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## Chikungunya: an imminent threat to the United States

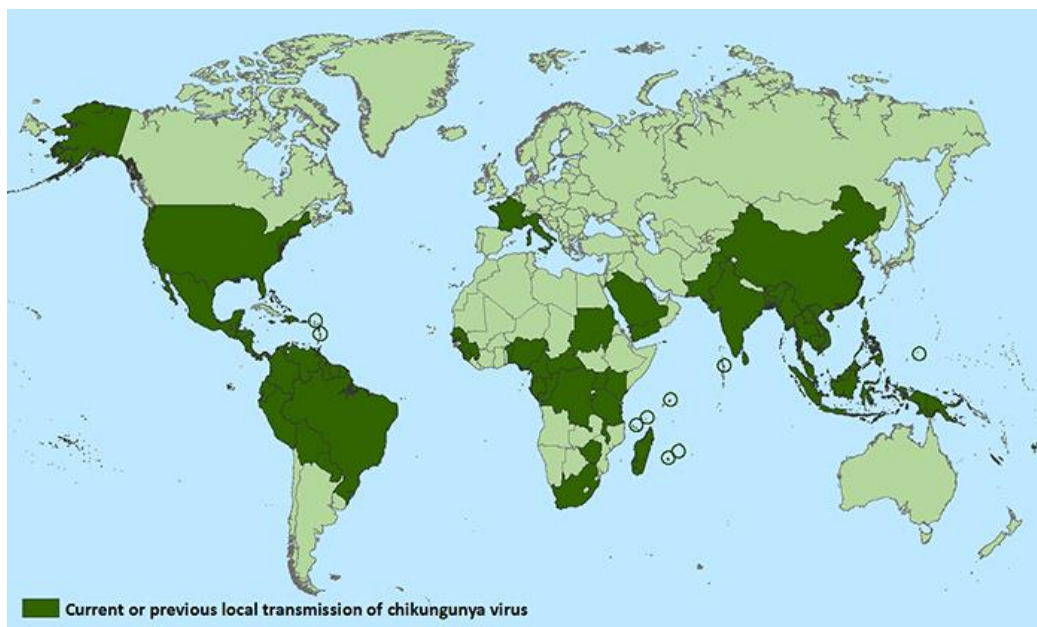
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**Abstract.** Recent years have seen a drastic increase in the number of cases of Chikungunya, a mosquito-vectorized disease spread by day-feeding mosquitoes in the genus *Aedes* (Diptera: Culicidae). Cases of this disease have been on the rise in the Caribbean Islands as well as in many South American countries. The presence of the vector in many parts of the United States, as well as the proximity to these cases make Chikungunya a looming threat to the United States. While this disease is rarely considered a lethal one, the lasting impacts of an outbreak would be significantly detrimental to the infrastructure of the United States.

**Key Words:** One health, Chikungunya, mosquitoes

### Background

Chikungunya, often abbreviated as CHIKV, was first isolated in Tasmania in the 1950's. CHIKV is an alpha virus in the family Togaviridae, and is rated as Category C priority pathogen by the National Institutes of Health. The NIH rates illnesses based upon threat to the public, how easily the disease can be spread and the public perception of an illness. This disease was mostly isolated to small occurrences throughout Asia and Africa for many years, with occasional larger outbreaks in Europe and many island nations. In the last decade or so, Chikungunya has made its return to the Americas with an alarming rate of outbreaks (Jansen et al. 2015) (Figure 1).



