

New York State
Department of Health
Mosquito Borne Illness
Surveillance & Response Plan
2012

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SUMMARY

This plan provides mosquito surveillance and response guidance for local health departments (LHDs) in New York State (NYS) and reflects a review of recent surveillance activities, control efforts and education and risk communication initiatives. Specific information is provided to assist LHDs to reduce the risk of human disease from West Nile virus (WNV), Eastern Equine Encephalitis virus (EEEV), and other mosquito-borne illnesses.

Key activities include:

- **Mosquito surveillance:** LHDs are responsible for establishing mosquito surveillance programs. Working with LHDs and starting in early summer, NYSDOH coordinates the weekly collection and identification of mosquitoes from traps located in key habitats throughout NYS.
- **Mosquito testing:** NYSDOH's Wadsworth Laboratory performs arboviral testing on mosquitoes on a weekly basis. The information on infection in subpopulations of mammal-biting species is used by LHDs to decide on appropriate control measures.
- **Animal surveillance:** NYSDOH encourages veterinary surveillance for encephalitis in horses. Horses are very sensitive to EEEV and infection is often fatal, however its signs are indistinguishable from those of rabies. In all cases of suspected encephalitis in horses, rabies is the primary consideration. Encephalitic horses that are negative for rabies are subsequently tested for mosquito-borne viruses.
- **Human surveillance:** Encephalitis and meningitis are reportable conditions in NYS. Each summer, NYSDOH sends alerts to physicians to be aware of the symptoms of WNV, EEEV, and other forms of infectious encephalitis/meningitis. Suspect cases are reported to LHDs and may be tested at the Wadsworth Laboratory for a host of potential causes.
- **Education:** NYSDOH staff have developed more than a dozen different educational brochures on mosquito-borne diseases. They are available in several languages for statewide distribution. The Department issues press releases and health advisories throughout the mosquito season that highlight personal protective measures for the public and technical and diagnostic information for providers.

INTRODUCTION

NYSDOH conducts surveillance for mosquito-borne viruses that pose a risk to human health. Activities are performed in cooperation with LHDs and include training personnel on mosquito trapping and speciation; testing of mosquitoes, humans and when appropriate, animals; assisting with the identification of local areas of disease risk; and providing surveillance information to guide local decision-making on prevention and control measures. Efforts focus on WNV and EEEV, which are the most common mosquito-borne viruses and pose the greatest public health risk in NYS.

DISEASE HISTORY AND BACKGROUND

West Nile Virus

The incubation period for WNV ranges from 3 to 14 days. About 1 in 150 people infected with WNV will develop severe illness including high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. These symptoms may last several weeks, and neurological effects may be permanent. Up to 20 percent of those who become infected have less severe symptoms such as fever, headache, body aches, nausea, vomiting, and/or a rash on the chest, stomach or back. Symptoms can last for as short as a few days to several weeks. Importantly, approximately 80 percent of those infected will not show any symptoms at all. No human vaccine is commercially available.

WNV is established in NYS and activity will continue to occur annually. The virus is maintained by a cycle of continuous transmission between mosquito vectors and bird reservoir hosts. The principal mosquito vectors are members of the genus *Culex* and are abundant in urban areas, breeding easily in artificial containers such as birdbaths, discarded tires, buckets, clogged gutters, catch basins and other standing water sources. *Culex pipiens* and *Culex restuans* feed mainly on birds and occasionally mammals (including humans), and are most active from dusk into the late evening. *Culex salinarius*, which feeds on birds, amphibians and mammals (including humans), prefers brackish and freshwater wetlands. Other species may also play a role in transmission.

Cumulative high temperatures and lower precipitation rates have been associated with higher mosquito infection and human illness rates. Additionally, warmer winter temperatures may result in larger numbers of *Culex* species overwintering as adults, with resulting increases in early season *Culex* abundance the following year.

Eastern Equine Encephalitis Virus

Five cases of EEEV have been diagnosed in humans in NYS since 1971, with a case in each of the last three years; all have been fatal. Prior to 2009, there had not been a human case detected in NYS in over 25 years.

The incubation period for EEEV ranges from 4 to 10 days, and infection can result in one of two types of illness, systemic or encephalitic. The type of illness depends on the age of the person and other host factors. Some people with infection may be asymptomatic.

