

7/25/01

# **State of Georgia**

## **West Nile Virus**

### **Surveillance and Response Plan**

Drafted by the State of Georgia

West Nile Virus Working Group

## **West Nile Virus Background**

In late summer of 1999, the first domestically acquired human cases of West Nile Encephalitis were documented in northeastern area of the United States. By the end of the 2000 mosquito-borne pathogen transmission season, West Nile Virus (WNV) activity had been identified in a 12 state area from Vermont and New Hampshire in the northeast to North Carolina in the south. In the year 2000, there were 21 humans, 63 horses, 4,304 birds and 480 mosquito pools (14 species) reported with WNV. This annual human case incidence now ranks WNV second only to LaCrosse encephalitis virus as the leading cause of reported human arboviral encephalitis in the United States.

WNV is a member of the family Flaviviridae (genus Flavivirus). It is a member of the Japanese encephalitis complex that includes St. Louis encephalitis. WNV was first recognized in Uganda in 1937 with the largest recorded epidemic occurring in South Africa in 1974. European epidemics of West Nile encephalitis occurred in Southern France in 1962, Southeastern Romania in 1996 and South-Central Russia in 1999. European equine outbreaks occurred in Italy during 1998 and in France during 2000.

WNV can infect a wide range of vertebrates. Human cases may involve asymptomatic infection, mild febrile disease sometimes accompanied by rash, or severe and fatal infection in a small percentage of patients. During the 1999 outbreak in New York, approximately 40% of laboratory positive humans with encephalitis or meningitis had severe muscle weakness and 10% developed flaccid paralysis. The human case fatality rate in the United States has steadied around 11%.

Mortality in a wide variety of bird species has been a hallmark of WNV in the United States. Public health officials used bird mortalities to effectively track WNV expansion in 2000. Field studies determined that areas with bird mortality due to WNV infection were experiencing ongoing enzootic transmission.

In 1999, *Culex* species of mosquitoes was the principal vector for WNV transmission. In 2000, a total of 14 WNV mosquito species were identified as infected, although 89% of positive mosquito pools were *Culex*. As opposed to *Culex*, many of the other mosquito species feed primarily on mammals during day light hours. It is not yet known what affect this widened spectrum of WNV infected mosquito species will have on Georgia's WNV ecology. It must be remembered, however, that WNV infection does not always implicate a mosquito species as the competent viral vector.

To assess the implication of introduction of the WNV into Georgia and to develop a state response plan, a Georgia WNV Working Group was formed. Members of this group include representatives of several federal, state and local agencies. Participants in this group have met to discuss current surveillance activities as well as to propose responses to WNV infection in Georgia.

7/25/01

Current WNV activities have focused on surveillance and public awareness campaigns. Presently, statewide surveillance includes: active wild bird surveillance, enhanced passive veterinary surveillance and enhanced passive human surveillance.

### **Georgia West Nile Virus Surveillance and Response Plan**

The state WNV plan includes the following goals:

- To reduce the likelihood of transmission of disease to humans and animals.
- To identify the role of local, state and federal agencies as well as private industry in Georgia during surveillance and in the event of WNV infection,
- To provide for rapid dissemination of information between state, federal and local agencies,
- To encourage the development and implementation of individual health district plans
- To provide guidance and assist local health districts with WNV plan formation,
- To educate local health districts as to risks and costs likely incurred with surveillance and response,
- To identify possible state and federal resources, including laboratory support, that may be available for surveillance and response, and to encourage necessary funds be made available to support WNV activities.
- To coordinate a state public awareness campaign to ensure a consistent message to the public.

### **Georgia WNV Surveillance and Response Plan Outline**

Activities to be carried out uniformly across the state will follow the following outline:

#### **I. Surveillance**

According to their individual plan, local health districts will implement surveillance activities consistent with the state plan with the exception of mosquito surveillance and control which will be modified according to local capabilities and resources.

##### **A. Wild Bird Surveillance (Detailed in Appendix A)**

1. DHR, PH will coordinate collection of information on wild bird mortality
  - a. Collect reports on dead bird sightings of all species

1. Local health departments and DNR, Wildlife Resources Division will collect data and send in weekly report to DHR, PH.
  2. Reports will be issued on standardized forms
  3. Local Board of Health will publicize system
- b. Dead crows (and other species) will be submitted through local Board of Health for WNV testing
1. Testing will be done at SCWDS ( pending continued funding )
  2. Testing will be limited to areas not confirmed to have presence of WNV
  3. Testing will include all species until load becomes too great for SCWDS. Testing will then be limited to crows.
2. Live wild bird surveillance will be performed by SCWDS pending continued funding. (Active Surveillance)
3. Information on mortality rates and location as well as WNV testing results will be compiled by DHR, PH and disseminated to other agencies as well as local health departments.
- B. Domestic Birds and Animal Surveillance (Equine investigations detailed in Appendix B)
1. GDA and USDA, APHIS will investigate all cases involving domestic animals, poultry and pet birds with suspicious neurologic diseases
    - a. Testing for WNV on domestic animals and birds will be performed at one of the UGA veterinary diagnostic laboratories after ruling out rabies.
    - b. Suspected positives for WNV will be sent to NVSL for confirmation.
  2. GDA will conduct passive surveillance by collecting information on all reported suspect cases. Information will be sent to DHR, PH for dissemination to other agencies and local health departments.
  3. GDA will perform active surveillance on domestic animals as needed.
  4. Sentinel poultry populations will be established as needed.
- C. Human Surveillance
1. DHR, PH will review all cases of encephalitis reported by health care providers and hospitals

2. Arboviral testing will be performed on appropriate acute and paired specimens
3. Results of reported cases as well as test results will be compiled by DHR, PH and disseminated to other appropriate agencies and local health departments.
4. Active surveillance will be conducted as needed.

D. Mosquito Surveillance (Detailed in Appendix C)

1. Should be performed by local health districts ( with support from state and federal agencies ) and should follow CDC guidelines for Arbovirus surveillance.
2. Should include:
  - a. Mosquito species composition and abundance
  - b. Seasonal and spacial distribution of mosquito vectors
3. Virus surveillance for infected mosquitoes should begin in areas where a certain number of birds or 1 horse is confirmed to have WNV or where local municipalities have structure and resources in place to begin surveillance.
4. Information will be compiled and disseminated by DHR, PH.

II. Public Relations and Communications

Public Relations and Education will be spearheaded by DHR, GEMA and local health departments. Activities should include:

1. Educate municipal officials, the media, and public on WNV disease prevention recommendations including personal protective measures and homeowner source reduction.
2. Increase awareness among health care providers and veterinarians about the virus, its prevention and diagnosis.
3. Facilitate communication between municipal officials, the public and other state agencies.
4. Disseminate information from state agencies to municipal officials, the media and the public.
5. Educate the public on mosquito control methods necessary to address the human health risks.

