Commonwealth of Pennsylvania

West Nile Virus and other Arboviral Diseases: Surveillance, Prevention and Control Plan

Revision Date: April 2019

A Multi-Agency Cooperative Effort Between:

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

pennsylvania
DEPARTMENT OF HEALTH

pennsylvania
DEPARTMENT OF AGRICULTURE

Contents

I. Introduction

In 1999, West Nile virus (WNV), an arbovirus, was detected in New York City resulting in the first ever domestically-acquired human cases of WNV disease in the Western Hemisphere, which rapidly spread to surrounding states [1]. Since 2000, WNV has been and continues to be the most frequently reported arbovirus in Pennsylvania. In recent years, other locally-acquired arboviruses (e.g., Jamestown Canyon, Powassan, Eastern equine encephalitis, etc.) have also been identified in Pennsylvania. Additionally, cases of imported arboviruses (e.g., dengue, chikungunya, Zika, etc.) are detected annually in Pennsylvania residents returning from travel to impacted regions.

In response to the emerging threat of WNV and its anticipated spread, a multi-agency task force was established in 2000 with the goal of reducing expected morbidity and mortality, health care costs, and the financial impact that WNV disease outbreaks would have upon commonwealth industries (i.e., agriculture, fishing, hunting, tourism, etc.) through a coordinated and comprehensive surveillance and mosquito control program. This task force includes three state agencies: Department of Environmental Protection (DEP), Department of Health (DOH) and Department of Agriculture (PDA). Members of the task force hold workgroup meetings monthly from March through October (see Appendix 2 for a list of workgroup members). This plan, which is reviewed and updated annually, was developed through multi-agency collaboration and review of Pennsylvania surveillance data as well other state arbovirus response plans. The purpose of this plan is to describe how surveillance, prevention and control activities are carried out in Pennsylvania regarding WNV and other arboviral threats.

II. Roles and Responsibilities

Prevention and control of WNV and other arboviruses in Pennsylvania is the responsibility of several state and local agencies. Program effectiveness relies on interagency coordination, surveillance data sharing, and familiarity with agency-specific roles and responsibilities. A summary of these roles and responsibilities is provided below.

Pennsylvania Department of Environmental Protection (DEP)
Primary Contact:
Matt Helwig, WNV Program Specialist; mhelwig@pa.gov, 717-346-8243.

- Serve as the lead state agency for WNV surveillance and control activities related to mosquitoes and other vectors
- Conduct or support monitoring and investigations of WNV infection in mosquitoes, bird and animal populations to determine a baseline for its presence and to develop intervention strategies to protect public health
- Support county efforts to conduct education, surveillance, control and source reduction for mosquitoes that may be carriers of WNV through technical expertise (i.e., mosquito identification, equipment and materials, technical training, etc.), grant funding and data management
- Conduct reactive WNV monitoring and control of mosquito populations in non-grant funded counties where current WNV activity has been detected in humans, equine, or other reports
- Maintain and refine an intrastate agency shared data system to serve DEP, DOH, PDA, county government, and CDC in the joint efforts in WNV surveillance and control
- Coordinate communications related to mosquito surveillance and control with other local, state and federal agencies
- Communicate across the state to reach key audiences with basic information about mosquito prevention and control
- Obtain and enforce a statewide National Pollutant Discharge Elimination System (NPDES) permit for the use of pesticides to control mosquitoes in Pennsylvania
- Provide consultation or other support for investigations of human arboviral infections as requested

Pennsylvania Department of Health, Bureau of Epidemiology (DOH-BOE)
Primary Contact:
Krystal Mason, MPH, Arbovirus Coordinator; krymason@pa.gov, 717-547-3526.
(Backup: Betsy Schroeder, DVM; beschroede@pa.gov, 717-787-3350)

- Serve as the lead state agency for the surveillance, prevention and control of human arboviral disease
- Maintain updated manuals and guidance documents for the current case definitions, surveillance, and investigation of arboviral diseases
- Conduct epidemiological analysis of arboviral surveillance data supplied by partner agencies
- Conduct, participate, and provide guidance for epidemiologic investigations of human arboviral disease statewide

- Disseminate weekly arboviral surveillance data summaries to partner agencies
- Maintain the human disease surveillance database (Pennsylvania's National Electronic Disease Surveillance System [PANEDSS])
- Utilize Pennsylvania's syndromic surveillance system, EpiCenter™, to conduct case finding for potentially unreported human arboviral disease cases
- Develop health alert network (HAN) messages to communicate key information to the public health and healthcare provider community regarding human arboviral disease
- Collaborate with DOH Office of Communications for press inquiry responses related to human arboviral disease
- Share human arboviral case data with DEP and DA to facilitate surveillance and control efforts
- Report human WNV case data to Pennsylvania's West Nile Control Program database
- Report human and non-human arboviral surveillance data to the national arboviral surveillance system, ArboNET, which is coordinated by the Centers for Disease Control and Prevention (CDC)
- Consult with CDC subject matter experts on arboviral disease issues as needed

Pennsylvania Department of Health, Bureau of Laboratories (DOH-BOL)
Primary Contact:
Lisa Dettinger, MT (ASCP), Microbiology Division Director; ldettinger@pa.gov, 484-870-6416.

- Conduct testing of human specimens to support diagnosis of arboviral disease
- Conduct testing of non-human specimens to support arboviral disease surveillance activities
- Communicate positive arboviral disease test results to specimen submitter and report electronically to PANEDSS
- Explore development of new test methods and conduct necessary validation studies
- Forward select specimens to CDC for confirmatory testing

Pennsylvania Department of Health, Bureau of Community Health Systems (DOH-BCHS)
Primary Contact:
Jennifer Shirk, Community Health Consultant; jenshirk@pa.gov, 717-787-4366.

- Monitor reports of suspected human arboviral disease cases submitted to PANEDSS by laboratories or healthcare providers
- Conduct epidemiological investigations of reported human arboviral disease in a timely manner and using current guidelines
- Document person (e.g., demographics, symptoms, complications, risk factors), place (e.g., patient residence, travel history), and time (e.g., onset date) characteristics of investigated human arboviral disease cases in PANEDSS
- Facilitate submission of diagnostic specimens from hospitals and healthcare providers to DOH-BOL as needed

Pennsylvania Department of Agriculture (PDA)
Primary Contact:
Nan Hanshaw, DVM, DACVPM, Animal Health Division Chief; 717-784-4737.

- Serve as the lead state agency for surveillance and control activities related to veterinary arboviral diseases
- Conduct testing of veterinary specimens to support diagnosis of arboviral disease
- Forward veterinary specimens to the National Veterinary Services Laboratory for confirmatory testing as needed
- Notify DOH and DEP of veterinary arboviral disease cases and report to Pennsylvania's West Nile Control Program database

Pennsylvania Game Commission (PGC)
Primary Contact:
TBD; main number 717-787-4250.

- Maintain wild bird mortality event surveillance
- Provide consultation and technical assistance as needed on arboviral disease in wildlife

County and Municipal Health Departments (CMHDs)

- Monitor reports of suspected human arboviral disease cases submitted to PANEDSS by laboratories or healthcare providers
- Conduct epidemiological investigations of reported human arboviral disease in a timely manner and using current guidelines
- Document person (e.g., demographics, symptoms, complications, risk factors), place (e.g., patient residence, travel history), and time (e.g., onset date) characteristics of investigated human arboviral disease cases in PANEDSS
- Facilitate submission of diagnostic specimens from hospitals and healthcare providers to DOH-BOL as needed
- Conduct mosquito surveillance and control activities (if DEP funded)
- Maintain a DEP-approved Pesticide Discharge Management Plan (PDMP) (if DEP funded)
- Report mosquito surveillance data to Pennsylvania's West Nile Control Program database (if DEP funded)

Other County Mosquito Control Programs

- Conduct mosquito surveillance and control activities
- Report mosquito surveillance data to Pennsylvania's West Nile Control Program database
- Maintain a DEP-approved Pesticide Discharge Management Plan (PDMP)

III. Disease Background

The word "arbovirus" is an acronym for "**ar**thropod-**bo**rne virus" and represents several thousand distinct viruses from around the globe that are primarily transmitted by blood-feeding arthropods (mostly mosquitoes, but certain arboviruses are transmitted by ticks and fleas), typically maintained in complex life cycles involving mammalian and/or avian hosts [2]. Approximately 130 arboviruses are known to cause human disease and most arboviruses of public health importance belong to one of three virus genera: *Flavivirus*, *Alphavirus*, and *Bunyavirus*. The clinical spectrum of human arboviral infections can range from subclinical infections with no apparent symptoms, to mild flu-like illness, to severe neuroinvasive—and occasionally fatal—disease. For example, up to 80% of WNV infections are asymptomatic with approximately 20% presenting with non-neuroinvasive illness (e.g., WNV fever) and the remaining about 1% experiencing neuroinvasive disease (e.g., WNV encephalitis) [3].

The geographic and temporal distribution of specific arboviruses is dependent upon climate and vector populations. In Pennsylvania, most locally-acquired human arboviral infections occur during the months when mosquito populations are most active, with peak WNV disease activity occurring from August to October. However, infections due to non-native arboviruses may be reported year-round due to Pennsylvania residents' travel to impacted regions. The geographic distribution of arboviruses is not static. The relatively recent introduction of WNV in North America (which, prior to 1999 did not occur anywhere in the Western Hemisphere) and the speed at which it spread (e.g. from the U.S. east coast to the U.S. west coast within five years) and displacement of other established arboviruses (e.g., St. Louis encephalitis virus) is a testament to the importance of recognizing that due to changes in global climate and travel speed, exotic viruses are not necessarily limited to their previously understood geographic range [1,4].

Although WNV is the most frequently reported arbovirus in Pennsylvania, other arboviruses have been documented as occurring in Pennsylvania. Additionally, several non-native arboviruses have caused infections among Pennsylvanians who have traveled to regions where these arboviruses are endemic. In this section, arboviruses documented in Pennsylvania from available surveillance data are briefly summarized in Table 1. All the arboviruses in the table are transmitted by mosquitoes except for Powassan virus, which is transmitted by *Ixodes scapularis*, a tick native to Pennsylvania and found in all 67 counties [5].

Table 1. Summary of arboviruses that have been identified in Pennsylvania through routine surveillance activities by DOH, DEP and PDA.

Arbovirus	**Most Recent Year Identified, by type***	**Range and Median Number of Human Cases per Year, 2006-2018****	**Local Vectorborne Transmission Documented*****	**Important Pennsylvania Vectors**	**Primary Reservoir/Host**	**For More Information (note: technical information available at CDC's ArboCat website: https://wwwn.cdc.gov/Arbocat/Default.aspx)**
West Nile virus (WNV)	2018 (human, equine, avian, and mosquito)	Range: 0 – 130 Median: 14.0	Yes	*Culex pipiens* *Culex restuans*	Birds	https://www.cdc.gov/westnile/
Eastern Equine encephalitis virus (EEEV)	2012 (equine) 2005 (mosquito) 2018 (human)	Range: 0 – 1 Median: 0.0	Yes	*Coquillettidia perturbans* *Culiseta melanura*	Birds	https://www.cdc.gov/EasternEquineEncephalitis/
Jamestown Canyon virus (JCV)	2013 (human)	Range: 0 – 1 Median: 0.0	Yes	*Culiseta inornata* (possibly other *Aedes* spp., *Anopheles* spp.)	Deer/Elk	(note: CDC does not host a JCV-specific web page; the MMWR article linked below contains useful background information) https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6020a3.htm
La Crosse encephalitis virus (LACV)	2000 (human)**	Range: 0 – 0 Median: 0.0	Unknown, but multiple human cases reported in Ohio border counties in recent years	Aedes triseriatus	Small mammals/ rodents	https://www.cdc.gov/lac/tech/virus.html
Powassan virus (POWV)	2018 (human)	Range: 0 – 4 Median: 0.0	Yes	*Ixodes scapularis*, *Ixodes cookei*	Small and medium-sized mammals	https://www.cdc.gov/powassan/
St. Louis encephalitis virus (SLEV)	2018 (human)	Range: 0 – 1 Median: 0.0	Yes	*Culex pipiens*	Birds	https://www.cdc.gov/sle/
Dengue virus (DENV)	2018 (human)	Range: 3 – 24 Median: 15.0	No (travel-associated)	*Aedes albopictus*	Humans, non-human primates	https://www.cdc.gov/dengue/
Chikungunya virus (CHIKV)	2018 (human)	Range: 0 – 97 Median: 1.0	No (travel-associated)	*Aedes albopictus*	Humans, non-human primates	https://www.cdc.gov/chikungunya/
Zika virus (ZIKV)	2018 (human)	Range: 0 – 206 Median: 0.0 (includes asymptomatic infections)	No (travel-associated; however, other modes of transmission [e.g., sexual, etc.] have resulted in locally-acquired infections)	*Aedes albopictus*	Humans, non-human primates	https://www.cdc.gov/zika/

*Confirmed or probable cases only. Data source: Nationally Notifiable Disease Surveillance System (1964-2002), ArboNET (2003-2018), Pennsylvania Department of Environmental Protection WNV Program, Pennsylvania Department of Agriculture.
**Prior to 2003, CDC reported LACV infections as California (CAL) serogroup (which includes LACV, JCV and several others) infections; therefore it is uncertain if the case reported in 2000 was LACV or some other CAL virus.
***For cases with known travel history.

IV. Surveillance

The cornerstone of prevention and control of any disease is surveillance. Without arboviral surveillance data, it is not possible to determine important epidemiologic factors, including the infecting arbovirus, the transmitting vectors, the geographic area affected, the timing of infections, clinical spectrum of disease and the people at greatest risk of disease—all of which are important for assessing transmission risk, determining effectiveness of prevention efforts, and shaping appropriate control measures. Arboviral surveillance, and particularly WNV surveillance, consists of two similar but complementary activities—epidemiological surveillance of humans and environmental surveillance of non-human vertebrate hosts and vectors [6]. In Pennsylvania, environmental surveillance is regularly conducted on mosquitoes, birds and veterinary animals (e.g., equines). Prior to 2018, tick surveillance was conducted in response to a specific concern such as identifying the location of a certain species or in response to clusters of human disease [5]. State funding in 2018 allowed the first systematic collection of ticks from all counties in Pennsylvania.