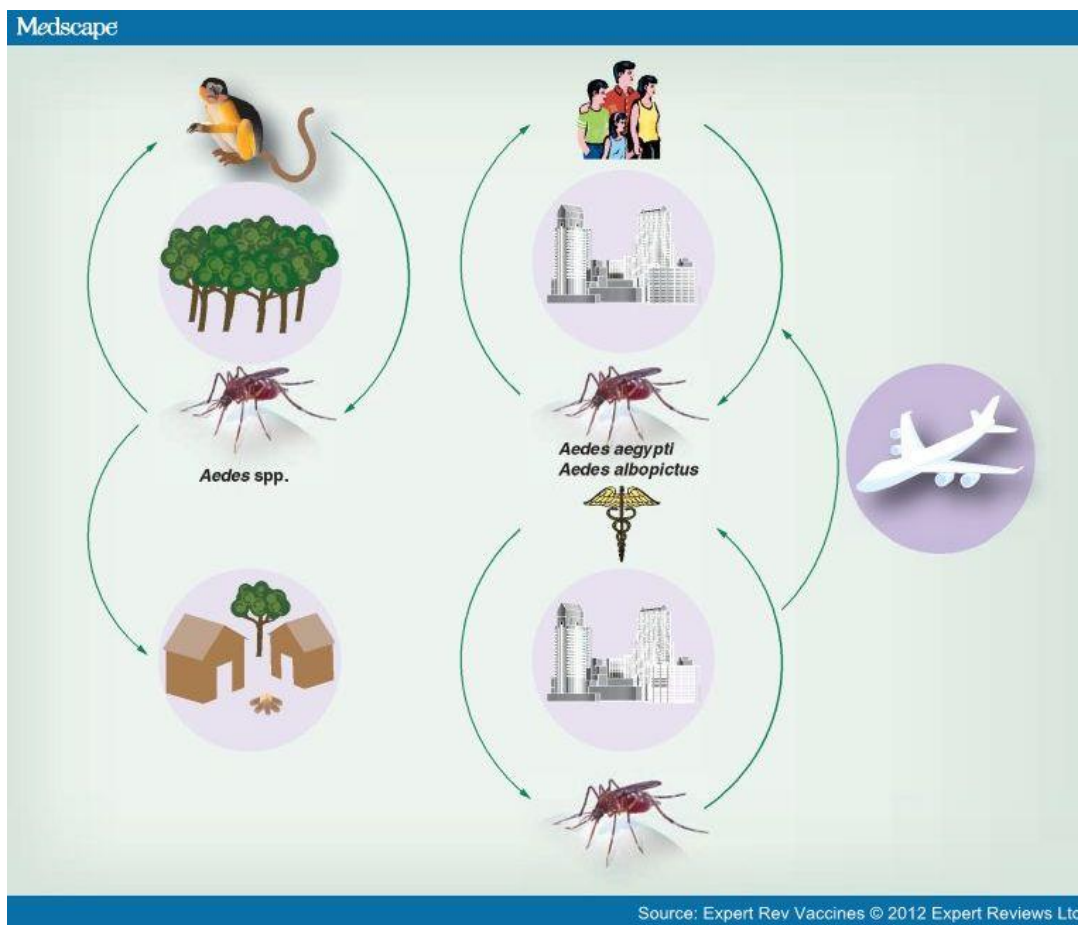
**Figure 1.** Reported cases of locally transmitted Chikungunya virus as of October 2015.

<http://www.cdc.gov/chikungunya/geo/>

**Introduction**

Chikungunya is an Arbovirus, meaning that it is transmitted by an arthropod vector. The preferred vectors of this disease are mosquitoes in the genus *Aedes* (Diptera: Culicidae), specifically *Aedes albopictus* (Skuse) and *A. aegypti* (L.). These mosquitoes feed during the day, unlike many species that feed at night. Transmission occurs when a female mosquito takes a blood meal prior to laying eggs. Feeding on a host while it is awake and mobile has many implications for the spread of the disease. As the host travels, the disease can be carried farther in a shorter period of time than it would otherwise (Figure 2).

There are two types of Chikungunya transmission. In a jungle setting, *Aedes spp.* mosquitoes transmit the virus among different species of primates, mainly monkeys. In urban settings, people are impacted by the disease. It has been noted that humans are the major host for the virus (Fischer and Staples 2014).



**Figure 2.** Two ways that Chikungunya is transmitted. [http://www.medscape.com/viewarticle/774865\\_3](http://www.medscape.com/viewarticle/774865_3)

The day-time feeding of *Aedes* shows a great risk for farmers and other people working outdoors that may be exposed to mosquitoes. These are the people and jobs that form the backbone of the country, and if a majority or even just a large portion were to be weakened by the lasting effects of Chikungunya, then the economic toll could easily destabilize the United States.

Many cases of Chikungunya have been reported in the Caribbean Islands in recent years, and it is spreading through South America at a rapid pace. There have been a handful of cases in the United States already, mostly confined to Florida. However, the vector is present in much of the US and the disease could be easily spread if not contained. If Chikungunya were to become established in the United

States, the cost would be immeasurable. While the disease is rarely fatal, it leaves a lasting impact on the health of the infected. Joint pain and weakness can follow infection for months to years after the person was infected. This would potentially take a large portion of the work force either entirely out of commission, or at least drastically reduce the amount that people would be able to work at times. The potential economic impact is drastic.