7/25/01

6. Use of State WNV Working Group Members as a technical resource.

### III. Response

1. Response to diagnosis of WNV within the state of Georgia will follow approach outlined by local health district plan and local EMA and modified according to local resources.
2. State and Federal resources will be activated within their current capacities.
3. GEMA response plan may be activated depending upon magnitude of event.
4. Statewide surveillance activities, public information campaigns and environmental assessments will be amended accordingly.
5. DHR will report overall status and encourage activities based upon human health and animal health risks.

### IV. Local Municipality/Health District Plan

1. The State of Georgia West Nile Virus Working Group recommends local health districts and municipalities draft a surveillance and response plan compatible with local resources. Coordination of surveillance and response on a regional level is recommended.
2. The DeKalb County Board of Health West Nile Virus Surveillance and Response Plan (Appendix D) can be modified to suit local needs.
3. Mosquito surveillance and control activities should follow guidelines outlined in Appendix C, the Center for Disease Control and Prevention's "Epidemic/Epizootic West Nile Virus in the United States: Revised Guidelines for Surveillance, Prevention, and Control."

### **Distribution**

The State of Georgia West Nile Virus Surveillance and Response Plan will be distributed as follows:

Health Districts/Local Boards of Health  
Georgia Department of Human Resources  
Georgia Department of Agriculture  
Georgia Emergency Management Agency  
Georgia Department of Natural Resources  
Centers for Disease Control and Prevention  
United State Department of Agriculture, Animal Plant Health Inspection Service, Veterinary Services  
United States Parks Service  
University of Georgia, College of Veterinary Medicine

7/25/01

Southeastern Cooperative Wildlife Disease Study  
University of Georgia, Department of Entomology

The plan will also be available online at:

<http://health.state.ga.us/>

<http://www.agr.state.ga.us/>

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7/25/01

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## Appendix A

### West Nile Virus Surveillance -- Wild Bird Component Southeastern Cooperative Wildlife Disease Study, The University of Georgia in Collaboration with the Georgia Department of Human Resources, Division of Public Health

**Goal:** To determine if West Nile virus is present in Georgia

**Objectives:** (Primary objective): To test (virus isolation and serology) a sufficient number of wild birds from representative ecological areas of Georgia to determine if West Nile virus is or has been present within the State. (Secondary objectives) a) If the presence of WNV is confirmed by virus isolation or if serologic evidence of infection is detected: to evaluate potential species and regional differences in distribution of positive cases and antibody prevalence rates; b) To provide an estimate of background SLE exposure in crows.

#### Surveillance Plan

##### I. Dead Bird Surveillance (WNV testing)

**A. Targeted species-**Targeted species to test will include crows (American and fish), blue jays and raptors.

**B. Other species-**When feasible (based on case load), all species will be tested.

**C. Contingency plan-**Should submission become excessive, testing of dead birds may be restricted to targeted species (or an additional species if unexpected WNV-related mortality is detected). Efforts will be made to confirm WNV at the county level and if possible on a monthly basis to understand the duration of viral transmission. Testing will initially be restricted to virus isolation. Following the first confirmed case, immunohistochemistry and PCR also will be incorporated into testing protocols.

##### **Rational:**

-Dead bird surveillance has proven to be a reliable indicator of WNV transmission in the northern states

-Dead bird surveillance represents the most likely and cost efficient strategy to confirm WNV by virus isolation

-Although corvids have been shown to be a very susceptible group of birds in the Northeast, we will include other species until this is demonstrated in the Southeast. There are at least three reasons for this: 1. Crow densities and resulting detection of mortality in Georgia may not be similar to the Northeast experience; 2. Other species in the Southeast that are not present in the Northeast or are at

lower population densities may provide alternative dead-bird surveillance targets; and 3. It is unknown if or how previous exposure to SLE will influence susceptibility to WNV in crows or other species

## **II. Live Bird Surveillance**

### **A. Targeted species (Serosurvey)**

1. Non-migratory species including boat-tailed grackles, pigeons, and resident Canada geese
2. Migratory species including crows and gulls (breeding populations)

#### **Rational:**

- Targeted species approach will allow us to evaluate future trends if evidence of West Nile infection is detected (consistency in surveillance)
- Non-migratory species will allow documentation of in-state transmission
- As it is known that crows and gulls are susceptible to WNV, breeding populations of these migratory species (especially hatching year birds) will provide an indication of local exposure. With regard to crows, we would like to evaluate background levels of SLE antibody, as this could potentially influence sensitivity of our dead bird surveillance.

### **B. “Non-targeted species” (general bird survey)**

Summer collections (locally breeding birds of many species)

#### **Rational:**

- Biologically sound, many diverse groups of birds have been infected with WNV
- May provide a basis to determine target species for future surveillance
- Breeding migratory species (especially hatching year birds) may provide better coverage for a national perspective
- Many avian species may be involved in the epidemiology of this virus

**Proposed Minimum Sample Size--Wild bird surveillance**

Sample	Species	Coastal	Coastal Plain	Piedmont
Targeted	Boat-tailed grackle	60-100	--	--
	Pigeon	100	60	60
	Canada Geese	--	100	200
	Crows	30-60	30-60	30-60
	Gulls	30-60		
Non-targeted	Summer	100	100	100

Minimum projected sample size: Coastal: approx. 500, Coastal Plain: approx. 300, Piedmont: approx. 400 Total: approx. 1200

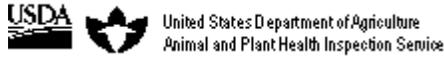
**Lab support:** Lab support (serology and virus isolation for the wild bird component of this surveillance will be conducted at the Southeastern Cooperative Wildlife Disease Study, UGA)

**Dead Bird Testing**--All necropsies will be done at the Southeastern Cooperative Wildlife Disease Study. Testing will initially be restricted to virus isolation from brain, heart, and/or kidney. Following the first confirmed case, immunohistochemistry and PCR also will be incorporated into testing protocols. (See virus isolation below)

**Serology**-- All birds will be tested by plaque reduction assays. Samples initially will be screened for antibodies to West Nile virus at the minimum serum dilution (1:10). Positive samples will require further titrations by plaque reduction assays (WNV and SLE) to test for potential non-specific cross-reactions.

**Virus isolation**--Virus isolation will be attempted on Vero cells. Potential isolates will be identified by IFA and PCR. Initial (suspected positives) will be forwarded to CDC Fort Collins for confirmation.

## Appendix B



### **Guidelines for Investigating Suspect West Nile Virus Cases in Equine Veterinary Services May 2000**

#### Introduction

In the United States, West Nile virus (WNV) has caused disease and deaths in humans, wild birds, zoo birds, and horses. Wild birds are the reservoir for the virus, which is transmitted by mosquitoes. Limiting exposure to mosquitoes and controlling mosquitoes are fundamental in preventing the disease. The purpose of this document is to guide veterinary practitioners and field personnel in investigating and reporting suspect cases of WNV infection in equine.