Systemic infection has an abrupt onset and is characterized by chills, fever, malaise, arthralgia, and myalgia. The illness lasts 1 to 2 weeks, and recovery is complete when there is no central nervous system involvement. In infants, the encephalitic form is characterized by abrupt onset; in older children and adults, encephalitis is manifested after a few days of systemic illness. Signs

and symptoms in encephalitic patients include fever, headache, irritability, restlessness, drowsiness, anorexia, vomiting, diarrhea, cyanosis, convulsions, and coma. Approximately a third of all people with EEEv die from the disease. Death usually occurs 2 to 10 days after onset of symptoms but can occur much later. Of those who recover, many are left with disabling and progressive mental and physical sequelae, which can range from minimal brain dysfunction to severe intellectual impairment, personality disorders, seizures, paralysis, and cranial nerve dysfunction. Many patients with severe sequelae die within a few years. No human vaccine is commercially available.¹

EEEv is found in some passerine bird species living in fresh-water swamp habitats. The transmission cycle of EEEv occurs between wild birds and the enzootic vector mosquitoes, *Culiseta melanura* and to a lesser extent *Culiseta morsitans*. Both species feed predominantly on birds. Abundance of these species, especially *Culiseta melanura*, impacts levels of virus transmission. When populations are high, a greater opportunity exists for the virus to perpetuate or amplify within the bird population, increasing the potential for spillover infection into bridge vectors that bite humans including *Coquillettidia perturbans*, *Ochlerotatus canadensis*, *Aedes vexans* and *Culex* species. Additionally, long-term weather patterns during the fall and winter that produce high ground water levels and snow cover may enhance survival of *Culiseta melanura* larval populations. The abundance of these larval populations may serve as an early indicator of the potential for human disease later in the year.

Eastern Equine Encephalitis Virus: Special Considerations in Central New York

Historically, the majority of EEEv findings in mosquitoes, horses and humans have occurred in a four county region of Central New York: Madison, Oneida, Onondaga and Oswego Counties. NYSDOH data suggest that there are two large swamp complexes where EEEv initiates and amplifies, most likely through a *Culiseta melanura* – wild bird cycle. The two swamp complexes are Cicero Swamp (Onondaga County) and Toad Harbor Swamp (Oswego County). The first statewide detections of EEEv in a year are most often from *Culiseta melanura* collected from one of these swamps. LHDs in the region should attempt to control the virus during its amplification in the Cicero and Toad Harbor Swamps--before infected mosquitoes spread geographically outward from these areas.

Other viruses

Current Wadsworth Laboratory testing methods can detect the presence of other arboviruses that may impact human health. If atypical results are noted and the sample is negative for WNV and EEEv, it is tested for other arboviruses including: St. Louis Encephalitis virus, Jamestown Canyon virus, Cache Valley, California group viruses, and Lacrosse Encephalitis virus. These techniques are also capable of detecting newly introduced or emerging viruses in vector mosquitoes.

¹ The U.S. Army Medical Research and Materiel Command is currently recruiting participants for a study designed to determine the safety and immunogenicity of a human EEEv vaccine. Additional information is available at <http://clinicaltrials.gov/ct2/show/NCT00584805>.

ROLES AND RESPONSIBILITIES

New York State Public Health Law and the New York State Sanitary Code prescribe many of the roles and responsibilities of NYSDOH and LHDs regarding mosquito borne illness surveillance, response and control.²

NYSDOH

NYSDOH's primary role is to support LHDs. Staff are responsible for performing laboratory testing of mosquito and clinical specimens; monitoring statewide mosquito, animal and human surveillance trends; and providing timely data and subject matter expertise. NYSDOH also provides advice, support and technical assistance on control measures to LHDs.

LHDs

LHDs are responsible for establishing mosquito surveillance programs and are required to conduct human surveillance. Available resources may include both county-supported and State-supported assets. County budgets for surveillance should reflect appropriate levels of personnel, supplies, equipment and travel needs. State-supported resources include fiscal reimbursement for approved surveillance and control activities and laboratory testing of an allocated number of mosquito pools.³ LHDs should determine if it is necessary to divide a county or area of interest into smaller areas and allot a number of traps to each. Since NYS is a home rule state, decisions on control measures, such as aerial adulticiding ("spraying") must be made by local authorities. NYSDOH provides technical assistance to help inform local decision making.

² New York State Public Health Law 602; New York State Public Health Law Article 15; New York State Sanitary Code Part 2.6; New York State Sanitary Code Part 44

³ Detailed information on fiscal reimbursement for LHDs (including eligible expenses) is available at <http://goo.gl/1AVjd>

The following table summarizes key activities and the responsible public health agency.

