

Public Health

Department of Entomology

WEST NILE VIRUS IN INDIANA

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With the arrival of summer, another West Nile virus (WNV) season is just around the corner. Because of the potential health effects of this mosquito borne virus, you should learn more about WNV and how to take simple precautions that can reduce the risk of WNV for you and your family.

What is West Nile virus?

WNV is a flavivirus (this is a group of viruses that includes St Louis and Japanese Encephalitis viruses). Following transmission by an infected mosquito, WNV multiplies in the person's blood system and can interfere with normal central nervous system functioning. WNV is a relatively new disease in the US. Research on WNV and its effects on humans, mosquitoes, birds and other animals is limited. There are many aspects of this disease that we still do not understand.

Where did WNV come from?

WNV is not a new disease; it was first identified in the West Nile district of Uganda in 1937 and WNV outbreaks have occurred in the Eastern hemisphere (Africa, West Asia, the Middle East and parts of Europe). WNV has only been recognized in the US for 5 years, after being confirmed in New York City in 1999. Since its introduction, WNV has spread west and south across the US. In 2003, WNV was identified in all states except Alaska, Hawaii, Oregon and Washington State and is now considered to be established in the US. Although we do not know how WNV made its way to the US, it is likely that it arrived in an unintentionally infected person, bird or mosquito.

How is West Nile Virus transmitted?

WNV is transmitted to humans through the bite of infected mosquitoes. Mosquitoes become infected with WNV when they feed on infected birds. Certain species of birds are reservoirs for WNV; places where the virus can multiply in the bird before being transmitted to a mosquito. Within the mosquito, the virus passes through the gut into the mosquito blood and finally infects the glands that produce mosquito saliva. The mosquito passes the virus to humans in its saliva when it takes a blood meal. WNV is transmitted only by the female mosquito when she takes a blood meal from an animal for egg development. Only certain species of mosquitoes can transmit WNV to

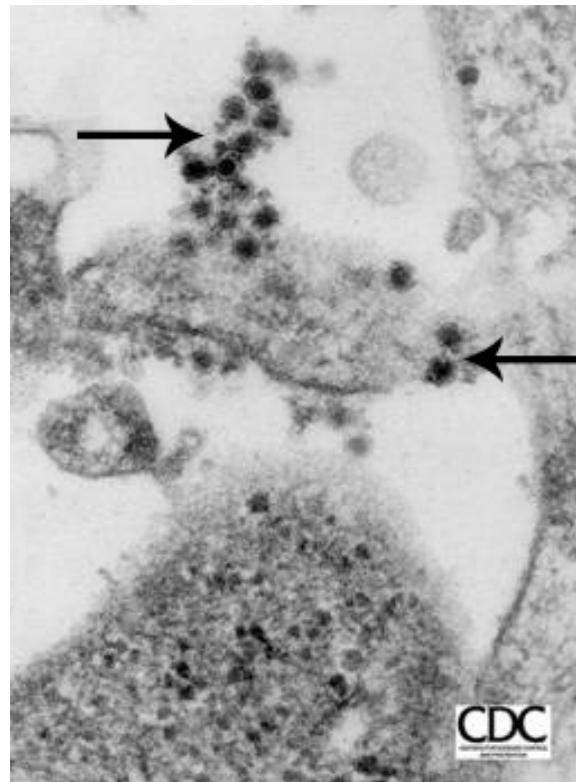


Figure 1. West Nile virus in brain tissue from a crow found in New York. Arrow indicates a WNV particle 65,625X magnification. (Photo Credit: Bruce Cropp, Centers for Disease Control & Prevention)

people, partly because only certain mosquito species will feed both on birds and humans. In Indiana, *Culex restuans* mosquitoes are almost exclusively bird feeding mosquitoes and are probably responsible for amplifying WNV in bird populations. *Culex pipiens* and *Culex salinarius* mosquitoes feed on both birds and mammals and may act as "bridge vectors", transmitting WNV from birds to humans. However, more research is needed to be sure. Humans are incidental or dead-end hosts. In other words, although people can get sick from WNV, there is usually not enough virus in humans for mosquitoes to pick up and pass the virus to other animals.