#### Equine Precautions

APHIS Veterinary Services (VS) is concerned about horses and other equine because 25 cases of illness in horses on Long Island, New York, were found to be attributable to WNV in 1999. Nine of those horses died or had to be euthanized. An additional 36 horses on Long Island were found to have been exposed to WNV and developed antibodies to the virus, but did not develop clinical illness.

To prevent exposure of equine to WNV, it is necessary to prevent their exposure to mosquitoes. No vaccine for WNV is currently available. The most important action to prevent exposure to mosquitoes is source reduction, i.e., the elimination of stagnant water sources where mosquitoes may breed. Insect-proofing stables and other measures that reduce exposure of equine to mosquitoes may be useful in areas where current WNV activity has been documented in mosquitoes, birds, humans, or equine.

#### Human Precautions

When working with an equine or other mammal showing signs of a central nervous system disorder, always take precautions to avoid exposure to rabies virus. In addition, persons visiting a premises to investigate an unknown disease condition should take measures to prevent exposure to a variety of arthropod-borne zoonotic pathogens. Application of commercially available insect repellants containing DEET to clothing and to exposed parts of the body should be sufficient to protect oneself from mosquitoes carrying WNV.

#### Equine Surveillance

What should be considered a suspect case of equine WNV infection and how it should be investigated depend on whether or not it occurs in a WNV-affected area.

7/25/01

A WNV-affected area is any county where a WNV infection in an equine has been confirmed in the current calendar year (2000), or any location within 10 miles of a confirmed equine WNV infection. Illness in an equine in a WNV-affected area should be considered a suspect case if at least one of the following signs is present:

- ataxia (including stumbling);
- inability to stand;
- multiple limb paralysis.

A non-WNV-affected area is any county where WNV infection in equine has not been diagnosed in the current calendar year, or any location more than 10 miles from a positive equine case of WNV infection. Illness in an equine in a non-WNV-affected area should be considered a suspect case if at least one of the following signs is present:

- apprehension;
- depression;
- listlessness;

plus any two of these signs:

- head shaking;
- flaccid paralysis of the lower lip;
- ataxia (including stumbling);
- weakness of hind limbs;
- inability to stand;
- limb paralysis;
- paresis;
- acute death.

A suspect equine case in a non-WNV-affected area should be investigated as a foreign animal disease (FAD).

FAD investigations should be completed in accordance with VS Memorandum 580.4. Specimens should be submitted to the National Veterinary Services Laboratories (NVSL) with an FAD investigation number in order to facilitate tracking and timely reporting of diagnostic results.

#### Sample Submission

Samples for submission to NVSL should be shipped by Federal Express to:

Dr. Eileen Ostlund  
NVSL  
1800 Dayton Road  
Ames, IA 50010

Contact NVSL (phone: 515-663-7551, fax: 515-663-7348) to provide an airway bill number, the number of samples, and relevant epidemiological information.

#### Antemortem Sample Collection

7/25/01

Collect one serum sample (in a 10 ml red-top tube) and one whole blood sample (in a 10 ml EDTA purple-top tube). Send the serum and whole blood to NVSL.

#### Postmortem Sample Collection

Use appropriate protective gear when collecting and processing postmortem samples (see "Recommendations for Safe Practices for Conducting Necropsies of Suspected WNV Cases" below).

If a suspect equine is to be euthanized, collect at least one serum sample (in a 10 ml red-top tube) and one whole blood sample (in a 10 ml EDTA purple-top tube) prior to euthanasia. Send the serum and whole blood to NVSL.

When a postmortem on a suspect equine is performed, the following samples should be collected and sent to NVSL or the State public health laboratory, as indicated:

- Fresh brain tissue (for rabies testing) -- send to State public health laboratory.
- Fresh and fixed brain tissue -- send to NVSL.
- Fresh and fixed spinal cord segments (cervical, thoracic, and lumbar) -- send to NVSL.
- Cervical and lumbo-sacral cerebrospinal fluid (CSF) -- send to NVSL.

Samples collected from the postmortem of a suspect equine and submitted to NVSL for WNV testing will be processed only after the animal has tested negative for rabies according to established protocols in a given State. The foreign animal disease diagnostician should notify NVSL of the rabies test results as soon as they are available.

#### Recommendations for Safe Practices for Conducting Necropsies of Suspected WNV Cases

WNV is a flavivirus transmitted in nature by mosquitoes. Infection of otherwise healthy people causes a mild febrile illness or no symptoms at all. Mortality has been reported in the elderly; immunocompromised individuals also are at a higher risk.

Although aerosol transmission of WNV is very unlikely, precautions should be taken in laboratory and field settings. The main concern should be to prevent viral contact with open wounds and mucous membranes.

#### Recommendations for Field Necropsy of WNV Suspect Animals:

1. Keep the use of needles and sharp instruments to a minimum.
2. Do NOT use mechanical saws to obtain spinal cord samples. For proper procedures, see "Collection of Spinal Cord Segments" below.
3. Procedures that create an aerosol should be done in a way to minimize the dispersal of the aerosol particles.
4. Wear Tyvek® disposable coveralls or, at a minimum, a solid-front, water-resistant, long-sleeve gown.
5. Wear three pairs of gloves. The innermost pair should be latex or other disposable gloves. Substantial waterproof gloves (e.g., Playtex® kitchen gloves) should be worn over the innermost

7/25/01

pair. The gloves should be long enough for the gown sleeves to be tucked inside the gloves; duct tape may be useful for keeping sleeves inside gloves. The outermost pair of gloves should be metal or Kevlar®, e.g., a Whizard® Hand Guard (steel/Kevlar®) glove from Koch® (1-800-456-5624) or a locally purchased filleting glove. **THIS OUTER PAIR OF GLOVES MUST BE WORN** throughout the necropsy procedure.

6. Wear a face shield or goggles to protect mucous membranes, and wear a disposable "half mask" HEPA respirator (3M® 8293) to avoid aerosol infection.

#### Collection of Equine Brain Tissue

Diagrams showing the procedure for collecting equine brain tissue are reproduced from *Equine Medicine and Surgery*, 3rd ed., 1982, edited by Mansmann, McAllister, and Pratt (see the last page of these guidelines). Always use appropriate protective gear when collecting and processing samples.

#### Collection of Spinal Cord Segments

Collect spinal cord in 4-centimeter-long segments from cervical, thoracic, and lumbar sites.