Activity	Responsibility
Establish a mosquito surveillance and control program	LHD
Trap collection	LHD
Identify areas of disease risk	Shared
Test mosquitoes, horses, humans and other animals as appropriate	NYSDOH
Estimate viral infection rates in mosquitoes	NYSDOH
Track trends in arboviral infections by geographic area	Shared
Provide mosquito surveillance data to guide local decision-making	NYSDOH
Conduct surveillance for animal disease	NYSDOH
Conduct surveillance for human disease	LHD
Educate human and animal medical practitioners on the appropriate procedures for diagnosing mosquito borne illness	Shared
Educate the public on mosquito-borne diseases, risk, and preventive measures	Shared
Request Declaration of an Imminent Threat to Public Health	LHD
Approve Declaration of an Imminent Threat to Public Health	NYSDOH
Provide technical assistance on mosquito control measures	NYSDOH
Decide upon and conduct mosquito control measures (aerial adulticiding or “spraying”)	LHD
Permit aerial pesticide/adulticide applicators	NYSDEC ⁴
Authorize specific areas targeted aerial adulticiding	NYSDEC
On-site inspection of aerial pesticide/adulticide applicators prior to flight	NYSDEC
Participate in the Centers for Disease Control and Prevention's Arbovirus Surveillance Network.	NYSDOH

⁴ New York State Department of Environmental Conservation

SURVEILLANCE

Mosquito Surveillance

Mosquitoes are aquatic in three of their four life stages (eggs, larvae and pupae). Larvae and pupae are concentrated in water sources, and adults are widely-dispersed terrestrially. Mosquito surveillance activities can be directed toward identifying and mapping larval habitats and monitoring adult activity. Both provide valuable information for public health.

Larval mosquito surveillance allows the identification of the location and characteristics of breeding areas, determination of population densities and geographic distribution, provides an estimate of adult emergence and establishes optimal times for the application of larval control measures. Mosquito breeding can occur anywhere where there is standing water. Examples are numerous and include temporary flooded areas, swamps, marshes and other wetlands that are not subject to wind or wave action, flooded depressions, or stream edges where quiet water pools exist. Mosquitoes also breed in natural and artificial containers.

Because direct transmission to humans requires the bite of an adult mosquito, most vector surveillance activities are directed to the collection of mosquitoes in this stage. Monitoring adult mosquitoes in a standardized fashion provides information about species composition, density and age structure; numbers of individuals within a species, and seasonal population trends. Surveillance should start in the spring when daytime air temperatures warm to greater than or equal to 50F (possibly in April or May) and should end in late September or October unless warm air temperatures or evidence of continued activity requires extended surveillance.

Standardized data collection is the preferred method to monitor mosquito populations and is the basis for an effective local mosquito program. Long term, established trap sites provide the best available baseline information for detecting trends in mosquito abundance and virus prevalence that can be used to estimate the risk of human infection. Test results from routine collections of mosquito pools are made available to LHDs immediately. If the emergence of large numbers of human-biting mosquitoes in an area with a high rate of virus activity occurs or if unusual numbers/patterns of cases are reported, LHDs should consider enhancing surveillance with additional collection sites. When planning for the following mosquito season, LHDs should consider establishing these emerging areas as long term trap sites.

Target species for laboratory submission varies. For WNV, in addition to *Culex pipiens*, *Culex restuans* and *Culex salinarius*, species of interest include *Ochlerotatus cantator*, *Ochlerotatus japonicus*, *Ochlerotatus sollicitans*, *Ochlerotatus triseriatus*, *Ochlerotatus trivittatus*, *Aedes vexans*, *Anopheles punctipennis*, and *Anopheles quadrimaculatus*. For EEEV, *Culiseta melanura* is the primary enzootic vector and its frequency of feeding on large mammalian hosts (equines and deer) suggests that it may also function as an epizootic vector. Bridge vectors, including *Ochlerotatus canadensis*, *Coquillettidia perturbans*, and *Aedes vexans* may also play an important role in the cycle. It is too early to assess the public health importance of the introduction of *Aedes albopictus* (Asian tiger mosquito) to NYS.

Evaluating Mosquito Surveillance Data

The most basic form of evaluating mosquito surveillance data is the number of positive mosquito pools found in collections of a particular mosquito species over a defined time and area. LHDs should routinely incorporate an index of relative virus activity, the virus infection rate (IR), into their evaluation of local activity. Regular tracking of the mosquito IR provides important predictive indicators of transmission activity levels and human risk.

Estimates of the IR are usually presented as the number of infected mosquitoes per 1,000 tested. The simplest estimate, the minimum infection rate (MIR), can be calculated on the Health Commerce System. It is calculated as the $([\text{number of positive pools} / \text{total specimens tested}] \times 1000)$, with the data representing a single species or species group collected over a time period and geographic area. The MIR calculation assumes that a positive pool contains only one infected mosquito and should be interpreted as such, especially when infection rates are high. However, when MIR is tracked over time in a standardized manner by location and species, it can quickly identify an increasing risk of transmission.

Avian Surveillance

NYSDOH no longer recommends collecting dead birds for WNV surveillance. The virus' continued presence in the State has been sufficiently established and additional testing is unlikely to reveal additional information that would change prevention or control measures. Most birds that are infected with EEEV generally survive infection, eliminating dead bird surveillance as a useful tool. Several states have utilized sentinel chicken flocks for surveillance. The effectiveness of these approaches has been mixed, especially compared to mosquito and equine surveillance. Shifting resources away from avian surveillance allows resources to be used more effectively in other areas of surveillance and control.