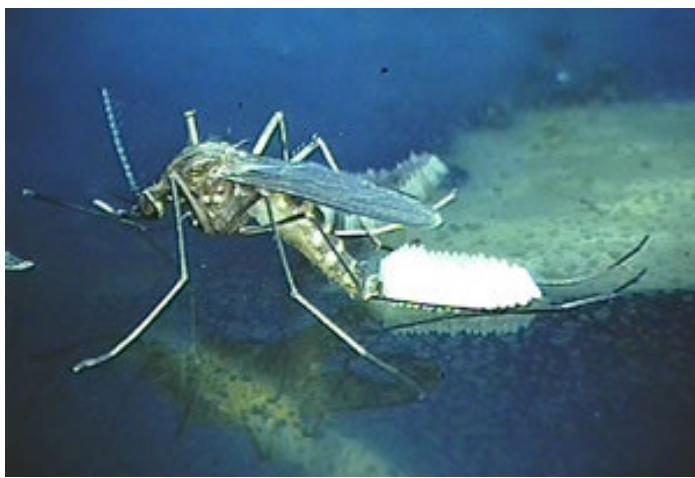


Figure 2. Female *Culex* mosquito laying eggs.
(Photo Credit: Richard G. Weber, Centers for Disease Control and Prevention)

West Nile Virus Transmission Cycle

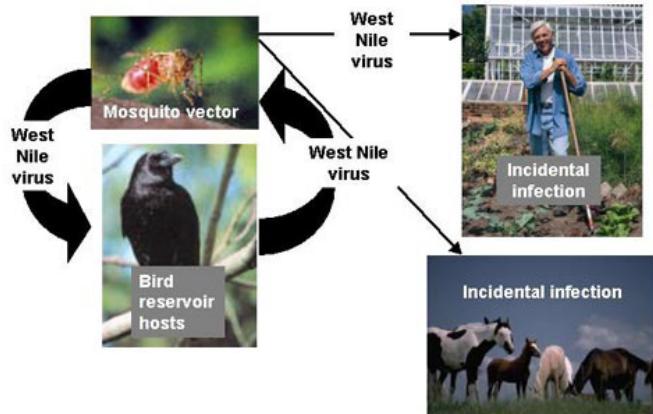


Figure 3. West Nile virus disease transmission cycle.
(Photo Credit: Centers for Disease Control and Prevention)

What are the symptoms of West Nile Virus?

WNV symptoms may develop 3-15 days after a bite from an infected mosquito. Most people who become infected with WNV will experience no or very mild symptoms. Approximately 20% of people will experience mild, flu-like symptoms. Symptoms may include but are not limited to high fever, severe headache, muscle weakness or paralysis, joint pain (arthralgia), nausea, vomiting, and neck stiffness. These symptoms are often confused with the flu or other conditions, and it is possible that many WNV cases may go unconfirmed. If you live in an area where WNV has been detected in birds or mosquitoes or where positive WNV human cases have been confirmed and you experience these symptoms, you should consult a doctor.

Severe disease is possible in older individuals or people with weakened immune systems. In these cases, infected individuals may develop West Nile encephalitis (brain swelling), meningitis (swelling of the membrane that surrounds the brain and spinal chord), or meningio-encephalitis (combination of both). WNV, like other encephalitis viruses, can cause long-term neurological complications.

One case of trans-placental (transmission from mother to child) WNV transmission was documented in 2002. Because of ongoing concerns that mother-to-child WNV transmission and possible adverse health effects can occur, pregnant women should take precautions to reduce their risk for WNV by avoiding mosquitoes, using protective clothing, and using repellents, preferably those containing DEET. Repellents with DEET are considered safe for pregnant women. Very rarely, cases of WNV transmission associated with organ and blood donation have been documented. As of July 14, 2003, U.S. blood banks screen donated blood for WNV, and there is no serious risk of acquiring WNV through blood transfusion.

How is West Nile Virus treated?

Unfortunately, there is no approved drug treatment for people with WNV, and there is no human vaccine to protect against WNV at this time. Intensive supportive care is provided to people with severe WNV disease.

How serious is West Nile Virus, and what is my risk of becoming ill with WNV?

It has been estimated that only 1% of mosquitoes are infected with WNV. Estimates also suggest that only 1-2% of people who become infected will experience a serious illness. It is important to remember that your risk is small. However, because serious illness and/or long-term complications have been associated with WNV, you should take precautions to protect yourself during the mosquito season, especially if WNV-positive birds, mosquitoes, or human cases have been documented in your area.

In Indiana, the highest risk of WNV generally occurs when *Culex spp.* mosquito populations are highest, from July to late October. Peak WNV cases generally occur in September. However, the WNV season can be significantly affected by environmental conditions because temperature and rainfall can influence mosquito populations. No two WNV seasons are the same, and it is very difficult to predict how severe a WNV season will be in any given year.

How is WNV risk monitored in Indiana?