##### Procedures for Obtaining Cervical Spinal Cord Segments:

1. At the vertebral column where the head has been disarticulated, remove the soft tissue from 4 or 5 cervical vertebrae.
2. Depending on the circumstances, it may be advantageous to disarticulate the cervical vertebral column from the rest of the carcass, allowing the specimen to be placed on an elevated surface for further dissection. Assistance may be needed to hold the specimen on an elevated surface for further dissection. Assistance in holding the specimen steady, in the form of either a person or a vise, will facilitate the remaining steps.
3. Using a manual bone saw, make transverse cuts through the midportion of each of the first four vertebral bodies. This will produce four isolated segments of cervical vertebral column, each containing an intervertebral joint at its center.
4. Observe the isolated vertebral segments from the cut ends, noting the spinal cord held in place by the spinal nerves, which exit the vertebral canal through the intervertebral foramina. Grasp the dura mater with toothed thumb forceps, apply gentle traction, and snip the spinal nerves with long thin scissors (e.g., Metzenbaums). Perform this procedure at each end of the vertebral segment.
5. For sample submission: divide each cervical spinal cord segment in half; fix one half in formalin and maintain the other half as a fresh sample. Ship the fresh and fixed segments to NVSL.

##### Procedures for Obtaining Thoracic and Lumbar Spinal Cord Segments:

1. Excise and remove the last two ribs.

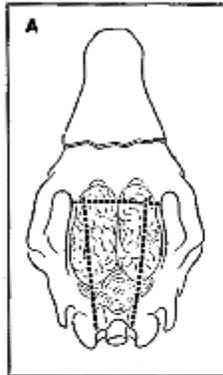
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2. Remove the soft tissue around the thoracic vertebrae that have had the ribs removed. Also remove the soft tissue from around the adjacent lumbar vertebrae.
3. Basically, repeat the steps used for collecting the cervical spinal cord segments by making transverse cuts through the thoracic vertebrae and continuing down through the exposed lumbar vertebrae.
4. Remove the spinal cord segments from the vertebral segments as described for the cervical cord segments.
5. For sample submission: divide each thoracic and lumbar spinal cord segment in half; fix one half in formalin and maintain the other half as a fresh sample. Ship the fresh and fixed segments to NVSL.

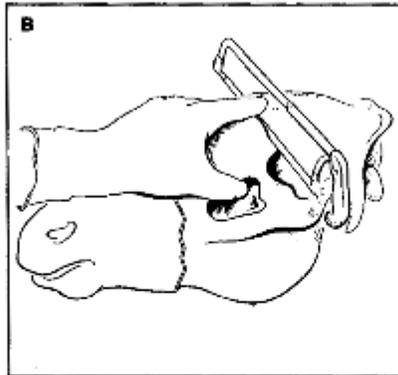
#### Collection of CSF

A good site to collect CSF is at the atlanto-occipital junction just as one cuts through the ligaments prior to decapitation. Up to 15 ml of CSF can be collected from this site. Collect as much fluid as possible. CSF may also be collected from a sacral tap on postmortem. Identify the CSF as to site of collection and submit to NVSL.

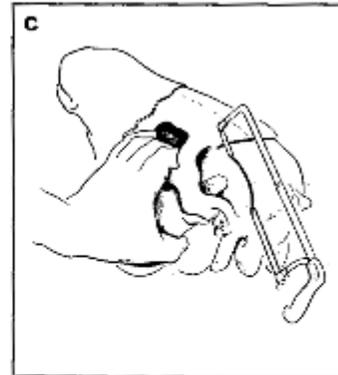
\* Mention of a commercial product, trademark, or brand name is for illustrative purposes only and does not constitute endorsement by any individual nor by any agency of the U.S. government.



A. Dorsal view of skull showing location of brain. Remove major muscle masses from area of incisions (dotted lines).



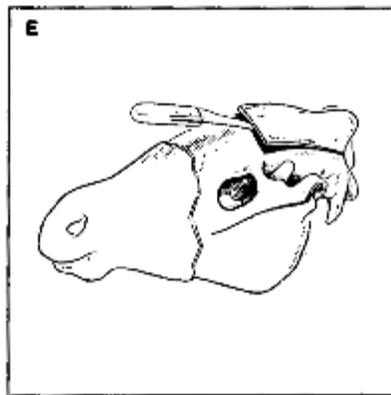
B. Hold head with thumb in eye socket and index finger on saw blade. Cut transversely through frontal bone caudal to supraorbital process.



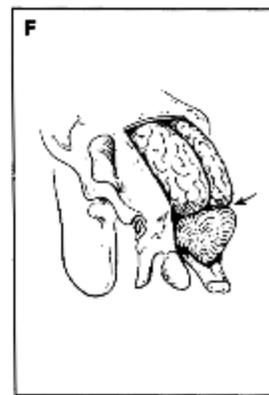
C. Place head on right side. Second cut is sagittal, just medial to left occipital condyle.



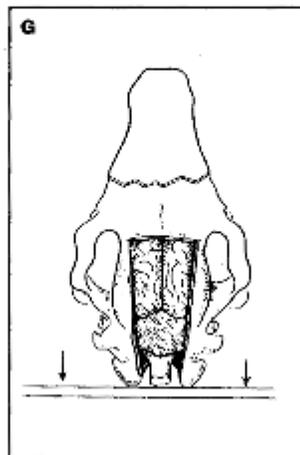
D. Place head on left side for right sagittal cut. Place nose toward you, thumb in eye socket and fingers around mandible.



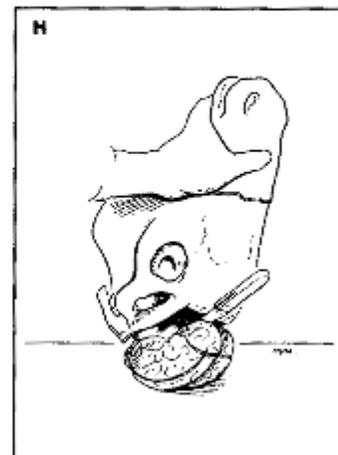
E. Pry up and remove skull cap.



F. Be sure tentorium cerebelli (arrow) and other limiting dura are removed.



G. With head in upright position, tap it lightly on table to loosen brain.



H. Cut olfactory tracts and cranial nerves as brain is removed. Tilt head so that brain rests on table. Section, label and place in formalin.

Fig 8a. Necropsy technic for removal of the brain. [Adapted from Mod Vet Pract 60 (1979) 109]

## **Appendix C**

### **Centers for Disease Control and Prevention**

#### **Epidemic/Epizootic West Nile Virus in the United States: Revised Guidelines for Surveillance, Prevention, and Control**

**From a Workshop Held in Charlotte, North Carolina  
January 31 - February 4, 2001**

**U.S. Department of Health and Human Services Public Health Service  
Centers for Disease Control and Prevention  
National Center for Infectious Diseases  
Division of Vector-Borne Infectious Diseases  
Fort Collins, Colorado  
April 2001**

### **III. PREVENTION AND CONTROL**

Prevention and control of arboviral diseases is accomplished most effectively through a comprehensive, integrated mosquito management program.<sup>36</sup> Programs consistent with best practices and community needs should be established at the local level and, at minimum, should be capable of performing surveillance adequate to detect WN virus epizootic transmission activity that has been associated with risk of disease in humans or domestic animals. Integrated mosquito management programs to minimize risk of WN virus transmission and prevent infections of humans and domestic animals should optimally include the following components (modified from information provided by the American Mosquito Control Association and the New Jersey Mosquito Control Association and the Florida Coordinating Council on Mosquito Control)<sup>37-39</sup>

#### **A. Surveillance**

Effective mosquito control begins with a surveillance program that targets pest and vector species, identifies and maps their immature habitats by season, and documents the need for control. Records should be kept on the species composition of mosquito populations prior to enacting control of any kind and to allow programs to determine the effectiveness of control operations. All components of the integrated management <sup>27</sup> program must be monitored for efficacy using best practices and standard indices of effectiveness. The following is a list of surveillance methodologies used by mosquito control agencies.