IV.a. Environmental surveillance

Non-human surveillance of arboviruses is important, as it serves as an indicator of arbovirus transmission risk to humans. For WNV, mosquito surveillance serves as the most important source of data to warn of conditions that are optimal for transmission of WNV to humans. However, detecting WNV or another arbovirus in birds or equines can also serve as important sentinel events that may indicate increased risk of arboviral disease transmission to humans.

IV.a.i. Mosquito surveillance (lead agency: DEP)

Background

All actions taken by DEP during the execution of this plan are authorized by and conducted in accordance with the following: Section 1917-A of the Act of April 9, 1929 (P.L. 177, No.175), as amended, known as the Administrative Code of 1929. 25 PA Code, Chapter 243.
The creation of the PA WNV Control Program in 2000 was the first statewide mosquito surveillance program in PA since before 1985. Prior to 1985, the Department of Environmental Resources conducted limited mosquito surveillance.

Mosquito Surveillance and Control Program Development

DEP offers grants designed to develop surveillance and control infrastructure at the county level to protect residents from mosquito-borne disease. Grant funding is directed at the local level to provide local input on mosquito control activities.

- DEP provides financial and technical support to county grantees, as well as mosquito identification, virus testing, outreach training, and facilitates information exchange.
- Grant funding to counties includes reimbursing the costs associated with mosquito surveillance, habitat reduction, and larval and adult control. Reimbursement eligible costs include: material, personnel, equipment and training. After legislative funding is approved, DEP will develop and execute an agreement with counties.
- Based on the historic risk of WNV and availability of funding, some counties will not be offered grants.

Mosquito Surveillance
Mosquito surveillance revolves around the prompt collection, enumeration and testing of key vectors in disease transmission to facilitate timely control interventions in targeted vector populations. It is recognized that rapid control interventions can result in significant reduction of associated health-care costs, disease morbidity and mortality caused by the spread of WNV and other arboviral disease within the commonwealth.

Surveillance Scope and Virus Testing
Mosquito surveillance and virus testing is an essential part of the DEP WNV control program. This requires commitment of DEP regional and central office staff, as well as significant support from county governments. Considering Pennsylvania's size, social and political complexities, and mosquito habitat diversity, the most effective way to control mosquitoes in the commonwealth is through county programs. DEP will maintain a comprehensive knowledge base and equipment with the capability to target mosquitoes and other arthropods that may play a role in arboviral transmission. The program's primary emphasis will be mosquitoes that may carry WNV. Surveillance will be conducted across the commonwealth in a manner that is recommended by CDC and health professionals to reduce at-risk human and horse populations.

DEP uses standardized protocol to determine the distribution and activity level of WNV and concentrates on counties with historically at-risk human and horse populations. This information assists in determining the potential for virus transmission and provides a baseline for control intervention across the commonwealth. Sampling and testing results will be maintained in the WNV data system.

Surveillance will include conducting mosquito sampling to determine species composition, abundance, geographic distribution, and presence of WNV. This will include collection of all mosquito life stages: eggs, larvae, pupae and adults. Adult and larval mosquito sampling will be expanded as needed to determine the geographic scope of likely transmission. Additional surveillance will be conducted to determine the levels of treatment effectiveness and to determine the need for additional treatments.

DEP maintains laboratory facilities and capacity to support county and commonwealth vector management staff activities. This will include identification and enumeration of mosquitoes, developing guidelines for testing as well as testing samples of mosquitoes using polymerase chain reaction (PCR) in the DEP lab. If needed, samples will also be sent to DOH BOL for WNV testing to increase the program's testing capacity.

Properly collected adult mosquitoes will be tested for WNV. The number of sites sampled, and the frequency of the sampling, will be based on historic and current mosquito populations, citizen complaints, potential for disease transmission, WNV surveillance information and other environmental factors.

Response to Other Vector-borne Diseases
DEP will respond as needed to the report of other, non-WNV vector-borne disease. The scope of the response will be determined internally based on: risk, funding and staffing capacity to respond. For example, during the Zika response efforts during 2016−2018, DEP conducted a statewide *Aedes albopictus* and *Aedes aegypti* distribution and abundance survey to determine which areas of Pennsylvania might be at risk for transmission of Zika virus infection.

IV.a.ii. Tick surveillance (lead agency: DEP)

Background

The Centers for Disease Control and Prevention (CDC) estimates cases of tickborne diseases have doubled in the U.S. between 2004 and 2016 [7]. Since 2004, seven new tickborne diseases have emerged and the geographic distribution of ticks is spreading. Pennsylvania must be ready to respond to these emerging diseases when they are reported. An awareness of the types of ticks found in Pennsylvania can help determine the risk of tickborne illnesses to persons living in or visiting Pennsylvania.

Tick Surveillance

DEP will investigate emerging tickborne diseases in collaboration with DOH and PDA. After four human cases of Powassan virus were reported in 2017 in the Northeast district of Pennsylvania, DEP conducted tick surveillance and testing for the counties in the affected region. The extent of tick surveillance depends on staffing capacity and available funding. In 2018, DEP started a tick surveillance program with state funding where ticks will be collected from all 67 counties during four collection periods in late winter, spring, summer, and fall/early winter. The ticks will be speciated and tested for the following human pathogens: *Borrelia burgdorferi, Babesia microti, Anaplasma phagocytophilum,* and Powassan virus. Concentrating on high use public habitats such as state parks and recreation areas, this active surveillance will provide data to determine the geographical and temporal patterns of the primary vectors of tickborne disease in Pennsylvania.

IV.a.iii. Avian surveillance (lead agency: DEP)

Background

The monitoring of dead birds is an integral component of the PA WNV surveillance program. There are two important aspects of the program, namely reporting of sick or dead birds by citizens and the testing of dead birds. Data suggests that corvids, raptors and robins are the species most susceptible to serious illness from WNV infection. They suffer increased morbidity and mortality compared to other avian species. This characteristic makes the report of dead or dying corvids and raptors a useful tool to point out the presence of viral activity in an area.

Dead Bird Surveillance

DEP will receive and test dead corvid, raptor and robin species that appear to have died from WNV infection. Samples for testing will be obtained utilizing oral swabbing for PCR testing, as recommended by CDC. Dead birds can be reported by filling out this form https://www.depgis.state.pa.us/dead_bird_geoform/ located on the public website http://www.depgis.state.pa.us/WNV/index.html from April to October only, or by calling 717-346-8243. Reports are also generated from bird rehabbers and veterinarians. Once reported, WNV program personnel will determine whether birds should be submitted for testing and will either pick up the dead bird or inform the public where the dead bird can be dropped off. The WNV county personnel will swab and submit the sample to the DEP laboratory for testing.

Bird Reporting and Submission Protocol:
To ensure a uniform level of surveillance and standard practices to measure the level of WNV in a county and the effectiveness of control, DEP has established a protocol for staff to both record reported sightings and to submit dead birds for testing:

District office, state health centers and county/municipal staff will receive calls from residents regarding dead birds. District offices and health centers will direct calls to county WNV coordinators.

1. Upon receipt of a call, county WNV staff will determine if the bird(s) meets either of the following criteria:
   a. Fewer than five corvids or raptors have been collected that week and the bird/s is/are known to be dead 48 hours or less (relatively fresh specimens are required for testing; carcasses which are decomposed or scavenged are usually of very limited diagnostic value).
   b. Five or more corvids or raptors have been collected that week, or the birds are known to be dead more than 48 hours, or if the time of death is unknown and the birds have been outside in hot weather showing signs of decomposition (visibly sunken dried eyes and/or infested with ants or maggots). These are not suitable specimens for testing.

2. If the call falls into category 1.a. above:
   a. Birds will be swabbed in the field. The swabs placed in a collection vial, labeled and shipped during normal work-hours. Do not ship swabs on Friday or the day before a holiday. In such instances, the swab should be retained on dry ice until the next available shipping day.
   b. Each county WNV coordinator will be provided with specimen collection materials and barcoded labels for each specimen.
   c. Printed barcode label will be attached to specimen bottle.
   d. Pack specimens in the containers provided with dry ice and ship it through the DEP laboratory courier system.

3. If the call falls into category 1.b. above, staff should:
   a. Enter data into the WNV secure data portal and mark it as sighted but not shipped.
   b. Thank the caller for the information and explain that the carcass is not suitable for testing or that we are over testing capacity for the week. Inform the caller to safely dispose of the carcass by using gloves to bag the carcass and place it in the garbage.

4. County WNV Staff should report to their respective DEP Coordinator when five or more dead birds are reported to have occurred at one location during the same period of time (see Appendix 4). DEP staff will contact the Regional Game Commission office and the PGC Wildlife Veterinarian with reports of five or more dead birds in the same area, indicting a possible poisoning or bird disease outbreak other than WNV.

IV.a.iv. Veterinary/equine Surveillance (lead agency: PDA)

Background
Since 2000, the PDA has provided testing of equine and avian specimens through the Pennsylvania Animal Diagnostic Laboratory System (PADLS). WNV and Eastern equine encephalitis (EEE) infections are reportable animal diseases in Pennsylvania and all laboratories with positive animal or veterinary test results should notify PDA of those results. See Appendix 5 for a list of reportable diseases in animals in Pennsylvania.

Positive test results on veterinary specimens are reported to DOH and DEP, and the location information for a positive specimen is provided to DEP so that any necessary mosquito surveillance in the area may be conducted. The location of positive specimens can be important to guide mosquito control efforts aimed at reducing the risk of further transmission for the protection of human and animal health. Also, the location information for a positive specimen is provided to DOH in order to enhance human case surveillance in the area.

Veterinary Diagnostic Samples
The Pennsylvania Veterinary Laboratory in Harrisburg (PVL) can test serum samples obtained from equines showing neurological symptoms consistent with WNV or Eastern equine encephalitis (EEE) infection. Serum samples are tested using the IgM Capture Enzyme-Linked Immunoassay (MAC-ELISA). Fresh brain samples from animals submitted for necropsy can be tested at PADLS Laboratories for WNV and/or EEE using Immunohistochemistry (IHC) and/or Real-time Polymerase Chain Reaction (RT-PCR) if the referring veterinarian requests the testing or if the case coordinator suspects WNV or EEE infection. Real time RT-PCR can be run for these diseases on formalin fixed tissues from multiple species.
When positive WNV or EEE equine samples are identified at PVL, a notification protocol is used:

1. The laboratory will send a fax/email with the test results to the referring veterinarian(s).
2. The Arbovirus Coordinator at the Department of Agriculture Bureau of Animal Health and Diagnostic Services will provide owner contact information to DEP (information is to be kept confidential) so that DEP can conduct a risk analysis on the owner's property.
3. The Arbovirus Coordinator at the Department of Agriculture Bureau of Animal Health and Diagnostic Services will provide location information to DOH for enhanced human surveillance.

Serology samples for species, other than equine, are forwarded to the National Veterinary Services Laboratories (NVSL) in Ames, Iowa. Brain samples from equine specimens submitted for rabies testing and found negative for rabies can be tested upon request for WNV and/or EEE using IHC and/or PCR. Tissue samples from exotic birds are also tested at PVL by IHC or PCR. Samples from other species, including livestock and pets, will be referred to NVSL or Cornell diagnostic laboratories for testing. Specimens submitted from exotic birds will continue to be treated as diagnostic specimens rather than part of the dead bird surveillance program and may be submitted directly to PADLS for testing. For more information on PADLS, see http://www.padls.org/about.html.

IV.b.i. Epidemiological Surveillance (lead agency: DOH-BOE)

Background
The Pennsylvania Department of Health (DOH) is the lead agency responsible for surveillance and investigation of human arboviral infections, as authorized by the Disease Prevention and Control Law of 1955 (35 P. S. § § 521.1—521.21). The DOH Arbovirus Coordinator, within the Bureau of Epidemiology (BOE), is the primary point of contact for Pennsylvania's human arboviral surveillance and investigation activities.

Passive Surveillance
In Pennsylvania, all human arboviral infections are reportable to DOH per 28 Pa. Code § 27.21a, 28 Pa. Code § 27.22 within 24 hours by clinicians/healthcare providers, and within the next business day by laboratories. Additionally, encephalitis and viral meningitis are also reportable conditions in Pennsylvania and could represent possible neuroinvasive arboviral infections. See Appendix 6 for the Pennsylvania reportable disease list.

At the beginning of mosquito season and during other periods of arboviral activity as needed, DOH will distribute a Health Alert Network (HAN) message to healthcare providers with the purpose of reminding them of the reporting requirements for arboviral infections, summarizing the clinical signs and symptoms of arboviral infections, and describing the arboviral laboratory testing available through the DOH BOL. Suggested prevention messaging will also be included in the HAN. Additional HAN messages may be developed and distributed due to the detection of unexpected increases in arboviral disease activity within Pennsylvania, or to share information regarding emerging arboviral threats outside of Pennsylvania. An example of a prior HAN message is included in Appendix 7.

Syndromic Surveillance
DOH receives de-identified emergency department visit data in near real-time from more than 90% of hospitals with emergency departments statewide. By using a combination of specific text string searches within the chief complaint field, with search of relevant disease-specific ICD-10 codes within the discharge diagnosis field, emergency department visits from patients with potential arboviral infection may be identified. These data are queried using a standardized search, and results are evaluated for visits that require follow-up. As these visits are identified, local DOH investigators are notified and query results are shared to facilitate follow-up.

Presumptively Viremic Donors (PVDs)
WNV and Zika virus infections in blood donors are important surveillance events. Blood collection agencies have protocols in place, required by the Food and Drug Administration (FDA), to screen donations for evidence of WNV and Zika viremia using nucleic acid amplification tests (NAATs) to identify PVDs and prevent transfusion-related infections. PVDs are reportable to DOH and all PVD reports are investigated by DOH to ascertain risk factors during the exposure period and presence of symptoms that may have developed after the donation date.

