

NEHA
First Confirmed Case of Imported Zika Virus in Houston Texas

Hello, and welcome to the presentation First Confirmed Case of Imported Zika Virus in Houston, Texas: Preventing Transmission. To ask questions about this presentation, join the presenter for a chat hour in the networking lounge.

I would now like to introduce our presenter, Amanda Eckert, Surveillance Investigator with the Houston Health Department.

Hi. Welcome. My name is Amanda Eckert, and I am an epidemiologist here at the City of Houston Health Department. I have my Master's in Public Health from the University of West Florida with an emphasis on infection control. And before I came to the City of Houston, I was actually an intern at the Escambia County Health Department in Florida.

Today I am going to present a slide show on Zika virus, and I will discuss the first confirmed case of imported Zika virus here in Houston, Texas. Most of the information being presented was obtained from the Centers for Disease Control and Prevention website, as they are our nation's health protection agency. So you can find all of the updated information on Zika virus on their website.

Okay. So the objectives. Today we're going to go into discuss epidemiology of Zika virus. We're going to describe the Zika case investigation of the first confirmed case in Houston, Texas. I will discuss how emerging diseases are controlled by timely identification and reporting from clinicians. And articulate the importance of prompt surveillance and patient education in preventing the spread of vector-borne diseases.

Okay, so here's a little Zika virus introduction. It is a single-stranded RNA virus. It's family is Flaviviridae and its genus is Flavivirus. It is related to dengue, Japanese encephalitis, yellow fever and West Nile virus. And it is transmitted to humans by Aedes species mosquitoes.

Okay, so a Zika virus timeline. So I found this Zika virus timeline on the World Health Organization's website. It shows you that this is not a new virus. It has been around for a while.

So Zika virus was first discovered in 1947 from a rhesus monkey and is named after the Zika forest in Uganda. In 1952, the first human cases of Zika were detected, and since then outbreaks of Zika have been reported in tropical Africa, southeast Asia, and the Pacific Islands. Zika outbreaks have probably occurred in many locations. Before 2007, at least 14 cases of Zika had been documented according to the CDC although other cases were likely to have occurred and were not reported. Because the symptoms of Zika are similar to those of many other diseases, especially dengue and chikungunya, many cases may not have been recognized.

Okay, so modes of transmission. In the jungle cycle, mosquitoes and monkeys transmit the virus back and forth to each other. International trade brought Aedes mosquitoes to different parts of the country where they have infected humans. Aedes species mosquitoes are the same mosquitoes that spread dengue and chikungunya. They are aggressive daytime biters, but they can also bite at night.

The Zika virus is not transmitted from person to person, but if a mosquito bites an infected person, the mosquito can be infected and then transmit the virus to other people.

Okay. So there are some other modes of transmission. Zika virus can be spread by a man to his sex partner, so there is documentation of sexual transmission. In known cases of likely sexual transmission, the men had Zika symptoms, but the virus can be transmitted before, during and after symptoms develop. In one case the virus was spread a few days before symptoms developed. The virus is present in semen longer than in blood.

As of February 1, 2016, there have not been any confirmed blood transfusion transmission cases in the United States. But it is important to note that it is a possibility.

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There have been multiple reports of blood transfusion transmission cases in Brazil. These reports are currently being investigated.

A mother already infected with Zika virus near the time of delivery can pass on the virus to her newborn around the time of birth. A pregnant woman can pass Zika virus to her fetus during pregnancy. Public health officials are studying the adverse pregnancy and infant outcomes associated with Zika virus infection during pregnancy. To date there are no reports of infants getting Zika virus through breastfeeding. Because of the benefits of breastfeeding, mothers are encouraged to breastfeed even in areas where Zika virus is found.