Animal Surveillance

In NYS both EEEV and WNV routinely occur in mammals, primarily horses, as spillover from their bird-mosquito transmission cycles. However, as with all encephalitic/neurologic disease occurring in mammals, rabies infection should be a primary consideration for horses and other mammals presenting with primary encephalitis or progressive neurologic disease. Veterinarians are reminded annually by NYSDOH and New York State Department of Agriculture and Markets (NYSDAM) to consider rabies first in such cases and to report them to LHDs. Wadsworth Center's Rabies Laboratory has a standard mechanism to submit equine brain specimens for viral encephalitis testing if rabies tests are negative.

In situations where rabies exposure is not a consideration, and a veterinarian wishes to have diagnostic work performed on brain tissue, LHDs should advise the veterinarian to pursue diagnostic testing through their veterinary laboratories, including the Animal Health Diagnostic Center (AHDC) at Cornell University. AHDC staff will determine if rabies testing should be performed first, and will coordinate directly with the Wadsworth Center.

Regardless of the laboratory performing the testing, if vector-borne zoonotic encephalitis virus infections are detected in mammals, NYSDOH and LHDs are notified. While veterinary medical information is not subject to Health Insurance Portability and Accountability Act (HIPAA) requirements, all such medical information is confidential under NYS law. Press announcements or public service announcements should not provide information that would lead to the identification of the animal, owner, or location where the animal was housed. If such information is considered necessary to release, NYSDOH should first be consulted, and communication messages coordinated with NYSDAM.

When interpreting animal surveillance data, LHDs should remember that an effective equine vaccine exists against WNV and EEEV, potentially limiting the number of positive horses irrespective of viral activity in the environment.

Human Surveillance

In NYS, human cases of mosquito-borne diseases are reportable to LHDs. A critical component of surveillance efforts is the rapid detection and timely reporting of viral encephalitis and viral meningitis by medical providers. At the beginning of each mosquito season, NYSDOH contacts physicians statewide to encourage health care providers to consider arboviral infection in the differential diagnosis of any patient with clinical evidence of viral encephalitis or viral meningitis. During the mosquito season, LHDs should supplement NYSDOH's outreach by working with their local and regional health care providers.

Immediate reporting of viral encephalitis cases is required of physicians and laboratories year round. During the mosquito season, from June through October, LHDs should encourage health care providers to also immediately report any patient with clinical evidence of viral meningitis. For the remainder of the year, providers should be reminded that while viral meningitis is still reportable, immediate notification is less critical.

Testing and Collection of Specimens

Wadsworth Center offers testing for several mosquito-borne diseases including WNV and EEEV. Cerebrospinal fluid (CSF) testing by polymerase chain reaction (PCR) may be less sensitive than testing serum by serology. Ideally, both CSF and acute/convalescent serum specimens should be submitted for testing. Convalescent specimens should be drawn at least 3 weeks after acute specimens.

LHDs should coordinate specimen submission to Wadsworth Center whether sent directly from providers or forwarded from commercial laboratories. Instructions on the collection and submission of clinical specimens, a detailed algorithm regarding which tests will be conducted, and the Viral Encephalitis/Meningitis Case Report and History Forms can be found on the Wadsworth Center website at: <http://www.wadsworth.org/divisions/infdis/enceph/form.htm>.

Additional Human Surveillance Activities

Areas that have had significant arboviral activity in the past may consider conducting enhanced passive and/or active surveillance during the mosquito season. Enhanced passive surveillance efforts may include the broadcast of facsimile advisories, telephone calls and/or mailings to hospitals and health care providers regarding the importance of physician reporting, criteria for reporting, and instructions for submission of appropriate laboratory specimens to Wadsworth Center.

Active surveillance may include regular calls to hospitals to canvass for suspect viral encephalitis and meningitis cases and sending out health alerts to providers asking them to include mosquito-borne diseases in differential diagnoses. Additionally, LHDs should encourage providers to consider submitting specimens to Wadsworth Center for testing if clinical illness is consistent with mosquito-borne disease, even if commercial testing is inconclusive or negative.

Communication of Surveillance Information

NYSDOH provides timely mosquito, animal and human surveillance information to LHDs to guide planning and control measures to reduce the risk of human disease. Staff routinely communicates with neighboring states and share relevant findings. Key activities include:

- Prior to the beginning of the arboviral season, clinical information and specimen submission procedures are provided to LHDs and providers. Additional information and fact sheets are posted on the NYSDOH website and are available for physicians, veterinarians, other agencies and the public.
- Positive arboviral findings in mosquitoes are reported to the LHD immediately.
- Laboratory confirmation of a human arboviral cases are reported to the submitting physician and the LHD where the individual resides.
- Laboratory confirmation of infection in a horse (or other veterinary specimen) is reported to the submitting veterinarian, the NYS Department of Agriculture. This information is then shared with NYSDOH and the LHD.
- Coordinating regular telephone conference calls for LHDs during the mosquito season to share findings, strategies and concerns.