Phased Response to WNV Surveillance Data
DOH has developed a risk-based approach regarding its response activities relative to available WNV surveillance data, as WNV is the most commonly reported arboviral disease in Pennsylvania among nontraveler associated arboviruses. There is routine surveillance performed in both human and non-human populations (see Table 2). The guidelines incorporate several recommendations from CDC's document "West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control" [6]. The assessment of risk of arboviral disease in humans is complex and geographic areas of risk may

be focally defined; DOH will work with partners to evaluate specific situations as the phased approach is meant to be used as a framework for decision making rather than a set of specific prescribed actions.

Table 2. Phased DOH response to WNV surveillance data and recommended prevention messages for the public to reduce the risk of human illness.

Phase	Definition	Probability of human illness	DOH response activities	Recommended prevention messages for the public
0	No biting adult mosquitoes active	None	1. Maintain routine human case surveillance/investigation processes 2. Review/revise state plan 3. Review existing public fact sheets and education provided on DOH website 4. Develop and distribute annual arbovirus surveillance and control report (prior year)	
1	Biting adult mosquitoes active	Low	1. Closely monitor non-human surveillance data reported by response partners 2. Initiate monthly workgroup meetings with response partners 3. Create and distribute weekly surveillance reports	1. Wear mosquito repellant when outdoors per label instructions 2. Wear long sleeves and pants when outdoors during peak mosquito activity (dusk and dawn) 3. Use mosquito netting on baby carriages and playpens when outdoors 4. Repair window/door screens 5. Check for and dump standing water around property (but do not attempt to drain/alter natural bodies of water) 6. Clean roof gutters so stagnant water cannot collect in them 7. Report nuisance mosquito activity and dead birds to DEP or local health department
2	Limited or sporadic epizootic activity based on current available surveillance data **-or-** Detection of one or more confirmed equine cases **-or-** Detection of a probable or confirmed human case (or viremic blood donor)	Moderate	As above, plus: 1. Enhance human surveillance (health alert network [HAN] message distributed to healthcare providers) 2. Rapid sharing of human surveillance data with DEP 3. Coordinate with agency communications office(s) to intensify public messaging	
3	Sustained epizootic activity based on current available surveillance data **-or-** Detection of multiple probable or confirmed human cases (or viremic blood donors)	High	As above, plus: 1. Increase meeting frequency with response partners, as needed/requested 2. Coordinate with agency communications office(s) to emphasize urgency of personal protection and community-based prevention through public education efforts	As above, plus: 1. Avoid areas with heavy mosquito activity 2. Adjust outdoor activity to avoid peak mosquito hours (dusk and dawn)
4	The number of probable or confirmed human cases exceeds statistical threshold based on expected counts from historic surveillance data	Very High	As above, plus: 1. Additional HAN message distributed to healthcare providers alerting them to outbreak 2. Work with communications offices/local health departments to actively seek out high-risk populations (e.g., nursing homes, schools, etc.) to provide prevention education 3. Meet with DEP to discuss/support control efforts	As above, plus: 1. Consider cancelling or rescheduling large outdoor gatherings during peak mosquito hours, especially in areas with heavy mosquito activity

Case Investigation

Reports of disease and/or positive laboratory results are submitted electronically through Pennsylvania's National Electronic Disease Surveillance System (PANEDSS), a secure web-based portal utilizing secure sockets layer (SSL) to encrypt confidential data. Reports may come from a variety of sources, including healthcare providers, hospitals, laboratories or DOH Central Office. Reports are assigned to DOH public health investigators for follow-up according to patient residence location.

Human arbovirus disease reports are investigated by DOH-BCHS and CMHD staff. Investigations of human arbovirus reports are to be initiated within one business day of receipt. Guidance for case investigations of arboviral diseases are provided to field staff in an internal DOH publication, "Epidemiology Manual for the Identification, Investigation and Control of Infectious Diseases." The following is a summary of the case investigation procedure for DOH investigators:

1. Contact the testing laboratory (if not BOL) to request specimen(s) from IgM positive sample be sent to BOL for further testing (WNV only).
2. Print off PANEDSS template questionnaire for the arbovirus under investigation. If the specific arbovirus is not listed in PANEDSS, use the WNV questionnaire.
3. Obtain the following information from healthcare provider or hospital infection control nurse and document in PANEDSS:
    - Illness onset date
    - Diagnosis given
    - Clinical data requested in PANEDSS questionnaire
    - Additional related test results, if performed
    - Patient status (living or deceased; hospitalization, pregnancy status if female)
    - Patient demographic information, if not reported (e.g., race and ethnicity)
    - Full patient address, if not reported
    - Education already provided to patient regarding condition
4. Inform healthcare provider or hospital infection control nurse that the patient (or a proxy) needs to be interviewed by DOH to assess risk factors and identify potential means to prevent further illness.
    - Determine how and where best to contact patient or proxy
5. Contact patient or proxy to complete the PANEDSS questionnaire and document:
    - Illness onset date, if unable to obtain from provider
    - Signs and symptoms, if unable to obtain from provider
    - History of mosquito bites during 14 days prior to illness
    - Travel outside county, state, or country in the four weeks prior to illness
    - Occupation at date of illness onset
    - Donation or receipt of organs in the four weeks prior to illness onset
    - Donation or receipt of blood products in the four weeks prior to illness onset
    - Pregnancy status at the time of infection, if unable to obtain from provider
6. As part of the interview, discuss the following with the patient/proxy:
    - Provide education regarding disease, prevention of mosquito bites and reducing mosquito breeding habitat
    - Discuss importance of avoiding mosquito bites during the first week of illness (only relevant for certain arboviruses—e.g., Zika, dengue, chikungunya, etc.)
    - For patients with apparent travel-related infections, discuss health precautions while traveling and share CDC's Travelers' Health website (https://wwwnc.cdc.gov/travel) as a resource
7. Assign case classification and submit for review

Patient Confidentiality

As required by the Disease Prevention and Control Law of 1955, DOH protects the confidentiality of all persons who may have arboviral or other notifiable diseases; however, when there is a need to protect the public's health, DOH is allowed to share confidential information with people who need to know in order to protect the public's health (PA ST 35 P.S. § 521.15). Such instances include sharing mosquito exposure location information of human arbovirus cases with recent disease onset with persons responsible for mosquito surveillance and control activities. In Pennsylvania, the lead agency for mosquito surveillance and control activities is DEP. A letter of understanding has been developed between DOH and DEP which defines the protocol for sharing and protecting of confidential patient information between agencies.

Case Definitions

Standard case definitions for various arboviruses designated as nationally notifiable by CDC have been developed by the Council of State and Territorial Epidemiologists (CSTE) and approved by CDC. Case definitions are used to assign the proper case classification (i.e., confirmed or probable vs. not a case) based on available clinical, laboratory and epidemiologic data. Links to the current case definitions for nationally notifiable arboviruses are below, with full text of definitions available in Appendix 8.

- Arboviral Diseases, Neuroinvasive and Non-neuroinvasive (2015)
    - Includes the following arboviruses: California serogroup virus diseases, chikungunya virus disease, Eastern equine encephalitis virus disease, Powassan virus disease, St. Louis encephalitis virus disease, West Nile virus disease, and Western equine encephalitis virus disease
    - https://wwwn.cdc.gov/nndss/conditions/arboviral-diseases-neuroinvasive-and-non-neuroinvasive/case-definition/2015/
- Dengue Virus Infections (2015)
    - Includes dengue, dengue-like illness, and severe dengue
    - https://wwwn.cdc.gov/nndss/conditions/dengue/case-definition/2015/
- Yellow Fever (2019)
    - https://wwwn.cdc.gov/nndss/conditions/yellow-fever/case-definition/2019/
- Zika Virus Disease and Zika Virus Infection (2016)
    - Includes Zika virus disease (congenital), Zika virus disease (non-congenital), Zika virus infection (congenital), and Zika virus infection (non-congenital)
    - https://wwwn.cdc.gov/nndss/conditions/zika-virus-disease-non-congenital/case-definition/2016/06/
- Presumptively Viremic Donors (from latest ArboNET guidelines)
    - WNV:
        - One reactive NAAT with a signal-to-cutoff ratio greater than or equal to 17 OR
        - Two reactive NAATs
    - Zika:
        - One reactive NAAT, AND
        - Culture of Zika virus from any specimen; OR
        - Detection of Zika virus antigen or viral RNA in any specimen, including a reactive result by the same or alternate NAAT assay on a sample from the same donation, or on a follow up sample; OR

- Positive Zika virus IgM antibody test in serum or CSF with positive Zika virus neutralizing antibody titers in a sample from the same donation, or on a follow up sample

Surveillance and Investigation Follow-up Activities/Response

As a result of routine surveillance and investigation of human arbovirus cases, DOH may initiate or help facilitate various follow-up activities as needed. The DOH Arbovirus Coordinator monitors arbovirus cases reported to PANEDSS on a daily basis from April – October (weekly from November – March) and assists with several duties including but not limited to:

- Contacting the assigned DOH investigator or other local designee if there has been no evidence of case follow-up after more than two business days from PANEDSS report date
- Contacting the assigned DOH investigator or other local designee regarding any reports of human arbovirus cases not reported through PANEDSS, including possible human arbovirus cases identified through syndromic surveillance
- Contacting the assigned DOH investigator or other local designee regarding human arbovirus cases missing documentation of critical data in PANEDSS, including but not limited to onset date, hospitalization, death, symptoms, and travel history
- Contacting the assigned DOH investigator or other local designee regarding the need for pursuing a convalescent specimen, particularly regarding reports of patients with WNV specimens meeting the following criteria:
    - Negative IgM in CSF without positive IgG in serum or CSF, AND
        - Specimen collection date less than eight days from onset date;
        - Patient has meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician; and
        - Absence of a more likely explanation for neurologic symptoms
- Notifying BOL regarding cases that should have specimen(s) forwarded to CDC for confirmatory neutralization testing, particularly for WNV specimens meeting the following criteria:
    - Positive IgM in CSF/serum without positive culture or nucleic acid detection; and
        - Patient is one of the first 10 patients with a positive IgM specimen collected within the months of April – October; or
        - Patient has positive IgM specimen collected within the months of November – March
- Notifying DEP regarding confirmed and probable human WNV disease cases as they are identified, as well as verified reports of presumed WNV viremic blood donors, and entering de-identified information regarding cases into DEP's WNV database
    - Note: see "Communication of Surveillance Information" section, below
- Ensuring accurate and timely reporting of all confirmed or probable human arboviral cases and all verified PVDs to ArboNET, the national surveillance system created by the Centers for Disease Control and Prevention (CDC) that monitors arboviral infections in humans, mosquitoes, birds, and other animals
- Monitoring for reports of rare/unusual human arboviral disease cases as well as spatio-temporal clustering of human arboviral disease cases and rapid communication with BOE leadership to determine appropriate follow up and response

IV.b.ii. Human arboviral disease laboratory services (lead agency: DOH-BOL)

Background

The DOH BOL provides laboratory testing services for patients with clinical signs of arboviral disease. Testing for specific arboviruses is important due to the nonspecific nature of arboviral infection symptoms. Most arboviral infections are diagnosed serologically, although other test methods are available. Several challenges exist which complicate efforts to confirm a diagnosis of arboviral infection. The following factors require careful consideration: the time of specimen collection relative to the date of symptom onset, the type of testing performed, the patient's previous arbovirus infection and vaccination history, and serum cross-reactivity within the antigenic complex.

For WNV and most other arboviruses, virus is briefly present and potentially detectable in blood (or possibly cerebral spinal fluid [CSF], depending on the virus) of an infected patient within a few days of symptom onset or exposure (if asymptomatic) [8]. At the time a patient presents to a healthcare provider, the window in which virus could be detected (e.g., via culture or nucleic acid amplification test) in blood or CSF may have already passed. Virus-specific IgM antibodies, which are used as a marker of acute infection, start to become detectable beginning around day three of illness, and most patients should have detectable IgM by day eight of illness. Therefore, serum collected within eight days of illness onset may not have detectable IgM and testing should be repeated on a convalescent-phase sample to rule out arboviral infection in those with a compatible clinical syndrome.

Positive arbovirus test results also require caution with interpretation. Arboviral IgM antibodies may be detected in some patients months or years after their acute infection. Therefore, the presence of these virus-specific IgM antibodies may signify a past infection and be unrelated to the current acute illness. Finding virus-specific IgM antibodies in CSF, or a fourfold or greater rise or fall in virus-specific antibody titers between acute- and convalescent-phase serum specimens, provides additional laboratory evidence that the arbovirus was the likely cause of the patient's recent illness. Clinical and epidemiologic history also should be carefully considered. Arboviral IgG and neutralizing antibodies can persist for many years following a symptomatic or asymptomatic infection. Therefore, the presence of these antibodies alone is only evidence of previous infection. Clinically compatible cases with the presence of IgG, but not IgM, should be evaluated for other etiologic agents. Additionally, arboviruses from the same genus produce cross-reactive antibodies. In geographic areas where two or more closely-related arboviruses occur, serologic testing for more than one virus may be needed and results compared to determine the specific causative virus. For example, such testing might be needed to distinguish antibodies resulting from infections within genera such as flaviviruses like West Nile, St. Louis encephalitis, Powassan, Dengue, or Japanese encephalitis viruses. Lastly, prior vaccination to certain arboviruses (e.g. yellow fever) should also be considered when interpreting results.

Laboratory Safety Issues

Laboratory-associated infections with WNV and other arboviruses have been reported in the literature. WNV should be manipulated under biosafety-level 3 (BSL-3) conditions [9]. For more information, see Appendix 9.

Available Laboratory Testing

The current arboviral testing capabilities at the BOL are summarized below in Table 3. For testing BOL does not have the capability to perform, specimens can be sent to the CDC Arbovirus Diagnostic Laboratory in Fort Collins, Colorado. However, please note that these specimens should always be processed through the BOL as it will ensure there are no delays in testing or receipt of test results. CDC has specific forms and criteria for arbovirus testing, and only reports test results back to state health

departments regardless of the specimen submitter. The BOL can only provide results to submitters from specimens they have received and processed.

Table 3. Arboviral testing capabilities at the BOL. Testing that is available is denoted with an "X"; all other testing (including for viruses not listed) must be sent to the CDC Arbovirus Diagnostic Laboratory.