So I took this picture from the CDC website to highlight some of the symptoms of Zika. So about one in five people infected with Zika virus become ill or develop Zika. The most common symptoms of Zika are fever, rash, joint pain, or conjunctivitis, also known as red eyes. Other common symptoms include muscle pain, headache, and malaise. People usually don't get sick enough to go to the hospital, and they very rarely die from Zika virus. For this reason, many people may not realize they've been infected. There can be other complications from Zika virus infection, like microcephaly and Guillain-Barre syndrome, which I will touch on later in this presentation.

The incubation period for Zika is not clear, but the consensus right now is that it is a few days to a week. So there are still many things that we don't know yet about Zika virus, so we don't know how long the virus is present in semen in men who have had Zika. We don't know if infected men who develop symptoms can have Zika virus in their semen. We do not know if infected men who never develop symptoms can transmit Zika virus through sex. We don't know if a woman can transmit Zika virus to her sex partners. We don't know if Zika can be spread through oral sex. So it is not known if Zika can be spread from other body fluids that may be exchanged during oral sex including saliva and vaginal fluid. So there's still a lot of research that is being done, and we're getting information every day, we're getting updates on Zika virus.

So next let's look at treatment. So there is no vaccine to prevent or specific medicine to treat Zika infections. You have to treat the symptoms. So get plenty of rest. Drink fluids to prevent dehydration. You can take medicine such as Tylenol to relieve fever and pain. Do not take aspirin or other non-steroidal anti-inflammatory drugs. These can cause bleeding and should be avoided until dengue is ruled out. If you are taking medicine for another medical condition, talk to your healthcare provider before taking additional medication.

The key is reducing the risk to pregnant women. That means reducing travel of pregnant women to areas where Zika is spreading.

So prevention. Right now it is best to avoid being bitten by mosquitoes, especially if you are traveling to areas where the Zika virus is being spread. You should wear mosquito repellent and long sleeves and pants, stay in air conditioning if that's possible, put screens on your windows, use bed nets if necessary or if traveling to countries where that would be needed.

During the first week of infection, Zika virus can be found in the blood and passed from an infected person to another mosquito through mosquito bites. An infected mosquito can then spread the virus to other people. So to help prevent others from getting sick, avoid mosquito bites during the first week of illness.

So at the Health Department we have developed these flyers with the three Ds on them to help remind everyone what they can do to prevent bites. So drain standing water around your home. Dress in long sleeves and pants, and wear mosquito repellent with DEET. So I'll touch a little more on prevention later in this presentation. I'll get into more specifics.

Okay, so let's talk about our case investigation here at the City of Houston Health Department, our first confirmed case of Zika virus.

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On November 16, 2015, a Houston clinician reported to the Houston Health Department, Bureau of Epidemiology, two suspected cases of Zika virus. So reporting from a physician is not unusual. We receive reports of suspected cases directly by phone, fax, and electronically through our electronic laboratory reporting system.

An investigation was conducted to determine the source of infection and prevent the spread of disease. This physician suspected Zika virus based on the clinical symptoms and the travel history. The patient also stated her symptoms were similar to what her family experienced the month prior. They live in Columbia, and were all diagnosed with Zika the previous month. In November of last year, Zika virus was not a notifiable condition yet, but providers were told to test symptomatic travelers from Brazil and Columbia.

Okay. So here is a little information on both of our suspect cases. Suspect case number one was a 59-year-old Hispanic female which traveled to Columbia. And her onset date of symptoms was November 10, 2015. Suspect case number two was a 60-year-old Hispanic female who traveled to Columbia, and she had an onset date of November 13, 2015. So both of these women were friends, and they traveled to the same place and they stayed at the same house.

I apologize if my screen on there, the last part of it is cut off, but I'll tell you what it says.

So both suspected cases traveled to Santa Marta, Columbia, between 11/3 of 15 and 11/10 of 15. So last November, the third through the tenth. So you can see on the map that the red arrow is pointing to Santa Marta.

So in October, 2015, the Columbian health authorities reported active transmission of Zika virus. So a month prior was when active transmission actually began in Columbia.