##### **1. Larval Mosquito Surveillance**

Larval surveillance involves sampling a wide range of aquatic habitats for the presence of pest and vector species during their developmental stages. Most established programs have a team of trained inspectors to collect larval specimens on a regular basis from known larval habitats, and perform systematic surveillance for new sources. A mosquito identification specialist normally has the task of identifying the larvae to species. Properly trained mosquito identification specialists can separate mosquito nuisance and vector species. Responsible control programs target vector and pest populations for control and avoid managing habitat that supports benign species.

## 2. Adult Mosquito Surveillance

Adult surveillance measures mosquito populations that have emerged from aquatic habitats. Various methods are available for this purpose and have been demonstrated to be effective in collecting certain mosquito species.<sup>40</sup> The New Jersey light trap, CDC miniature light trap, and other modifications of this design, with or without carbon dioxide bait, have been used extensively for collecting adult mosquitoes.<sup>41</sup> Gravid traps frequently are used to measure populations of *Culex pipiens* and *Culex restuans*, which have been incriminated as the primary enzootic vectors of WN virus in the northeastern states.<sup>42, 43</sup> Resting boxes frequently are used to measure populations of *Culiseta melanura*, a bird-feeding mosquito that is important in the amplification of EEE virus. Pigeon-baited traps are sometimes employed to measure *Culex* mosquitoes that amplify SLE virus. Trap deployment should address carefully species habitat requirements on several spatial scales.

## 3. Virus Surveillance

The structure and function of virus surveillance in the vector population is described in more detail in section I.A.3. In general, the purpose of this component of the vector management program is to determine the proportion of the mosquito population carrying the virus, or the Minimum Infection Rate (MIR, expressed as the number infected per 1000 specimens tested). Specimens collected by the adult mosquito surveillance program, plus specimens collected in key areas that may provide important indicators of virus transmission activity and related human risk, can be used for this purpose. Mosquito collections made at permanent study sites can provide important baseline data to which current surveillance data are compared and decisions about human risk and need for emergency interventions are made. Surveillance assets should be deployed to monitor activity in rural, suburban and urban setting to detect initial amplification, spread and population risk, respectively.

## B. Source Reduction 28

Source reduction is the alteration or elimination of mosquito larval habitat to prevent mosquitoes from breeding there. This remains the most effective and economical method of providing long-term mosquito control in many habitats. Source reduction can include activities as simple as the proper disposal of used tires and the cleaning of rain gutters, bird baths and unused swimming pools by individual property owners, to extensive regional water management projects conducted by mosquito control agencies on state and/or federal lands. All of these activities eliminate or substantially reduce mosquito breeding habitats and the need for repeated applications of

7/25/01

insecticides in the affected habitat. Source reduction activities can be separated into the following two general categories:

### 1. Sanitation

The by-products of the activities of humans have been a major contributor to the creation of mosquito breeding habitats. An item as small as a bottle cap or as large as the foundation of a demolished building can serve as a mosquito breeding area. Sanitation, such as tire removal, stream restoration, catch basin cleaning and container removal, is a major part of all integrated vector management programs. Mosquito control agencies in many jurisdictions have statutory police powers that allow for due process and summary abatement of mosquito-related public health nuisances created on both public and private property. The sanitation problems most often resolved by agency inspectors are problems of neglect, oversight or lack of information on the part of property owners. Educational information about the importance of sanitation in the form of videos, slide shows and fact sheets distributed at press briefings, fairs, schools and other public areas are effective.

### 2. Water Management

Water management for mosquito control is a form of source reduction that is conducted in fresh and saltwater breeding habitats. Water management programs for vector control generally take two forms:

#### a. Impoundment Management

Impoundments are mosquito-producing marshes around which dikes are constructed, thereby allowing water to stand or to be pumped onto the marsh surface from the adjacent estuary. This eliminates mosquito oviposition sites on the impounded marsh and effectively reduces their populations. Rotational Impoundment Management (RIM) is the technique developed to minimally flood the marsh during the summer months and then use flapgated culverts to reintegrate impoundments to the estuary for the remainder of the year, thereby allowing the marsh to provide many of its natural functions. Although impoundments usually achieve adequate control of salt-marsh mosquitoes, there are situations where impoundments can collect storm water or rainwater and create freshwater mosquito problems that must be addressed using other techniques.

#### b. Open Marsh Water Management (OMWM) 29

Ditching as a source reduction mosquito control technique has been used for many years. Open marsh water management is a technique whereby mosquito-producing locations on the marsh surface are connected to deep-water habitat (e.g., tidal creeks, deep ditches) with shallow ditches. Mosquito broods are controlled without pesticide use by allowing larvivorous fish access to mosquito-producing depressions. Conversely, the draining of these locations occurs before adult mosquitoes can emerge. OMWM can also include establishing or improving a hydrological connection between the marsh and estuary, providing natural resource enhancement as well as mosquito control benefits. The use of shallow ditching (ditches approx. 3 ft. or less in depth

rather than the deep ditching used in years past) is considered more environmentally acceptable because with shallow ditches, fewer unnatural hydrological impacts occur to the marsh.

### C. Chemical Control

When source reduction and water management are not feasible, or have failed because of unavoidable or unanticipated problems, chemicals are used judiciously to control both adult and immature mosquito populations. In addition, chemical controls may be required to prevent disease when surveillance indicates the presence of infected adult mosquitoes poses a risk to health. The chemicals used by mosquito control agencies must comply with state and federal requirements. All pesticide applicators and operators in most states are required to be licensed or certified by the appropriate state agencies. Chemical treatments can be directed against either the immature or adult stage of the mosquito life cycle.