Virus	ELISA		MIA		IFA		PRNT	PCR
	IgM	IgG	IgM	IgG	IgM	IgG		
CHIKV								X
DENV								X
EEEV								X
SLEV								X
WNV	X	X						X
ZIKV	X							X

Abbreviations: see Appendix 1.

Specimen Collection

The specimen types most frequently collected for arbovirus testing are serum and/or CSF, although for certain arboviruses other specimen types can be tested (e.g., urine for Zika virus only, and requires submission of a paired serum sample). For serum samples, a gold tube or serum separator tube should be used for blood collection, and then centrifuged. Serum should be transferred to a sterile transport tube (do not send whole blood). At least 1.0 mL of serum (3.0 mL is preferred) and at least 1.0 mL of CSF must be submitted for proper testing to proceed.

Shipping Specimens

A completed submission form should be submitted for each patient. Two disease-specific submission forms exist—Zika virus and West Nile virus (see Appendix 9 and 10). For any other arbovirus testing that is requested, the CDC 50.34 form should be completed. In all cases, form(s) must be as complete as possible to avoid delays in testing or sample rejection.

Specimens should be stored in a refrigerator until transport to the laboratory. Ship the specimen with cold packs in an insulated container to the BOL Monday through Thursday only.

Reporting of Test Results

Test results from the BOL will normally be available 10 to 14 days after receipt of specimen. During periods of heavy submission, or if the specimen must be sent to CDC to complete testing, turn-around times may be longer. Receipt of a hard copy of the results may take two weeks after completion of testing. The BOL will notify the submitting laboratory by fax or telephone of all positive test results as soon as they are received. A hard copy of the test result with interpretation will be mailed to the submitting laboratory.

V. Communications

Pennsylvania's West Nile Control Program Database

DEP, DOH and PDA routinely share arboviral surveillance data with each other to facilitate prevention and control activities. This is accomplished primarily through a secure online portal developed and maintained by DEP which allows all three agencies to report and share their arbovirus surveillance data. DEP uses this system to collect information on the presence of WNV in Pennsylvania in any vector, host, or reservoir; identify mosquito-breeding areas; and target control efforts. The system facilitates communication with the public, county governments, and state agencies. Figure 1 describes this system's data flow.

The data entered into Pennsylvania's West Nile Control Program database are aggregated and used to populate surveillance data that appears on Pennsylvania's public WNV website, www.depgis.state.pa.us/WNV/index.html. Each agency should report their positive surveillance data (e.g., positive specimens [non-human] and confirmed or probable cases or viremic blood donors [human]) to the secure online portal every workday before 10:00 a.m. The positive results and confirmed or probable cases will be uploaded onto the West Nile public website by 2:00 p.m. on the same day. When a horse or other non-human mammal is found to be positive for WNV or EEE, only the county, pathogen detected, animal type, and specimen collection date of the affected sample will be released to the public. When a dead wild bird or mosquito sample is found positive for WNV, only the county/township, species and collection date of the affected sample will be released to the public. When a human case of arboviral infection or disease is reported and verified as meeting case definition, only the patient's county of residence, patient's sex and month of report will be released to the public.

Agency Communications Offices

Each agency's respective communications office will be responsible for responding to media and public inquiries related to arboviral surveillance, prevention and control depending on the nature of the question:

- DOH: human health, personal risk, and protection issues
- PDA: animal health and agricultural issues
- DEP: mosquito surveillance and control issues

Additionally, each agency will work with their respective communications office to coordinate information releases regarding an event that necessitates a media release (e.g., detection of a new/emerging arbovirus, occurrence of epidemic levels of disease activity, etc.), as determined by each agency. The communications offices, after assessing the nature and scope of an event, and with approval from the Governor's office of communication, will disseminate information to target audiences as needed:

- Receive an event fact sheet from program staff for distribution and assign a member of the communications office to disseminate the facts of the event.
- Disseminate information to media by the designated spokesperson from the involved agency or agencies (DOH, DEP or PDA) with the most direct knowledge of the event.
- Ensure that key constituents have been notified.
- Reinforce the prevention message to media.
- Remember that all information, including the name and address of the owner or guardian of a positive animal, or patient, is confidential.

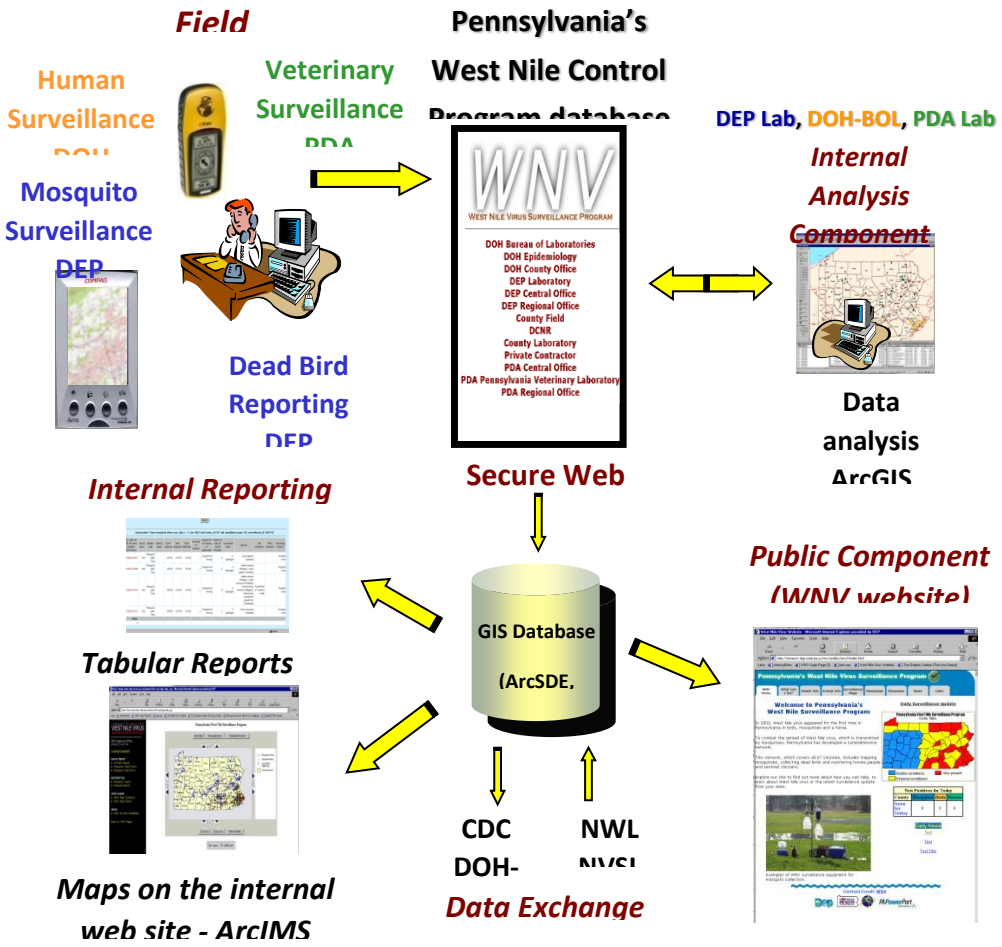

Figure 1. Graphic depiction of data flow in Pennsylvania's West Nile Control Program database.

Release of WNV Surveillance Information to the Public

The Pennsylvania West Nile website, available at www.depgis.state.pa.us/WNV/index.html, will provide daily surveillance updates posted by 2 p.m. during the surveillance season (April-October). Updates will be posted weekly during the remainder of the year. It will contain information about WNV and what citizens can do to reduce their risk of becoming infected with WNV. A notification section will be used to send information to interested parties via email (available to the public by signing up at https://www.ahs.dep.pa.gov/WestNileNews/).

VI. Disease Prevention and Public Education

Background

Prevention of arboviral infections is most effectively accomplished by avoiding arthropod bites. To avoid mosquito and tick bites, personal protection measures must be taken. Additionally, an important component of prevention is taking steps to reduce mosquito breeding habitat around the home. While controlling tick populations is much more difficult, steps can still be taken to prevent ticks from entering the environment around your home. Communication of personal protection measures and other prevention steps to the public should ideally be targeted to at-risk populations (e.g., elderly) in low-literacy forms and in languages appropriate to the local population. Several brochures are available on the WNV public website.

Prevention action steps for avoiding mosquito bites

1. Prevent mosquito breeding opportunities around the home:
    a. Eliminate standing water and empty containers (or drill holes)
    b. Remove tires
    c. Mow grass short and trim shrubs to maximize airflow
    d. Ensure gutters drain properly
    e. Tightly screen rain barrels
    f. Clean and chlorinate swimming pools/saunas/hot tubs. Empty and cover when not in use.
    g. Aerate ornamental ponds or stock with fish
    h. Turn over wheelbarrows and plastic wading pools when not in use
    i. Change bird bath water twice a week
    j. Remind or help neighbors with preventive measures
    k. Purchase and use "mosquito dunks" (Bti) for areas of stagnant water that cannot be drained. Follow all label directions carefully.
    l. Consult a county WNV coordinator for other measures

2. Personal protective measures that can be taken to avoid mosquito bites:
    a. Protective clothing such as long pants, long sleeve shirts and socks, should be worn when mosquitoes are actively biting. Many mosquito species that transmit WNV are most active at dawn and dusk.
    b. Use an insect repellant
        i. DEET is safe and most effective. The percent DEET concentration on a product indicates relative duration of protection for mosquitoes (e.g., a product containing 20% DEET will remain effective for more time than a product containing 10% DEET). DEET should not be used on children under 2 months of age.
        ii. Repellants containing Picaridin, oil of lemon eucalyptus and IR3535 provide protection similar to products with low DEET concentration. Oil of lemon eucalyptus should not be used on children under 3 years of age.
        iii. Always apply repellant for young children. Do not let them apply themselves. Apply repellant to your hands, and use your hands to apply repellant onto child's skin
        iv. Store repellant out of reach of young children
        v. Wash treated skin and clothing when returning indoors
    c. Mosquito netting can be used to protect young children and infants that are outdoors when mosquitoes are actively biting.
    d. Ensure doors and windows have tight-fitting screens. Repair or replace screens with tears or holes. The ordinary window screen with 16x16 or 14x18 meshes to the inch will keep out most mosquitoes.

e. Vitamin B, ultrasonic devices, incense and bug zappers have not been shown to be effective in preventing mosquito bites.

Prevention action steps for avoiding tick bites

1. Prevent ticks from entering areas around your home:
   a. Apply pesticides to reduce the number of ticks in the treated areas of your yard.
   b. Remove leaf litter.
   c. Clear tall grasses and brush around the home and at the edge of lawns.
   d. Place a three-foot wide barrier of wood chips or gravel between lawns and wooded areas to restrict tick migration into recreational areas.
   e. Mow the lawn frequently.
   f. Stack wood neatly and in a dry area (discourage rodents).
   g. Keep playground equipment, decks, and patios away from yard edges and trees.
   h. Discourage unwelcome animals (such as deer, raccoons, and stray dogs) from entering your yard by constructing fences.
   i. Remove old furniture, mattresses, or trash from the yard that may give ticks a place to hide.

2. Personal protective measures to avoid tick bites:
   a. Avoid wooded and brushy areas with high grass and leaf litter; walk in the center of trails.
   b. Treat clothing and gear with products containing 0.5% permethrin.
   c. Use an insect repellant (see 2b above).
   d. Check clothing and body for ticks after coming indoors, especially under the arms, in and around the ears, inside belly button, back of the knees, in and around the hair, between the legs, and around the waist.
   e. Shower soon after being outdoors.
   f. Check pets for ticks daily, especially after they spend time outdoors.
   g. Remove a tick as soon as possible if one is found on your skin.
      i. Use fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.
      ii. Pull upward with steady, even pressure. Don't twist or jerk the tick; this can cause the mouth-parts to break off and remain in the skin. If this happens, remove the mouth-parts with the tweezers. If you are unable to remove the mouth easily with clean tweezers, leave it alone and let the skin heal.
      iii. After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.
      iv. Never crush a tick with your fingers. Dispose of a live tick by putting it in alcohol, placing it in a sealed bag/container, wrapping it tightly in tape, or flushing it down the toilet.

Know Before You Go

Each year, Pennsylvanians visiting areas outside the continental United States become infected with arboviruses that are endemic or epidemic in the area they are visiting. Therefore, it is important for persons planning travel to learn about the risk of arboviruses (and other infectious diseases) that might be common in the area they plan to visit. Some of these conditions are preventable by vaccine or other treatment and require pre-planning to ensure sufficient time for maximum protection. The public can learn more about arboviral and other disease risks at CDC's travelers' health website: https://wwwnc.cdc.gov/travel/destinations/list. This website is kept up-to-date by CDC and contains information on disease risks and preventative measures that are available. Additionally, when visiting areas with risk of mosquito-borne disease, visitors must remember to take the same personal protection measures as described above.

Upon returning, travelers should know what symptoms to look for and see a healthcare provider if they develop symptoms of illness. If symptoms of illness develop (especially febrile illness), travelers should take enhanced precautions to avoid mosquito bites during the first week of the illness to prevent local mosquito populations from potentially spreading the arbovirus. Because most arboviral infections do not cause symptoms, it is further recommended that all returning travelers take enhanced precautions to prevent mosquito bites during the three weeks following return from travel to an area with endemic or epidemic levels of arbovirus activity.

DEP Education Initiatives

Education about mosquitoes, methods to control them (integrated pest management), and the DEP WNV Control Program are essential for successful vector management activities. Education will be conducted by DEP as two distinct tasks: internal and public. Each of these has a separate distinct objective. Internal education is defined as training and education of county coordinators, DEP staff, and other agency staff about mosquito surveillance and control. External education involves the provision of mosquito related information to the public.

Internal education will focus on sharing information with partner agencies and providing training. The specific objectives for this effort include:

- Maintaining and refining an internal website to collect and share information.
- Providing training in general mosquito taxonomy, sampling protocols, and vector biology, as well as system data entry and retrieval for appropriate agency staff involved in the WNV effort.
- Providing training on integrated pest management.
- Providing training on larval and adult mosquito control practices in accordance with PDA and EPA guidelines.

