



**INSECT-BORNE DISEASE OVERVIEW:
LYME DISEASE / WEST NILE VIRUS**

AN ERGODYNE WHITE PAPER

INTRODUCTION

These days, bugs are not simply annoying, they also have the potential to carry serious diseases such as West Nile Virus, Lyme disease or even Dengue fever. And no longer are these illnesses just a threat to those in Asia and Africa; they are here in the United States as well.

Increasing international travel, climate change, environmental degradation, and changing human migration patterns have all contributed to shifting patterns of insect-borne disease in the United States and elsewhere. Some scientists predict more tropical diseases such as malaria in zones where the disease had been eradicated—including the southern United States.

As the emergence of West Nile Virus in the U.S. has demonstrated, infectious and vector-borne diseases know no borders and we must be vigilant about protecting ourselves from them.

WEST NILE VIRUS

WHAT IS WEST NILE VIRUS AND HOW IS IT TRANSMITTED?

This virus was first isolated from a woman in the West Nile region of Uganda in 1937. It was found to be the cause of equine encephalitis (swelling of the brain and spinal cord in horses) in France and Egypt in the early 1960s. In 1999, West Nile virus first appeared in the United States with reports of encephalitis in horses and people. Since then, it has been reported in all states except Alaska and Hawaii.

There were 4,269 cases of West Nile virus reported to the CDC in 2006, including 177 deaths. While only 20% of infected individuals show symptoms, of those 20%, one out of every 150 infected develop serious disease symptoms.

Of the cases reported in 2006,

- 34% were reported as West Nile meningitis or encephalitis
- 61% were reported as West Nile fever
- 5% were unspecified

80% of people infected with West Nile virus have no symptoms, so most never realize they have the disease. The unfortunate minority who develop symptoms typically become ill 3 to 14 days after being bitten by an infected mosquito. They are still unlikely to know they have the virus. In addition, these figures most likely underestimate the prevalence of West Nile infection because the less serious fever is most likely not reported as frequently to health officials as encephalitis and meningitis cases.

The West Nile virus can infect mosquitoes, birds, people, horses and some other mammals. Most commonly found in Africa, West Asia, and the Middle East, it has also emerged in the United States and Europe in recent years. The virus causes a spectrum of clinical diseases, ranging from flu-like West Nile fever to potentially fatal West Nile meningitis (inflammation of the brain and spinal cord covering) and even West Nile encephalitis (inflammation of the brain).

In the United States, the West Nile virus is transmitted by mosquitoes—primarily members of the *Culex* species, although other species have been implicated as well. The virus is maintained in a complex life cycle that involves birds as the “reservoir” of the virus. People are not the

usual host and when infected, become “dead-end hosts” (the virus does not circulate in human blood.) While 317 species of birds have been found to carry the West Nile virus, the majority usually do not show illness signs and few die. However, West Nile virus infection can be fatal in crows and jays. It is also fatal for horses in approximately 40% of cases. Dogs and cats can also become infected, but there is no evidence of transmission from these animals to people.