Okay, so this epi curve was obtained on the World Health Organization's website. The graph shows the suspected and confirmed Zika cases reported in Columbia from October 2015 to February 2016. The pale tan color represents suspected cases while the orange represents confirmed cases. So if you look at November 2015 column – let me get my arrow showing up. There we go. Okay, so if you look at the November 2015 column, it shows that at the 45th week of the year there were 741 suspected cases of Zika virus. That's the pale tan color. And 95 confirmed cases that month. That's the orange color. This was the time both cases, our suspect cases, traveled to Columbia.

You can see the steady rise in cases since October of 2015 when local transmission began. And you can see the huge increase of cases since the beginning of this year. At the bottom of the screen, so at the bottom right-hand corner, you can see the cumulative cases as of February 25th of 2016, so in Columbia there have been 1,612 confirmed cases of Zika virus and 35,399 suspected cases. So this just kind of shows you what Columbia is dealing with right now. Back in November, it wasn't quite as bad as it is now, unfortunately. So hopefully the cases will start to drop off, but we're just going to have to see what happens.

Okay. So our investigation continued. So suspect case number one is the 59-year-old Hispanic female with the onset date of November 10th. Her symptoms started with fatigue, diarrhea and joint pain. On November 12th, she got a fever that was 101 degree Fahrenheit and a rash developed all over her body including her face and hands. The joints in her hands were visibly swollen and painful. Her eyes were slightly red and she felt pain behind them. This patient has had previous residence and extensive travel to dengue-endemic areas. She has also received a yellow fever vaccination in the past, but she could not recall the date.

Suspect number two is a 60-year-old Hispanic female with her onset date November 13th. She experienced diarrhea that lasted one day, arthralgia started on November 14th and persisted for a whole week. Her rash started on the 15th, and it started on her stomach and it spread to her arms, legs and face,

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and it lasted five to six days. She had a fever of 102 degrees Fahrenheit and conjunctivitis that started on November 16th. She felt very tired and had headaches off and on for two weeks.

So what we know about Zika virus is evolving. And at the time of this case investigation, all the reports were describing symptoms as mild, which, in comparison to dengue, these symptoms are mild. When I interviewed both of these cases, they had many friends and family who had been infected by Zika virus and were not concerned by the potential diagnosis. This was a bit before all the reports of increased microcephaly and Guillain-Barre cases. I would say both of these women were impacted by this illness. They lost time at work and had a new symptom pop up almost every day for a week. The symptoms that affected them the most were the arthralgia, headaches and malaise. So keep in mind that the clinical illness of Zika infection is mild, but you might still miss work and could have some unexpected medical bills.

Okay. So according to the CDC, the viremic (sp) phase for Zika virus is the first week after onset of symptoms. But this is not definite. And they have found it to be longer in some people. Once a person has been infected, he or she is likely to be protected from future infections.

When these two cases were reported, both women were still in the viremic phase, so the potentially existed to infect local *Aedes aegypti* and *albopictus* mosquito populations, especially because our weather here in Houston is still warm, off and on even in November. I know you're probably thinking, oh, they're in November, it's pretty cool in November, there's no mosquitoes, but I can definitely assure you there is.

Both cases were educated on all the prevention methods I told you about earlier, the three Ds. Don't forget those. They were also informed on how to eliminate vector breeding sites around their home. Both women were very concerned about spreading Zika virus here and listened to all of our recommendations. The Houston Health Department was in constant communication with the Department of State Health Services in Austin and the CDC. So at the time sexual transmission of Zika virus was not well documented, and the CDC did not think there was adequate documented risk to recommend that people with suspected or confirmed Zika virus infection avoid sexual intercourse. However, we did inform both cases about the theoretical risk.

Because there is no vaccine to treat Zika virus, you must treat the symptoms. Both women were instructed to get plenty of rest and drink fluids to prevent dehydration. They were told they could take Tylenol for pain but to stay away from aspirin and other non-steroidal anti-inflammatory drugs until dengue could be ruled out because they increase the risk of bleeding.