The public education segment will focus on providing complete and accurate information and outreach communications to the public. These activities will share general information and target key audiences with specific information. This education must be coordinated both within DEP and with other agencies involved in the WNV effort. The specific objectives for public education include:

- Improving public knowledge of the sources, reservoirs, and transmission of WNV.
- Encouraging the elimination of mosquito breeding sites through source reduction by producing videos, fact sheets, and other educational materials, and by providing support to community relations coordinators on technical information relevant to WNV and mosquitoes.
- Developing and maintaining web-based technologies to provide and share information and education outreach products (www.westnile.state.pa.us).
- Coordinating with partners to ensure the delivery of a unified message about mosquito production areas, source reduction, and other related activities.
- Creating a date share system. DEP will continue to develop and maintain an inter/intrastate agency shared data system to serve DEP, DOH, PDA, county governments, neighboring states and CDC in joint efforts in WNV surveillance and control.

VII. Mosquito Control

Background
Protecting the public from the mosquitoes that transmit WNV requires an integrated pest management program (IPM). In Pennsylvania, DEP is responsible for implementation and planning of mosquito control for WNV and other arboviral diseases.

DEP's WNV control program uses four fundamental approaches toward the management of disease vectors: education, larval habitat source reduction, and larval and adult mosquito control. This hierarchical approach from education to control provides the best integration of strategies to protect public health. The program constantly evaluates and evolves as new scientific information becomes available.

Source Reduction
Source reduction is an important part of an integrated pest management program. Whenever possible, source reduction is the preferred solution to mosquito control, because it permanently eliminates the mosquito production site. Source reduction includes:

- Development of education/outreach tools to encourage individual awareness and responsibility for eliminating backyard mosquito sources through individual actions such as properly maintaining birdbaths and water gardens, proper container storage, etc.
- Targeting of tire pile breeding areas. The program will work with the DEP Bureau of Land Recycling and Waste Management to develop strategies for proper recycling of waste tires across the commonwealth.

Larval and Adult Mosquito Control
Control efforts will be based on protecting public and animal health using a graded response and integrated pest management tools that will minimize environmental impacts.

Using available grant funding, DEP will encourage counties that have shown the greatest historic risk of WNV to develop the internal infrastructure and staff to carry out proactive control activities. DEP will provide technical, managerial and financial assistance to implement this strategy. Counties that are unable to be funded and/or have not shown to historically be at enzootic risk disease transmission will be covered by DEP. DEP will respond as needed to reports of infected birds, horses or people.

Control Guidance
The specific pesticides and actions used for mosquito control will be based on: habitat, mosquito life stage, time of year and nature of outbreak. When WNV has been found in an area, or there is a need to reduce the vectors of amplification as determined by surveillance and testing, application practices will be handled under the following guidelines:

- All contractor, county and DEP staff that conduct mosquito control activities will maintain certification for application of pesticides, Category 16.
- All pesticides used by DEP and county programs are EPA and PDA registered products. The decision of which product to use will be determined on a case-by-case basis.
- The larvicides used in The WNV Control Program's larval control strategy are biorational control agents. These products have shown minimal environmental impacts when used by certified applicators conforming to label requirements. Hand application, truck-mounted, and/or aerial equipment may be used for larvicide applications.

- Adulticiding operations will be conducted on a case-by- case basis as established risk thresholds are passed. DEP currently measures risk of human transmission using the CDC-developed "Vector Index". Vehicular mounted Ultra-Low Volume (ULV) applications are publicly announced 48-hours prior to execution and are GPS tracked. In addition to PDA regulations regarding hypersensitives, WNV applicators maintain a 500 foot buffer from all registered bee hives. All adulticiding for WNV must be done with prior DEP consultation and concurrence to receive grant funding. All control operations will be further guided by individual county Pesticide Discharge Management Plans (PDMP).

Mosquito Complaints

The public can report mosquito complaints via county coordinators on the public website: http://www.depgis.state.pa.us/WNV/index.html

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IX. Appendices

Appendix 1: Acronyms, abbreviations, and definitions.

Arbovirus:	Arthorpod-borne virus
BSL:	Biosafety Level
BTi:	*Bacillus thuringiensis* subspecies *israelensis*
CDC:	United States Centers for Disease Control and Prevention
CHIKV:	Chikungunya virus
CMHDs:	County and municipal health departments
DEET:	*N,N*-Diethyl-*meta*-toluamide
DENV:	Dengue virus
DEP:	Pennsylvania Department of Environmental Protection
DOH:	Pennsylvania Department of Health
DOH-BCHS:	Pennsylvania Department of Health, Bureau of Community Health Systems
DOH-BOE:	Pennsylvania Department of Health, Bureau of Epidemiology
DOH-BOL:	Pennsylvania Department of Health, Bureau of Laboratories
EEE:	Eastern equine encephalomyelitis
ELISA:	Enzyme-linked immunosorbent assay
EPA:	United States Environmental Protection Agency
HAN:	Health alert network
ICR:	Initial case report
IgM:	Immunoglobulin M (antibody class that indicates recent exposure to a pathogen)
IgG:	Immunoglobulin G (antibody class that indicates past exposure to a pathogen)
IHC:	Immunohistochemistry
IPM:	Integrated Pest Management
IR3535:	Insect Repellent 3535 (Ethyl butylacetylaminopropionate)
JCV:	Jamestown Canyon virus
LACV:	La Crosse encephalitis virus
Mosquito pool:	Subsamples of mosquito samples tested together by species
Mosquito sample:	All individual mosquitoes collected in one sampling effort
POWV:	Powassan virus
NVSL: `	National Veterinary Services Laboratory
PADLS:	Pennsylvania Animal Diagnostic Laboratory System
PANEDSS:	Pennsylvania's National Electronic Disease Surveillance System
PCR:	Polymerase Chain Reaction
PDA:	Pennsylvania Department of Agriculture
PDMP:	Pesticide discharge management plan
PGC:	Pennsylvania Game Commission
PRNT:	Plaque Reduction Neutralization Test
PVL:	Pennsylvania Veterinary Laboratory
SLEV:	St. Louis encephalitis virus
SSL:	Secure sockets layer
ULV:	Ultra-low volume
WNV:	West Nile virus
ZIKV:	Zika virus

Appendix 2: WNV/Arbovirus Workgroup Members

Member	Agency
Keith Price	DEP
Matt Helwig	DEP
Andrew Kyle	DEP
Jennifer Stough	DEP
Christian Boyer	DEP
Jenn Shirk	DOH-BCHS
Lisa Dettinger	DOH-BOL
Maria Strohecker	DOH-BOL
Betsy Schroeder	DOH-Epi
Ram Nambiar	DOH-Epi
Kirsten Waller	DOH-Epi
Jonah Long	DOH-Epi
Krystal Mason	DOH-Epi
Allison Longenberger	DOH-Epi
Barry Miller	DOH-Epi
Jen Fiddner	ACHD
Leah Lamonte	ACHD
Kerri Simone	PDPH
Nanette Hanshaw	PDA
David Thompson	PDA
Kyle Van Why	USDA-APHIS

Appendix 3: PROTOCOL for AVIAN MORTALITY in PA

DEP Vector Management 717-346-8238 Regular Hours: 0700-1500

This following protocol was created by the Pennsylvania Department of Health in concurrence with the Pennsylvania Game Commission and the Pennsylvania Department of Agriculture to address avian mortality with respect to avian influenza. Bird mortality events in Pennsylvania can be reported as follows:

Wild birds: If five or more dead birds (except pigeons) are found in one location (no limits per week or per jurisdiction), first contact the appropriate Regional PGC office and then, if needed, contact the PGC Wildlife Veterinarian: Justin Brown DMV, PhD at 814-863-8370.

Domestic/commercial birds: If any number of **dead domestic/commercial birds**, call the Pa. Department of Agriculture (24/7) at 717-772-2852 (24/7).

Pennsylvania Game Commission (PGC) Regional Office Contact List

NORTHWEST REGION Butler, Clarion, Crawford, Erie, Forest, Jefferson, Lawrence, Mercer, Venango, Warren **Phone: (814) 432-3187**	**SOUTHCENTRAL REGION** Adams, Bedford, Blair, Cumberland, Franklin, Fulton, Huntingdon, Juniata, Mifflin, Perry, Snyder **Phone: (814) 643-1831**
SOUTHWEST REGION Allegheny, Armstrong, Beaver, Cambria, Fayette, Greene, Indiana, Somerset, Washington, Westmoreland **Phone: (724) 238-9523**	**NORTHEAST REGION** Bradford, Carbon, Columbia, Lackawanna, Luzerne, Monroe, Montour, Northumberland, Pike, Sullivan, Susquehanna, Wayne, Wyoming **Phone: (570) 675-1143**
NORTHCENTRAL REGION Cameron, Centre, Clearfield, Clinton, Elk, Lycoming, McKean, Potter, Tioga, Union **Phone: (570) 398-4744**	**SOUTHEAST REGION** Berks, Bucks, Chester, Dauphin, Delaware, Lancaster, Lebanon, Lehigh, Montgomery, Northampton, Philadelphia, Schuylkill, York **Phone: (610) 926-3136**

Appendix 4: Reportable diseases in animals

The following infectious diseases of agricultural animals have been declared reportable by the Office of International Epizootics (OIE) and by Pennsylvania (see, http://www.pacode.com/secure/data/028/chapter27/s27.35.html). If you suspect a possible diagnosis of any of the diseases listed on the next page, please call the Bureau of Animal Health and Diagnostic Services (BAHDS) at (717) 787-836-3240. The BAHDS will then be able to participate with PADLS in expediting diagnostic efforts.

Bovine

- Actinomycosis
- Anaplasmosis
- Anthrax
- Asbestosis
- Blackleg
- Bluetongue
- Brucellosis
- Bovine genital campylobacter
- Bovine spongiform encephalopathy
- Bovine tuberculosis
- BVD type 2
- Chronic Wasting Disease
- Contagious bovine pleuropneumonia
- Cysticercosis
- Dermatophilosis
- Echinococcus/Hydatid cyst disease
- Enzootic bovine leukosis
- Foot and mouth disease
- Heartwater
- Hemorrhagic septicemia
- Infectious bovine rhinotracheitis/vulvovaginitis
- Leptospirosis
- Listeriosis
- Lumpy skin disease
- Malignant catarrhal fever
- Paratuberculosis/Johne's disease
- Pseudorabies
- Psoroptic mange
- Q fever
- Rabies
- Rinderpest
- *Salmonella typhimurium, Dublin*
- Screwworm
- Theileriasis
- Trichomoniasis
- Trypanosomiasis
- Vesicular stomatitis

Equine

- African horse sickness
- Anthrax
- Brucellosis
- Contagious equine metritis
- Dourine
- Epizootic lymphangitis
- Equine encephalomyelitis
- Equine infectious anemia
- Equine influenza
- Equine piroplasmosis
- Equine viral arteritis
- Glanders
- Horse mange (sarcoptes)
- Horse pox
- Japanese encephalitis
- Leptospirosis
- Neurotropic herpesvirus
- Rabies
- *Salmonella typhimurium*
- Screwworm
- Tuberculosis
- Venezuelan equine encephalitis
- Vesicular stomatitis
- West Nile virus

Fish

- Epizootic hematopoietic virus
- Herpes virus of salmonids
- Infectious hematopoietic necrosis
- Septicemia
- Spring viremia of carp
- Viral hemorrhagic disease

Porcine

- African swine fever
- Anthrax
- Atrophic rhinitis
- *Brucella suis*
- Cysticercosis
- Echinococcosis/ hytadid disease
- Enterovirus
- Foot and mouth disease
- Hog cholera
- Leptospirosis
- Rabies
- Porcine epidemic diarrhea (PED)
- Porcine reproductive/respiratory syndrome (PRRS)
- *Salmonella choleraesuis*
- Screwworm
- Swine vesicular disease
- Transmissible gastroenteritis
- Trichinellosis
- Tuberculosis
- Vesicular stomatitis
- Vesicular exanthema

Poultry

- Avian chlamydiosis
- Avian infectious bronchitis
- Avian influenza
- Avian tuberculosis
- Duck viral enteritis
- Duck viral hepatitis
- Fowl cholera (P. multocida)
- Fowl typhoid (S. gallinarum)
- Infectious bursal disease (Gumboro)
- Infectious laryngotracheitis
- Marek's disease
- Mycoplasmosis (MG, MS, MM)
- Newcastle disease
- Pullorum disease (*S. pullorum*)

Ovine/Caprine

- Actinomycosis
- Anthrax
- Blackleg
- Bluetongue
- Brucellosis
- BVD type 2
- Caprine arthritis/encephalitis
- Contagious caprine pleuropneumonia
- Contagious agalactia
- Echinococcus/hydatid disease
- Enzootic abortion (chlamydia)
- Foot and mouth disease
- Heartwater
- Leptospirosis
- Listerosis
- Nairobi sheep disease
- Ovine pulmonary adenomatosis
- Ovine progressive pneumonia
- Ovine epididymitis (*Brucella ovis*)
- Paratuberculosis
- Peste des petits ruminants
- Pseudorabies
- Psoroptic mange
- Q fever
- Rabies
- Rift valley fever
- Rinderpest
- *Salmonella typhimurium, dublin*
- *(abortus ovis)*
- Scrapie
- Screwworm
- Sheep and goat pox

Appendix 5: DOH reportable diseases

Per 28 Pa. Code § 27.21a, 28 Pa. Code § 27.22:

1. AIDS (Acquired Immune Deficiency Syndrome) $
2. Amebiasis
3. Animal bite #
4. Anthrax #
5. An unusual cluster of isolates
6. Arboviruses (includes Colorado tick fever, Crimean-Congo hemorrhagic fever, dengue, Eastern equine encephalitis, St. Louis encephalitis, West Nile virus infection, Yellow fever, et al.) #
7. Botulism (all forms) #
8. Brucellosis
9. Campylobacteriosis
10. Cancer ^
11. CD4 T-lymphocyte test result with a count <200 cells/microliter, or a CD4 T-lymphocyte % of < 14% of total lymphocytes $
12. Chancroid
13. Chickenpox (*Varicella*)
14. *Chlamydia trachomatis* infections
15. Cholera #
16. Congenital adrenal hyperplasia (CAH) (<5y/old)
17. Creutzfeldt-Jakob Disease
18. Cryptosporidiosis
19. Diphtheria #
20. Encephalitis (all types)
21. Enterohemorrhagic *E. coli* (shiga toxin-producing E. coli or STEC) # *
22. Food poisoning outbreak #
23. Galactosemia (<5y/old)
24. Giardiasis
25. Gonococcal infections
26. Granuloma inguinale
27. Guillain-Barre syndrome
28. *Haemophilus influenzae* invasive disease # *
29. Hantavirus pulmonary syndrome #
30. Hemorrhagic fever #
31. Hepatitis, viral, acute and chronic cases
32. Histoplasmosis
33. HIV infection $
34. Influenza (laboratory-confirmed only)
35. Lead poisoning #
36. Legionellosis #
37. Leprosy (Hansen's Disease)
38. Leptospirosis
39. Listeriosis
40. Lyme disease
41. Lymphogranuloma venereum
42. Malaria
43. Maple syrup urine disease (MSUD) (<5y/old)
44. Measles (Rubeola) #
45. Meningitis (all types--not limited to invasive *Haemophilus influenzae* or *Neisseria meningitidis*)
46. Meningococcal invasive disease # *
47. Mumps
48. Perinatal exposure of a newborn to HIV
49. Pertussis (whooping cough)
50. Phenylketonuria (PKU) (<5y/old)
51. Plague #
52. Poliomyelitis #
53. Primary congenital hypothyroidism (<5y/old)
54. Psittacosis (ornithosis)
55. Rabies #
56. Respiratory syncytial virus
57. Rickettsial diseases/infections (includes Anaplasmosis, Rocky Mountain Spotted Fever, Q fever, rickettsialpox, typhus, Ehrlichiosis)
58. Rubella (German measles) and congenital rubella syndrome
59. Salmonellosis *

60. Severe Acute Respiratory Syndrome (SARS) #
61. Shigellosis *
62. Sickle cell hemoglobinopathies (<5y/old)
63. Smallpox #
64. *Staphylococcal aureus*, Vancomycin Resistant (VRSA) or Intermediate (VISA) invasive disease
65. Streptococcal invasive disease (Group A)
66. *Streptococcus pneumoniae*, drug resistant invasive disease
67. Syphilis (all stages)
68. Tetanus
69. Toxic shock syndrome
70. Toxoplasmosis
71. Trichinosis
72. Tuberculosis, suspected or confirmed active disease (all sites) including the results of drug susceptibility testing
73. Tularemia
74. Typhoid fever #

For healthcare practitioners and healthcare facilities, all diseases are reportable within 5 work-days, unless otherwise noted.

Healthcare practitioners and healthcare facilities must report within 24 hours.

For clinical laboratories, all diseases are reportable by next work-day, unless otherwise noted.

$ Clinical laboratories must report within 5 days of obtaining the test result.
***** In addition to reporting, clinical laboratories must also submit isolates to the state Laboratory within 5 work-days of isolation.
^ Hospitals, clinical laboratories, and healthcare facilities must report within 180 days.

BLUE Not currently reportable via PA-NEDSS

Please note that certain broad categories such as #22 (Food Poisoning Outbreak) should be construed to mean all such illnesses, even if the etiology is either not otherwise listed here, or a specific etiology cannot be determined. Further, all disease outbreaks and/or unusual occurrences of disease are reportable within the Commonwealth. Finally, note that local jurisdictions may require reports of additional conditions not listed here within their jurisdictions.

Appendix 6: Arbovirus HAN Example (text only)

This week, the Pennsylvania Department of Health (DOH) investigated the first human West Nile virus (WNV) infection for 2019. The patient, a resident of Indiana County with no recent travel outside of Pennsylvania, experienced a non-neuroinvasive illness with onset in early June. The patient recalled receiving mosquito bites a few days prior to illness onset. The patient has since recovered.

Additionally, routine seasonal monitoring conducted by the Pennsylvania Department of Environmental Protection (DEP) West Nile virus surveillance program has detected eight WNV-infected mosquito samples and two WNV-infected birds from nine counties throughout the commonwealth. Risk of human WNV infection is likely to remain elevated over the next several months. Additional surveillance data is available at http://www.depgis.state.pa.us/WNV/index.html.

The DOH would like to remind health care providers to consider the diagnosis of arboviral infection in persons presenting with undifferentiated febrile illness or signs of meningoencephalitis, to ask about recent travel history so they can collect appropriate diagnostic specimens. All arbovirus infections (e.g., infections due to West Nile, dengue, chikungunya, Zika, etc.) are reportable within 24 hours in Pennsylvania.

EPIDEMIOLOGY OF ARBOVIRAL INFECTIONS IN PENNSYLVANIA

In Pennsylvania, WNV is the most commonly reported locally-acquired arbovirus and is most commonly seen during the months of July through September. Risk continues until the first hard frost. Most human WNV infections (80%) are asymptomatic. Approximately 20% of infections result in a non-specific febrile illness (West Nile fever), and less than 1% of infections develop into severe neuroinvasive disease (e.g., meningitis, encephalitis, acute flaccid paralysis, etc.) Neuroinvasive disease is more likely to occur in patients older than 50 years of age or those with compromised immunity.

WHEN TO CONSIDER ARBOVIRAL TESTING FOR YOUR PATIENT

1. Remember to ask about each patient's recent (past 3 weeks) travel history, as this can help determine which arbovirus to test for. The following clinical syndromes presenting during summer months among patients with no recent travel history should prompt consideration for WNV testing: Viral encephalitis, characterized by:
    - Fever >38^{o}C or 100^{o}F and,
    - CNS involvement, including altered mental status (altered level of consciousness, confusion, agitation, or lethargy) or other cortical signs (cranial nerve palsies, paresis or paralysis, or convulsions) and,
    - Abnormal CSF profile suggesting a viral etiology (negative bacterial Gram stain and culture with a pleocytosis [WBC between 5 and 1500 cells/mm3] and/or elevated protein level [>40 mg/dl]).
2. Viral meningitis, characterized by:
    - Fever >38^{o}C or 100^{o}F and,
    - Headache, stiff neck and/or other meningeal signs and,
    - Abnormal CSF profile suggesting viral etiology (negative bacterial Gram stain and culture with a pleocytosis [WBC of 5-1500 cells/mm3] and/or elevated protein level [>40 mg/dl]).
3. Poliomyelitis-like syndromes:
    - Acute flaccid paralysis or paresis, which may resemble Guillain-Barré syndrome, or other unexplained movement disorders such as tremor, myoclonus or Parkinson's-like symptoms, especially if associated with atypical features, such as fever, altered mental status and/or a CSF pleocytosis. Afebrile illness with asymmetric weakness, with or without areflexia, has also been reported in association with WNV.
4. Unexplained febrile illness:
    - Especially if accompanied by headache, fatigue, myalgias, stiff neck, or rash.

DIAGNOSIS OF ARBOVIRAL INFECTIONS

For most arboviral infections, serology and/or nucleic acid testing (e.g., PCR) can facilitate diagnosis. WNV diagnosis is usually serological, by detection of WNV-specific IgM antibody in serum or CSF. WNV IgM may not be detectable until day 8 of illness. Specimens collected less than 8 days after onset may be negative for IgM, and testing should be repeated 2-3 weeks later.

Suspected WNV cases can have specimens (serum and/or CSF) submitted to the PADOH Bureau of Laboratories. WNV IgM testing is performed free-of-charge. Instructions for submitting specimens can be found at http://files.dep.state.pa.us/Water/WNV/WNVSubmissionForm.pdf.

For questions, please call your local health department or PADOH at 1-877-PA HEALTH.

Appendix 7: Case Definitions for Human Arboviral Disease

Arboviral Diseases, Neuroinvasive and Non-neuroinvasive 2015 Case Definition

CSTE Position Statement(s)
14-ID-04

Subtype(s)

- California serogroup virus diseases
- Chikungunya virus disease
- Eastern equine encephalitis virus disease
- Powassan virus disease
- St. Louis encephalitis virus disease
- West Nile virus disease
- Western equine encephalitis virus disease

Background

Arthropod-borne viruses (arboviruses) are transmitted to humans primarily through the bites of infected mosquitoes, ticks, sand flies, or midges. Other modes of transmission for some arboviruses include blood transfusion, organ transplantation, perinatal transmission, breast feeding, and laboratory exposures.
More than 130 arboviruses are known to cause human disease. Most arboviruses of public health importance belong to one of three virus genera: *Flavivirus*, *Alphavirus*, and *Orthobunyavirus*.
California serogroup viruses include:

- California encephalitis
- Jamestown Canyon
- Keystone
- La Crosse
- Snowshoe hare
- Trivittatus viruses

Clinical Description

Most arboviral infections are asymptomatic. Clinical disease ranges from mild febrile illness to severe encephalitis. For the purpose of surveillance and reporting, based on their clinical presentation, arboviral disease cases are often categorized into two primary groups: neuroinvasive disease and non-neuroinvasive disease.

Neuroinvasive disease

Many arboviruses cause neuroinvasive disease such as aseptic meningitis, encephalitis, or acute flaccid paralysis (AFP). These illnesses are usually characterized by the acute onset of fever with headache, myalgia, stiff neck, altered mental status, seizures, limb weakness, or cerebrospinal fluid (CSF) pleocytosis. AFP may result from anterior ("polio") myelitis, peripheral neuritis, or post-infectious peripheral demyelinating neuropathy (i.e., Guillain-Barre' syndrome). Less common neurological manifestations, such as cranial nerve palsies, also occur.

Non-neuroinvasive disease

Most arboviruses can cause an acute systemic febrile illness (e.g., West Nile fever) that may include headache, myalgias, arthralgia, rash, or gastrointestinal symptoms. Some viruses also can cause more characteristic clinical manifestations, such as severe polyarthralgia or arthritis due to Chikungunya virus or other alphaviruses (e.g., Mayaro, Ross River, O'nyong-nyong).

Clinical Criteria

A clinically compatible case of arboviral disease is defined as follows:

Neuroinvasive disease

- Meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician, AND
- Absence of a more likely clinical explanation. Other clinically compatible symptoms of arbovirus disease include: headache, myalgia, rash, arthralgia, vertigo, vomiting, paresis and/ or nuchal rigidity.

Non-neuroinvasive disease

- Fever (chills) as reported by the patient or a health-care provider, AND
- Absence of neuroinvasive disease, AND
- Absence of a more likely clinical explanation. Other clinically compatible symptoms of arbovirus disease include: headache, myalgia, rash, arthralgia, vertigo, vomiting, paresis and/ or nuchal rigidity.

Laboratory Criteria for Diagnosis

Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in tissue, blood, CSF, or other body fluid, OR

- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, OR
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, OR
- Virus-specific IgM antibodies in CSF or serum.

Case Classification

Probable

Neuroinvasive disease

A case that meets the above clinical criteria for neuroinvasive disease and the following laboratory criteria:

- Virus-specific IgM antibodies in CSF or serum, but with no other testing.

Non-neuroinvasive disease

A case that meets the above clinical criteria for non-neuroinvasive disease and the laboratory criteria for a probable case:

- Virus-specific IgM antibodies in serum but with no other testing.

Confirmed

Neuroinvasive disease

A case that meets the above clinical criteria for neuroinvasive disease and one or more of the following laboratory criteria for a confirmed case:

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in tissue, blood, CSF, or other body fluid, OR
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, OR

- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, OR
- Virus-specific IgM antibodies in CSF, with or without a reported pleocytosis, and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

Non-neuroinvasive disease

A case that meets the above clinical criteria for non-neuroinvasive disease and one or more of the following laboratory criteria for a confirmed case:

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in tissue, blood, or other body fluid, excluding CSF, OR
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, OR
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen.

Comments

Imported arboviral diseases

Human disease cases due to Dengue or Yellow fever viruses are nationally notifiable to CDC using specific case definitions. However, many other exotic arboviruses (e.g., Japanese encephalitis, Tick-borne encephalitis, Venezuelan equine encephalitis, and Rift Valley fever viruses) are important public health risks for the United States as competent vectors exist that could allow for sustained transmission upon establishment of imported arboviral pathogens. Health-care providers and public health officials should maintain a high index of clinical suspicion for cases of potentially exotic or unusual arboviral etiology, particularly in international travelers. If a suspected case occurs, it should be reported to the appropriate local/state health agencies and CDC.

Interpreting arboviral laboratory results:

- Serologic cross-reactivity: In some instances, arboviruses from the same genus produce cross-reactive antibodies. In geographic areas where two or more closely-related arboviruses occur, serologic testing for more than one virus may be needed and results compared to determine the specific causative virus. For example, such testing might be needed to distinguish antibodies resulting from infections within genera, e.g., flaviviruses such as West Nile, St. Louis encephalitis, Powassan, Dengue, or Japanese encephalitis viruses.
- Rise and fall of IgM antibodies: For most arboviral infections, IgM antibodies are generally first detectable three to eight days after onset of illness and last for 30 to 90 days, but longer persistence has been documented (e.g., up to 500 days for West Nile virus). Serum collected within eight days of illness onset may not have detectable IgM and testing should be repeated on a convalescent-phase sample to rule out arboviral infection in those with a compatible clinical syndrome.
- Persistence of IgM antibodies: Arboviral IgM antibodies may be detected in some patients months or years after their acute infection. Therefore, the presence of these virus-specific IgM antibodies may signify a past infection and be unrelated to the current acute illness. Finding virus-specific IgM antibodies in CSF, or a fourfold or greater change in virus-specific antibody titers between acute- and convalescent-phase serum specimens provides additional laboratory evidence that the arbovirus was the likely cause of the patient's recent illness. Clinical and epidemiologic history also should be carefully considered.
- Persistence of IgG and neutralizing antibodies: Arboviral IgG and neutralizing antibodies can persist for many years following a symptomatic or asymptomatic infection. Therefore, the presence of these antibodies alone is only evidence of previous infection. Clinically compatible cases with the presence of IgG, but not IgM, should be evaluated for other etiologic agents.
- Arboviral serologic assays: Assays for the detection of IgM and IgG antibodies commonly include enzyme-linked immunosorbent assay (ELISA), microsphere immunoassay (MIA), or immunofluorescence assay (IFA). These assays provide a presumptive diagnosis and should have

confirmatory testing performed. Confirmatory testing involves the detection of arboviral-specific neutralizing antibodies utilizing assays such as plaque reduction neutralization test (PRNT).