Counties should also consider working with one another to create coordinated, regional approaches to sharing surveillance information. NYSDOH will support these efforts with regular conference calls and has created secure discussion forums on its Health Commerce System that can be utilized by LHD's to share findings and strategies, and ask questions and report concerns. NYSDOH will regularly update these forums with maps for each county/region that visually summarize testing results from mosquito samples, animals and humans. Weekly WNV and EEEV surveillance data will also be posted on the NYSDOH website and sent to the Centers for Disease Control and Prevention's (CDC) ArboNET reporting system.⁵

⁵ Accessible to the public at diseasemaps.usgs.gov.

Education and Risk Communication

Each mosquito season, NYSDOH engages in an education campaign known as “Fight the Bite” to improve knowledge about arboviral diseases, encourage the elimination of mosquito breeding sites, support the adoption of appropriate personal protection techniques, and promote the proper use of effective mosquito repellents and considerations for deciding on their use. Specific resources include generic public service announcements and press releases, brochures (in multiple languages) and other branded informational and marketing materials. The Fight the Bite campaign materials are available to all LHDs at no cost. More information and/or materials can be obtained by emailing bcdc@health.state.ny.us.

LHDs should share surveillance data and its implication for public health with local stakeholders and high-risk populations in their community, as appropriate. LHDs should utilize both traditional and social media when there is an indication of an increased risk of human disease or if a significant surveillance event occurs (i.e. the first arboviral activity of the season). In general, messaging should include the context surrounding current data and emphasize prevention strategies.

Counties should also work with one another to create coordinated, regional approaches to risk communication. NYSDOH will support these efforts and recommends that in addition to using social media, LHDs give specific consideration to utilizing *NY-Alert*⁶, New York State’s web-based, all-hazards alert and notification portal. NY-Alert allows LHDs to create specific messages to targeted audiences and the public. The system uses a variety of technologies to distribute messages to those who opt-in to receiving information, including press releases to local/traditional media outlets, really simple syndication (RSS) feeds from LHD websites, text/sms messages via cell phones mobile, apps for handheld devices (i.e. iphones and android smartphones). Additionally, the system allows counties to use reverse 911 data to reach a specific audience, when indicated.

Prevention, Response and Control Considerations:

Since multiple factors contribute to the risk of mosquito-borne illness, local decisions on control measures should be made only after consideration of all available data for an area.

Mosquito Control

In addition to personal protective measures, mosquito control is an effective means of protecting people and animals from mosquito-borne diseases. An effective control program includes source reduction, larval and adult mosquito control activities. When planning, LHDs should consider their long-term knowledge of the area with regard to mosquito populations, arboviruses, and

⁶ The public can sign up for *NY-Alert* via the web at www.nyalert.gov, by phone at 518-292-2299, or via email at support@nyalert.gov. Signing up for NY Alert is free and participants’ personal information is protected and never shared. Participants can modify what type of alerts they wish to receive and can unsubscribe at any time.

human disease, seasonal weather patterns, and potential impacts of significant weather events such as hurricanes and floods. Ongoing, local decision-making also requires assessing surveillance data as it becomes available.

Source Reduction

Source reduction, also known as physical or permanent control, typically is one part of a county's existing Integrated Pest Management (IPM) program. Source reduction is usually the most effective mosquito control technique and is accomplished by eliminating mosquito breeding sites. Members of the public can also play an important role in source reduction. Examples are numerous and include removing unused plastic pools, old tires, or buckets; clearing clogged gutters; emptying standing water from children's outdoor toys, flower or any object that can hold water; and keeping swimming pools chlorinated and their covers free of stagnant water. Source reduction can virtually eliminate the need for pesticide use in and adjacent to affected areas.

*Larval Control*⁷

Control of mosquito larvae and pupae prevents mosquitoes from becoming biting female adults capable of transmitting disease and producing another generation of mosquitoes. Larval control focuses target -specific agents in definable aquatic breeding sites and has three key components: environmental management, biological control, and chemical control.

Environmental management decreases habitat availability or suitability for immature mosquitoes through techniques such as increasing the water disposal rate through evaporation, percolation, recirculation, or drainage. Environmental management also may entail vegetation management because emergent vegetation provides food and refuge for mosquito larvae. Strategies include the periodic removal or thinning of vegetation, restricting growth of vegetation, and controlling algal growth.

Biological control uses natural predators, parasites, or pathogens to reduce the immature mosquito numbers. Mosquito fish, *Gambusia affinis*, are the most widely used biological control agent in NYS. These fish are released annually in a variety of habitats, such as small ponds and canals. Naturally-occurring vertebrates and invertebrates at ponds feed on immature and adult mosquitoes.