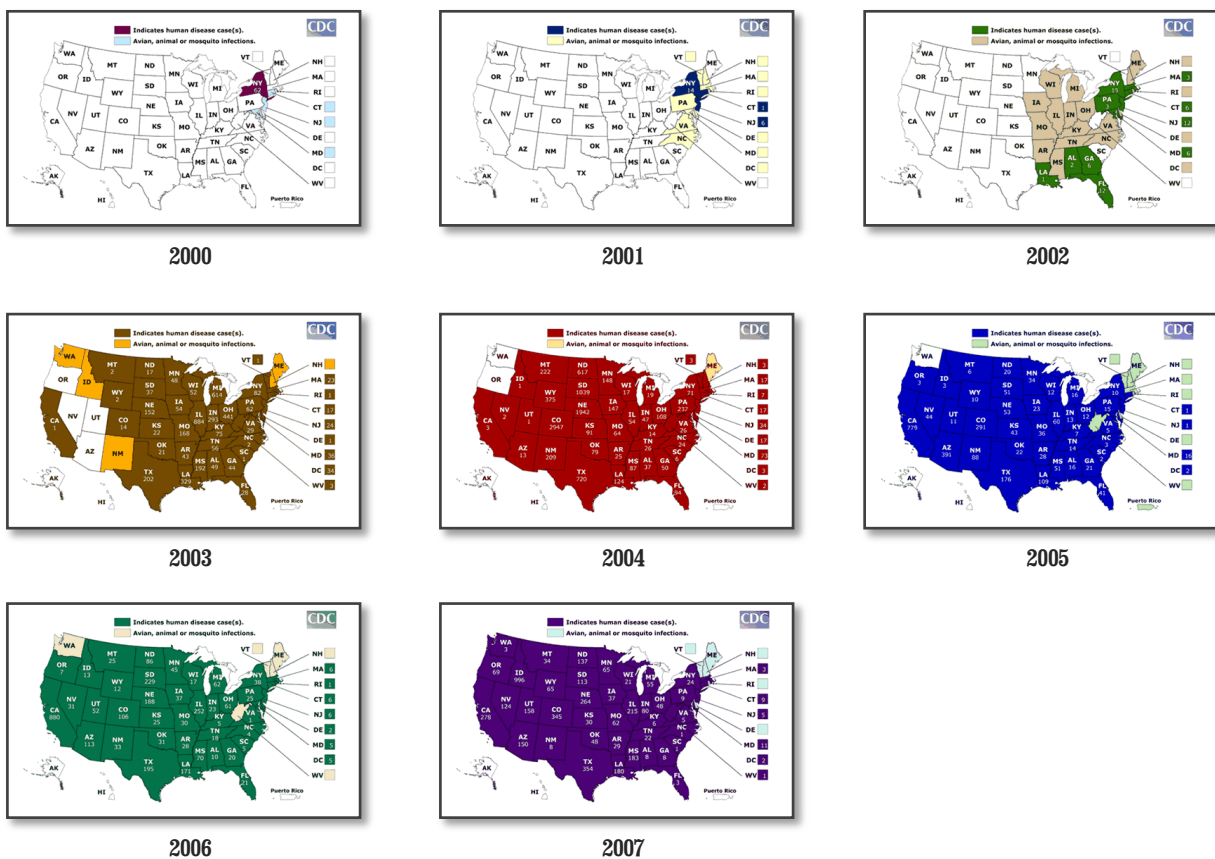
SYMPTOMS OF WEST NILE VIRUS

West Nile virus affects the central nervous system. Mild infections cause flu-like symptoms, including fever, headache, body aches, nausea, vomiting, and sometimes swollen lymph glands or a skin rash. Symptoms can last from a few days to several weeks. People over the age of 50 are more likely to develop symptoms.

Acute symptoms requiring hospitalization—including severe headaches or confusion, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis—occur in less than 1% of those infected. These symptoms may last several weeks, and neurological effects may be permanent. Intravenous fluids and respiratory support are common hospital treatments, but no cure for West Nile virus has been discovered.

WHO IS AT RISK FOR GETTING WEST NILE VIRUS?

The first recorded outbreak of West Nile virus in North America occurred in New York City in 1999. By the summer of 2004, the virus had spread to California. As the maps below show, West Nile virus has spread quickly and is now endemic in all states except Alaska and Hawaii. And, according to a recent New York Times article, cases of West Nile Virus in 2007 were four times what they were in 2006.



HOW IS WEST NILE VIRUS INFECTION TREATED?

As with other viral diseases for which there is no vaccine, West Nile virus infection has no specific treatment. Milder cases are usually self-limiting. Patients with encephalitis or meningitis are hospitalized, given intravenous fluids and respiratory support if necessary. Severe forms of West Nile virus infection are often life-threatening and require intensive medical treatment.

IS THERE A VACCINE FOR WEST NILE VIRUS?

There is a vaccine available to prevent West Nile virus infection in horses but not people. There are several initiatives in progress at present to develop a vaccine.

HOW CAN I PROTECT MYSELF FROM WEST NILE VIRUS?

Personal protection measures that prevent mosquito bites are key to reducing your risk.