#### 1. Larviciding

Larviciding, the application of chemicals to kill mosquito larvae or pupae by ground or aerial treatments, is typically more effective and target-specific than adulticiding, but less permanent than source reduction. An effective larviciding program is an important part of an integrated mosquito control operation. The objective of larviciding is to control the immature stages at the breeding habitat before adult populations have had a chance to disperse and to maintain populations are levels at which the risk of arbovirus transmission is minimal. Larvicides can be applied from the ground or by aerial application if large or inaccessible areas must be treated. Several materials in various formulations are labeled for mosquito larviciding including the organophosphate temephos (Abate); several "biorational" larvicides such as *Bacillus thuringiensis israelensis* (Bti, a bacterial larvicide), *Bacillus sphaericus*, and methoprene (Altosid, an insect growth regulator); and several oils (Golden Bear-petroleum based and Bonide-mineral based); and in some limited habitats diflubenzuron (Dimilin, a chitin synthesis inhibitor). Applications of larvicides often encompass fewer acres than adulticides because treatments are made to relatively small areas where larvae are concentrated as opposed to larger regions where adults have dispersed. Important goals when applying larvicides are that the material should be specific for mosquitoes, minimize impacts to non-target organisms and must, in many instances, be capable of penetrating dense vegetation canopies. Larvicide formulations (e.g., liquid, 30 granular, solid) must be appropriate to the habitat being treated, accurately applied and based on surveillance data. Accuracy of application is important because missing even a relatively small area can result in the emergence of a large mosquito brood resulting in the need for broad-scale adulticiding.

#### 2. Adulticiding

Adulticiding, the application of chemicals to kill adult mosquitoes by ground or aerial applications, is usually the least efficient mosquito control technique. Nevertheless, adulticiding based on surveillance data is an extremely important part of any integrated mosquito management program. Adulticides typically are applied as an Ultra-Low-Volume (ULV) spray where small amounts of insecticide are dispersed either by truck-mounted equipment or from fixed-wing or rotary aircraft.<sup>45-49</sup> Ground or aerial applied thermal applications of adulticides

also are used in some areas, but to a much lesser degree. Barrier treatments, typically applied as high volume liquids with hand-held spray equipment using compounds with residual characteristics, are common in some U.S. locations. This technique is especially attractive to individual homeowners living near mosquito producing habitats where residual chemicals applied along a property border can provide some control benefits. Mosquito adulticiding differs fundamentally from efforts to control many other adult insects. For adult mosquito control, insecticide must drift through the habitat in which mosquitoes are flying in order to provide optimal control benefits.

The EPA has determined that the insecticides labeled nationally for this type of application pose minimum risks to human health and the environment when used according to the label.<sup>37</sup> Adulticides labeled for mosquito control include several organophosphates such as malathion and naled. Some natural pyrethrins, synthetic pyrethroids (permethrin, resmethrin and sumithrin) also hold adulticide labels. Insecticide selection and time of application should be based on the distribution and behavior of the target mosquito species. Most Culex are nocturnal, compromising aerial application in urban areas.

#### D. Resistance Management

In order to delay or prevent the development of insecticide resistance in vector populations, integrated vector management programs should include a resistance management component (modified from Florida Coordinating Council on Mosquito Control, 1998).<sup>38</sup> Ideally, this includes annual monitoring of the status of resistance in the target populations to:

1. Provide baseline data for program planning and pesticide selection before the start of control operations.
2. Detect resistance at an early stage so that timely management can be implemented (even detection of resistance at a late stage can be important in elucidating the causes of failure of disease control; however, in such cases, management options other than replacement of the pesticide may not be possible).
3. Continuously monitor the effect of control strategies on resistance. <sup>31</sup> In addition to monitoring resistance in the vector population, the integrated program should include options for managing resistance that are appropriate for the local conditions.<sup>50, 51</sup>

The techniques regularly used are:

1. Management by Moderation - preventing onset of resistance by:
  - a. Using dosages no lower than the lowest label rate to avoid genetic selection.
  - b. Using less frequent applications.
  - c. Using chemicals of short environmental persistence.
  - d. Avoiding slow-release formulations.
  - e. Avoiding the use of the same class of insecticide to control both adults and immature stages.
  - f. Applying locally -- Currently, most districts treat only hot spots. Area-wide treatments are used only during public health alerts or outbreaks.
  - g. Leaving certain generations, population segments or areas untreated.
  - h. Establishing high pest mosquito densities or action thresholds prior to insecticide application.

i Alternation of biorational larvicides and IGRs annually or at longer intervals.

2. Management by Continued Suppression - a strategy used in areas of high-value (e.g., heavy tourist areas in the case of mosquito control) or where insect vectors of disease must be kept at very low densities.

This does not mean saturation of the environment by pesticides, but rather the saturation of the defense mechanisms of the insect by insecticide dosages that can overcome resistance. This is achieved by the application of dosages within label rates but sufficiently high to be lethal to susceptible as well as to heterozygous-resistant individuals. If the heterozygous individuals are killed, no resistance will occur because homozygous-resistant individuals do not exist or they are at such a small frequency that quick population build-up is unlikely. This method should not be used if any significant portion of the population in question is resistant. Another approach more commonly used is the addition of synergists that inhibit existing detoxification enzymes and thus eliminate the competitive advantage of these individuals. Commonly, the synergist of choice in mosquito control is piperonyl butoxide (PBO).

3. Management by Multiple Attack - achieving control through the action of several different and independent pressures such that selection for any one of them would be below that required for the development of resistance.

This strategy involves the use of insecticides with different modes of action in mixtures or in rotations. There are economic problems (e.g., costs of switching chemicals or having storage space for them) associated with this approach, and critical variables in addition to mode of action must be taken into consideration (e.g., mode of resistance inheritance, frequency of mutations, population dynamics of the target species, availability of refuges, and migration). General recommendations are to evaluate resistance patterns at least annually and the need for rotating insecticides at annual or longer intervals. 32

## E. Biological Control

Biological control is the use of biological organisms, or their by-products, to control pests. Biocontrol is popular in theory, because of its potential to be host-specific virtually without non-target effects. Overall, larvivorous fish are the most extensively used biocontrol agent for mosquitoes. Predaceous fish, typically *Gambusia* or other species which occur naturally in many aquatic habitats, can be placed in permanent or semi-permanent water bodies where mosquito larvae occur, providing some measure of control. Other biocontrol agents which have been tested for use by mosquito control, but to date generally are not widely used, include the predaceous mosquito *Toxorhynchites*, predacious copepods, the parasitic nematode *Romanomermis* and the fungus *Lagenidium giganteum*. Biocontrol certainly holds the possibility of becoming a more important tool and playing a larger role in mosquito control in the future.

## F. Continuing Education

7/25/01

Continuing education is directed toward operational workers to instill or refresh knowledge related to practical mosquito control. Training is primarily in safety, applied technology and requirements for the regulated certification program mandated by most states.

#### G. Community Outreach and Public Education

Public education is directed toward the general public to teach mosquito biology and encourage citizens to utilize prevention techniques. Examples include: fact sheets and brochures, classroom lectures at schools, slide shows, films and videos on mosquitoes and their control, and exhibits at fairs. It is important that the effectiveness of the techniques selected be tested prior to use and evaluated after implementation to determine if they were effective in increasing public knowledge and altering attitudes and behaviors. Obtaining the interest and investment of the community is critical to public education and outreach programs. Developing a community task force that includes civic, business, health, and environmental concerns has proven valuable in education programs, and in developing a common message. Additional assistance can be obtained from local media contacts and topical experts from local or state health departments, Centers for Disease Control and Prevention, and the American Mosquito Control Association.<sup>52, 53</sup>

#### H. Legislation

In addition to statutes permitting legal action to abate mosquito-related public health nuisances, legislation must be in place to allow creation of and provide funding for municipally-based integrated mosquito management programs. Local jurisdictions should can contact state mosquito control associations to provide examples of enabling legislation.