So at the time of this investigation, Zika virus was not a notifiable condition and there was no set protocol for specimen shipping. Another hurdle we had to overcome was obtaining the correct number of tubes of blood and fill out all the correct paperwork. Houston Health Department sent all the forms to the physician's office and we were helping them fill them out. We also recommended testing for chikungunya and dengue. They have similar symptoms and also circulate in Columbia.

We knew the virus was like other flaviviruses and we treated it as such. We consulted the CDC website and called the Department of State Health Services in Austin, Texas to let them know of the situation. We knew how important it was to get a blood sample and prevent any local transmission.

So unfortunately we ran into a little bit of a problem. The clinic that reported these two cases was unable to facilitate the blood draw and specimen shipping due to financial constraints. So I set up a time at each patient's home, and my coworker, who is a phlebotomist, and I went and collected blood samples from each of the suspect cases. We dropped off the specimen to the City of Houston lab, and they shipped the serum directly to CDC at Fort Collins for testing. We also collected convalescent samples from each case in December and shipped those to CDC from the Houston Health Department lab.

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Direct communication with the CDC and the State Health Department was vital during this investigation, so I'll definitely say that I was emailing at least 25 people every time there was an update on this investigation because there were so many people that needed to know what was going on, at what time the blood would arrive. So, again, communication during this investigation was extremely important.

Okay, so now I'm going to talk a little about testing. I don't want to go into any real in-depth conversation about the testing, but I wanted – if you aren't familiar with any of this testing, I just kind of wanted to give you a little overview. So serological tests were performed, specifically ELISA, which stands for Enzyme-Linked Immunosorbant assay. It is a common laboratory technique to measure the concentration of antibodies or antigens in solutions. Zika-specific IgM antibodies can be detected by ELISA in serum specimen from day four after the onset of symptoms. Acute samples of blood were taken on November 17th for suspect case number one and November 18th for suspect case number two. Convalescent samples were taken December 10, 2015 from both cases.

The samples are then compared to see if there is an increase in antibody titer. PRNT, or Plaque Reduction Neutralization Test, was also performed to confirm the positive result by showing at least a fourfold increase in titer of the neutralizing antibodies. So one of the limitations of this testing is the cross-reactivity between other circulating flaviviruses. This limitation must be considered when working in regions where multiple flaviviruses co-circulate. Other flaviviruses include dengue, yellow fever, and West Nile virus. So the PRNT test helped distinguish between these flavivirus infections.

Okay, so on this slide you can see a brief overview of the results. Suspect case number one tested positive for Zika and dengue. I said previously that you can have cross reaction with other flaviviruses, specifically dengue, yellow fever and West Nile. The test results showed positive results for both dengue and Zika, and the PRNT test could not distinguish definitively the identity of the recently-infecting virus. So the interpretation that was given to us by the CDC was that there was evidence of a recent infection with the flavivirus. The data are consistent with a secondary flavivirus infection, and the identity of the recently-infecting virus cannot be determined with certainty.

So this shows you an example of the limitations of this testing. It is important to mention that this patient has previous residence and extensive travel to dengue-endemic areas. She has also received a yellow fever vaccination in the past.

So our suspect case number two, on the right-hand side, she tested positive for Zika virus, and became the first confirmed positive in Houston, Texas, so that is our confirmed case. An interesting thing developed after we received these tests. Actually, let me back up a little bit. Our suspect case number two, the one I said is a confirmed positive, they were able to – the Zika IgM ELISA test was positive. The dengue was negative. And so was chikungunya and West Nile. So we were able to rule out all those other flaviviruses, and the PRNT test showed that it was definitely Zika virus that infected that individual. So, again, that's how we confirmed that that was definitely Zika virus.