- Eliminate potential mosquito breeding sites near your home by emptying containers that hold standing water.
- Your local government may have a mosquito control plan in place to eliminate mosquito breeding sites in public facilities such as stormwater drains and reservoirs.
- Use Insect Repellent

Repellents are an important tool to protect people from mosquito-borne diseases. The CDC recommends the use of EPA-registered products for use as repellents applied to skin and clothing. EPA registration of repellent active ingredients indicates the materials have been reviewed and approved for efficacy and human safety when applied according to the instructions on the label.

CDC evaluation of information contained in peer-reviewed scientific literature and data available from EPA has identified several EPA registered products that provide repellent activity sufficient to help people avoid the bites of disease carrying mosquitoes. Products containing these active ingredients typically provide reasonably long-lasting protection:

- DEET (Chemical Name: N,N-diethyl-m-toluamide or N,N-diethyl-3-methyl-benzamide)
- Picaridin (KBR 3023, Chemical Name: 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester)
- Oil of Lemon Eucalyptus* or PMD (Chemical Name: para-Menthane-3,8-diol) the synthesized version of oil of lemon eucalyptus
- IR3535 (Chemical Name: 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester)

EPA characterizes the active ingredients DEET and Picaridin as “conventional repellents” and Oil of Lemon Eucalyptus, PMD, and IR3535 as “biopesticide repellents”, which are derived from natural materials. For more information on repellent active ingredients see (http://www.epa.gov/pesticides/health/mosquitoes/ai_insectrp.htm).

Published data indicate that repellent efficacy and duration of protection vary considerably among products and among mosquito species. They are also markedly affected by ambient temperature, amount of perspiration, exposure to water, abrasive removal, and other factors.

In general, higher concentrations of active ingredients provide longer duration of protection, regardless of the active ingredient (although concentrations above ~50% do not offer a marked increase in protection time.) Products with <10% active ingredient may offer only limited protection, often from 1-2 hours. Products that offer sustained release or controlled release (micro-encapsulated) formulations, even with lower active ingredient concentrations, may

provide longer protection times. Regardless of what product you use, if you start to get mosquito bites, reapply the repellent according to the label instructions or remove yourself from the area with biting insects if possible.

REPELLENTS FOR USE ON CLOTHING:

Certain products containing permethrin are recommended for use on clothing, shoes, bed nets, and camping gear, and are registered with EPA for this use. Permethrin is highly effective as an insecticide and as a repellent.

Permethrin-treated clothing repels and kills ticks, mosquitoes, and other arthropods and retains this effect after repeated laundering. The permethrin insecticide should be reapplied following the label instructions. Some commercial products are available pretreated with permethrin. Insect Shield® Repellent Apparel is proven and registered to repel mosquitoes—including those that can carry West Nile virus.

LYME DISEASE

WHAT IS LYME DISEASE AND HOW IS IT TRANSMITTED?

Lyme disease was first scientifically addressed at a 1909 research conference in which a Swedish dermatologist presented a study about an expanding, ring-like lesion he had observed in an older woman following the bite of a sheep tick. However, the full syndrome now known as Lyme disease was not recognized until 1975. That's when a cluster of cases originally thought to be juvenile rheumatoid arthritis was identified near Lyme, Connecticut. The study of these patients in the United States eventually led researchers to the recognition that "Lyme arthritis" was simply another manifestation of the tick-borne condition discovered in Europe nearly a century earlier.

In 2007, there were 27,444 cases of Lyme disease reported to the Centers for Disease Control. In fact, reported cases of Lyme disease have risen steadily for the past 10 years and are spreading to new areas every year.

Lyme disease vectors include

- The black-legged or deer tick (*Ixodes scapularis*) in the Northeast U. S.
- The western black-legged tick (*Ixodes pacificus*) in Pacific coastal U.S.



Ixodes scapularis



Ixodes pacificus

Caused by the *Borrelia burgdorferi* bacterium, Lyme disease is transmitted by the bite of certain species of ticks. The bacterium, normally found in mice, squirrels, and other small mammals, does not harm these animals. Nor does it harm the deer these ticks feed on. But it

does cause serious disease when transmitted to people. Most cases occur in the early spring and summer when the ticks are in the nymph stage, and people are most likely to be outdoors. Nymph-stage ticks are difficult to see with the naked eye.