### One Health

Chikungunya is a worldwide disease. It impacts people in Europe, Asia, the Americas, Africa and the Pacific Islands. The vector is present in large numbers all over the world, and with an increase in travel among countries the number of cases is rising.

In Australia, work has been done that indicates that two of their endemic mosquitoes would be competent vectors. These mosquitoes also belong to the genus *Aedes*. Despite being able to vector the disease, however, these mosquitoes would not be as effective as *A. albopictus* or *A. aegypti* (Jansen et al. 2015). This raises the question of other species in the genus potentially aiding in the spread of the disease.

### Epidemiology

Chikungunya infection is often described as a high fever and joint pain that lasts for about a week in most cases, with the joint pain continuing for a long time. Other signs and symptoms reported include diarrhea, rash, swelling and muscle pain. In healthy people, it is similar to a severe flu with lasting soreness and recurring joint pain. This pain can last for a considerable amount of time post-infection, sometimes lasting many years. In the extremely young, the elderly, and the immunocompromised, this disease can be deadly.

In some cases, the symptoms are severe enough that doctors confuse Chikungunya with a more dangerous disease, Dengue Fever. Both share the common traits of severe joint pain and fever. Laboratory testing can be used to determine the actual disease, and symptoms are treated accordingly. A medicine to treat Chikungunya has not been developed as of yet. The symptoms are treated using fever and pain reducers and patients are encouraged to rest and drink fluids (Sharp et al. 2014).

### Approach

Much of the data on Chikungunya virus has come from the doctors that have treated it and the entomologists who have studied the vector. This data gets reported in the Center for Disease Control and Preventions Morbidity and Mortality Weekly Reports. The information is then made available for the public and is used to evaluate the spread of disease (Fischer and Staples 2014, Sharp et al. 2014).

Fischer and Staples (2014) examined data from the western hemisphere and noted the countries with the highest reported incidences of local transmission of Chikungunya. The countries with high levels of local transmission all have high levels of tourist travel coming in and out.

Sharp et al. (2014) looked at the numbers of Chikungunya cases in Puerto Rico. Laboratory methods were used to examine cases of suspected dengue fever. A portion of the cases tested were negative or dengue, and around nine percent of those tested positive for Chikungunya.

To test the potential of other *Aedes* mosquitoes in transmitting Chikungunya, Jansen et al. (2015) compared information found in the literature that would implicate two additional species of *Aedes* mosquitoes endemic to Australia. Jansen et al (2015) took this information and put it into a vectoral capacity model to examine the potential of these mosquitoes to transmit Chikungunya. The model showed that while these mosquitoes could potentially transmit the virus, it would be less effective than *A. aegypti* or *A. albopictus*.

### Control Recommendations

The threat Chikungunya poses to the United States is real, but it can be combatted. The easiest way to combat mosquito borne illness is to fight the vector. Increased public education and outreach can be used hand in hand with traditional Integrated Pest Management (IPM) practices to reduce the bites that people sustain. Repellants should also be made easier to access by the general public, especially people who work outdoors during the times that *Aedes* are most active. Employers could provide their workers with these repellants as part of corporate policies.

School age children in areas where Chikungunya can be easily transmitted, especially Florida and the rest of the Southeastern United States, should be educated from a young age about the threat of mosquito-borne illnesses and ways to protect themselves. Starting with the children, parents and other adults should also be informed and taught how to protect themselves from bites.

Along with education, IPM practices should be used to reduce the number of mosquitoes in an area. Spraying, reducing the amount of standing water available for breeding, and other management can be used to protect the general public.

One potential practice to help keep Chikungunya from becoming established in the United States is to have screening done at airports on flights returning from areas where the disease is prevalent. Ideally, the screening process would be minimally invasive and require little time to complete. While this is going on, work must go forward to create a vaccine to combat this disease.

### Conclusions

Chikungunya is an arthropod-borne disease that could drastically impact life in the United States. Though there is a low death rate from this flu-like illness, the lasting effects could take a massive toll on the American working class. The vector mosquitoes in the genus *Aedes* are most active during the day, a time when many people are working. The virus is easily spread from country to country via citizens traveling for work or vacations.

Through education of the general public and management of the vector, Chikungunya can potentially be slowed down or stopped from establishing itself in the United States. This is not the only thing that should be done, however. Scientists and doctors must keep working together to find a medicine to treat Chikungunya. That is the only way to truly rid the world of this disease.

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