In Indiana, the Indiana State Department of Health (ISDH) tracks WNV-positive identifications in birds, horses, mosquitoes, and humans in all counties on a regular basis. You can find WNV maps on the ISDH Website <<http://www.in.gov/isdh/>>. The ISDH will accept birds for WNV testing. Once a positive bird has been identified in a particular county, the ISDH will discontinue bird monitoring for the season because WNV is considered established in that county. The presence of WNV-positive birds and mosquitoes indicates that WNV transmission to humans could occur. The presence of WNV-positive human cases indicates that WNV transmission has occurred; if you reside in an area where WNV-positive human cases have been confirmed, you have an increased risk of acquiring WNV. WNV is a notifiable disease in the U.S. Health providers are required by law to report a WNV positive human diagnosis to State or local public health officials. The Centers for Disease Control and Prevention (CDC) and the U.S. Geological Survey also track bird, mosquito, veterinary, and human cases state-by-state across the U.S.

How can I protect myself from West Nile Virus?

The best way to avoid WNV is to avoid being bitten by mosquitoes. There are a number of simple ways to do this. Mosquitoes are active from dusk to dawn, and many species of mosquitoes have a peak in activity at sunset; this is when the female mosquito searches for a vertebrate host to take a blood meal. You can avoid being bitten by:

- Staying indoors during peak mosquito activity
- Wearing protective clothing (e.g., long pants and a shirt, shoes and socks)
- Using an approved insect repellent such as DEET; follow label directions
- Checking and repairing the screens on doors and windows
- Keeping doors and windows closed at night
- Using a mosquito net if you are camping

Citronella candles and bug zappers have not proven effective in preventing mosquito bites. Newer devices such as the “Mosquito Magnet” may be effective at reducing mosquitoes in an area but should not be relied on to prevent exposure to mosquitoes infected with WNV or other mosquito-borne diseases.

How can I control mosquitoes in and around my home?

Another way to avoid mosquito bites is to eliminate mosquitoes in your immediate area by eliminating their breeding sites. Immature mosquitoes have an aquatic stage; the mosquitoes that transmit WNV prefer to breed in shallow, stagnant pools of water. Following a blood meal, the female mosquito will lay her eggs in batches on the water surface.

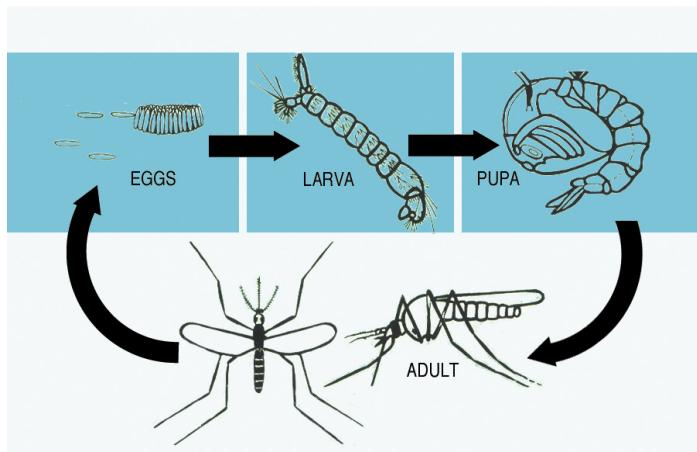


Figure 4. Mosquito life-cycle

Eggs will develop into larvae (wrigglers) and then into pupae (tumblers) over the course of several weeks. Actual mosquito development time is affected by weather conditions, especially temperature and rainfall. The aquatic phases feed on bacteria, and for this reason, mosquitoes prefer to breed in water sources that are high in organic matter. Adult mosquitoes emerge from pupal stages at the surface of water.

Mosquito numbers can build up very quickly given appropriate weather conditions and breeding sites. Mosquito breeding season generally occurs from May until September (or the first hard frost) in Indiana. However, while the birds that act as WNV reservoirs can presumably travel relatively large



Figure 5. *Culex* larvae collected from a horse water trough.
(Photo Credit: Ralph Williams)

distances, mosquitoes do not fly very far from their breeding sites (no more than 1-2 miles). Therefore, you can significantly reduce your WNV risk by eliminating mosquito breeding sites around your home or work environment. You should do this at the start of each summer and **before** the beginning of the mosquito breeding season. Ways to do this include:

- Cleaning out clogged rain gutters
- Emptying water from flower pots, buckets, barrels, bird baths, swimming pool covers, pet dishes, etc.
- Chlorinating swimming pools
- Mowing grass regularly and keeping shrubbery trimmed



Figure 6. Typical mosquito breeding sites (top) clogged gutters around the home; (bottom) storm drain catch basin.
(Photo Credit: (top) Purdue University and, (bottom) Centers for Disease Control and Prevention)



Figure 7. Mosquito larvae breeding in trash that has collected rainwater.