SYMPTOMS OF LYME DISEASE

The first symptom of Lyme disease appears 3 to 30 days after the tick bite. This is a circular rash (*erythema migrans*) around the bite site. It develops into a characteristic “bull’s eye” with a clear center up to 12 inches in diameter. Patients also experience painful lymph node swelling, joint pain (arthralgia), chills, fever, headache, muscle aches (myalgia) and other non-specific symptoms.

Left untreated, the infection can lead to more serious symptoms such as drooping of the face (Bell’s palsy), heart palpitations, dizziness, severe headaches and joint pain. After several months, approximately half of all patients with untreated Lyme disease develop arthritis in large joints as well as chronic neurological problems, including cognitive difficulties.

Unfortunately, Lyme disease has a history of misdiagnosis. The untreated or inadequately treated patient may progress to experience intermittent swelling and pain of one or more joints—usually large, weight-bearing joints such as the knees. Some patients develop chronic axonal polyneuropathy or encephalopathy—the latter usually manifested by cognitive disorders, sleep disturbance, fatigue and personality changes. Infrequently, Lyme disease can be severe, chronic and disabling, but it is rarely, if ever, fatal. Symptoms can occur in some people following treatment, and Lyme disease can result in serious, life-long side effects.

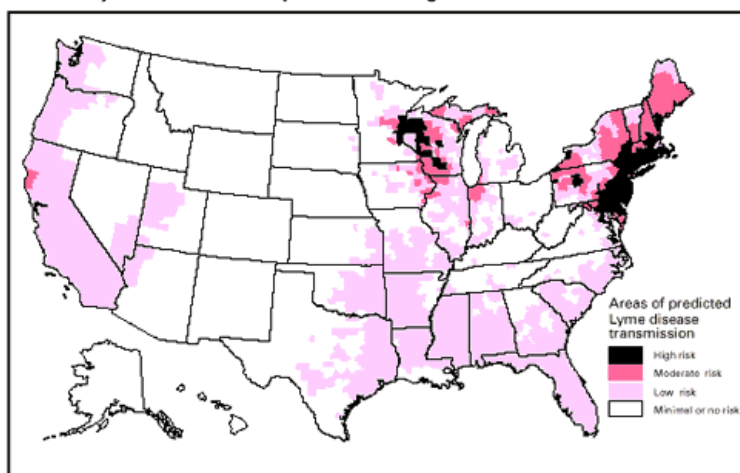


“Bull’s-Eye” rash typical of Lyme disease

WHO IS AT RISK FOR GETTING LYME DISEASE?

According to the Centers for Disease Control and Prevention (CDC): “Individuals who live or work in residential areas surrounded by tick-infested woods or overgrown brush are at risk of getting Lyme disease.” Therefore, anyone who works or plays in their yard, participates in recreational activities away from home like hiking, camping, fishing and hunting, or engages in outdoor occupations such as landscaping, brush clearing, forestry and wildlife or parks management in endemic areas may also be at risk of getting Lyme disease.

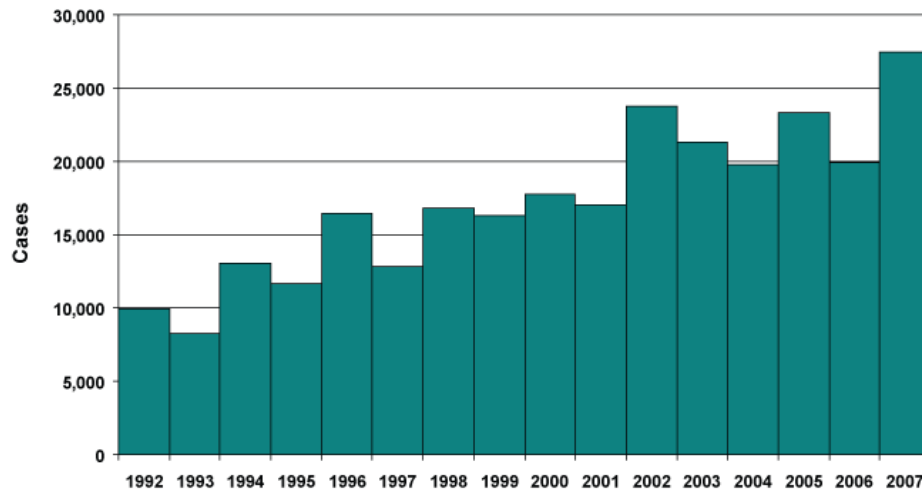
National Lyme disease risk map with four categories of risk



Note: This map demonstrates an approximate distribution of predicted Lyme disease risk in the United States. The true relative risk in any given county compared with other counties might differ from that shown here and might change from year to year. Risk categories are defined in the accompanying text. Information on risk distribution within states and counties is best obtained from state and local public health authorities.