So, again, the interesting thing that developed after we received the test results, I received a call from the CDC, and they requested blood samples from our confirmed case if she was willing. They wanted to use her blood as the positive control in their assays because her tests were so clean and Zika IgM was so high. They don't see many primary cases, and the CDC was predicting the increase in testing in the United States. So the suspect case consented, and the City of Houston drew five tubes of blood and sent it to the CDC so they could be used in future testing.

Okay. So these are some of the conclusions of our case investigation. So both cases were imported from Columbia, where local transmission is ongoing. Rapid identification of the possibility of Zika virus, and quick notification to the local health department is imperative, especially with emerging diseases. What I believe saved time and narrowed down the diagnosis was that the patient was aware of Zika virus. Her family lives in Columbia, and they have all been sick with it. She told her doctor where she had traveled and that her family had recently been sick with Zika and she was experiencing the same symptoms.

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Providing public health education is critical in preventing transmission. Both cases were at the end of the feremic (sp) period when they went to the doctor. But it's so important to get the correct information out to the public. Both cases were very concerned with transmitting the disease and listened to all of our recommendations. They also told their friends and family ways to reduce mosquito breeding around their home and the precautions to take while traveling.

So, again, both cases were imported from Columbia, where there is local transmission. Rapid identification of disease and notification by clinician was imperative in this case and so was education.

Right now the Texas case counts, as of March 16, 2016, Texas has had 23 confirmed cases of Zika virus. Twenty-two were in travelers who were infected abroad and diagnosed after they returned home. One case involved a Dallas County resident who had sexual contact with someone who acquired the Zika infection while traveling abroad.

So I'll give you the case counts by county real fast. Bexar County, Texas has had three confirmed cases. Dallas County has had four. Fort Bend has had one. Harris County, which is where our case was, Harris County has had one. Tarrant County has had three. And Travis County has had two.

So these cases are all the confirmed cases where Zika virus was identified as the infecting virus and not any other flavivirus.

The Texas Department of State Health Services is encouraging people to follow travel precautions for regions in certain countries where Zika virus transmission is ongoing. So the Department of State Health Services recommends travelers avoid mosquito bites while abroad, for seven days after returning in case they have been exposed to Zika virus.

Okay. So all of our departments within the Houston Health Department have been coordinating together to prevent the spread of Zika virus. The CDC states that mosquito-based surveillance is the preferred method for monitoring and predicting West Nile virus outbreaks, but it is not the preferred method for monitoring or predicting dengue, chikungunya, yellow fever, or Zika outbreaks. For these arboviruses, it is more efficient to detect cases in people. So in the United States, dengue and chikungunya are both nationally-notifiable conditions, as is Zika. Healthcare providers are therefore required to report any confirmed or suspect cases to local and state health departments. Then health departments notify state or local vector control districts or authorities.

So controlling Zika virus requires constant communication between healthcare providers, local and state public health departments, and vector control specialists. Effective vector-based dengue, chikungunya, yellow fever and Zika prevention involves initiating control measures such as source reduction or container elimination and larvacide treatments before the beginning of the mosquito season and adult reduction measures such as adulticide treatments following the detection of human arbovirus activity.

Containment, a combination of procedures to prevent dengue, chikungunya, Zika and yellow fever from spreading may be initiated whenever a suspected confirmed imported or locally-acquired case is detected. During outbreaks, a combination of containment and large-scale vector control may be used to minimize vector-human contact.

So City of Houston Solid Waste Management Department began a comprehensive citywide cleanup of illegal dump sites and collection of heavy trash to help reduce mosquito breeding sites and combat the spread of Zika virus. And they have collected over 1,000 tons of waste in various neighborhoods around the City of Houston. Several city departments have stepped up to help stop the spread, including Health, Solid Waste, Public Works and Neighborhoods. So we are really trying to eliminate the waste before mosquitoes have the opportunity to start breeding.

We have also created these flyers, like the one you see on the slide, with mosquito control information on it for the public.