- Other information to consider. Vaccination history, detailed travel history, date of onset of symptoms, and knowledge of potentially cross-reactive arboviruses known to circulate in the geographic area should be considered when interpreting results.

Dengue Virus Infections 2015 Case Definition

CSTE Position Statement(s)
14-ID-10

Subtype(s)
- Dengue
- Dengue-like illness
- Severe dengue

Background

Dengue is a potentially fatal acute febrile illness caused by infection with any of four dengue viruses (DENV-1, -2, -3, and -4). Dengue is a major public health problem worldwide, where an estimated 400 million DENV infections and 100 million clinically apparent dengue cases occurred in 2010. Although ~75% of individuals infected with a DENV will be asymptomatic, ~5% of individuals that develop dengue will progress to severe dengue, an illness characterized by plasma leakage leading to hypovolemic shock, hemorrhage, and potentially death. The case-fatality rate for individuals with severe dengue can be as high as 10% if untreated, or 0.1% with appropriate clinical management.

DENVs are transmitted primarily through the bite of *Aedes aegypti* and *Ae. albopictus* mosquitoes. Because these mosquitoes are endemic throughout the tropics and sub-tropics, an estimated 40% of the world's population is at risk for DENV infection. These mosquitoes are also present in the United States. *Ae. aegypti* is present throughout southern Florida, southern Louisiana, parts of New Mexico and Arizona, southern and central Texas (most prominently around urban centers such as Houston, Dallas, and Austin) [4], and have recently been detected in central California and southern Utah. *Ae. albopictus* is widely present throughout most of the southern United States and as far north as Illinois and New York.

Laboratory Criteria for Diagnosis
- **Confirmatory**:
    - Detection of DENV nucleic acid in serum, plasma, blood, cerebrospinal fluid (CSF), other body fluid or tissue by validated reverse transcriptase-polymerase chain reaction (PCR), or
    - Detection of DENV antigens in tissue by a validated immunofluorescence or immunohistochemistry assay, or
    - Detection in serum or plasma of DENV NS1 antigen by a validated immunoassay; or
    - Cell culture isolation of DENV from a serum, plasma, or CSF specimen; or
    - Detection of IgM anti-DENV by validated immunoassay in a serum specimen or CSF in a person living in a dengue endemic or non-endemic area of the United States without evidence of other flavivirus transmission (e.g., WNV, SLEV, or recent vaccination against a flavivirus (e.g., YFV, JEV)); or
    - Detection of IgM anti-DENV in a serum specimen or CSF by validated immunoassay in a traveler returning from a dengue endemic area without ongoing transmission of another flavivirus (e.g., WNV, JEV, YFV), clinical evidence of co-infection with one of these flaviviruses, or recent vaccination against a flavivirus (e.g., YFV, JEV); or
    - IgM anti-DENV seroconversion by validated immunoassay in acute (i.e., collected <5 days of illness onset) and convalescent (i.e., collected >5 days after illness onset) serum specimens; or
    - IgG anti-DENV seroconversion or ≥4-fold rise in titer by a validated immunoassay in serum specimens collected >2 weeks apart, and confirmed by a neutralization test (e.g., plaque

reduction neutralization test) with a >4-fold higher end point titer as compared to other flaviviruses tested.

- **Probable**:
    - Detection of IgM anti-DENV by validated immunoassay in a serum specimen or CSF in a person living in a dengue endemic or non-endemic area of the United States with evidence of other flavivirus transmission (e.g., WNV, SLEV), or recent vaccination against a flavivirus (e.g., YFV, JEV).
    - Detection of IgM anti-DENV in a serum specimen or CSF by validated immunoassay in a traveler returning from a dengue endemic area with ongoing transmission of another flavivirus (e.g., WNV, JEV, YFV), clinical evidence of co-infection with one of these flaviviruses, or recent vaccination against a flavivirus (e.g., YFV, JEV).
- **Suspected**:
    - The absence of IgM anti-DENV by validated immunoassay in a serum or CSF specimen collected <5 days after illness onset and in which molecular diagnostic testing was not performed in a patient with an epidemiologic linkage.

Epidemiologic Linkage

- Travel to a dengue endemic country or presence at location with ongoing outbreak within previous two weeks of onset of an acute febrile illness or dengue, or
- Association in time and place (e.g., household member, family member, classmate, or neighbor) with a confirmed or probable dengue case.

Criteria to Distinguish a New Case from an Existing Case

DENV infection results in long-lasting immunity to symptomatic infection (dengue) with that DENV-type. However, cross-protective (heterotypic) immunity against dengue is short-lived with estimated durations of 1-3 years. In dengue endemic areas where infection pressure is high, individuals have been shown to infrequently have sequential episodes of dengue with two different infecting serotypes.
Based on these data, a person with two clinical episodes of dengue occurring at least two weeks apart and shown to be due to different infecting DENV-types confirmed by molecular diagnostic testing would be classified as two different cases.

However, for two clinical episodes of dengue in the same person diagnosed only by IgM anti-DENV on the second episode; to be considered separate cases, they would have to occur >90 days apart due to the persistence of detectable IgM anti-DENV for ~90 days.

Exposure

- During the two weeks prior to onset of fever, travel to a dengue endemic country or presence in a location experiencing an ongoing dengue outbreak, OR
- Association in time and place with a confirmed or probable dengue case.

Endemicity

The largest burden of dengue in the United States is in the territories of Puerto Rico and the U.S. Virgin Islands where it is endemic. As such, the majority of reported dengue cases in the U.S. come from these two territories, where existing surveillance systems are in place to capture both the incidence and to some degree the spectrum of disease. Other areas of the US where dengue is or has been endemic include American Samoa, the Northern Marianas, and Guam. In addition, hundreds of travel-associated dengue cases occur each year, primarily in the 50 United States and the District of Columbia.

Subtype(s) Case Definition

Dengue

Clinical Description

Dengue is defined by fever as reported by the patient or healthcare provider and the presence of one or more of the following signs and symptoms:

- Nausea/vomiting
- Rash
- Aches and pains (e.g., headache, retro-orbital pain, joint pain, myalgia, arthralgia)
- Tourniquet test positive
- Leukopenia (a total white blood cell count of <5,000/mm^3), or
- Any warning sign for severe dengue:
    - Abdominal pain or tenderness
    - Persistent vomiting
    - Extravascular fluid accumulation (e.g., pleural or pericardial effusion, ascites)
    - Mucosal bleeding at any site
    - Liver enlargement >2 centimeters
    - Increasing hematocrit concurrent with rapid decrease in platelet count

Dengue-like illness

Clinical Description

Dengue-like illness is defined by fever as reported by the patient or healthcare provider.

Comments

* In June 2014, the Council of State and Territorial Epidemiologists (CSTE) recommended Dengue-like illness become nationally notifiable. Dengue-like illness will be added to the list of National Notifiable Infectious Conditions when the CDC receives Office of Management and Budget (OMB) Paperwork Reduction Act (PRA) approval to receive data for this condition.

Severe dengue

Clinical Description

Severe dengue is defined as dengue with any one or more of the following scenarios:

- Severe plasma leakage evidenced by hypovolemic shock and/or extravascular fluid accumulation (e.g., pleural or pericardial effusion, ascites) with respiratory distress. A high hematocrit value for patient age and sex offers further evidence of plasma leakage.
- Severe bleeding from the gastrointestinal tract (e.g., hematemesis, melena) or vagina (menorrhagia) as defined by requirement for medical intervention including intravenous fluid resuscitation or blood transfusion.
- Severe organ involvement, including any of the following:
    - Elevated liver transaminases: aspartate aminotransferase (AST) or alanine aminotransferase (ALT) ≥1,000 per liter (U/L)
    - Impaired level of consciousness and/or diagnosis of encephalitis, encephalopathy, or meningitis

- Heart or other organ involvement including myocarditis, cholecystitis, and pancreatitis

Case Classification

Suspected
A clinically compatible case of dengue-like illness, dengue, or severe dengue with an epidemiologic linkage, as defined above.

Probable
A clinically compatible case of dengue-like illness, dengue, or severe dengue with laboratory results indicative of probable infection, as defined above.

Confirmed
A clinically compatible case of dengue-like illness, dengue, or severe dengue with confirmatory laboratory results, as defined above.

Comments
The 2009 CSTE Dengue Position Statement included the reporting of DENV-positive asymptomatic blood donors identified through pilot screening projects in dengue endemic areas. However, these screening projects have ended, no cases were reported, and the "Asymptomatic Blood or Tissue Donor" reporting category will be deleted, limiting reporting to persons with symptomatic DENV infection (i.e., dengue).

Yellow Fever 2019 Case Definition

CSTE Position Statement(s)
18-ID-04

Background
Yellow fever virus is a mosquito-borne flavivirus that is closely related to dengue, Japanese encephalitis, West Nile, and Zika viruses. On average, only one travel-associated case of yellow fever has been identified among U.S. travelers every 10 years. However, increasing numbers of travelers to and from endemic areas and outbreaks near major urban areas have heightened concern for the possible introduction and spread of the virus in the United States. Yellow fever is preventable by a safe and effective vaccine.

Clinical Description
Most yellow fever virus infections are asymptomatic. Following an incubation period of 3–9 days, approximately one-third of infected people develop symptomatic illness characterized by fever and headache. Other clinical findings include chills, vomiting, myalgia, lumbosacral pain, and bradycardia relative to elevated body temperature. An estimated 5%–25% of patients progress to more severe disease, including jaundice, renal insufficiency, cardiovascular instability, or hemorrhage (e.g., epistaxis, hematemesis, melena, hematuria, petechiae, or ecchymoses). The case-fatality rate for severe yellow fever is 30%–60%.

Clinical Criteria
A clinically compatible case of yellow fever is defined as:

- Acute illness with at least one of the following: fever, jaundice, or elevated total bilirubin ≥ 3 mg/dl
  AND

- Absence of a more likely clinical explanation.

Laboratory Criteria for Diagnosis
Confirmatory laboratory evidence:

- Isolation of yellow fever virus from, or demonstration of yellow fever viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid.
- Four-fold or greater rise or fall in yellow fever virus-specific neutralizing antibody titers in paired sera.
- Yellow fever virus-specific IgM antibodies in CSF or serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen.

Presumptive laboratory evidence:

- Yellow fever virus-specific IgM antibodies in CSF or serum, and negative IgM results for other arboviruses endemic to the region where exposure occurred.

Epidemiologic Linkage
Epidemiologically linked to a confirmed yellow fever case, or visited or resided in an area with a risk of yellow fever in the 2 weeks before onset of illness.

Case Classification

Probable
A case that meets the above clinical and epidemiologic linkage criteria, and meets the following:

- Yellow fever virus-specific IgM antibodies in CSF or serum, **AND** negative IgM results for other arboviruses endemic to the region where exposure occurred, **AND** no history of yellow fever vaccination.

Confirmed

A case that meets the above clinical criteria and meets one or more of the following:

- Isolation of yellow fever virus from, or demonstration of yellow fever viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, **AND** no history of yellow fever vaccination within 30 days before onset of illness unless there is molecular evidence of infection with wild-type yellow fever virus.
- Four-fold or greater rise or fall in yellow fever virus-specific neutralizing antibody titers in paired sera, **AND** no history of yellow fever vaccination within 30 days before onset of illness.
- Yellow fever virus-specific IgM antibodies in CSF or serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, **AND** no history of yellow fever vaccination.

Zika Virus Disease and Zika Virus Infection 2016 Case Definition, Approved June 2016

CSTE Position Statement(s)
16-ID-01

Subtype(s)
- Zika virus disease, congenital
- Zika virus disease, non-congenital
- Zika virus infection, congenital
- Zika virus infection, non-congenital

Background
Zika virus (ZIKV), a flavivirus transmitted by *Aedes* species mosquitoes, was first identified in the Zika Forest by the Virus Research Institute in Uganda in a non-human primate in 1947 and from *Aedes africanus* mosquitoes in 1948. Before 2007, there had been only 14 human ZIKV disease cases documented. In 2007, an outbreak of ZIKV disease occurred on Yap Island, Federated States of Micronesia and the ensuing investigation included the first population-based epidemiological study of ZIKV infection and disease. It was estimated that 75% (attack rate) of the island's inhabitants were infected with ZIKV resulting in 18% symptomatic and 82% asymptomatic infections. The most common symptoms documented in this outbreak were maculopapular rash, fever, arthralgia, and conjunctivitis. From 2013 to 2014 there was a large outbreak in French Polynesia where *Aedes aegypti* was considered the most important vector. There continues to be ongoing transmission in the Pacific Islands.

Due to the rapidly evolving epidemic of Zika virus infection, the Council of State and Territorial Epidemiologists (CSTE) Executive Board developed an interim position statement to establish standardized case definitions for Zika virus disease and ZIKV congenital infection dated February 26, 2016, and to add these conditions to the Nationally Notifiable Diseases List. As laboratory testing for ZIKV has been more widely performed, limitations of the interpretation of serologic test results, including plaque reduction neutralization testing have been recognized, necessitating revisions to the laboratory criteria of the case definitions. Additionally, numerous asymptomatic persons, particularly pregnant women are tested for ZIKV infection and will meet laboratory criteria for infection. Because asymptomatic infection might be epidemiologically significant, revisions to the interim surveillance case definitions are proposed to include ZIKV infections without disease. Public health jurisdictions are encouraged to evaluate, report, and monitor identified ZIKV infections, particularly in pregnant women, that don't meet the clinical criteria of the confirmed and probable congenital and non-congenital disease case classifications.