Certain regions of the United States have experienced a high incidence of Lyme disease. Go to <http://www.cdc.gov/ncidod/dvbid/lyme> to see a U.S. Lyme Disease Risk Map, an illustration of the deer tick, as well as more detailed information about Lyme disease.

In 2007, there were 27,444 cases of Lyme disease reported to the Centers for Disease Control.



HOW IS LYME DISEASE TREATED?

Most cases can be treated effectively with antibiotics if treatment begins early. However, a small percentage of those infected and treated continue to experience symptoms such as muscle and joint pain, neurological difficulties and fatigue—likely due to autoimmune disorders triggered by the infection.

IS THERE A VACCINE FOR LYME DISEASE?

There has been a FDA-approved vaccine for Lyme disease since 1998. However, this vaccine does not provide complete protection against all strains of the bacteria. Therefore, protective measures should be taken—even by those who have been vaccinated.

HOW CAN I PROTECT MYSELF FROM LYME DISEASE?

You should take measures to prevent tick bites, particularly if you are planning on being in wooded areas where carrier ticks are common.

- Avoid tick-infested areas whenever possible. Ticks prefer wooded and bushy areas with high grass and a lot of leaf litter. These are areas to avoid. Take extra precautions in May, June, and July. This is when ticks that transmit Lyme disease are most active. If you do enter a tick area, walk in the center of the trail to avoid contact with overgrown grass, brush and leaf litter. You can also contact your local health department and park or extension service about tick infested areas to avoid.
- Keep ticks off your skin. Wear long pants, long sleeves, and long socks. Light-colored clothing will help you spot ticks more easily. Tucking pant legs into socks or boots and tucking shirts into pants help keep ticks on the outside of clothing. If you'll be outside for an extended period of time, tape the area where your pants and socks meet to prevent ticks from crawling under your clothes.
- Use insect repellent with 20% - 30% DEET on exposed skin and clothing to prevent tick bites.

- Use Permethrin repellent. It can be purchased at outdoor equipment stores that carry camping or hunting gear and kills ticks on contact. One application to pants, socks, and shoes typically stays effective through several washings. Permethrin should not be applied directly to skin. For details on permethrin visit the National Pesticide Information Center.
- Permethrin-based Insect Shield® Repellent Apparel is effective in repelling ticks, including the kind that can carry Lyme disease. Insect Shield® clothing such as bandanas, hats, shirts, pants and socks can prove helpful in thickly wooded or tick infested areas.
- Check your skin and clothes for ticks every day. Remove ticks from your clothes before going indoors. To kill ticks that you may have missed, wash your clothes with hot water and dry them using high heat for a least one hour. Perform daily tick checks after being outdoors, even in your own yard. Inspect all parts of your body carefully including armpits, scalp, and groin. Remove ticks immediately using a fine-tipped tweezers. If a tick is attached to your skin for less than 24 hours, your chance of getting Lyme disease is extremely small. Just to be safe, monitor your health closely after a tick bite and be alert for signs and symptoms of tick-borne illness.

RESOURCES

WEST NILE VIRUS

- The Centers for Disease Control and Prevention (CDC) website at <http://www.cdc.gov/ncidod/dvbid/westnile> features up-to-date maps of West Nile virus activity for the United States, including state maps with county-level data.
- Cornell University Environmental Risk Analysis Program: <http://environmentalrisk.cornell.edu/WNV/>

LYME DISEASE

- American Lyme Disease Foundation website: <http://www.aldf.com/About.asp>
- Lyme Disease Association: <http://www.lymediseaseassociation.org>
- International Lyme and Associated Diseases Society: <http://www.ilads.org>.