⁷ Compounds currently approved for larval and adult mosquito control are available at www.dec.ny.gov/docs/materials_minerals_pdf/pestprod.pdf. LHDs should consider several factors when contemplating such products including efficacy against the target species or life cycle stage; DEC requirements, pesticide resistance and label requirements; availability of pesticide and application equipment; environmental condition and toxicity to non-target species, including humans.

There are several mosquito control products that are highly specific and thus have minimal impact on non-target organisms. These include microbial control agents such as *Bacillus thuringiensis israelensis* (Bti). Importantly these agents, also known as dunks, are for use in contained sources of water (i.e. abandoned swimming pools) not for use in areas where water sources flow together or in swampy regions, such as the Oneida Lake area.⁸

Other products, such as insect growth regulators (i.e., methoprene), that prevent immature mosquitoes from developing into adults may negatively impact non-target organisms. The documented effectiveness of these agents on *Culiseta melanura* larvae in research studies, including one conducted in the Toad Harbor-Big Bay Swap Complex in Oswego County, is limited.⁹ In addition to its potential negative impact on non-target organisms, significant technical, logistical, environmental and regulatory barriers exist. NYSDOH canvassed other states faced with a significant burden of *Culiseta/EEEv* and is not aware of any jurisdictions that routinely larvicide against these mosquitoes. Surface films are very effective against both larvae and pupae, but also may suffocate other surface breathing aquatic insects.

Species Specific Larval Control

Culex mosquito species are the primary vector of WNV. *Culex* are container-breeders and for example, may breed and develop in association with abandoned, nutrient-rich swimming pools storm drains and sumps. An application of larvicide product to this contained habitat may provide mosquito control for a length of time.

Culiseta mosquito species are the primary mosquito vector of EEE virus. *Culiseta* develop in wooded wetlands in dark, water-filled spaces created by tree roots, often termed “crypts”. Reasons why larviciding for *Culiseta* control may not be effective include the inability of the product to penetrate the wooded canopy and crypts, potential negative effects on non-target organisms, potential restrictions on aerial product application and that truck-mounted or backpack delivery systems do not lend themselves well to these habitats. Additionally, *Culiseta* is also a bi-voltine or tri-voltine species (i.e., two or three population peaks per season), complicating control since determining the proper timing of multiple larvicide applications can be difficult.

⁸ LHDs and other interested parties should be sure to follow the manufacturer’s directions and may wish to contact DEC regarding any relevant regulations about their use in a given setting.

⁹ Woodrow RJ, Howard JJ, White DJ. Field trials with methoprene, temephos, and *Bacillus thuringiensis* serovar *israelensis* for the control of larval *Culiseta melanura*. *J Am Mosq Control Assoc.* 1995 Dec;11(4):424-7.

Adult Control

When larval control is not possible or has been used to the fullest extent possible, adult mosquito control may be required to suppress populations of infected mosquitoes. While NYSDOH provides technical assistance and a list of permitted commercial applicators to LHDs contemplating adult control measures, the decision to implement adult mosquito control is a local decision. Factors that should be considered include but are not limited to:

- The numbers and species of positive mosquito populations and trends (some species are more likely to bite humans, others more likely to bite birds).
- Trends in minimum infectivity of mosquitoes.
- The most recent human, horse and mosquito surveillance data and trends.
- Whether the current positive results are geographically focal or widespread and/or in emerging geographic areas that have not recently had infected mosquitoes.
- The density and proximity of human populations to positive mosquitoes.
- The time of year that positive results are found relative to historical trends.
- The geography of and accessibility to the area where mosquitoes are located.
- The potential harmful impact that adulticides may have on humans, other insect species, and the environment.

Adult mosquito control products may be applied using ground-based equipment, fixed wing airplanes, or helicopters. These products include organophosphates, such as malathion, and pyrethroids such as resmethrin, sumithrin, and permethrin.

Aerial adulticiding has uncertain and potentially, very limited benefits for preventing illness among humans. It is only feasible in relatively limited geographic areas due to cost, the location of mosquitoes, and accessibility for spraying by planes. Aerial adulticiding is not recommended when air temperatures are less than 55°F, if rain has occurred during the previous 24 hours and has not dried from vegetation, or if winds are >10 mph. More urban and suburban areas may require ground-based equipment such as trucks. Adulticiding also has a time limited benefit because it does not kill all mosquitoes in the area and those that are killed can rapidly be replaced by new mosquitoes that can possibly become infected. NYSDOH subject-matters experts are available to provide consultation to LHDs who may be working through this local decision making process.

Given the limitations of adulticiding, the primary strategy to prevent mosquito-borne illness among humans must continue to be the promotion of personal preventive measures.