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So after the first investigation of Zika virus at the Health Department, things evolved rapidly and they are continuing to. This is our strategy to respond to Zika. Our City of Houston lab is now able to perform reverse transcriptase PCR testing, or RTPCR, to hone in on the virus. So this test has higher specificity than an (inaudible) test. So this will cut down on the number of specimen being sent to the CDC and also get results to providers faster.

So our strategy here at the City of Houston Health Department is to develop laboratory testing capacity, which we did. Investigate cases and their contacts. Coordinate with mosquito control surveillance. Maintain situational awareness in the city and region. Improve our understanding of the virus and its effects. Conduct neighborhood outreach to vulnerable communities. Clean up garbage in neighborhoods. Eliminate standing water. Educate travelers and expecting mothers. And also help with mosquito control. So we work with the Harris County Public Health Environmental Services, and when we have a case of an arboviral illness, we will let them know and they will go and spray around that neighborhood to combat any mosquitoes.

Okay. So I know this is kind of difficult to see, but I want you to pay attention to the arrows. So here is the cumulative Zika suspected and confirmed cases reported by countries and territories in the Americas as of the end of February. So you can find this on the World Health Organization's website. So I know there's a lot of information on this chart, so I've put the arrows next to the important numbers.

So you can see that Columbia, the black arrow, and Brazil, the yellow arrow, have had the most confirmed cases to date. You can also see the deaths among Zika cases. Three in Columbia, one in Venezuela, and four Brazil and four in Suriname.

So I just wanted to show you kind of a snapshot of the thousands of suspected cases that these countries are dealing with.

Okay, so this map is showing the countries with active Zika virus transmission. This is as of February 2016. So you can find this, again, on the Centers for Disease Control and Prevention website. They keep this updated every day of the countries that are showing active transmission.

So there are further complications that we are still investigating, or public health individuals are investigating from Zika virus. Guillain-Barre syndrome, so there have been reports of Guillain-Barre syndrome in patients following a Zika virus infection. Right now the relationship is not known. It is a rare condition where a person's immune system attacks their peripheral nerves. Treatment is symptomatic and supportive, and recovery can take several weeks or months and can often cause prolonged disability requiring rehabilitation. So, again, right now all of this is still being investigated, all these complications.

Another complication that I'm sure all of you have heard about is microcephaly. So the CDC has linked Zika virus to a serious birth defect of the brain called microcephaly. I'm not going to go into much detail about microcephaly, but I wanted to show you this graph showing the number of microcephaly cases reported in the northeast region of Brazil from November of 2015 to February of 2016 so you can understand the public health emergency Brazil is facing. So right now there seems to be a trend of microcephaly reports decreasing. So on this map you can kind of see it's going down a little bit. So let's hope this continues.

So microcephaly is where a baby's head is smaller than expected when compared to babies of the same sex and age. Their brains can be smaller and may not develop properly. You might be wondering how the CDC linked the Zika virus. Traces of the virus were found in the tissue of two babies who died in Brazil from underdeveloped brains. So the Director of the CDC said this does not prove that Zika virus is the cause of thousands of cases of microcephaly in Brazil since the spring, but it is the strongest connection we have yet. More tests are being conducted to confirm that Zika virus is the cause of the birth defect.

So you can see the northeastern part of Brazil in green. The reason this is showing the northeast region is because this is where the first excess of microcephaly cases were identified. There have been a total of

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5,640 microcephaly cases reported by the Ministry of Health of Brazil, and 583 of these are confirmed cases so far while others are being investigated. So they've had thousands reported, and right now they've only confirmed about 583. And, again, this is as of the end of February of 2016, so I'm sure that's going to change.

Okay, so here is a map of the United States as reported cases of Zika virus. The light blue are cases that are imported. As of February 2016, we have only had local transmission in our U.S. territories, so Puerto Rico, Virgin Islands, American Samoa, those are going to be the areas that have local transmissions. So all the ones you see in light blue have all been imported from outside the country.

