables to predict the likelihood (very low, low, moderate, or high) that these mosquitoes could survive and reproduce if introduced to an area during the months when mosquitoes are locally active. Maps are not meant to represent risk for spread of any specific disease. (See Johnson TL et al. Modeling the environmental suitability for *Aedes (Stegomyia) aegypti* and *Aedes (Stegomyia) albopictus* (Diptera: Culicidae) in the contiguous United States. Jrl Med Entomol. Sept. 2017;[ahead of print].)

Algorithm B. DENV Transmission Risk Levels and Recommended Actions for Travel Associated Dengue Cases

A flowchart with recommendations about how to respond to travel associated dengue cases based on risk. The following are recommendations for all areas:

▶ Increase traveler awareness about how to protect themselves against mosquito bites during and after travel and to seek care if they develop symptoms.

▶ Encourage people to use and repair screens in windows and doors to prevent mosquito bites.

▶ Promote the use of EPA-registered repellents and protective clothing while in areas where mosquito bites are possible.

▶ Educate healthcare providers to consider and test for dengue virus (DENV) infection in febrile returning travelers from an area with ongoing DENV transmission within the last 14 days.

▶ Familiarize healthcare providers with DENV testing, including the recommended test types and interpretation.

▶ Advise patients to seek care in the presence of warning signs of severe dengue.

▶ If travel was to a location in the United States, state health officials should notify the jurisdiction where infection was acquired.

To decide if additional actions should be considered, start by asking, "are *Aedes aegypti* or *Aedes albopictus* mosquitoes present?"*† If "no, *Aedes aegypti* or *Aedes albopictus* mosquitoes are not present," there is no risk of DENV transmission, and you can follow recommendations for all areas. If "yes, *Aedes aegypti* or *Aedes albopictus* mosquitoes are present," you should next determine if local dengue virus transmission has occurred in the past. If "no—local dengue virus transmission has not occurred in the past," there is low risk of DENV transmission. If there is low risk, the health department should follow recommendations for all areas and establish or maintain communications

with vector control agencies to coordinate surveillance and vector control efforts.

If *Aedes aegypti* or *Aedes albopictus* mosquitoes are present and local dengue virus transmission has occurred in the past, there is moderate risk of DENV transmission. In addition to recommendations for all areas, establish communication with vector control agencies to coordinate surveillance and vector control efforts. Additional recommendations if there is moderate risk are as follows:

▶ Vector control

  • Implement source reduction, larvicide treatment, and spray mosquito resting places and containers that cannot be eliminated around the home with residual insecticide.

  • These steps should extend to a 100–200-meter radius† of the reported case(s).

  • Engage in community outreach and educational campaigns on effective mosquito control, clean-up campaigns to remove or reduce aquatic habitats, and reporting possible mosquito sources.

▶ Enhanced surveillance

  • Consider enhanced surveillance in areas with increased risk, such as higher-than-expected numbers of travel-associated cases in a small geographic area or historical locally acquired cases. Use larvae/pupae surveys to identify and target the most productive aquatic habitats.

  • Active case finding around travel-associated cases, including anyone symptomatic or with recent travel to an area with dengue transmission.

▶ Healthcare provider outreach

  • Inform healthcare providers to consider testing for dengue in patients with symptoms

highly compatible with dengue regardless of recent travel history, and in the absence of another diagnosis.

- Provide them with clinical management resources.

* As confirmed by local vector surveillance or based on best estimates of the potential range of *Aedes.*

† Other factors that may affect dengue transmission include:

▸ Increase:

- High numbers of travel-associated cases

- High human population density

- Elevated *Aedes* abundance and increased frequency of breeding sites

- High precipitation

- Average daytime temperatures between 68–95°F

▸ Decrease:

- Elevation greater than or equal to 6,000 feet

† Average flight range of a newly emerged *Aedes* mosquito

Links

▸ How to protect against mosquito bites

▸ Test types and interpretation

▸ Warning signs

▸ Clinical management resources

▸ Potential range of *Aedes*

Algorithm C. Recommended Actions for Locally Acquired Dengue Cases

A flowchart explaining what to do if local dengue transmission occurs. In all instances, the following steps should be taken:

▶ Coordination

- Coordinate with CDC and other agencies regarding local DENV transmission and response.

- Establish or strengthen communication channels between public health and vector control agencies to coordinate surveillance and vector control efforts.

▶ Vector control

- Implement source reduction, larvicide treatment, and spray mosquito resting places and containers that cannot be eliminated around the home with residual insecticide in a 100–200-meter radius† of reported case(s).

- Extend to neighboring areas in case the virus has spread beyond the immediate area. Monitor the effectiveness of vector control efforts.

▶ Enhanced surveillance

- Offer DENV testing to household members with a recent febrile illness.

- Strongly consider enhanced surveillance around the household, particularly if the source of DENV is unknown, including:

  ◆ Door-to-door active case finding to identify and offer testing to people with elevated risk based on symptoms, ask about travel history.

  ◆ Serosurveys among households within 100–200 meters of dengue case households.

  ◆ Consider virologic surveillance of *Aedes aegypti* and *albopictus* mosquitoes within 100–200 meters† of the location where the patient is likely to have been infected

if this is the first locally acquired dengue case in an area.

▶ Provider outreach

- Intensify clinician outreach activities to enhance dengue detection, diagnosis, and management.

- Inform providers to suspect and test for dengue in patients with compatible symptoms, regardless of recent travel, and in the absence of other diagnosis.

- Provide them with dengue clinical management resources.

▶ Communication

- Conduct appropriate risk communication, following established principles.

- Provide updated epidemiologic reports to key stakeholders.

- Continue mosquito control education and tailor messages to communities at risk of increased transmission.

Additional actions should be taken if multiple geographic areas are affected (greater than 500 meters apart) or locally acquired case numbers are above expected levels. These additional actions are as follows:

▶ Expand vector control

- Implement area-wide larvicide and adulticide treatments by prioritizing areas based on the number of cases reported and vector surveillance results as outlined in vector control recommendations above.

- Intensify community outreach and educational campaigns on effective mosquito control, the importance of clean-up campaigns to remove or reduce aquatic habitats and reporting possible mosquito sources to authorities, and personal protective measures against mosquito bites.

- Expand enhanced surveillance

  - In addition to enhanced surveillance activities outlined above:

    - Implement syndromic surveillance in healthcare facilities around the areas of concern.

    - Work with commercial labs to re-test positive or equivocal results by any test (RT-PCR, NS1, IgM and IgG) from suspected dengue cases with NAAT and IgM.

    - Implement sentinel surveillance for dengue-like illness in high-risk areas.

[†] Average flight range of a newly emerged *Aedes* mosquito.

Links

- Test for dengue

- Dengue clinical management resources

- Risk communication

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