Summary of Recommendations for Phased LHD Response to WNV Surveillance Data

<p>→</p> <p>Suggested WNV-Related Activities, May through WNV+ Findings</p> <p>→</p>	<p>1. Conduct passive surveillance of viral encephalitis/meningitis. Fully investigate cases of viral encephalitis/meningitis to rule out arboviral disease. Counties may wish to send an alert to providers at the beginning of the season to convey the importance of reporting viral encephalitis cases in warmer months in light of WNV. Prepare a list of contacts for local emergency rooms and health care providers to conduct active case surveillance during the mosquito season.</p>	<p>4. Perform larval and/or habitat surveillance for mosquito species involved in WNV transmission.</p>		
	<p>2. Request mosquito surveillance/ID training session from NYSDOH if necessary.</p>	<p>5. Conduct adult mosquito surveillance for mosquito species involved in WNV transmission, using CO2-baited CDC light traps and gravid traps.</p>		
	<p>3. Contact NYSDEC and certified pest control applicators for routine mosquito control and/or emergency contingencies.</p>	<p>6. Share public health education messages focusing on personal protection and behaviors that can minimize mosquito breeding. Use any available resources: press releases, submitted articles, LHD websites, social media, etc.</p>		
Summary of Recommendations for Phased LHD Response to WNV Surveillance Data				
Date of Findings	WNV+ Findings Through August		WNV+ Findings in September Through First Hard Frost	
Suggested Response By	County of Findings	Adjoining County	County of Findings	Adjoining County
Human Disease Surveillance	<p>If WNV+ findings are in humans, horses, or human-biting mosquito species, conduct active surveillance of viral encephalitis and/or meningitis cases. Notify Emergency Rooms, ID physicians, large practices of findings, make calls to canvas for suspect cases, and encourage workup and reporting of viral encephalitis and/or meningitis cases. Viral encephalitis cases should be prioritized if resources are limited.</p>		<p>If WNV+ findings are in humans, horses, or human-biting mosquito species, conduct active surveillance of viral encephalitis and/or meningitis cases. Notify Emergency Rooms, ID physicians, large practices of findings, make calls to canvas for suspect cases, and encourage workup and reporting of viral encephalitis and/or meningitis cases. Viral encephalitis cases should be prioritized if resources are limited.</p>	
Public Education	<p>Perform education concerning personal protection messages; If human cases, consider using big media (TV, radio)</p>	<p>Perform education concerning personal protection messages</p>	<p>Perform education concerning personal protection messages</p>	
Provider Education	<p>Include info/fact sheet on WNV with surveillance notification</p>		<p>Include info/fact sheet on WNV with surveillance notification</p>	
Adult Mosquito Surveillance	<p>Commence/enhance adult mosquito surveillance using gravid traps (which catch mosquitoes more likely to be infected)</p>		<p>Enhance adult mosquito surveillance; continue as conditions and catches permit</p>	
Large Mammal and Avian Surveillance	<p>Alert veterinary community to local WNV transmission, suggest equine vaccination. Avian surveillance no longer recommended.</p>		<p>Alert veterinary community to local WNV transmission. Avian surveillance no longer recommended.</p>	
Mosquito Control	<p>Depending on number of human cases, positive pools, and/or presence of positive bridge vectors, consider larviciding and/or ground-based and aerial adult mosquito control</p>	<p>Based on surveillance results, habitat, and proximity to other findings, consider larval or adult mosquito control</p>	<p>Rely on surveillance data and air temperatures to determine necessity for control</p>	
Other	<p>Request ITPH if desired; make contact with NYSDOH for technical assistance if needed</p>	<p>Make contact with NYSDOH for technical assistance if needed</p>	<p>Request ITPH if desired; make contact with NYSDOH for technical assistance if needed</p>	<p>Make contact with NYSDOH for technical assistance if needed</p>