Laboratory Criteria for Diagnosis
Recent ZIKV infection
- Culture of ZIKV from blood, body fluid, or tissue; **OR**
- Detection of ZIKV antigen or viral ribonucleic acid (RNA) in serum, cerebrospinal fluid (CSF), placenta, umbilical cord, fetal tissue, or other specimen (e.g., amniotic fluid, urine, semen, saliva), **OR**
- Positive ZIKV immunoglobulin M (IgM) antibody test in serum or CSF **with** positive ZIKV neutralizing antibody titers and negative neutralizing antibody titers against dengue or other flaviviruses endemic to the region where exposure occurred

Recent flavivirus infection, possible ZIKV
- Positive ZIKV IgM antibody test of serum or CSF with positive neutralizing antibody titers against ZIKV and dengue virus or other flaviviruses endemic to the region where exposure occurred

- Positive ZIKV IgM antibody test **AND** negative dengue virus IgM antibody test with no neutralizing antibody testing performed

Epidemiologic Linkage

- Resides in or recent travel to an area with known ZIKV transmission; **OR**
- Sexual contact with a confirmed or probable case within the infection transmission risk window of ZIKV infection or person with recent travel to an area with known ZIKV transmission; **OR**
- Receipt of blood or blood products within 30 days of symptom onset; **OR**
- Organ or tissue transplant recipient within 30 days of symptom onset; **OR**
- Association in time and place with a confirmed or probable case; **OR**
- Likely vector exposure in an area with suitable seasonal and ecological conditions for potential local vectorborne transmission

Subtype(s) Case Definition

Zika virus disease, congenital
Clinical Criteria
Liveborn infant with congenital microcephaly, or intracranial calcifications, or structural brain or eye abnormalities, or other congenital central nervous system-related abnormalities not explained by another etiology.
(As part of the complete evaluation of congenital microcephaly or other central nervous system [CNS] birth defects, testing for other congenital infections such as syphilis, toxoplasmosis, rubella, cytomegalovirus infection, lymphocytic choriomeningitis virus infection, and herpes simplex virus infections should be considered. An assessment of potential genetic and other teratogenic causes of the congenital anomalies should also be performed.)

Case Classification
Probable
A neonate meets clinical criteria for congenital disease; **AND**
The neonate's mother has an epidemiologic linkage or meets laboratory criteria for recent ZIKV or flavivirus infection; **AND**
The neonate has laboratory evidence of ZIKV or flavivirus infection by:

- Positive ZIKV IgM antibody test of serum or CSF collected within 2 days of birth; **AND**
    - positive neutralizing antibody titers against ZIKV and dengue or other flaviviruses endemic to the region where exposure occurred; **OR**
    - negative dengue virus IgM antibody test and no neutralizing antibody testing performed.

Confirmed
A neonate meets the clinical criteria for congenital disease **AND** meets one of the following laboratory criteria:

- ZIKV detection by culture, viral antigen, or viral RNA in fetal tissue, umbilical cord blood, or amniotic fluid; or neonatal serum, CSF, or urine collected within 2 days of birth; **OR**
- Positive ZIKV IgM antibody test of umbilical cord blood, neonatal serum or CSF collected within 2 days of birth **with** positive ZIKV neutralizing antibody titers and negative neutralizing antibody titers against dengue or other flaviviruses endemic to the region where exposure occurred.

Zika virus disease, non-congenital
Clinical Criteria
A person with one or more of the following not explained by another etiology:

- Clinically compatible illness that includes

    - acute onset of fever (measured or reported), **OR**
    - maculopapular rash, **OR**
    - arthralgia, **OR**
    - conjunctivitis
- Complication of pregnancy
    - fetal loss; **OR**
    - fetus or neonate with congenital microcephaly, congenital intracranial calcifications, other structural brain or eye abnormalities, or other congenital central nervous system-related abnormalities including defects such as clubfoot or multiple joint contractures
- Guillain-Barré syndrome or other neurologic manifestations

Case Classification
Probable
Meets clinical criteria for non-congenital disease; **AND**
Has an epidemiologic linkage; **AND**
Has laboratory evidence of recent ZIKV or flavivirus infection by:

- Positive ZIKV IgM antibody test of serum or CSF with:
    - positive neutralizing antibody titers against ZIKV and dengue or other flaviviruses endemic to the region where exposure occurred; **OR**
    - negative dengue virus IgM antibody test and no neutralizing antibody testing performed.

Confirmed
Meets clinical criteria for non-congenital disease; **AND**
Has laboratory evidence of recent ZIKV infection by:

- Detection of ZIKV by culture, viral antigen or viral RNA in serum, CSF, tissue, or other specimen (e.g. amniotic fluid, urine, semen, saliva); **OR**
- Positive ZIKV IgM antibody test of serum or CSF **with** positive ZIKV neutralizing antibody titers and negative neutralizing antibody titers against dengue or other flaviviruses endemic to the region where exposure occurred.

Zika virus infection, congenital
Case Classification
Probable
A neonate who does not meet clinical criteria for a congenital disease case; **BUT**
The neonate's mother has an epidemiologic linkage or meets laboratory criteria for recent ZIKV or flavivirus infection; **AND**
The neonate has laboratory evidence of ZIKV or flavivirus infection by:

- Positive ZIKV IgM antibody test of serum or CSF collected within 2 days of birth; **AND**
    - negative dengue IgM antibody test and no neutralizing antibody testing performed; **OR**
    - positive neutralizing antibody titers against ZIKV and dengue or other flaviviruses endemic to the region where exposure occurred.

Confirmed
A neonate who does not meet clinical criteria for a congenital disease case; **BUT**
The neonate has laboratory evidence of recent ZIKV or flavivirus infection by:

- ZIKV detection by culture, viral antigen or viral RNA in fetal tissue, umbilical cord blood, or amniotic fluid; or neonatal serum, CSF, or urine collected within 2 days of birth; **OR**

- Positive ZIKV IgM antibody test of umbilical cord blood, neonatal serum or CSF collected within 2 days of birth **with** positive ZIKV neutralizing antibody titers and negative neutralizing antibody titers against dengue or other flaviviruses endemic to the region where exposure occurred.

Zika virus infection, non-congenital
Case Classification
Probable
A person who does not meet clinical criteria for non-congenital disease; **BUT**
Has an epidemiologic linkage; **AND**
Has laboratory evidence of recent ZIKV infection by:

- Positive ZIKV IgM antibody test of serum or CSF with:
    - positive neutralizing antibody titers against ZIKV and dengue or other flaviviruses endemic to the region where exposure occurred; **OR**
    - negative dengue IgM antibody test and no neutralizing antibody testing performed.

Confirmed
A person who does not meet clinical criteria for non-congenital disease; **AND**
Has laboratory evidence of recent ZIKV infection by:

- Detection of ZIKV by culture, viral antigen or viral RNA in serum, CSF, tissue, or other specimen (e.g. amniotic fluid, urine, semen, saliva); **OR**
- Positive ZIKV IgM antibody test of serum or CSF **with** positive ZIKV neutralizing antibody titers and negative neutralizing antibody titers against dengue or other flaviviruses endemic to the region where exposure occurred.

Comments
CSTE approved position statement 16-ID-01 in June 2016, which modified the previous February 2016 interim case definition and naming convention from "Zika virus, congenital infection" to "Zika virus disease, congenital" and from "Zika virus disease, non-congenital infection" to "Zika virus disease, non-congenital".

Appendix 8: WNV Biosafety

The Centers for Disease Control and Prevention/National Institutes of Health publication *Biosafety in Microbiological and Biomedical Laboratories*, 5th ed. (2009) recommends WNV be handled under biosafety level 3 (BSL-3) conditions. Parenteral inoculation with contaminated materials poses the greatest hazard; contact exposure of broken skin is a possible risk. Sharps precautions should be strictly adhered to when handling potentially infectious materials. Workers performing necropsies on infected animals may be at higher risk of infection.

An excerpt from *Biosafety in Microbiological and Biomedical Laboratories*, 5th ed, "Agent Summary Statements: Arboviruses and Related Zoonotic Viruses" recommended the following regarding WNV biosafety:

- BSL-2 practices, containment equipment, and facilities are recommended for activities with human diagnostic specimens, although it is unusual to recover virus from specimens obtained from clinically ill patients.
- BSL-2 is recommended for processing field collected mosquito pools whereas BSL-3 and ABSL-3 practices, containment equipment, and facilities are recommended for all manipulations of WNV cultures and for experimental animal and vector studies, respectively.
- Dissection of field collected dead birds for histopathology and culture is recommended at BSL-3 containment due to the potentially high levels of virus found in such samples. Non-invasive procedures performed on dead birds (such as oropharyngeal or cloacal swabs) can be conducted at BSL-2.

Appendix 9: BOL WNV Submission Form

PENNSYLVANIA DEPARTMENT OF HEALTH

PHYSICIAN INITIAL CASE AND LABORATORY SUBMISSION REPORT FOR VIRAL ENCEPHALITIS/MENINGITIS/FEVER – WNV/OTHER

CSF PCR and culture will only be performed with the approval of Epidemiology. Please call 717-787-3350 for instructions.

1. IDENTIFYING PATIENT INFORMATION **Date of Report:** ____/____/____

Date of onset of symptoms(must be completed): ____/____/____

Last name		First Name		MI
DOB / /		Sex: Male Female		
Street Address		Apt .		
City:	State Zip	County	Tel. H ( ) -	

2. REPORTED/SUBMITTED BY: Last name First name

Work address City State Zip Code

Telephone ( ) - Pager ( ) -

3. CLINICAL INFORMATION

Current diagnosis: **Encephalitis** **Meningitis** **Other (Specify_____)**

Hospitalized? Yes No Hospital Name_____

Submitting Laboratory Name_____

Address:_____

Hospital Lab Phone #_____ Hospital Lab Fax #_____

Fever (>38C or 100F)	Yes	No	Unknown		Altered Mental Status	Yes	No	Unknown
Muscle Weakness	Yes	No	Unknown		Stiff neck/Meningeal signs	Yes	No	Unknown
Headache	Yes	No	Unknown		Seizures	Yes	No	Unknown
Rash	Yes	No	Unknown		Muscle Pain	Yes	No	Unknown
Joint Pain	Yes	No	Unknown		Other Neurological signs	Yes	No	Unknown

Outcome: Recovered Still with symptoms/deficits Died (date of death ____/____/____)
Unknown

Discharge Diagnosis_____

Did patient travel outside PA in the 3 weeks before onset? Yes No If yes, where?_____

Did patient have a blood transfusion, organs or blood products in the last 3 months? Yes No

If yes, Facility Name_____ When _____

Did patient donate blood in the previous 2 weeks? Yes No

4. SPECIMENS BEING SUBMITTED TO PA BOL FOR WEST NILE TESTING

CSF should be kept cold; sera 5-10 ml in red top tube should be kept cold; ship with ice packs; use overnight delivery service

Specimen No.	Type: Specify CSF or Serum	DATE OF COLLECTION *****Required*****	FOR BOL USE ONLY BOL Accession No.

Submit specimens directly to: PENNSYLVANIA DEPT. OF HEALTH, BUREAU OF LABORATORIES, 110 PICKERING WAY, LIONVILLE, PA 19353. Call the Laboratory at **610-280-3464** if you have any questions about testing and shipping of specimens. Report cases of meningitis or encephalitis using PA NEDSS (National Electronic Disease Surveillance System) or call the DIVISION OF COMMUNICABLE DISEASE EPIDEMIOLOGY at **717-787-3350** if you have questions or for assistance. Revised 3/04

Appendix 10: BOL Zika Submission Form

Zika Virus Specimen Submission Form

pennsylvania
DEPARTMENT OF HEALTH

Testing Requires Public Health Approval
Name of public health official approving testing*:

Please type directly into form. All asterisked (*) fields must be completed.

Patient Information:

Last name*:		First name*:	MI:
Date of birth*:	Sex*: ☐ Male ☐ Female	Race: ☐ White ☐ American Indian Alaskan Native ☐ Pacific Islander ☐ Black ☐ Asian ☐ Other	Ethnicity: ☐ Hispanic or Latino ☐ Not Hispanic or Latino
Street address*:			
City*:	State*:	Zip*:	County*:
Specimen #1 source*:	Collection date*:		Patient ID:
Specimen #2 source:	Collection date:		

Submitter Information:

Name*:			Ordering provider*:
Street address*:	City*:	State*:	Zip*:
Telephone*:	Fax*:	Laboratory name:	

Reason for Testing (Exposure History):

☐	Patient traveled to Zika-affected area International or United States
	Travel areas (be specific):
	Travel dates: to
☐	Patient is symptomatic and did not travel to Zika-affected area but had sexual contact with a person who did travel to affected area. Specify travel area:
☐	Patient is symptomatic and did not travel to Zika-affected area but is a household contact of a person who did travel to affected area. Specify travel area:
☐	Patient is pregnant and did not travel to Zika-affected area but had sexual contact with a person who did travel to affected area. Specify travel area:

Clinical Information:

Was patient pregnant within eight weeks of exposure*?	☐ Yes ☐ No ☐ N/A	Gestational age (weeks):	Estimated date of delivery:
If pregnant, have any fetal abnormalities been identified or has patient experienced a fetal loss*?	☐ Yes ☐ No ☐ N/A	Describe fetal abnormalities or fetal loss:	
Has patient had any of the following symptoms*? (specify symptoms below)	☐ Yes ☐ No	Onset date:	
☐ Fever (measured or subjective) ☐ Arthralgia ☐ Rash ☐ Conjuctivitis ☐ Guillain-Barré syndrome			
☐ Other symptoms:			
Ever vaccinated for:	☐ Yellow fever (YF) ☐ Japanese encephalitis (JE) ☐ Tickborne encephalitis (TBE)		
Ever diagnosed with:	☐ Dengue fever ☐ West Nile ☐ St. Louis encephalitis ☐ YF ☐ JE ☐ TBE		
Additional comments:			

Submit specimens on cold pack(s) directly to the address below. Call the laboratory if you have any questions.

Bureau of Laboratories
110 Pickering Way | Exton, PA 19341-1310 | 610-280-3464 | F 610-450-1932 | www.health.pa.gov/labs

rev 10.06.2016