(Photo Credit: Centers for Disease Control and Prevention)

Mosquito breeding sites are often associated with temporary bodies of water, especially those produced by human activity. Suitable habitats may include poorly drained retention ponds, evaporation ponds associated with livestock enterprises, tire ruts, flood plains, and storm-water catchment areas. Well established, natural bodies of water such as rivers and lakes are not generally suitable mosquito breeding habitats. For property owners, communities, and municipalities that deal with larger bodies of water, there are a number of measures that can be used to eliminate mosquito breeding sites. These include:

- Ditching and cleaning stagnant streams
- Draining or filling shallow, temporary bodies of water
- Maintaining lakes, ponds, and ornamental pools:
 - Keep a steep shoreline
 - Remove vegetation and debris
 - Stock with fish, e.g., top feeding minnows
 - Aerate
- Encouraging natural predators such as fish as part of wetland improvement projects

For more information, refer to Purdue Extension bulletin WQ-41, "Managing Ponds, Wetlands, and Other Water Reservoirs to Minimize Mosquitoes" <<http://www.ecn.purdue.edu/SafeWater/Ponds/WQ-41-W.pdf>>

Are there other ways to control WNV transmitting mosquitoes?

While there are many species of mosquitoes in Indiana, only a handful are capable of disease transmission. Several biological and chemical measures are approved for control of those mosquitoes. However, these are recommended only for control of mosquito species that transmit disease and generally only as a last resort, when all other control options have been exhausted.

Larviciding (application of products to control adults emerging from larval breeding sites) may be recommended to control nuisance mosquitoes or if WNV-positive mosquito

species have been confirmed in an area. Adulticiding (spraying to control adult mosquitoes) is generally recommended only in emergency situations and should **only** be conducted by trained professionals when the risk of WNV transmission to humans is considered to be high. By law, persons who conduct adulticiding on public property in Indiana must be Category 8 certified. More information on Category 8 training and certification is available from the State Chemists web site <<http://www.isco.purdue.edu/>>. Refer to Purdue Extension publications E-26 "Mosquitoes In and Around the Home" <<http://extension.entm.purdue.edu/publications/E-26.pdf>> and E-52 "Mosquito Management by Trained Personnel" <<http://extension.entm.purdue.edu/publications/E-52.pdf>> for more information on larviciding.



Figure 8. Typical mosquito breeding sites: (top) poorly drained area associated with storm water run-off; (bottom) shallow, temporary body of water caused by broken pipe and contaminated with livestock waste.

(Photo Credit: Ralph Williams)

Where can I find more information on WNV?

Many Web sites provide additional information on WNV and associated public health issues. The following Web sites are recommended as accurate and current sources of information.

Mosquito Information and Control:

The Purdue Cooperative Extension Service and the American Mosquito Control Association provide useful information on mosquitoes and mosquito control.

- Purdue Cooperative Extension Service <<http://www.extension.purdue.edu/extmedia/menu.htm>>
- American Mosquito Control Association <<http://www.mosquito.org/>>

General WNV Information and WNV Cases in Your Area:

The CDC, U.S. Geological Survey, and the ISDH monitor and track WNV positive bird, mosquito, horse, and human cases. The ISDH reports county by county on a daily basis. The CDC and ISDH also provide useful information on protection measures.

- Centers for Disease Control and Prevention <<http://www.cdc.gov/>>
- Indiana State Department of Health <<http://www.in.gov/isdh/>>
- U.S. Geological Survey <<http://www.usgs.gov/>>

Pesticide Information:

Both the EPA and the U.S. National Pesticide Information Center provide useful information on pesticides approved for use and on pesticide rules and regulations.

- EPA <<http://www.epa.gov/>>
- U.S. National Pesticide Information Center <<http://npic.orst.edu/>>

READ AND FOLLOW ALL LABEL INSTRUCTIONS. THIS INCLUDES DIRECTIONS FOR USE, PRECAUTIONARY STATEMENTS (HAZARDS TO HUMANS, DOMESTIC ANIMALS, AND ENDANGERED SPECIES), ENVIRONMENTAL HAZARDS, RATES OF APPLICATION, NUMBER OF APPLICATIONS, REENTRY INTERVALS, HARVEST RESTRICTIONS, STORAGE AND DISPOSAL, AND ANY SPECIFIC WARNINGS AND/OR PRECAUTIONS FOR SAFE HANDLING OF THE PESTICIDE.

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