Summary of Recommendations for Phased LHD Response to EEEv Surveillance Data

<p style="margin: 0;">→</p> <p style="margin: 0;">Suggested EEE-Related Activities, May through EEE+ Findings</p> <p style="margin: 0;">→</p>	<p>1. Develop communication with large animal veterinarians or County Supervising Veterinarians; encourage testing of specimens from ill equines and captive birds. Encourage equine vaccination.</p> <p>2. Locate captive bird farms (pheasants, quail, ducks, emus, etc.). Contact farmers to educate them about captive birds and EEE, and to encourage them to report bird deaths</p> <p>3. Request mosquito surveillance/ID training session from NYSDOH if necessary</p> <p>4. Perform larval and/or habitat surveillance for <i>Culiseta melanura</i></p>	<p>5. Conduct adult mosquito surveillance for virus evidence near <i>Cs. melanura</i> habitats using CO₂-baited CDC light traps and diurnal resting boxes</p> <p>6. Contact NYSDEC and certified pest control applicators for mosquito control contingencies</p> <p>7. Conduct passive surveillance of viral encephalitis/meningitis. Fully investigate cases of viral encephalitis/meningitis to rule out arboviral disease. Counties may wish to send an alert to providers at the beginning of the season to convey the importance of reporting viral encephalitis cases in light of historic EEE. Prepare a list of contacts for local emergency rooms and health care providers to conduct active case surveillance during the mosquito season.</p>		
Summary of Recommendations for Phased LHD Response to EEEv Surveillance Data				
Date of Findings	EEE+ Findings Through August		EEE+ Findings in September Through First Hard Frost	
Suggested Response By	County of Findings	Adjoining County	County of Findings	Adjoining County
Human Disease Surveillance	<p>If EEE+ findings are in humans, horses, or human-biting mosquito species, conduct active surveillance of viral encephalitis and/or meningitis cases. Notify Emergency Rooms, ID physicians, large practices of findings, make calls to canvas for suspect cases, and encourage workup and reporting of viral encephalitis and/or meningitis cases. Viral encephalitis cases should be prioritized if resources are limited.</p>		<p>If EEE+ findings are in humans, horses, or human-biting mosquito species, conduct active surveillance of viral encephalitis and/or meningitis cases. Notify Emergency Rooms, ID physicians, large practices of findings, make calls to canvas for suspect cases, and encourage workup and reporting of viral encephalitis and/or meningitis cases. Viral encephalitis cases should be prioritized if resources are limited.</p>	
Public Education	<p>Perform education concerning personal protection messages; Target horse owners if possible; If human cases, consider using big media (TV, radio); Limit outside activity</p>	<p>Perform education concerning personal protection messages</p>	<p>Perform education concerning personal protection messages</p>	
Provider Education	<p>Include info/fact sheet on EEE with surveillance notification</p>		<p>Include info/fact sheet on EEE with surveillance notification</p>	
Adult Mosquito Surveillance	<p>Enhance adult mosquito surveillance</p>		<p>Enhance adult mosquito surveillance; continue as conditions and catches permit</p>	
Large Mammal and Captive Avian Surveillance	<p>Alert veterinary community to local EEE transmission, ask for samples from ill equines and captive birds</p>		<p>Alert veterinary community to local EEE transmission, ask for samples from ill equines and captive birds</p>	
Adult Mosquito Control	<p>Depending on number of positive pools, and presence of positive bridge vectors, consider ground-based and aerial adult mosquito control</p>	<p>Based on surveillance results, habitat, and proximity to other findings, consider larval or adult mosquito control</p>	<p>Rely on surveillance data and air temperatures to determine necessity for control</p>	
Other	<p>Request ITPH if desired; make contact with NYSDOH for technical assistance if needed</p>	<p>Make contact with NYSDOH for technical assistance if needed</p>	<p>Request ITPH if desired; make contact with NYSDOH for technical assistance if needed</p>	<p>Make contact with NYSDOH for technical assistance if needed</p>

NYSDOH Educational Resources

Websites:

For more information about West Nile Virus visit <http://goo.gl/VHXJh>

For more information about Eastern Equine Encephalitis in humans, visit <http://goo.gl/KRhE3>

For more information about Eastern Equine Encephalitis in horses, talk to a veterinarian or visit the US Department of Agriculture at <http://goo.gl/iHF49>

For general information on mosquito-borne disease prevention and the most current mosquito, animal and human surveillance data visit <http://goo.gl/McW06>

Brochures, Factsheets and Posters:

NYSDOH offers limited quantities of free mosquito-borne disease educational materials to NYS residents and organizations. To preview, verify availability or order any of the following materials, please visit <http://goo.gl/UCGCS>, email arbobl@health.state.ny.us or call 518-473-4439.

Brochures:

Reducing Pesticide Exposure

Fight the Bite (Also Available in Spanish)

Tick & Insect Repellents: Deciding on Use (Also Available in Spanish)

Factsheets:

Health Advisory: Tick and Insect Repellents

Anvil® and Mosquito Control

Scourge® and Mosquito Control

Malathion and Mosquito Control

WNV Information for Outdoor Workers (Also Available in Spanish)

WNV: DEET Tips – For Proper Protection

WNV: Frequently Asked Questions

WNV: Do Mosquitoes Love Your Home and Yard?

WNV: Suggested Community Activities

What Do I Do if There is Spraying in My Community?

WNV: Senior Citizens

Posters and Other Items:

Dress to Repel – 11” x 17” flier

Fight the Bite – Protect Your Home Against Mosquitoes (Also Available in Spanish)

Dress To Repel

Dress to Repel – 11” x 17” flier (Spanish)

Dress To Repel (Spanish)

Fight the Bite – magnet

Avoiding Tick/Mosquito Bites – magnet

NYSDOH Arthropod Borne Disease Staff and Locations