Okay, this graph shows you the travel-associated confirmed case counts by state as of February 24, 2016. Florida has reported the most confirmed cases, followed by New York and then Texas.

Okay, this graph shows you the number of confirmed Zika cases in U.S. territories. These areas do have local transmission, and you can see that Puerto Rico has had 34 locally transmitted confirmed cases so far.

Okay, so that was just a quick overview of what the United States is dealing with in terms of confirmed cases of Zika virus. That does not include the probable cases or cases that are being investigated. Luckily we have only had local transmission in our territory so far, although with travel in the upcoming Olympics, we are expecting our number of travel-associated cases to increase.

So I mentioned in the earlier slide that Zika virus was spread by *Aedes* mosquitoes, specifically *Aedes aegypti* and *albopictus*. So these pictures show you the distribution of each type of mosquito in the United States. And, again, I got these pictures from the CDC website. So more than half of the world's population lives in areas where *Aedes aegypti* is present according to the World Health Organization. This mosquito is opportunistic and has the ability to adapt to changing environments. Travel and urbanization have not diminished its numbers.

So *Aedes aegypti* most likely originated in Africa. And since then the mosquito has migrated globally throughout the tropical, subtropical and parts of the temperate world through global trade and shipping activities. *Aedes aegypti* mosquitoes have a high vectoral capacity or effectiveness of virus transmission in nature for dengue, chikungunya, Zika and yellow fever.

Aedes albopictus originated in Asia. Like *aegypti*, *albopictus* has migrated globally throughout the tropical, subtropical and temperate world primarily through international trade in used tires. *Aedes albopictus* has adapted to survive in a broader temperature range and at cooler temperatures, which enables them to persist in more temperate climates. These mosquitoes live in close proximity to people, but less so than *Aedes aegypti*.

So here is some prevention continued. These mosquitoes can breed in water collected in tree holes and axils of plant leaves in forests. They are known as container breeders and can breed wherever rain collects or water is stored. It does not matter if the container is artificial, so it doesn't matter if it's plastic cups, bottle caps, plates, under potted plants, bird baths, basins in cemeteries or pet water bowls. Other areas include septic tanks, toilet tanks and shower stalls, construction sites, used tires, clogged rain gutters. It is so important to educate the public on where breeding sites are found. We receive many phone calls at the Health Department asking what and how to prevent Zika virus and how to get rid of mosquitoes.

Okay, so I'm going to tell you a few mosquito fun facts to wrap this up. Laid eggs can survive for very long periods of time in a dry state, often more than a year. Once submerged in water, they hatch immediately. If temperatures are cool, mosquitoes can remain in the larval stage for months so long as the water supply is sufficient. The eggs are sticky, virtually gluing themselves to the insides of containers. International trade in used tires is the best documented vehicle for introducing the mosquito to distant places.

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Another fact is that only female mosquitoes bite, and they have evolved to show distinct preferences for human blood. *Aedes aegypti* females are sip feeders, so instead of drawing sufficient blood for a meal in a single bite, they take multiple little sips during multiple bites, thus increasing the number of people a single mosquito carrying the virus can infect. This shows you how important it is to educate the public on where mosquitoes breed and how to eliminate them. It is also so important for all departments to work together to stop the spread of emerging vector-borne diseases.

Okay, here is my references. And I just wanted to say thank you so much for joining me. And I hope you found our Zika case interesting. Thank you to everyone who assisted with this investigation including the Texas Department of State Health Services and the Centers for Disease Control and Prevention. I will be available during one of the presenter chat hours if you have any questions regarding our investigation.

Thank you so much.

Thank you, Amanda, and thank you everyone for attending today's presentation, First Confirmed Case of Imported Zika Virus in Houston, Texas: Preventing Transmission. On behalf of the National Environmental Health Association and our presenter, thank you for joining us today.