#### I. Vector Management in Public Health Emergencies<sup>33</sup>

Epidemic or epizootic transmission of enzootic arboviruses typically precedes detection of human cases by several days to two weeks or longer (e.g., as found in SLE epidemics).<sup>54, 55</sup> Therefore, a surveillance program adequate to monitor WN virus transmission activity levels that indicate human risk must be in place. Control activity should be initiated in response to evidence of virus transmission, as deemed necessary by the local health departments. Such programs minimally should consist of an intervention program including public education emphasizing personal protection and residential source reduction; municipal larval control to prevent re-population of the area with competent vectors; adult mosquito control to decrease the density of infected, adult mosquitoes in the area; and continued surveillance to monitor virus activity and control efficacy.

As evidence of sustained or intensified virus transmission in an area increases, emergency preparations should be commenced and implemented as needed. This is particularly important in areas where vector surveillance indicates that potential accessory vectors (e.g., those demonstrating mammalophilic host ranges) are infected with WN virus. Delaying adulticide applications in areas with these surveillance indicators until human cases occur negates the value and purpose of the surveillance system.

## J. Adult Mosquito Control Recommendations

Ground-based (truck mounted) application of adult mosquito control agents has several positive attributes. Where road access is adequate, such as in urban and suburban residential areas, good coverage may be achieved. In addition, truck application can be done throughout the night, thereby targeting night-active mosquito species. Ground applications are prone to skips and patchy coverage in areas where road coverage is not adequate or in which the habitat contains significant barriers to spray dispersal and penetration.

Aerial application is capable of covering larger areas in shorter time periods than ground-based applications. This is a critical positive attribute when large residential areas must be treated quickly. In addition, aerial application is less prone to patchy coverage than ground-based application in areas where road coverage is not adequate. One limitation of aerial application is that many applicators will not fly at night, reducing the effectiveness of the applications in *Culex* species control efforts.

Cost benefits of aerial application over ground application may not be realized unless relatively large areas are treated.

Several formulations of a variety of active ingredients are available for adulticide applications. Material choice for ground or aerially applied mosquito control in public health emergency situations is limited by EPA restrictions on the pesticide label and applicable state and local regulations.

Multiple applications will likely be required to appreciably reduce *Culex* populations. An emergency response plan developed for the city of New Orleans, Louisiana 44 indicates the need for repeated applications to control *Cx. quinquefasciatus*, and the need to repeatedly apply adulticides in high risk areas (areas with human cases or positive<sup>34</sup> surveillance events). Two to three adulticide applications spaced 3-4 days apart may be required to significantly reduce *Culex pipiens* populations. Effective surveillance must be maintained to determine if and when re-treatment is required to maintain suppression of the vector populations.

Urban/suburban population centers with multiple positive surveillance events as described above should be treated first to most efficiently protect the largest number of people from exposure to the virus. Applications should be timed to coincide with the peak activity periods of the target species. For example, applications should be made at night to maximize control of night-active *Culex* species. Other species such as *Oc. sollicitans* or *Ae. vexans* are active shortly after sunset and are effectively controlled with applications timed appropriately. Day active potential accessory vectors (e.g., *Oc. japonicus*, *Oc. triseriatus*, *Ae. albopictus*) must be addressed separately and are most effectively controlled by residential source reduction efforts.

## K. Determining the Scope of Mosquito Adulticiding Operations

Once arbovirus activity is detected in a jurisdiction and a decision is made to implement mosquito control by using adulticides, the size of the area to be treated must be determined. In the broadest context, the underlying program objective (i.e., interruption of the enzootic

transmission cycle vs. prevention of transmission to humans and domestic animals) determines the amount of adulticide coverage that is required. For most jurisdictions the objective is the prevention of transmission to humans and domestic animals. There is no simple formula for determining how large an area to treat around a positive surveillance indicator or a suspected or confirmed human case of WN virus. Nor is there adequate information to guide decisions about the degree of vector population suppression that must be attained, or for how long this suppression must be maintained to reduce risk of disease. At a minimum, the following factors must be considered when deciding the scope of the adulticiding effort:

1. The general ecology of the area—key habitat types, and the presence of natural barriers such as large rivers;
2. The flight range of affected/infected bird species;
3. The flight range of vectors known or believed to be of importance in the area;
4. The population density and age (proportion of parous females) of the vectors;
5. The length of time since birds started dying or became infected in the impacted area (typically, there may be a lag of several weeks between recovery of dead birds and confirmation of WN virus infection) or since virus-positive mosquito pools were collected;
6. The human population at risk—distribution relative to the positive locality (e.g., urban vs. rural), community perception of the relative risk of pesticides vs. WN virus infection, age demographics of the area; 35
7. Evidence of persistent transmission activity detected by the surveillance program;
8. Season of the year - how much time the transmission risk can be expected to persist until the vector(s) enter diapause.

Several of these factors will be unknown or only poorly known. Technical assistance from a mosquito control professional, particularly one experienced in mosquito control in the region, is crucial in this process. Practical experience in conducting mosquito control is required to refine control recommendations. For example, the size of an area selected for control applications may be reduced in response to structures like open areas, bodies of water, major highways, or other barriers that may restrict the distribution of targeted species. Alternatively, adulticide coverage may be expanded to cover large urban or suburban residential neighborhoods with large human population densities.

#### L. Evaluation of Adult Mosquito Control

The following parameters should be periodically monitored during control operations:

1. Minimum requirements:
  - a. Pre and post spray mosquito densities inside and outside control area using CO<sub>2</sub> -baited traps and gravid traps.
  - b. Mosquito infection rates pre and post spray inside and outside control area.
  - c. Weather conditions during application (temperature, wind speed, direction).
2. Desirable additions if capacity exists:
  - a. Population age structure of key mosquito species (*Cx. pipiens*).
3. In addition, the following should be documented for each piece of application equipment:
  - a. Droplet size of ULV.
  - b. Flow rate.

4. During application, GPS monitoring of spray track should be conducted if equipment is available on aircraft.

#### M. Public Information Programs

Public acceptance will be critical for emergency adult mosquito control to happen, especially in areas where mosquito control is an unfamiliar activity. Public education programs to distribute information about the nature of mosquito-borne disease, and the risks and benefits of adulticide use will be necessary. Public information offices at federal, state and local levels need to be involved in this process. Repeated efforts will<sup>36</sup> be needed regarding core messages about personal protection and source reduction.

The media will significantly influence the public's perception of emergency adulticiding and adequate public health information resources will be needed to assure the government's rationale is well represented. Several public information resources are currently available through the EPA and CDC. These materials should be incorporated into routine press releases throughout the season and augmented in the event that adulticiding activities are required.

#### N. Guidelines for a Phased Response to WN Virus Surveillance Data

The principle goal is to minimize the health impact of the WN virus in humans, as well as in domestic and zoo animals. Given the limited understanding of the ecology and epidemiology of the WN virus in the U.S., the sporadic nature of the occurrence of arboviral encephalitis, and the limitations of prevention methods, it is expected that prevention and control measures, no matter how intensive, cannot prevent all WN virus infections in humans.

The recommended response levels for the prevention and control of the WN virus should augment, but not replace long standing mosquito control efforts by established mosquito control programs. These programs often have two objectives: 1) to control nuisance mosquitoes, and 2) to control vector mosquitoes that can transmit pathogenic organisms. Nuisance mosquito control often has different objectives than vector control, and the mosquito species to be controlled are often different than vector species. Established mosquito control programs often have a long-standing experience with the surveillance and control of the other established arboviral encephalitis viruses found in the U.S. These programs have established thresholds for response based on years of data. No such long-standing experience exists for the WN virus. Therefore, the recommendations for WN virus must be interpreted only in light of established practices for the other established arboviral encephalitis virus control programs. These guidelines for the prevention and control of the WN virus should be interpreted according to the following considerations:

1. All of the continental states should prepare for the occurrence of the WN virus. The WN virus epizootic expanded markedly in 2000. Given its occurrence in many different habitats and ecosystems in the Old World, and the fact that the SLE virus, a related flavivirus, is widespread in the U.S., suggests the potential for additional geographic spread of the WN virus. The kinds of preparation may vary with the proximity to the known spread of the virus in 2000. At a

minimum, a plan for the surveillance, prevention, and control of the WN virus should be developed.

2. Measures of the intensity of the WN virus epizootic in an area should be considered when determining the level of the public health response. Although only one year of prospective data are available, analyses indicate that the WN virus epizootic intensity as measured by avian mortality, such the number of dead crows found per square mile, may indicate increased human infection risk. The minimum infection rate in *Culex* mosquitoes, the number of infected mosquito species in an area, and the WN virus antibody prevalence in hatching-year live birds may also portend<sup>37</sup> increased human risk, although these data are limited. Data from NYC indicated that isolated cases of WN infection in humans were more likely in counties with >0.1 dead crow reports per square mile per week and in Staten Island, the only location with a human outbreak in 2000, the levels exceeded 1.5 dead crow reports per square mile per week. These figures should be interpreted as a guide, rather than absolute, because the human cases in 2000 were limited to smaller urban counties in and around the NYC metropolitan area. It is unknown what levels of epizootic activity will correlate with increased human risk in subsequent years, in other regions of the country, and in more rural areas.

3. Flexibility is required when implementing the guidelines. Knowledge gained from subsequent surveillance and research data are likely to change the recommendations for response. Specific recommendations that will fit all possible scenarios also cannot be made, particularly at a local level. Therefore, public health action should depend on interpretation of the best available surveillance data in an area, in light of these general guidelines. In addition, many other factors should be considered when translating these guidelines into a plan of action:

- a. Current weather and predicted climate anomalies,
- b. Quality, availability, and timeliness of surveillance data,
- c. Feasibility of the planned prevention and control activities, given existing budgets and infrastructure,
- d. Public acceptance of the planned prevention and control strategies,
- e. Expected future duration of transmission (surveillance events earlier in the transmission season will generally have greater significance),
- f. Other ongoing mosquito control activities, such as nuisance mosquito control or vector mosquito control for the established arboviral encephalitis viruses.

The recommended phased response to WN virus surveillance data are indicated in the table below. Local and regional characteristics may alter the risk level at which specific actions must be taken.

Table 1. Suggested Guidelines for Phased Response to West Nile Virus Surveillance Data

Risk category	Probability of human outbreak	Definition	Recommended response*
0	None	Off-season; adult vectors inactive; climate unsuitable.	Develop WN virus response plan. Secure surveillance and control resources necessary to enable emergency response. Initiate community outreach and public education programs.
1a	Remote	Spring, summer, or fall; areas unlikely to have WN virus epizootic in 2001 based on lack of previous or current WN virus activity in the region.	Response as in category 0, plus: Conduct entomologic survey (inventory and map mosquito populations; see AMCA and other manuals for guidance); community outreach and public education; avian mortality, human encephalitis/meningitis and equine surveillance.
1b	Remote	Spring, summer, or fall; areas anticipating WN virus epizootic in 2001 based on previous or current WN virus activity in the region; no current surveillance findings indicating WN virus epizootic activity in the area.	Response as in category 1a, plus: Source reduction; use larvicides at specific sources identified by entomologic survey and targeted at likely amplifying and bridge vector species; maintain avian mortality, vector and virus surveillance; public education emphasizing source reduction.
2	Low	Spring, summer, or fall; areas with initial, sporadic or limited WN virus epizootic activity in birds and/or mosquitoes.	Response as in category 1b, plus: Increase larval control and source reduction and public education emphasizing personal protection measures, particularly among the elderly. Enhance human surveillance and activities to further quantify epizootic activity (e.g., mosquito trapping and testing). Consider focal or targeted adult mosquito control if surveillance indicates likely potential for human risk to increase.
3	Moderate	Spring, summer, or fall; areas with initial confirmation of WN virus in a horse and/or a human, or moderate WN virus activity in birds and/or	Response as in category 2, plus: Strongly consider adult mosquito control if surveillance indicates likely potential for human risk to persist or increase.
4	High	Spring, summer, or fall; quantitative measures indicating WN virus epizootic activity at a level suggesting high risk of human infection (for example, high dead bird densities, high mosquito infection rates, multiple positive mosquito species, horse or mammal cases indicating escalating epizootic transmission, or a human case and high levels of epizootic activity) and abundant adult vectors.	Response as in category 3, plus: Expand public information program to include TV, radio, and newspapers (use of repellents, personal protection, continued source reduction, risk communication about adult mosquito control); initiate or continue active surveillance for human cases; implement adult mosquito control program targeted at areas of potential human risk.
5	Outbreak in progress	Multiple confirmed cases in humans; conditions favoring continued transmission to humans (see level 3)	Response as in category 4, plus: Implement or intensify emergency adult mosquito control program, enhanced risk communication about adult mosquito control, monitor efficacy of spraying on target mosquito populations. If outbreak is widespread and covers multiple jurisdictions, consider wide-spread aerial spraying as per the WN virus Emergency Contingency Plan.

\* Local and regional characteristics may alter the risk level at which specific actions must be taken.

7/25/01

## **Appendix D**

**Local municipality / health district template**

**Drafted by DeKalb County Board of Health**

**Downloadable at <http://dekalbhealth.net/bt/bt-home.html>**